wbcsd

# Pathfinder Framework

## Guidance for the Accounting and Exchange of Product Life Cycle Emissions

## Contents

**WBCSD would like to thank the following companies and organizations that have supported and contributed to the development of the Pathfinder Framework:**

**For supporting this collaboration as a knowledge partner, WBCSD extends special thanks to:**

# Foreword

## A MESSAGE TO ALL BUSINESS LEADERS AND STAKEHOLDERS

**There is an increasing urgency to decarbonize. Failure to do so will result in an increase of the global surface temperature beyond the 1.5°C or 2.0°C target of the Paris Agreement. Businesses have an important role to play in taking a leading role for the required decarbonization actions and setting ambitious and realistic internal net-zero commitments.**

There are still some significant hurdles to decarbonization, though, even for the most driven organizations. Scope 3 is the key word. Within many companies, Scope 3 emissions – i.e., those emissions which arise across the value chain – usually make up the major share of total emissions. Due to lack of transparency across value chains, however, these are specifically hard to tackle. Solving this challenge presents a tremendous opportunity and the potential to accelerate decarbonization significantly. In addition, this would unlock numerous use cases, embedding environmental considerations deeply within business decision-making, like informed product portfolio choices, product footprint labeling and targeted investment.

In order to create transparency, it is necessary to have both more detailed guidelines to consistently calculate and account for emissions on a product level as well as an infrastructure, for the exchange of verified and reliable data across value chains.

The Pathfinder Framework constitutes the first step in addressing these needs. This emissions accounting guidance was developed over the past year in a concerted effort by 35+ companies, standard-setting bodies and industry initiatives. Building on the longstanding work with the World Resources Institute under the GHG Protocol, it takes an industry-agnostic approach and is designed to help organizations develop verified primary data-based product carbon footprints to share with peers in the supply chain. This adds tremendous value as it enables companies to consistently measure and track the emissions of their products.

It is important to emphasize that the goal to accelerate decarbonization of value chains cannot be solved by individual actors in isolation. It requires an aligned, coordinated and open approach, driven jointly by businesses across all industries and value chains, including SMEs.

In light of this, it is exciting to see the increasing number of ongoing efforts in companies and organizations aiming to accelerate their current trajectories. I am particularly pleased to see the large number of companies, organizations and institutions that have collaborated on and contributed to this Framework. Thank you to all who were involved by providing valuable feedback and insights, as well as McKinsey & Company as our knowledge partner. I urge you to keep these actions up and ensure we all continue to join forces on this essential topic.

The publication of this guidance represents the achievement of a first significant milestone in solving the Scope 3 emissions challenge. Now it is time to get to the real work: I invite all of you to start applying the Framework within your organizations, to jointly shape its evolution and to work on creating the necessary technological infrastructure, for the exchange of granular emissions data to become the new norm. Let's unite for decarbonization.

**Peter Bakker**
President & CEO, WBCSD

# 1 Introduction

# 1 Introduction

**Greenhouse gas (GHG) emissions play a major role in climate change by contributing to global warming.[1] Unless GHG emissions are reduced significantly within the next few decades, the global surface temperature will increase beyond the 1.5°C or 2.0°C target of the Paris Agreement.[2]**

Current efforts to reduce GHG emissions are insufficient to ensure such targets can be met by 2050.[3] Unsurprisingly perhaps, given the role businesses can play in changing this trajectory, pressures to accelerate decarbonization activities are mounting – from consumers, customers, policy makers, regulators and standard setters, shareholders and investors alike. Consumers are increasingly demanding sustainable products and information on the environmental impact of their purchases, for example with regards to their GHG emissions.

Business customers are likewise increasingly driven by such concerns and are now considering how they can decarbonize beyond their own production, implementing environmental performance criteria for their suppliers. Regulators are setting policy agendas and introducing legislation aligned with the targets of the Paris Agreement.

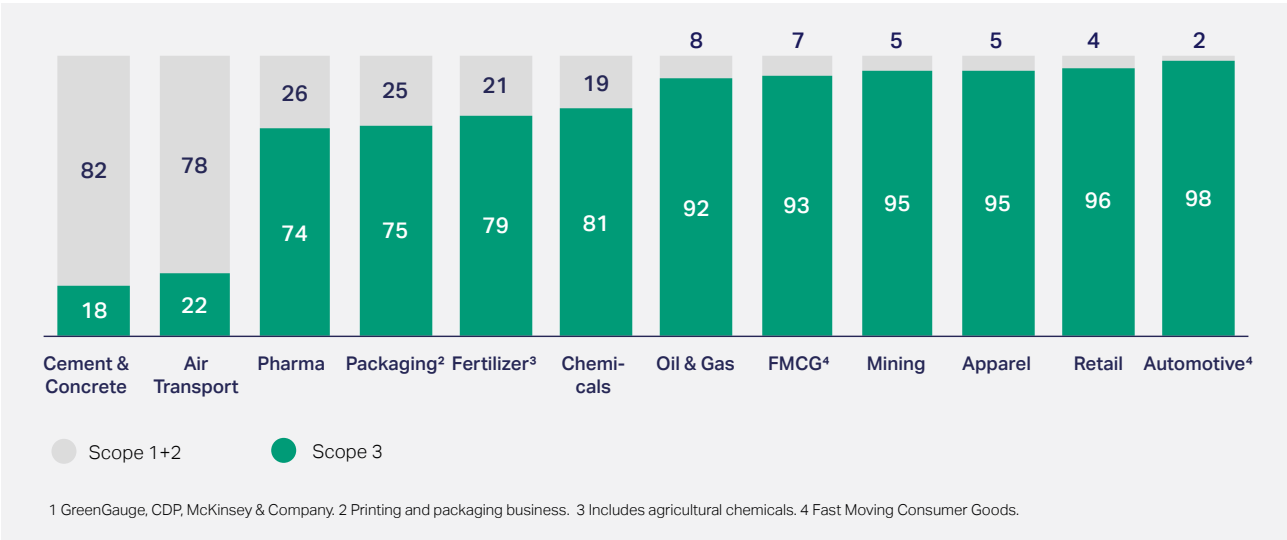
The European Commission, for example, is introducing two new laws, the EU Green Claims Regulation and the Sustainable Product Initiative, both based on the use of the Product Environmental Footprint (PEF) method (more details below). In addition, standard-setting organizations are increasing their obligations for businesses, with the Science Based Targets initiative launching a Net-Zero Standard that includes a requirement for at least 90% of Scope 3 emissions to be included in the net-zero targets set.[4]

Shareholders and investors are in turn using their financial muscle to force internal changes, adjusting capital allocation and returns to account for climate risk. With all signs pointing toward a significant need for change, the number of companies who are setting decarbonization goals and making net-zero declarations is steadily increasing.[5]

## 1.1 The challenge

Accounting for and tracking GHG emissions, both within companies and their supply chains, is a key prerequisite to achieving these targets and enabling decarbonization. Reporting of Scope 1 and 2 emissions (including emissions within reasonable control of a company) is already mandatory for many companies throughout the world. Emissions occurring in the value chain (Scope 3), in contrast, have so far been less in focus, even though these often constitute the lion's share of a company's overall emissions (Figure 1) – especially for stakeholders further downstream.

**Figure 1:** Percent of total Scope 1 to 3 emissions, 2019, based on self-reported CDP data[6]




1 GreenGauge, CDP, McKinsey & Company. 2 Printing and packaging business. 3 Includes agricultural chemicals. 4 Fast Moving Consumer Goods.

However, all companies aiming to tackle value chain emissions face a common challenge: access to sufficiently granular, accurate and verified primary data. Such data inadequacy impedes quality accounting and data exchange for product life cycle emissions (and therefore also for Scope 3 emissions – see Box 1). This challenge is caused by both data accounting and data access factors.

### Data accounting: Room for interpretation and inconsistency in existing methods and standards

Companies often lack primary data, particularly to account for processes within a product's life cycle not under their ownership or control. As a result, general-purpose emission factor databases are used to meet data needs, though these do not provide the specificity needed for most decision making, as data is based on averages.

High-quality product life cycle accounting is also inhibited by the inconsistent use of methodology to account for product emissions. Existing standards and protocols (such as ISO standards, GHG Protocol standards) and sector guidelines (like the Product Category Rules (PCRs) or the Product Environmental Footprint (PEF) methods) thus leave significant room for interpretation.

While there are ongoing efforts such as EU PEF and PCRs to harmonize GHG accounting and exchange on a product level, the current diverging accounting standards and guidelines create challenges for streamlined and scalable application of these standards. This results in inconsistent and unreliable accounting, reporting and exchange of emissions data, which ultimately impedes decarbonization efforts.

### Data access: Complex value chains and lack of interoperability between technology solutions

Cross-organizational data sharing is limited by complex value chains, data collection challenges and a lack of interoperability between IT solutions.[7] Additionally, product-level data is often competitively relevant and therefore treated as highly confidential by many companies. This creates a data-sharing dilemma and high transaction costs (for manual effort) for companies that strive to create transparency on supply chain emissions with the intention to decarbonize their supply chains.

Today's value chains are often intricate and complex, spanning multiple (international) stakeholders from different industries and offering little visibility on suppliers beyond Tier 1 of their value chains. Most enterprise resource planning systems are by their very nature not designed to enable the exchange of emissions data between them and across company boundaries (though some exchange of other information may be already taking place with suppliers). Further, sophisticated technology solutions only play a limited role in the context of emissions data sharing, with many businesses using simple surveys or spreadsheets to collect such data, if at all.

Sharing of comparable, consistent, verified emissions data across the value chain and accounting for product carbon emissions is therefore currently not possible in practice. Given the importance of Scope 3 emissions, companies therefore lack a core piece of the puzzle for the acceleration of individual decarbonization activities as well as those of their value chain. It is impossible to track and reduce emissions without understanding the full extent of the task. Creating end-to-end value chain transparency is therefore critical.

## 1.2 Addressing the challenge

Committed stakeholders from across value chains and industries, targeted industry initiatives, standard-setting experts, policy makers and leading technology companies have come together in the Carbon Transparency Partnership to jointly tackle this challenge. The Partnership is driven by a common objective: to accelerate targeted decarbonization action and strengthen emissions accountability.

This objective can be achieved through the creation of greater emissions transparency, for example by supporting stakeholders in fully understanding their Scope 3 emissions on as granular a level as possible and thus being able to account for them (see Box 1). To make this a reality, an infrastructure which allows for the consistent calculation and simple exchange of verified primary Product Carbon Footprints (PCFs) between stakeholders across value chains and industries needs to be set up.

The Partnership therefore is putting the following in place:

1. The Pathfinder Framework – methodological guidance for the accounting and exchange of more accurate product-level emissions data (PCFs), including a quality-assurance and verification scheme to ensure the comparability and reliability of such data.
2. The Pathfinder Network – an open network for the exchange of PCFs, which connects different technology solutions used by businesses by ensuring interoperability (in progress, see Section 9).[8]

## 1.3 The opportunity

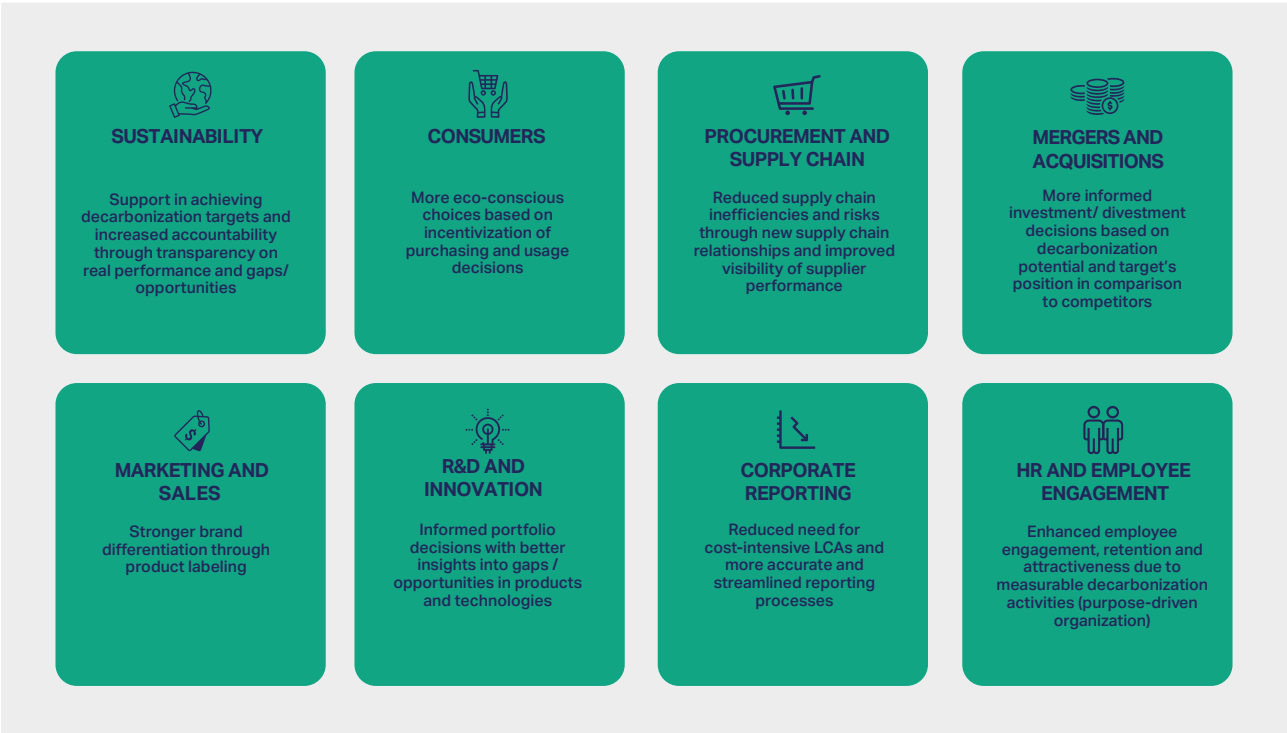
The creation of greater emissions transparency will constitute a major opportunity for businesses as well as other stakeholders. Access to more granular data can unlock a host of different use cases that, for example, help reinforce internal business decision making and improve corporate accuracy (see Figure 2).

This can positively influence the bottom line, mitigate (climate-related) risks, drive competitive advantages and more. In addition, customers and consumers also stand to benefit; for example, clear product labeling can enable eco-conscious buying decisions.

By setting up infrastructure for the technology-enabled exchange of emissions data, the foundations for creating greater transparency on other environmental factors can also be put in place.

Operating with a strong focus on transparency is undoubtedly a move away from the status quo. It not only requires a mindset shift, but is also likely to take stakeholders beyond their comfort zone. If businesses are, however, ready to embark on this journey jointly, the rewards in store will be significant – not least of all for our climate.

**Figure 2:** Example use cases for businesses resulting from emissions transparency



**BOX 1**

### Product life cycle accounting enables better Scope 3 accounting and management

GHG emissions accounting methods and standards allow for companies to gain a better understanding of their own emissions (Scope 1 and 2), both on a corporate and product level. For emissions occurring along a company's value chain (Scope 3), there are equivalent guidelines.

1. **Corporate-level standards** (such as the GHG Protocol Corporate Value Chain (Scope 3) Standard) focus on emissions arising upstream and downstream from a company, providing a top-down overview of emissions across the value chain. They apply to corporate activities as a whole – in other words, to *all* activities associated with the goods or services the organization provides from a supply chain perspective, as well as other indirect emissions associated with corporate activities, such as business travel.
2. **Product-level standards** (such as the GHG Product Standard) in turn focus on individual products or services. They support accounting for emissions of products throughout their life cycle (see Section 4.3 for more details on the stages). In doing so, they enable a more granular approach compared to corporate accounting, providing detailed insights which can help identify targeted emission reduction opportunities.

These two types of accounting are highly interrelated: the emissions resulting from a company's products make up a large share of a company's corporate Scope 3 emissions. Thus, life cycle product emissions data is extensively used for Scope 3 accounting.[9] Management of these corporate emissions is therefore highly dependent on good-quality accounting for product-level emissions.

The Pathfinder Framework seeks to further improve the accuracy and comparability of data, by enabling the exchange of primary data of product life cycle emissions with value chain partners, in turn increasing their access to primary data. In doing so, transparency on emissions can be created along the value chain. This has the dual benefit of providing companies with better data to support a variety of use cases as well as improving corporate-level accounting, ultimately supporting the acceleration of decarbonization.

# 2 Overview of general setup

# ② Overview of general setup

**This section provides an overview of the general setup of the Framework, with the aim of easing navigation and setting out some essential context.**

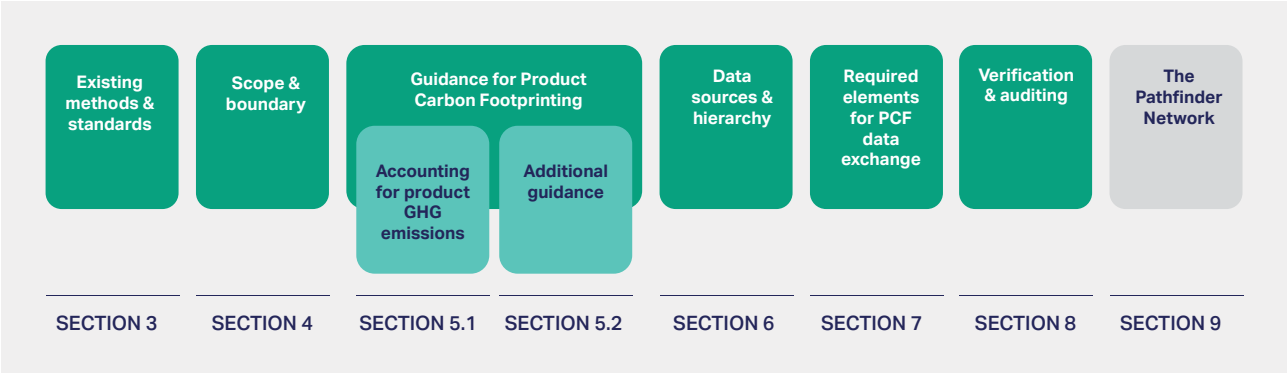
### 2.1 General structure

The main part of the Pathfinder Framework is divided into six distinct sections (Figure 3). While the first two (Section 3 and 4) give some additional context and lay out fundamental guardrails, the other four sections (Sections 5 to 8) each represent key steps of the process toward creating emissions transparency across the value chain.

A final section provides details on how the Pathfinder Framework could be integrated as part of an IT infrastructure to help application of the Framework and facilitate the exchange of emissions data (Section 9).

A summary of key takeaways for each section can be found below.

Figure 3: Overview of sections within the Pathfinder Framework




### 2.2 Purpose and application

The Pathfinder Framework was created with the aim of addressing the existing challenges to data transparency. It seeks to help businesses develop a better understanding of the carbon emissions of their products by encouraging and guiding the exchange of primary carbon footprint data across value chains. The Framework provides supplementary guidance for accounting, verification and exchange of cradle-to-gate PCFs, with the aim of creating more granular, comparable and consistent emissions data.

The Framework should thus be seen as an extension and refinement of the existing methods and standards referenced in Section 3 and shall be used in conjunction with these. The Framework has been drafted as a baseline applicable across different industries. It therefore constitutes a blueprint to build on, which all stakeholders developing specific guidance to meet additional industry needs should use as a starting point. As alignment in this context is critical, the Carbon Transparency Partnership has been set up to support such a process.

While the Framework is designed to be a guidance document and is therefore voluntary in nature, its application will ensure greater emissions data consistency for all stakeholders as well as across industries. To further encourage broad application, the Framework is published openly for everyone to freely access and use.

The Framework should be applied by stakeholders such as:

- Businesses wishing to better understand and share the carbon footprint of the products they produce
- Auditors supporting businesses in the above endeavor by verifying carbon footprint data exchanged

- Technology companies creating solutions for the calculation or exchange of such carbon footprints
- Initiatives driving industry-focused approaches to data transparency and developing additional methodological guidance or technological solutions for data exchange in this context.

## 2.3 Version

The Pathfinder Framework is intentionally published as a Version 1, with the knowledge that the development of consistent rules requires some trial and error, hence possibly requiring future additions or adjustments.
In particular, this also allows for later revisions resulting from its pilot testing and practical application, newly developed sector-specific guidance and the creation of a technology-enabled data-sharing infrastructure.

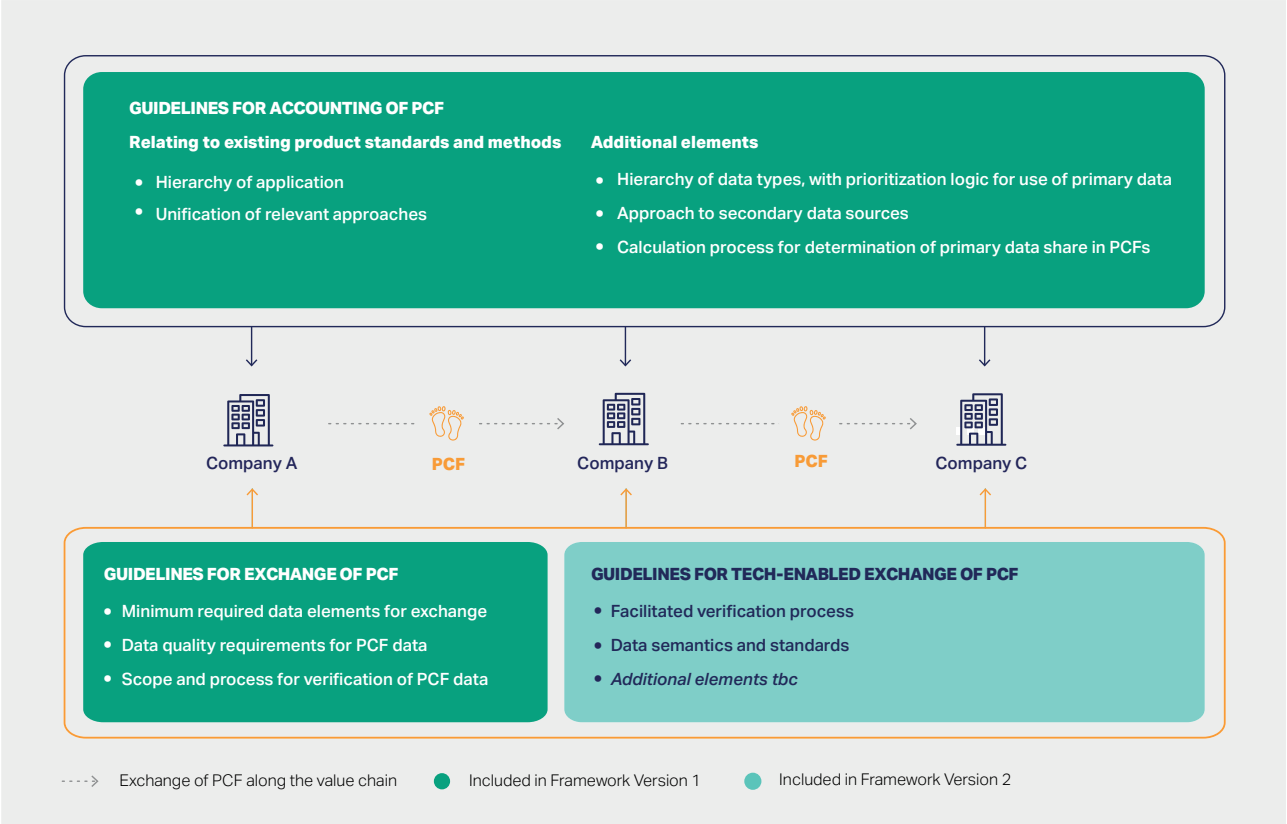
Version 1 contains guidelines for the calculation of PCFs, building on existing methods and standards as well as providing additional detail. It also covers guidelines for the exchange of PCF data, in particular focusing on data quality requirements, verification of data and data elements to share (Figure 4). Version 2 will be developed following the same collaborative process as Version 1. Further topics for inclusion in Version 2 are already highlighted throughout (but shall not be considered exhaustive).

## 2.4 Terminology

The Pathfinder Framework uses different terms to differentiate between requirements, recommendations and permissible or allowable options. The term "shall" is used to indicate which rules need to be followed by companies applying the Pathfinder Framework, while the term "should" is used to indicate which rules are recommendations. The term "may" indicates an option that is permissible or allowable.[10]

Additional definitions of frequently used terms throughout the Framework can be found in the glossary (Appendix A).

**Figure 4:** Focus of Version 1 of the Pathfinder Framework



## 2.5 Summary of guidelines

**3 Existing methods and standards**

- The Pathfinder Framework shall be read in conjunction with existing methods and standards for PCF assessment
- PEFCRs or PCRs shall be prioritized for the calculation and allocation of PCFs
- At a minimum, calculation and allocation shall be compliant with the GHG Protocol Product standard or applicable ISO standards

**4 Scope and boundary**

- The Framework follows an attributional LCA approach, focusing on climate change impact (GHG emissions)
- The boundary of the Framework is a cradle-to-gate PCF, comprising all stages of the product life cycle (including transportation), but excluding downstream emissions from product use and end-of-life
- Use of primary data shall be prioritized
- PCFs shall be exchanged upstream to downstream, providing kg of $CO_2e$ per declared unit of product[1]

**5 Guidance for Product Carbon Footprinting**

**Accountig for product GHG emission** 5.1

The carbon footprint of a product shall be calculated as follows (and then shared downstream):

- Collection of primary data on all relevant process inputs (activity data) and emission factors
- Multiplication of activity data with relevant emission factors ($CO_2e$/declared unit)
- If necessary: allocation of emissions to outputs

**Additional Guidance** 5.2

Transportation emissions

- Upstream and direct transportation emissions within the cradle-to-gate boundary shall be calculated and shared
- Only transportation emissions relating to the fuel life cycle shall be included
- Calculations should consider internal transportation as part of direct activities and external transportation between different tiers in the supply chain

Waste treatment and recycling emissions

- Emissions resulting from waste treatment as part of the production process shall be calculated and shared by the company that generated the waste
- Emissions from the end-of-life stage are not included in the Framework Version 1 boundary
- All production emissions shall be allocated to the main product or co-product, rather than to the waste or recyclable material itself
- Recycled products enter another product's life cycle without any emissions ("burden free"), except for emissions associated with recycling processes
- The recycled content method should be used to allocate emissions from recycling disposed products

**6 Data source & hierarchy**

- Activity data that is used to calculate PCF shall be company-specific, i.e., primary data
- Secondary data shall only be used when primary data is not available and be sourced from accepted global or national emission factor databases

**7 Required elements for PCF data exchange**

- Data owners shall share their cradle-to-gate PCF as well as a set of minimum required data elements downstream in the value chain
- As part of the minimum required data elements, the share of primary data used in calculations shall be determined and communicated

**8 Verification and auditing**

- Verification of PCF data prior to sharing is strongly encouraged to ensure high-quality and trustworthy data
- Businesses shall share a completed self-declaration (Product Carbon Footprint Questionnaire) or, alternatively, complete a more extensive audit through a third-party provider
- Any audit should verify adherence to the Pathfinder Framework (PCF calculation) and data selection, input and quality requirements

1 Boundary and scope will be extended in Version 2 of the framework.

# 3 Existing methods and standards

# ③ Existing methods and standards

**Existing methods and standards are a key fundament of the Pathfinder Framework.**

### 3.1 Relationship

The Framework leverages and aligns with existing methods and standards for the calculation and allocation of emissions, including:

- Product Environmental Footprint method (PEF) and Product Environmental Footprint Category Rules (PEFCR) by the European Commission
- Product Category Rules (PCRs) by Environmental Product Declaration (the International EPD System) (and other program operators)
- GHG Protocol Product Life Cycle Accounting and Reporting standard and GHG Protocol Corporate Value Chain (Scope 3) standard by WBCSD and World Resources Institute under the GHG Protocol
- ISO standards (14044/40, 14067, 14025).

### 3.2 Hierarchy of application

In general, existing methods and standards can be classified into two types:

1. product-specific or sector-specific rules (for example PEFCRs, PCRs or Plastics Europe)
2. overarching cross-sectoral protocols and standards (for example GHG Protocol standards, ISO standards).

Application off these rules shall follow the below hierarchy (see also Figure 5).

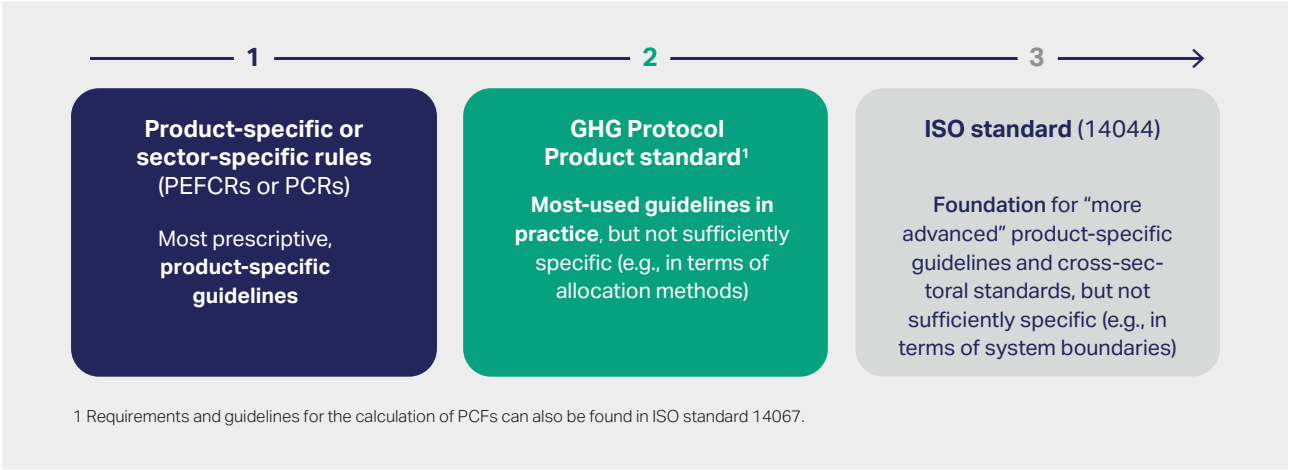
**Product-specific or sector-specific rules exist**
Where product-specific and sector-specific rules exist, their application shall always be prioritized for PCF calculation, as they provide the most detailed guidance in relation to a specific product or sector and hence can contribute towards increasing the granularity of data shared across value chains.[11]

**Only overarching rules exist**
Where no product-specific or sector-specific rules exist, calculation and allocation shall be compliant with the GHG Protocol Product standard, or – at a minimum – the equivalent ISO standard (ISO 14067). In parallel, businesses are encouraged to develop more detailed product or sectoral rules in collaboration with other stakeholders, to address any need for more specific standards.[12]

Further ISO standards (such as ISO 14044) provide foundational requirements and guidelines for life cycle assessments and may be consulted as a baseline.

To create greater transparency and enable comparability, information on the exact methods or standards applied shall be shared downstream as part of the elements for data exchange (Section 7.2). In the case of sector-specific rules which are not officially declared as PEFCRs or PCRs, application shall also be justified and verified.[13]

**Figure 5:** Prioritization of methods and standards




1 Requirements and guidelines for the calculation of PCFs can also be found in ISO standard 14067.

**BOX 2**

## EU Product Environmental Footprint (PEF) and Product Environmental Footprint Category Rules (PEFCRs)

### Background

While the demand for environmental declarations at the product (and organizational) level has increased in recent years, so far there has not been a single, widely adopted approach, resulting in a lack of comparability and consistency. The European Commission has sought to address this gap through the development of a method for footprinting, the Product Environmental Footprints (PEF) and the accompanying Product Environmental Footprint Category Rules (PEFCRs).[14]

As defined in the PEFCR Guidance:

- **The PEF method** is based on a Life Cycle Assessment (LCA) method to quantify the relevant environmental impacts of products (goods or services).
- **PEFCRs** are rules based on product category and life cycle rules that complement general methodological guidance for PEF assessments by providing further specifications at the level of a specific product category.

To date, PEFCRs have been developed for more than 20 different product categories, following a common process defined by the PEF method and, whenever possible, building on existing work such as PCRs.

The objective of these PEFCRs is to help companies identify the most significant environmental impacts and activities throughout the life cycle of a given product. In addition, the use of these common PEFCRs will increase comparability and consistency of results.

### Use

From 2013 to 2019, the European Commission led a pilot phase for 26 product categories. The development phase is now entering a transition stage where the PEFCRs will be implemented on a larger scale, which will determine if and how the PEFCRs will come into effect or be required by law within the European Union.

### Link to the Pathfinder Framework

The Pathfinder Framework promotes the application of PEFCRs and builds on them (see Section 3.2). Notably, PEF methodology and PEFCRs include a set of overarching and product-specific rules, definitions and proprietary secondary data sources, as well as further life cycle impact categories, which are in addition to the general framework stipulated here. The Pathfinder Framework can be used for reporting that's compliant with the PEF methodology, if those additional requirements from the PEF and PEFCR methodology are met. In order to meet these requirements, companies should refer to the PEF and respective PEFCR documentation.

Any developments by the European Commission in this context will be closely monitored to evaluate and assess the further implementation of PEF and PEFCR requirements into iterations of this Framework.

# 4 Scope and boundary

# 4 Scope and boundary

## Understanding the scope and boundary of this Framework is an essential starting point for the calculation of PCFs.

### 4.1 LCA approach

The Pathfinder Framework is based on the attributional LCA approach. This approach seeks to determine the ex-post environmental impacts associated with a product's life cycle. GHG emissions are attributed to a specific unit of a product by adding up the emissions of all attributable processes along its life cycle.

### 4.2 Focus on GHG emissions

The Pathfinder Framework provides the methodological framework for studying GHG emissions. The GHGs that shall be accounted for are identified within the GHG Protocol titled "Required Greenhouse Gases in Inventories; Accounting and Reporting Standard Amendment".[15]

The list includes Carbon dioxide ($CO_2$), Methane ($CH_4$), Nitrous oxide ($N_2O$), Hydrofluorocarbons (HFCs), Perfluorinated compounds, Sulphur hexafluoride ($SF_6$), Nitrogen triflouride ($NF_3$), Perfluorocarbons (PFCs), Fluorinated ethers (HFEs), Perfluoropolyethers (e.g. PFPEs), Chlorofluorocarbon (CFCs), and Hydrochlorofluorocarbon (HCFCs). Following common practice, the global warming impact of these gases can be converted in and expressed as $CO_2e$. Their respective characterization factors (100-year Global Warming Potential) shall be derived from the IPCC Assessment Report AR 5.

### 4.3 Boundary

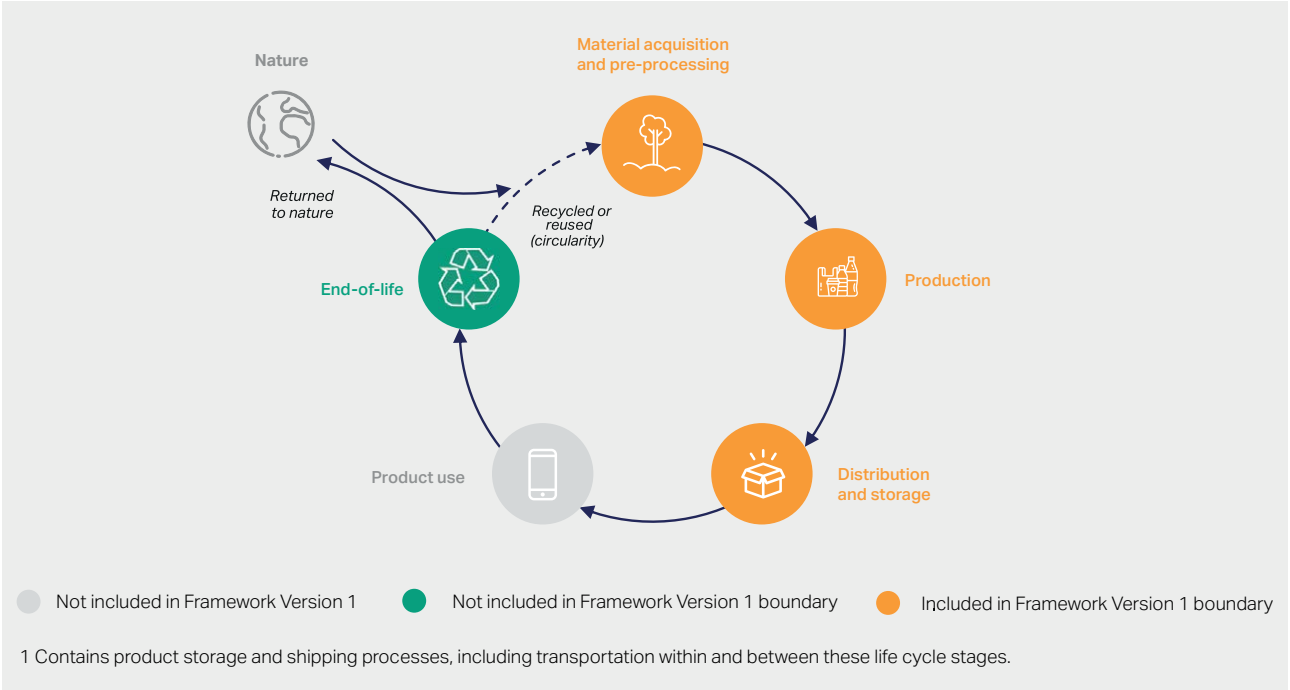
The boundary of the Pathfinder Framework, that is, the processes and their associated emissions that should be accounted for and exchanged as part of the PCF by a company, is a cradle-to-gate PCF.

This includes all the attributable upstream and direct emissions[16] of a product, including all upstream transportation activities.[17] The life cycle emissions that shall be accounted for in this cradle-to-gate PCF exclude downstream emissions related to the product use and end-of-life stages.[18]

When accounting for emissions, companies shall further define their cradle-to-gate boundary by organizing the attributable process of their studied product into defined life cycle stages (Figure 6). Ultimately, the boundary will be disclosed as attributable processes per life cycle stage.

The life cycle of a product is composed of five stages: (1) material acquisition and pre-processing, (2) production, (3) distribution and storage, (4) product use and (5) end-of-life (Figure 6).

**Figure 6:** Product life cycle stages and boundary




1 Contains product storage and shipping processes, including transportation within and between these life cycle stages.

### Material acquisition and pre-processing

Material acquisition refers to the extraction of resources from the environment needed to create a product. Pre-processing refers to the refining of all the acquired natural and biogenic resources so they can be used in a production facility. Transportation to and from the sites of resource extraction, pre-processing facilities and production facilities is also included in this initial life cycle stage. This initial stage is often referred to as the cradle of the product life cycle.

### Production

The production stage refers to the additional processing, manufacturing, assembly and preparation of product components to create a finished product. Transportation of semi-finished products between intermediate facilities is also included in the production stage. The production stage ends when the product is ready to leave the production facility (or facilities, considering there may be numerous intermediate facilities involved in the production stage) and can be used as a finished product. Additionally, production "sites" and "gates" are also terms that are often used to describe production facilities. Treatment of waste created during production is also considered in this life cycle phase.

### Distribution and storage

Product distribution and storage begins when the product leaves the production site. It includes product storage and shipping processes, including transportation within and between these life cycle stages. Storage sites include distribution and retail centers. This stage ends when the product is acquired by the consumer.

### Product use[19]

Product use consists of the span of customer possession of the product and customer disposal of the product. This stage also includes transportation to the product use location.

### End-of-life

The final stage is the end-of-life stage, which is also known as a product's grave. It begins when the consumer disposes of the product and ends when the product either returns to the environment or contributes to the life cycle of a separate product. For example, when a product is reused or recycled, it is then considered part of a new life cycle, beginning anew at the first stage above. The end-of-life phase includes the transportation of the product to a waste management facility, disassembly of the product and additional waste management processes.[20]

## 4.4 Use of primary data

The Pathfinder Framework prioritizes the use of primary data, in line with existing standards such the GHG Protocol Product standard, which stipulates that "primary data should be collected for all processes in the product's life cycle" if it is "available and of sufficient quality." Secondary data (such as from verified or national databases) should only be used when primary data is unavailable.

To create visibility for recipients of carbon footprint data and encourage businesses to use product-specific primary data, the Framework requires the primary data share (PDS) used in calculations to be disclosed when data is exchanged (see Section 3.2).

## 4.5 Scope of the Pathfinder Framework

The focus of Version 1 of Pathfinder Framework is on upstream to downstream exchange of cradle-to-gate PCFs. The objective is to enable businesses along the value chain to obtain a cradle-to-gate PCF based on primary data from their suppliers upstream for the calculation of their own PCFs. In calculating cradle-to-gate PCFs, which are in turn shared downstream to the next value chain actor, the entire value chain of products and carbon emissions can be linked up, ultimately creating greater transparency for businesses and end consumers alike. This exchange also unlocks a host of different use cases for businesses. The creation of a technology infrastructure that allows for the technology-enabled sharing of data will significantly facilitate data exchange (upstream-to-downstream, but also downstream-to-upstream) and strengthen quality and trustworthiness, while preserving business confidentiality across the value chain.

That said, the creation of transparency on downstream-to-upstream emissions is also of interest for certain stakeholders wanting to tackle decarbonization of their products. Thus, for some products, emissions arising from distribution, manufacturing and downstream use are significant. For instance, the ability to trace biogenic or fossil carbon stored in products during their use and end-of-life, including any losses from product carbon pools sold by the companies, can be used to report on product carbon storage.

In addition, access to emissions data from downstream processes and use also allows insights into the climate benefits products can bring. In sectors where downstream Scope 3 emissions contribute significantly to overall GHG emissions,[2] this means companies can have a fuller picture on the emissions associated with their products throughout their entire life cycle.

One of the key reasons for this initial focus is the availability of primary data for the upstream life cycle stages included in the boundary. Upstream GHG emissions and direct emissions that make up cradle-to-gate PCFs can be collected or estimated based on historical data, that is, data for activities that have already taken place at the time of data collection.

Downstream emissions (specifically related to the use phase and the end-of-life of a product), in contrast, typically occur at a later point in time. For this reason, it is common practice that such GHG emissions are estimated based on valid assumptions and using secondary data sources.

Further consideration and alignment regarding the approach to calculation, allocation and exchange of these emissions based on location and function within the value chain is required, in particular to avoid double-counting and address the fact that the relevant data is less likely to be of a primary nature. This is out of scope for Version 1 of this Framework (but will be addressed in Version 2).

Whenever sharing a PCF, the life cycle stages considered in the calculation of data shall be indicated. In addition, data should be provided in such a way that it can be easily integrated into PCF calculations by recipients of the data. The requirements and recommendations for data exchange are explained further in Section 7 and Appendix B.

### 4.6 Unit of analysis

The unit of analysis of the product (declared unit, see Box 3) serves as the basis for all data collection and inventory results. Final PCF inventory results shall thus be disclosed as kg of $CO_2e$ per unit of analysis (for example, GHG emissions per kilogram or liter of product).

**BOX 3**

**Distinction between functional and declared unit**

LCA inventory results are provided in terms of functional units.[22] A functional unit describes the function of a product in question. For example, for a laundry detergent, the functional unit could be defined as "washing 4.5 kg of dry fabric with the recommended dosage with medium-hard water". Understanding the functional unit is essential for comparability between products with the same function, as it provides the reference to which the input (materials and energy) and output (such as products, byproducts, waste) are quantified.

Intermediate products, that is, products which will still be processed further to create a final product, can, however, have several functions based on their eventual end use. In this case (and where an LCA does not cover the full life cycle), the term declared unit – typically referring to the physical quantity of a product, for example "1 liter of liquid laundry detergent with 30 percent water content" – can be used instead.

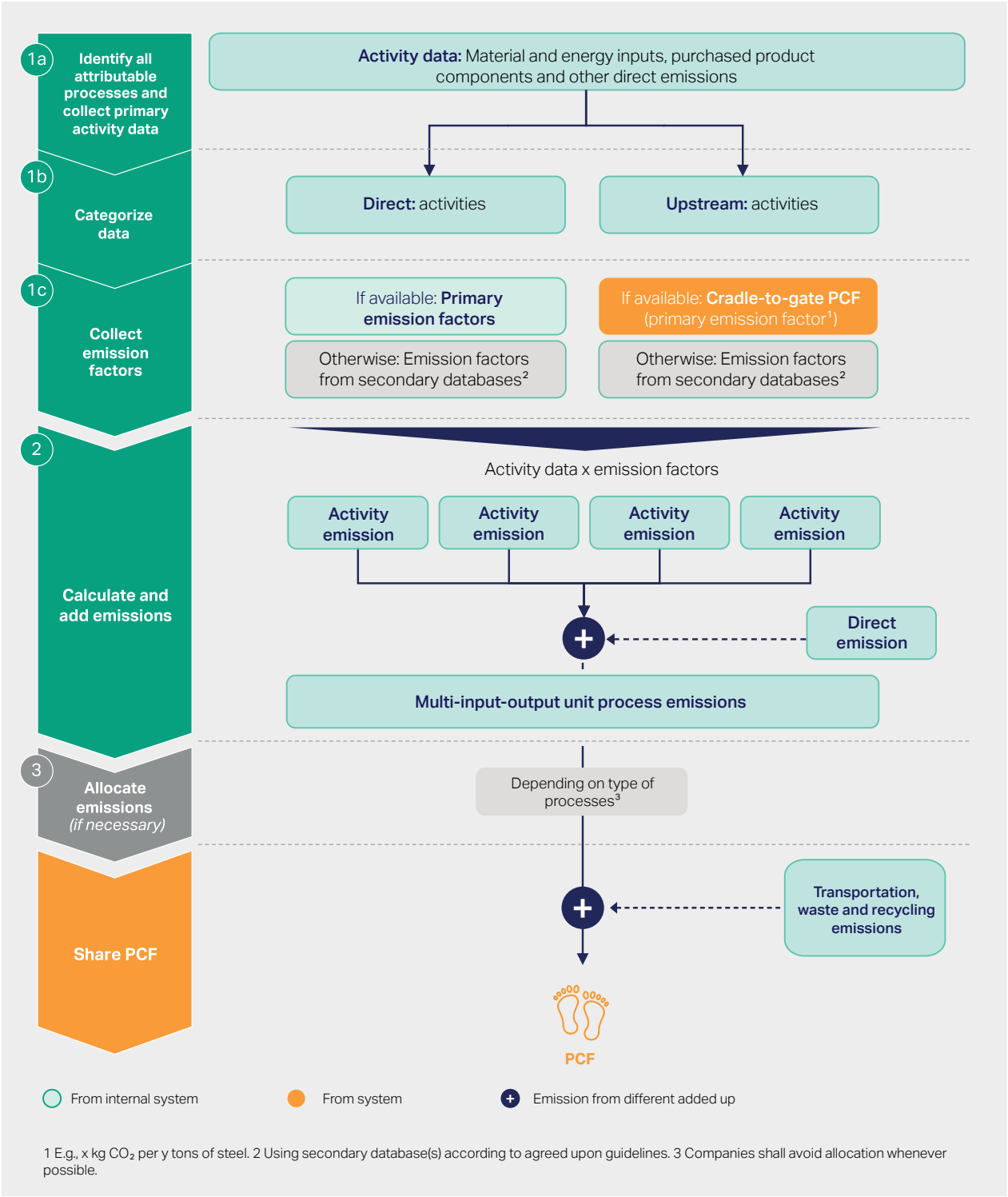
# 5 Guidance for product carbon footprinting

# 5 Guidance for product carbon footprinting

**In order to create a better understanding of emissions, companies shall calculate their Product Carbon Footprint and share this along the value chain.**

This Section provides guidance on how to do this, which should be used in conjunction with existing methods and standards.

**Figure 7:** Overview of steps for product carbon footprint calculation

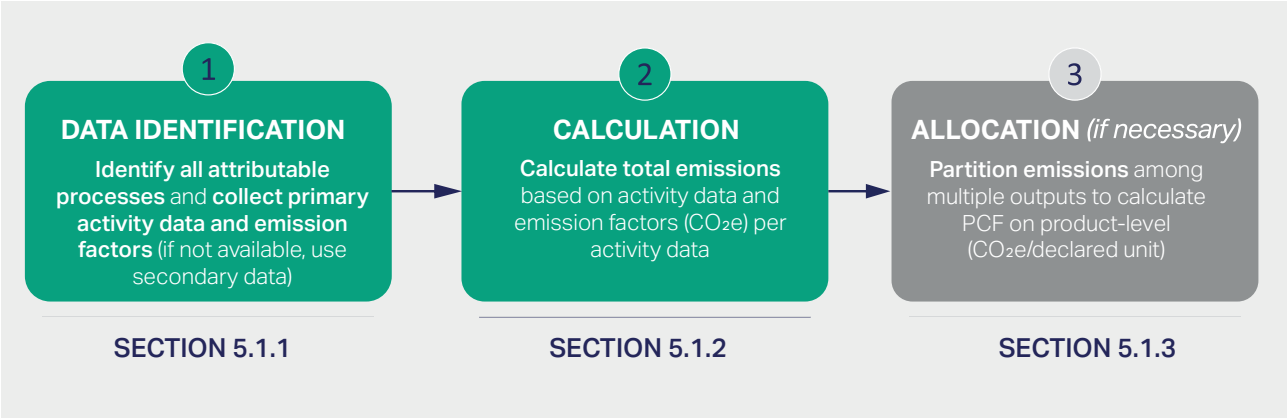



1 E.g., x kg $CO_2$ per y tons of steel. 2 Using secondary database(s) according to agreed upon guidelines. 3 Companies shall avoid allocation whenever possible.

## 5.1 Accounting for product GHG emissions

The following steps are used in the calculation of a PCF: (i) identifying and collecting necessary data, (ii) calculating emissions using relevant emission factors and (iii) allocating these to specific products or materials (Figure 8).

**Figure 8:** General steps for the calculation of a PCF




### 5.1.1 Data identification

To begin, all the attributable processes should be identified (Section 3.1). In alignment with the GHG Protocol Product standard as well as PCRs by the International EPD System, only those processes that are immediately related to the production of the main product are part of the assessment. The following activities are generally not included within the boundaries: manufacturing of production equipment, buildings and other capital goods, business travel by personnel, travel to and from work by personnel, and research and development activities. If, however, data on any of the above activities is available and relevant, this should be included in the product GHG emissions calculation.

To determine multi-input-output unit process emissions, relevant activity data and emission factors based on a company's own processes (direct activities) as well as the relevant material or energy input flows from suppliers upstream (upstream activities) shall be collected.

Activity data in particular shall be collected with regard to:

- Material input (for example, 10 tons of steel, 300 kg of aluminum)
- Energy input[23] such as purchased electricity, cooling and heating (for example, 100 kWh)
- Purchased product components (for example, chemical product, unit, amount)
- Any other direct emissions not included (for example, $CO_2$ formed during the production process).

After identification of the data, all data shall be categorized as direct or upstream activities (Figure 7).

### 5.1.2 Calculation

GHG emissions arising from a process can be determined by multiplying the relevant activity data with an emission factor ($CO_2e$ per declared unit). The resulting activity emissions shall then be added to direct emissions (if any) to obtain multi-input-output unit process GHG emissions (Figure 7). To allow for flexibility in applying accounting standards, calculation and allocation should be separated to the largest extent possible. This ensures that different standard guidelines can be adhered to if required (for example, case-specific allocation rules, additional emission categories such as biodiversity and acidification).

Relevant emission factors can be obtained in two ways (Figure 7):

- Primary emission factors: Where such emission factors are available directly from suppliers or internal processes, these shall be used.[24]
- No primary emission factors: Where no such data is available, the databases listed in Table 2 of Section 5.2.2 shall be used to find the most suitable emission factors.

### 5.1.3 Allocation

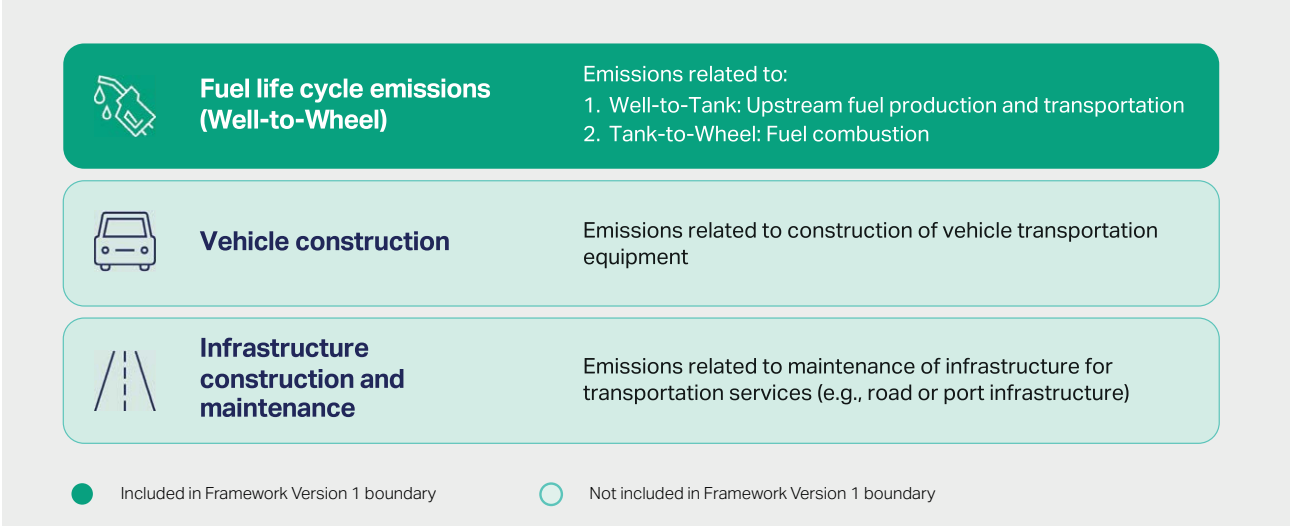
Allocation shall be avoided whenever possible by using process subdivision, system expansion or redefining the unit of analysis.[25] In reality, however, allocation is unavoidable in many cases as processes usually have multiple outputs. In those cases, emissions shall be divided among the multiple inputs and outputs in an accurate and consistent manner. This is essential for the quality of a PCF. Allocation rules shall follow the standards hierarchy described in Section 3.2.

## 5.2 Additional guidance

### 5.2.1 Accounting for transportation emissions

All upstream and direct transportation emissions within the cradle-to-gate boundary – that is, transportation emissions related to a company's direct activities and transportation activities between tiers in the supply chain – shall be accounted for. On a granular level, emissions pertaining to the fuel life cycle (Well-to-Wheel emissions) shall be included (Figure 9).

**Figure 9:** Transportation emissions accounted for within the boundary of Version 1 of the Pathfinder Framework




To this end, the following data and information should be collected and used:

- Fuel usage
- Mode of transportation, such as road, rail (if applicable)
- Mass of product in tons (expressed per unit of analysis)
- Distance covered
- Load specifications.

Calculation of product transportation emissions depends on the availability of data on fuel consumption, mass, distance and load factor. The prevalent unit of measure used for calculation is ton-km, reflecting the mass of the shipment (in tons) and distance transported.

Transportation of products can take place as follows:

- Internally and as part of direct activities, for example, the transportation of intermediate or final products between different sections within the factory or agricultural mobile emissions such as tractors (Section 5.2.1.1)
- Externally between different tiers in the supply chain, for example, the transportation of raw material to the company site (upstream) or transportation of the final product to consumers (downstream) (Section 5.2.1.2).

#### 5.2.1.1 Transportation within direct activities

All emissions from transportation taking place within the direct activities of an organization shall be included in the PCF.[26] The guidance provided in the Global Logistics Emissions Council (GLEC) Framework and GHG Protocol standards shall be employed for the calculation and allocation of such emissions. Production transportation emissions shall be calculated using primary data (fuel usage) and based on actual transportation mode, distance and vehicle load, if available. Data on fuel usage can be collected through fuel, fuel management systems or breakdown of annual spend. This data shall thus cover the full round trip, that is, include all fuel associated with full, partially loaded and empty trips, when relevant. Allocation of these emissions shall be based on the mass of the product.

Where transportation services are carried out by third-party companies, companies should use the guidance explained below (Section 5.2.1.2) to account for transportation emissions.

#### 5.2.1.2 Transportation between tiers in the upstream supply chain

Transportation emissions that occur upstream of the company in question shall also be accounted for. These emissions shall be included in the company's cradle-to-gate PCF. The following paragraphs provide guidance on how to calculate transportation emissions depending on the type of data available.

##### Primary fuel data available

If primary data on fuel is available, such data shall be used to calculate and exchange data on product-specific emissions. Calculation shall be carried out by the company operating the transportation, that is, the company with access to the relevant primary data (which in many cases is also the party paying for the transportation). This company shall also be responsible for sharing relevant emission factors or product-specific transportation emissions with all stakeholders in the supply chain.

There are two approaches for calculating and sharing transportation emission factors

- Companies calculate an internal emission factor ($CO_2e$ per ton-km), following the guidance of the GLEC Framework. This emission factor shall then be applied to mass and distance data by the users of the transportation service to obtain product-specific emissions.
- Companies calculate a product-specific emission factor ($CO_2e$ per ton shipped), based on the guidance of the GLEC Framework. This emission factor shall then be applied to mass data by the users of the transportation service to obtain product-specific emissions.

Any emission factor calculated internally (as well as information on distance per mode of transportation) shall be shared with stakeholders across the supply chain.

##### No primary fuel data available, but access to product-specific transportation emissions

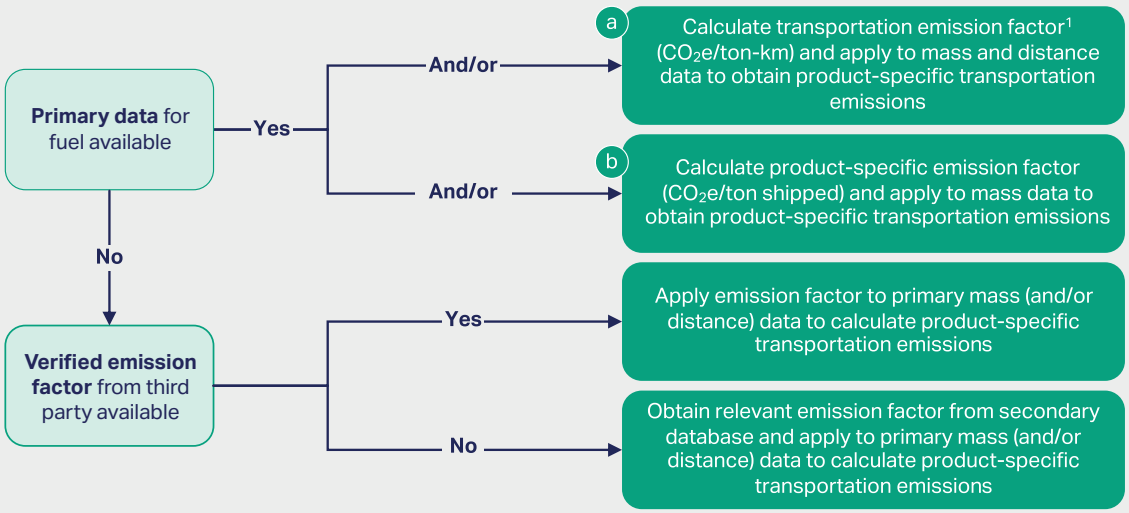
Where primary data is not available, but data on product-specific transportation emissions has been shared by the third party, such as the company operating the transportation, this data shall be used and included in any PCF shared downstream.

##### No fuel data available and no access to product-specific transportation emissions

Where a company has neither primary data on fuel usage nor access to product-specific transportation emissions, primary data on mass and most suitable distance shall be used for the calculation of emissions. The relevant emission factor per type of transportation (expressed in $CO_2e$ per ton-km) shall be applied to this data to calculate product-specific emissions. If no emission factor is available, relevant secondary databases shall be consulted to obtain the necessary emission factor (see Table 2, Section 5.2.2).

While in principle the mass of the product is known by the seller and the buyer (for example, as part of an invoice or purchasing order), data on the actual distance traveled is not fully transparent throughout the supply chain and often only visible to the transportation operator. If such distance data is not available, an estimated and suitable value shall be derived with reference to the provisions in the GLEC Framework. Once this has been calculated, the above rules shall be followed to calculate product-specific emissions, depending on the availability of emission factors.

**Figure 10:** Steps for calculating product transportation emissions




1 Emission factors are always per transportation mode and type.

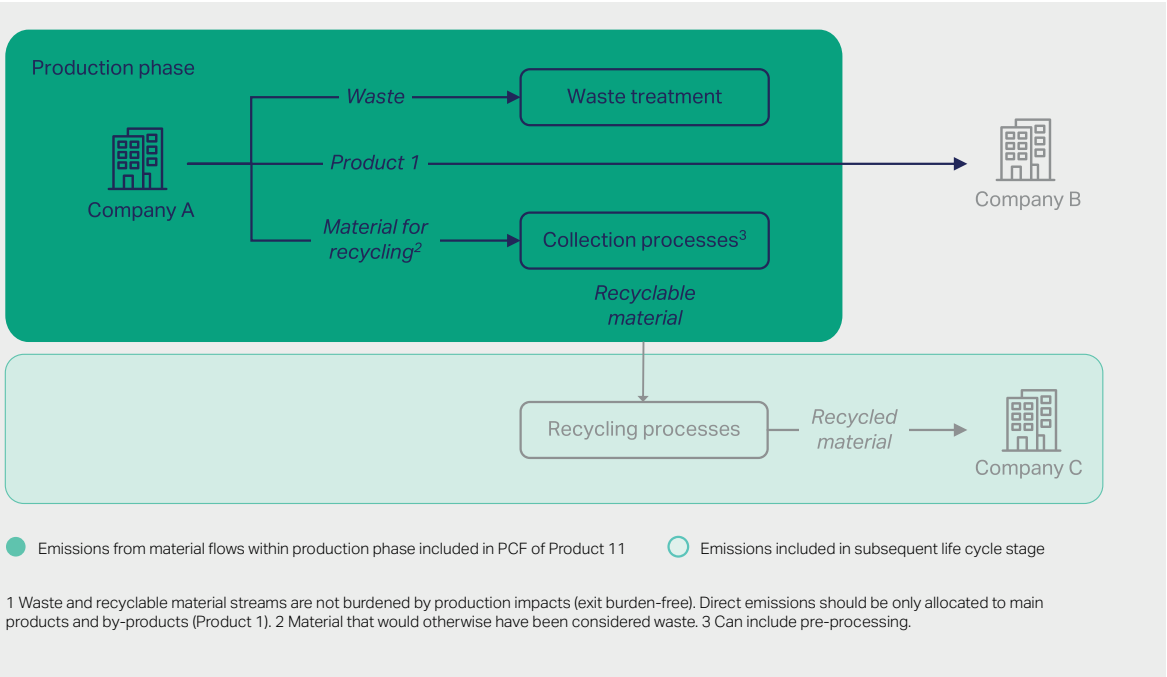
### 5.2.2 Accounting for waste treatment and recycling emissions

For each product that generates waste, companies need to determine whether such waste will be recycled or discarded as waste. If it is discarded, any emissions arising from the treatment of waste during the production process shall be included in the total PCF.[27]

Since the Pathfinder Framework's boundary does not include the end-of-life stage (see Section 4), emissions occurring in relation to the end-of-life stage, in contrast, are optional to include in the PCF. Companies may also produce materials that are recycled.

In this case, all emissions associated with the recycled material until it reaches the point at which it can be used as an input to recycling processes without requiring further processing shall be accounted for and included in the PCF.

**Figure 11:** Allocation of waste treatment and recycling emissions




1 Waste and recyclable material streams are not burdened by production impacts (exit burden-free). Direct emissions should be only allocated to main products and by-products (Product 1). 2 Material that would otherwise have been considered waste. 3 Can include pre-processing.

#### 5.2.2.1 Waste treatment

Waste can be generated during different stages of a product's life cycle, including production and end-of-life. In alignment with the GHG Protocol Product standard and the International EPD System, responsibility for waste processing is placed on the company who generates the waste, until the waste is returned to nature (for example, incinerated) or has reached its end state (final disposal),[28] e.g., is used in another product's life cycle (recycled). If additional processes follow after the end-of-waste state, then these are attributed to the company who is using the recycled or reused material flow as a secondary material.

#### 5.2.2.2 Data identification

All emissions arising from the treatment of waste shall be considered, namely:
Collection and transportation of end-of-life products, including packaging.

- Recovery for recycling
- Waste management
- Dismantling of components
- Shredding and sorting
- Incineration and sorting of bottom ash
- Landfill disposal and maintenance
- Wastewater treatment
- Composting
- Waste-to-energy or energy-from-waste (for example, combustion of municipal solid waste to generate electricity)
- Transportation of waste.[29]

While emissions from preparing and transporting waste that will be combusted in a waste-to-energy facility[30] shall be accounted for, emissions from the waste-to-energy combustion process itself shall not be included. Rather, these emissions shall be accounted for by the company who purchases the energy (in Scope 2 or as part of the PCF).

#### 5.2.2.3 Calculation

The applicable approach to calculating emissions depends on where the waste is treated.

**A. Waste treated by the company who generates it**
Emissions shall be calculated using primary data regarding the type of waste, its composition and type of waste treatment activity. Depending on the type of waste treatment (for example, landfill or incineration), companies may use waste treatment emission factors calculated based on internal primary data. Internal emission factors shall be verified by an independent auditor prior to being used. If no primary emission factors are available, emission factors derived from accepted secondary databases can be employed (Section 5.2.2, Table 2).

**B. Generated waste sent to a third party for waste treatment**
Waste treatment facilities should calculate their waste treatment emissions (Scope 1 and 2), develop emission factors and verify and communicate these to the company who has generated the waste.[31]

Alternatively, the waste treatment facility may share primary data with the company who has generated the waste via the supplier-specific method.[32] This involves collecting verified emissions data from waste treatment companies and allocating the corresponding emissions to the products in question (if required), using the same allocation framework that is used to allocate direct emissions across the products (Section 5.1.3).

If companies do not have access to primary data from waste treatment facilities, they shall estimate waste treatment emissions using primary data on the waste type and composition and specific emission factors according to the quantity and type of waste treatment and disposal (landfill, incineration or recycling). The list of accepted secondary databases in Table 2 below shall be referred to in this context (Section 5.2.2).

#### 5.2.2.4 Allocation

Emissions from the treatment of waste generated during production shall be allocated to the main product or co-products. Since waste is considered an output without economic value, no production emissions are allocated to the actual waste generated during production. Companies shall follow the applicable allocation rules (Section 5.1.3).

### 5.2.3 Recycling

Recycling occurs when a product or material exits the life cycle of one product (at any life cycle stage) and is reused as a material input into another product's life cycle. As recycling processes are often shared between different product life cycles, emissions resulting from recycling shall also be divided between (i) the process which produces the material for recycling, and (ii) the products using the recycled material as inputs in their production.

Recycling companies shall calculate their Scope 1 and 2 emissions and attribute these to the recycled materials. The resulting PCF should be shared with any companies using the recycled material.

#### 5.2.3.1 Calculation

Emissions from recycling processes are calculated in the same way as emissions for direct activities, following the hierarchy stipulated in Section 5.1.2.

#### 5.2.3.2 Allocation

By default, the "recycled content" method of the GHG Protocol Product standard[33] should be used for the allocation of emissions from recycling materials. This method is preferable as it is applicable to most use cases, including complex supply chains or where the product system includes many recycled material inputs and outputs.[34] Additionally, it is recommended for Scope 3 inventories due to its ease of implementation and consistency with inventory accounting methods and secondary emission factors.[35] Finally, the method also prevents emissions from being double counted if a company both purchases and sells recycled products.

The recycled content method stipulates that companies who use recycled material as an input in their production shall account for the emissions from the recycling stage, similar to when they account for the emissions of the material they purchase.

Any emissions associated with the preparation of the material for recycling (such as shredding and pre-processing) shall be accounted for by the company which produces the material for recycling.[36]

To allocate recycling emissions to products, the allocation hierarchy stipulated in Section 5.1.3 should be used.

#### 5.2.3.3 Further considerations

The proportion of material that is treated as waste shall be disclosed based on the calculation and allocation approach for waste emissions (Section 5.2.2.1). Any material that is recycled at its end-of-life shall be separately disclosed and follow the calculation and allocation process for recycling (Section 5.2.3).

## 5.3 Next steps

Once calculated, the cradle-to-gate PCF (incl. transportation, waste and recycling emissions) shall be verified (see Section 8) and shared downstream.

# 6 Data sources and hierarchy

# 6 Data sources and hierarchy

**One of the core aims of the Carbon Transparency Partnership is to increase the share of verified, primary data in PCFs. However, the use of secondary data is practically unavoidable, especially in the case of missing data. This section provides overarching guidance for the prioritization of data sources and the use of secondary data when primary data is not available.[37]**

### 6.1 Selecting primary data

Table 1 shows a hierarchy for data sources that can be used for energy (electricity, heating, cooling) and material inputs.

Activity data that is used to calculate product-level GHG emissions shall always be company-specific – primary data (see the "Activity data source" column in Table 1). The aim is to directly measure GHG emissions or calculate GHG emissions based on both primary activity data and emission factors ("Best case").

In some cases, further modeling, polishing and aggregation of the data is required to refine the estimate of emissions. Algorithms may be used to fill in the missing data, or data aggregation may be required to dampen the effect of revisions, turnarounds or other untypical production conditions.

The use of modeling tools to estimate GHG emissions is a common practice in several sectors (such as agriculture), where emissions calculation is complex and affected by several interrelated parameters (such as geography, temperature, type of input and agricultural practice). Modeling the data can make higher-quality data more accessible, particularly if it is properly calibrated and run with primary inputs. The results of a model that uses primary data as an input would also be considered primary.

**Table 1:** Data hierarchy for energy and material inputs

| Approach | Activity data source | | Emission factor source | |
|---|---|---|---|---|
| | Energy[1] | Material | Energy | Material |
| **Best case** | In-house/primary | | For on-site production: In-house/primary<br>For supplier-specific electricity: Primary/ guarantee of origin | From suppliers or via Pathfinder Network: primary |
| **Base case[2]** | In-house/primary | | Secondary databases | |
| **Worst case** | In-house/primary | | Data proxies | |

1 Electricity, heating/cooling, steam. 2 Prevalent approach in practice.

### 6.2 Selecting secondary data

Primary data is not always available; for instance, emissions associated with the energy flows (electricity, heating and cooling) that are purchased from the market. In such scenarios, emission factors from secondary databases shall be used ("Base case").

The employment of secondary data shall be compliant with the general quality rules for secondary data sources, and secondary data shall only be sourced from verified global or national emission factor databases (Table 2).

If secondary data is not available within the references listed in Table 2, other sources or proxy data can be used to fill in the missing emission factors ("Worst case"). The employment of proxy data sources shall be documented and made transparent to auditors and the recipient of any data (see Section 7.1).[38]

**Table 2:** General secondary emission factor databases accepted under Version 1 of the Pathfinder Framework

| Database | Sector | Link |
|---|---|---|
| Ecoinvent | All | https://www.ecoinvent.org/ |
| Gabi (Thinkstep) | All | http://www.gabi-software.com/international/databases |
| Global Logistics Emissions Council (GLEC) database | Transportation | https://www.smartfreightcentre.org/en/downloads/ |
| Official national emission factor databases | All | E.g., US EPA database: https://cfpub.epa.gov/ghgdata/inventoryexplorer/ |
| PEF | All | https://www.openlca.org/product-environmental-footprints-pefs-in-openlca/ |
| UNEP Global LCA Data Access Network | All | https://www.globallcadataaccess.org/ |

### 6.3 Additional quality rules for secondary data usage

In general, secondary data shall be sourced from the data sources listed in Table 2. Secondary data that is used as emission factors shall be selected according to the following criteria:

#### A. Temporal correlation

The reference year for the secondary data shall correspond to the assessment period of the activity data.

For instance, the electricity generation mix corresponding to the year of assessment or the most representative year shall be employed for the calculations.

#### B. Geographical correlation

The geography of the data shall correspond to the activity data most geographically relevant to the process. For instance, the electricity generation mix corresponding to the geography of the product (country or state if available) shall be employed for the calculations.

#### C. Technological correlation

The secondary data source shall correspond to the activity data that is technologically representative of the process. For instance, the electricity or heating generation mix shall be representative of the source of energy used.

# 7 Required elements for data exchange

# 7 Required elements for data exchange

**Standardized PCF accounting and data exchange constitutes an important step toward creating greater comparability and consistency around Scope 3 emissions data.**

Another factor to enhance comparability and consistency is the standardized sharing of data elements relating to the PCF between stakeholders within the supply chain, as this is a pre-requisite for more granular and accurate calculations by each stakeholder.

Emissions data calculated in line with the Pathfinder Framework shall therefore be shared in accordance with the guidelines set out in this section. These guidelines should additionally be referred to for the completion of the PCF Questionnaire (see Appendix B), which can be used to fulfill the PCF data verification requirement of Section 8.

### 7.1 Minimum data elements required

As a minimum, the following data elements shall be shared with a data recipient within a value chain:

- Data owner's company name
- Product name, short description of the production technology (if relevant) and unique UN Central Product Classification code[39]
- Declared unit (for example, mass or volume, depending on the product)
- Time period and geography of the data (see Sections 7.2.1 and 7.2.2)
- Standards used for measuring, estimating or calculating primary data, calculating or allocating GHG emissions (including PEF, PEFCRs, PCRs, GHG Protocol, ISO) and any additional approaches used (e.g., mandatory flagging when proxy data is used) (see Section 5.2.2)
- Share of primary data in a PCF (see Section 7.2.3)
- Product-specific PCF ($CO_2e$ per declared unit) (see Section 5), including upstream and direct emissions (see Section 5.2)
- Boundary, including life cycle stages (such as production) and attributable processes (see Section 4)
- Proof of audit or verification or filled-in PCF Questionnaire[40] (provided in Appendix B) (see Section 8).

Further details on data semantics and standards will be added in Version 2 of the Pathfinder Framework to enable exchange of consistent data across the Pathfinder Network.

Further data elements can be shared by the data owner on a voluntary basis. However, shared data does not require any information regarding the data owner's suppliers and customers or (company- or product-) specific emissions data from the data owner's upstream supply chain. In addition, data owners shall refrain from sharing any information on pricing, costs, bid strategies, additions and reductions of future capacity or output decisions.

### 7.2 Details on the required data elements

#### 7.2.1 Time period

Emissions shall be calculated and disclosed on an annual basis. The most recent full year (reporting or calendar year) should be the reporting period for the emissions.

Emissions which were averaged over several years may be reported, for example, to dampen the effect of revisions, turnarounds or other untypical production conditions.

If the data is more than five years old, this shall be flagged as part of the supplementary information.

The consideration of shorter time periods (for example, three to six months) or batch-level product emissions data requires further mechanisms to ensure consistency of data and is therefore not in the scope of Version 1 of the Pathfinder Framework.[41]

### 7.2.2 Geography

It is at the sole discretion of the business to choose the geographical granularity or level of aggregation of emissions data shared. ISO 3166-1 alpha-2 – defining the most widely used country codes (such as US for the United States or FR for France) – shall be used to indicate specific countries or regions.
If the same product is produced in various locations and the data owner chooses to provide regional information, the data owner can provide several product footprints pertaining to each respective geography. As an alternative, it is possible to report a single footprint for products which are produced in various locations. When following this approach, a weighted average of the respective product-specific emissions according to each geography's production quantity shall be calculated and shared.

This average nature of the footprint shall be flagged in the supplementary information.

### 7.2.3 Share of primary data

To create visibility on the share of primary data in PCF calculations, the PDS in each data set should be determined (and shared). This can be done by calculating the proportion (percentage) of the total GHG emissions ($CO_2e$) that is derived using primary data:

$$\frac{\text{Part of PCF based on primary data } (CO_2e)}{\text{PCF } (CO_2e)} = \text{PDS}_{\text{PCF}}(\%)$$

Ideally, the PDS for relevant input flows obtained from upstream suppliers (Tier n-1) are available. If so, the PDS of the PCF should be calculated using a weighted average approach of the material and energy inputs.

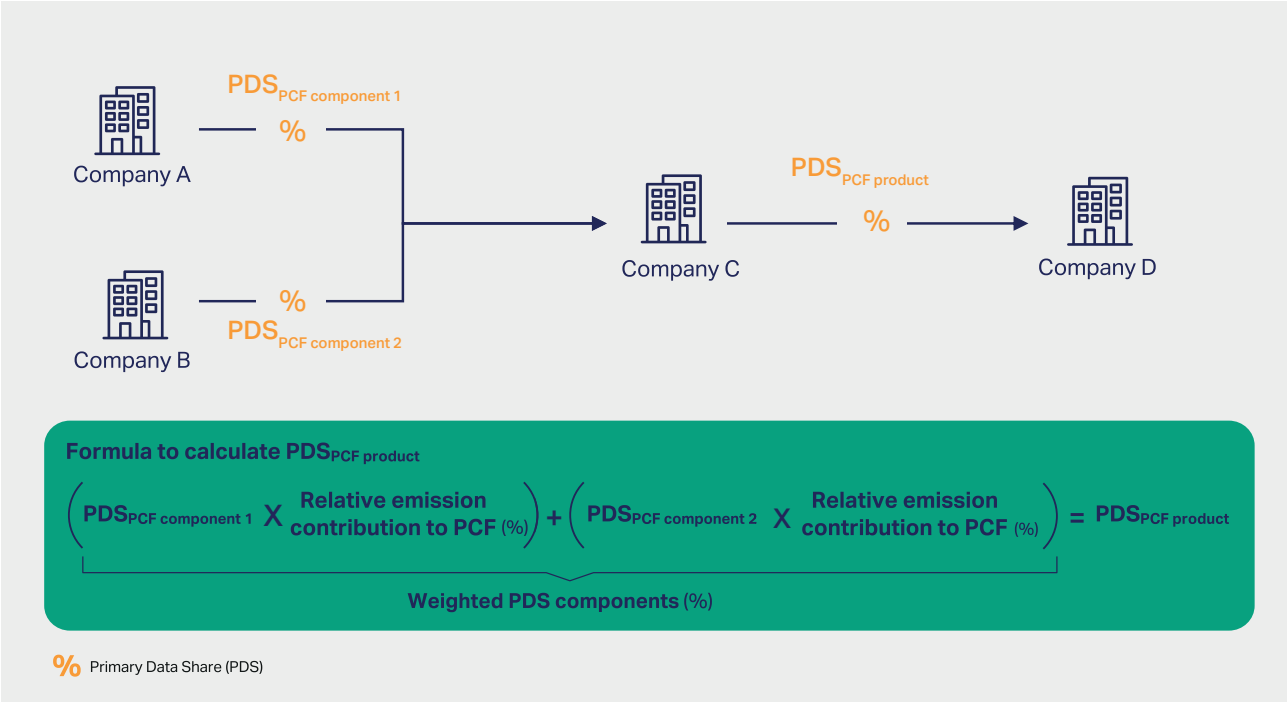
To do so, the individual PDS received from every input supplier ($PDS_{\text{PCF component 1}}$ and $PDS_{\text{PCF component 2}}$) as well other components, such as energy inputs or direct emissions from production, should be multiplied with their respective relative contribution (in percent) to the PCF of the product output.

All weighted PDS components should then be added up to obtain an overarching PDS ($PDS_{\text{PCF product}}$) (Figure 12).

To help increase transparency on primary data use, the overarching PDS ($PDS_{\text{PCF product}}$) should be shared downstream (Tier n+1), together with the PCF.

The inclusion of an explanation for the share of primary data is thus encouraged, with the objective of helping businesses support each other in increasing the amount of primary data flowing through the system and ensuring more accurate PCFs.

**Figure 12:** Calculation of Primary Data Share (PDS)



# 8 Verification and auditing

# 8 Verification and auditing

**The creation and sharing of high-quality (granular, comparable and consistent) and reliable data is an essential pre-requisite for the resolution of the Scope 3 challenge businesses face today.**

### 8.1 Goal and objective

While the Pathfinder Framework – as well as the existing methods and standards it builds on – paves the way toward ensuring data quality, auditing and verification are key in ensuring credibility and reliability. Auditing and verification through independent verifiers can help establish whether PCFs have been accounted for in compliance with the Pathfinder Framework and relevant standards, sectoral guidance, product rules and methods. This section provides guidance for verification and auditing of PCF results. This guidance can additionally be used to fill in the PCF Questionnaire, a template designed to support this process (see Appendix B).

### 8.2 Scope and process

In line with the minimum required data elements, it is strongly encouraged to only share verified and audited data. To this end, businesses shall complete a self-declaration in the form of the PCF Questionnaire (Appendix B). Data owners shall share the completed questionnaire with data recipients at the same time as they share their PCF data.

Alternatively, businesses can also elect to complete a more extensive audit independently through a third-party provider.

In this case, verification of all aspects relevant for the PCF should be included (this may cover verification of supplier data elements, that is, elements obtained from suppliers and used in PCF calculations). However, PCF data obtained from another supply chain stakeholder and used for calculations of a company's own PCF does not need to be (re) verified if it has been previously audited, as long as no changes are made to the underlying calculation models and data used by the company who shared the data. In the medium and long term and with more audits conducted by companies on their PCF, the focus of verification processes could be sharpened to those activities that are owned or controlled by the company itself (direct emissions), as any data received from peers across the value chain would be verified by those peers.

Finally, while the correct usage of emission factor databases shall be part of the verification (for example, following the data hierarchy and usage guidelines described above), emission factor data calculations do not need to go through (re)verification.

The set of requirements for the audit and verification are drawn from, and are therefore largely compliant with, the existing standards and guidelines for peer review of LCA studies and EPD audits. The results of an EPD or ISO-compliant audit can be used as proof of verification, as long as the companies can show that the audit conforms to the set of rules regarding the prioritization of use of primary data.

Once data exchange is technology-enabled through the Pathfinder Network, verification and auditing will become a simple-to-adhere-to requirement. Further details on a simplified verification process will be included in subsequent versions of the Pathfinder Framework.

### 8.3 Verification process

There are two major aspects that need to be verified to provide assurance on the results of a PCF:

- Data selection and quality (Section 8.3.1)
- Methodology and PCF calculations (Section 8.3.2).

### 8.3.1 Data selection and quality

Data identification and use shall be compliant with the rules listed below, which are compliant with ISO standard 14040. To confirm the adequacy of the data, the following shall be reviewed and verified:

- Provision of the minimum required data elements (see Section 7.1)
- Inclusion of the beginning and end of one unit process (boundary, its function, inclusion of all relevant attributable processes and any extraordinary processes (such as maintenance, downtime))
- Time period during which data was collected
- Method of data collection (for example, based on sampling or process-specific measurement)
- Sources of data (primary and secondary)
- Technological[42] representativeness (that the chosen data represents the underlying industrial or biological processes)
- Representative nature of data (geographical and temporal)
- Significance of possible exclusions and assumptions (cut-off rules and exemptions).

Any data that is relevant for the allocation of environmental emissions among co-products shall also be verified.

If higher-quality data exists in-house than available in secondary databases (for example, in-house emission factors for fuel) and is used for calculations, the adequacy of such in-house data shall also be reviewed and verified following the above criteria. Data sourced from verified emission factor databases (Table 2) does not need to go through verification, but its representativeness, relevance and correct application to the product in question should be a part of the verification process.

### 8.3.2 Methodology and PCF calculations

To ensure compliance with the Pathfinder Framework as well as applicable methods and standards such as PEFCRs and PCRs, the methodology used and resulting PCF calculations shall also be reviewed.

Verification should focus on:

- Completeness of life cycle stages
- Choice of declared unit
- Any data aggregation, data polishing and underlying modeling to calculate product inventory
- Correct calculation formulas and product allocation rules
- Use of correct and up-to-date characterization factors (see Section 4.2) and emission factors according to the guidance (Section 5.2.2)
- Calculation of PDS according to the guidance (see Section 7.2.3).

In addition, the adherence to any other specific rules required by the relevant PCRs shall be confirmed.

### 8.3.3 Data evidence

Primary data, such as activity data, shall be supplied to the auditor in a way that necessary evidence – such as bills of materials, (automated) usage statistics and reports, invoices, and equipment and machinery data – can be reviewed and verified. The review should include a random sampling procedure to ensure the validity of the data and the respective evidence.

# 9 The Pathfinder Network

# 9 The Pathfinder Network

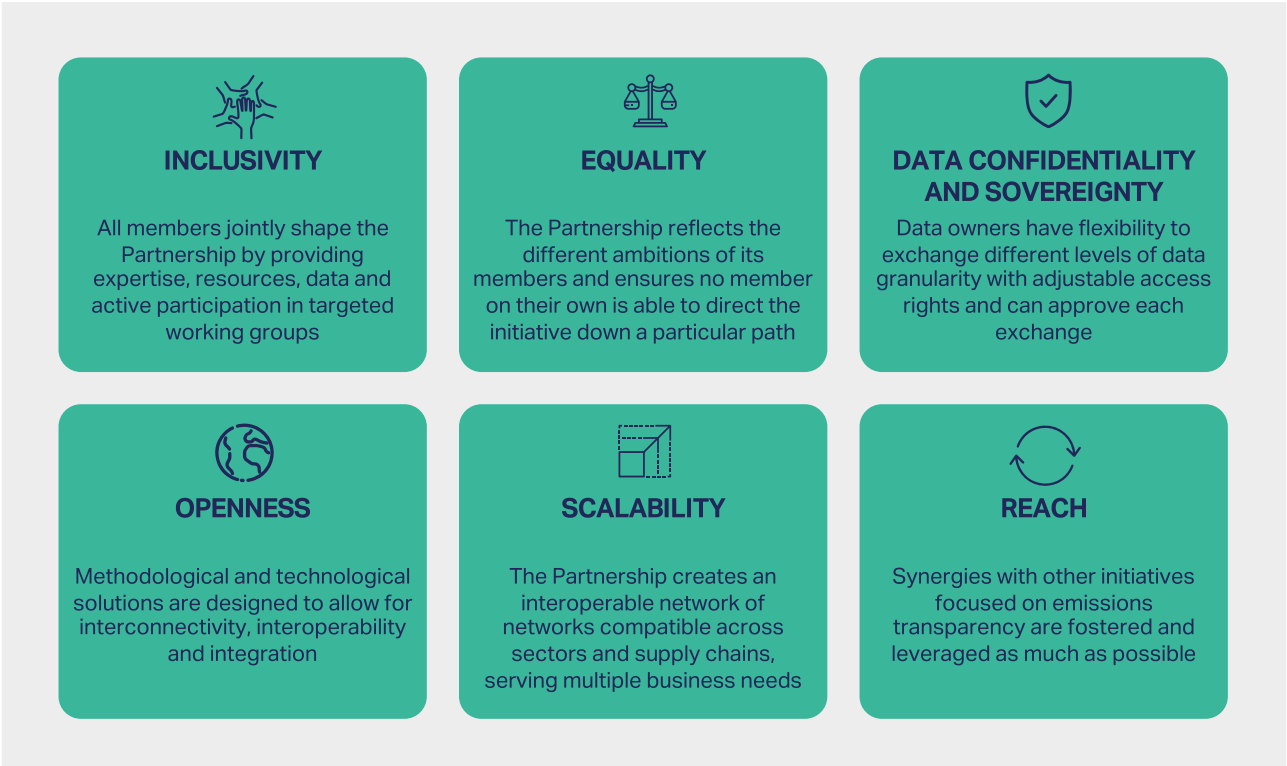
**Application of the guidance in this Pathfinder Framework will help businesses create more comparable and consistent product-level GHG emissions. However, to comprehensively tackle the lack of emissions transparency, it is equally essential to enable straightforward and confidential cross–value chain and cross-industry sharing of such data.**

Technology is without a doubt a key driving force in achieving this. Beyond the creation of this Framework, stakeholders within the Carbon Transparency Partnership are also collaborating on developing a network for the exchange of emissions data (working title: Pathfinder Network). The aim is to establish the missing (technological) link between different supply chain actors, for example through the creation of an interoperable network, connecting multiple underlying technology solutions.

In addition, the Network can strengthen the application of the Pathfinder Framework – and hence data comparability and consistency – by simplifying access to primary data or verification on the basis of immutable verification proofs, for instance.

The Pathfinder Network will be underpinned by the key values of the Carbon Transparency Partnership (Figure 13).

**Figure 13:** Key values of the Carbon Transparency Partnership



# Appendix A: Terms and definitions (Glossary)

| Definitions | Explanations |
|---|---|
| **Allocation** | The process of partitioning GHG emissions from a single facility or other systems (such as a process vehicle or business unit) among its various outputs, in particular products. |
| **Attributable process** | Those processes that consists of all service, material and energy flows that become, make and carry a product throughout its life cycle. |
| **Boundary** | The attributable processes and their associated emissions that should be accounted for and reported by a company as part of its PCF. |
| **$CO_2e$ (carbon dioxide equivalent)** | Unit comparing the radiative forcing (global warming impact) of a GHG, expressed in terms of the amount of $CO_2$ that would have an equivalent impact. |
| **Carbon Transparency Partnership** | A project led by WBCSD, set up to provide a forum for businesses across value chains and industries as well as for key decarbonization stakeholders to collaborate on the creation of GHG emissions transparency. |
| **Cradle-to-gate PCF** | Part of a product's full life cycle, covering all emissions allocated to a product upstream of a company plus all emissions resulting from processes within the company until the product leaves the company's gate. |
| **Data quality** | Characteristics of data (completeness, reliability and technological, temporal and geographical representativeness) that relate to their ability to satisfy stated requirements (the most common frameworks are the Pedigree Matrix (ecoinvent) and the Data Quality Matrix/Requirements (Product Category Rules)). |
| **Declared unit** | Unit of analysis chosen for PCF, which serves as the reference to which the inputs (materials and energy) and outputs (such as products, by-products, waste) are quantified. |
| **Downstream emissions** | Indirect GHG emissions that occur in the value chain *following* the processes owned or controlled by the reporting company. |
| **Direct emissions** | GHG emissions from the processes that are owned or controlled by the reporting company. |
| **Emission factor** | Amount of GHGs emitted, expressed as $CO_2e$ and relative to a unit of activity (for example, kg of $CO_2e$ per declared unit). |
| **Greenhouse gases (GHGs)** | Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, its atmosphere and clouds. GHGs include $CDCO_2$, Methane ($CH_4$), Nitrous Oxide($N_2O$), Hydrofluoro-Carbons (HFCs), Perfluorocarbons (PFCs) and Sulfur Hexafluoride ($SF_6$). |
| **Input** | Product, material or energy flow that enters a unit process. |
| **Inventory** | Summary of all input and output flows of a system (such as an organization's or product's GHG emissions and sources). |
| **Inventory results** | GHG impact of the studied product per unit of analysis. |
| **Life cycle** | Consecutive and interlinked stages of a product system, from raw material acquisition or generation of natural resources to end-of-life, inclusive of any recycling or recovery activity. |
| **Life cycle assessment (LCA)** | Compilation and evaluation of the inputs, outputs and potential environmental impacts of a product throughout its entire life cycle. |

| Definitions | Explanations |
|---|---|
| **Life cycle emissions** | The sum of GHG emissions resulting from all stages of the life cycle of a product and within the specified boundaries of the product. |
| **Material** | Physical products supplied from a supplier upstream, used as input for production processes of products. |
| **Multi-input-output unit process** | Operation or process with multiple inputs, such as materials and energy, and multiple outputs, such as co-products and waste. |
| **Output** | Product, material or energy that leaves a unit process. |
| **Pathfinder Network** | Network for the exchange of carbon footprint data that is being developed by the Carbon Transparency Partnership, with the aim of establishing the missing (technological) link between different supply chain actors, such as through the creation of interoperability for underlying technology solutions. |
| **Primary data** | Data pertaining to a specific product or activity within a company's value chain. Such data may take the form of activity data, emissions or emission factors. Primary data is site-specific, company-specific (if there are multiple sites for the same product) or supply chain–specific. Primary data may be obtained through meter readings, purchase records, utility bills, engineering models, direct monitoring, material or product balances, stoichiometry or other methods for obtaining data from specific processes in the value chain of the company.<br><br>A single calculation might include both primary and secondary data. For example, calculating emissions from the consumption of electricity could involve primary activity data, such as data on consumption in kWh, multiplied by a secondary emission factor provided by national GHG inventories representing GHG emission intensity ($CO_2e$ per kWh). |
| **Product** | Any good (tangible product, such as material) or service (intangible product). |
| **Product carbon footprint (PCF)** | Total GHG emissions generated during the life cycle of a product, measured in $CO_2e$. Within the boundary of Version 1 of the Pathfinder Framework, only material acquisition, pre-processing, production, distribution and storage are included in the PCF. |
| **Product category** | Group of products that can fulfill equivalent functions. |
| **Product category rules (PCRs)** | A set of specific rules, requirements and guidelines for calculating PCFs (among other things) and developing environmental declarations for one or more product categories according to BS EN ISO 14040:2006. |
| **Raw material** | Primary or secondary material used to produce a product. |
| **Secondary data** | Data that is not from specific activities within a company's value chain but from databases, based on averages, scientific reports or other sources. |
| **Unit process** | Smallest part of a product's life cycle for which input and output data is quantified. |
| **Upstream emissions** | Indirect GHG emissions that occur in the value chain prior to the processes owned or controlled by the reporting company. All upstream transportation emissions are also included as part of upstream emissions. |
| **Use phase** | That part of the life cycle of a product that occurs between the transfer of the product to the consumer and the end-of-life of the product. |
| **Value chain** | All the upstream and downstream activities associated with the operations of a company. |
| **Waste** | Materials, co-products, products or emissions without economic value that the holder discards, intends to discard or is required to discard. |

# Appendix B: PCF Questionnaire

**This PCF Questionnaire contains the information that companies shall include to report their PCF according to this Pathfinder Framework.**

| General information and scope | |
|---|---|
| **Company name** | *[Company name]* |
| **Contact information** | *[Contact's first and last name, email]* |
| **Product name** | *[Name of product or service, brand name if applicable]* |
| **Unique product code** | *[Unique UN Central Product Classification code][39]* |
| **Product description** | *[Brief description of the product and its function]* |
| **Declared unit** | *[Unit of analysis]* |
| **Biogenic carbon content (per declared unit)** | *[Biogenic carbon content (kg) per declared unit]* |
| **Fossil carbon content (per declared unit)** | *[Fossil carbon content (kg) per declared unit]* |
| **Standards, sector guidance or product rules used for PCF calculation** | *[Standard(s) (ISO, GHG Protocol, Publicly Available Specification 2050, PCRs, etc.) used for PCF calculation, including the information for which life cycle states the standard(s) are used]* |
| **GHGs included in PCF inventory** | *[GHGs included in this PCF, including disclosure and justification if any of the required gases (per the GHG Protocol Product Standard) are not included]* |
| **Global warming potential factors** | *[Global warming potential factors, which shall be derived from the IPCC Assessment Report AR 5]* |
| **Additional information** | *[To be included as relevant]* |

| Boundary | |
|---|---|
| **Boundary, including life cycle stages and attributable processes per life-cycle phase** | *[Life cycle stages accounted for in the PCF and attributable processes in each life cycle stage, including disclosure of whether and how life cycle stages are defined differently than in the Pathfinder Framework or were excluded]* |
| **Time period (PCF)** | *[PCF validity period]* |

| Data collection, quality and exchange | |
|---|---|
| **Share of primary data in the PCF** | *[Share of primary data used (see Section 7.2.3)]* |
| **Sources for primary data** | *[Primary data sources used (for example, directly from suppliers or customers across the value chain) and information on which life cycle stages the sources were used for]* |
| **Sources for secondary data** | *[Secondary data sources used and information on which life cycle stages the sources were used for]* |
| **Time period of the data collected** | [*Time period of data collection of both primary and secondary data sources]* |
| **Temporal representativeness** | *[Degree to which the selected data represents the time period corresponding to the PCF]* |
| **Geography of the data collected** | *[Country or smaller area within a country]* |
| **Geographical representativeness** | *[Degree to which the selected data represents the geography of the underlying processes]* |
| **Technological representativeness** | *[Degree to which the selected data represents the underlying technological or biological processes]* |
| **Methods of data collection and data aggregation, and data quality** | *[Data collection methods, data quality and any efforts to improve data quality, including indication of data aggregation used, such as per declared unit]* |
| **Mass balances validated (closed)** | *[Yes or no]* |
| **Cut-off rules and exemptions** | *[Explanation of decisions to use cut-off rules for waste treatment and recycling processes and omit life cycle stages, unit processes or data]* |
| **Uncertainty assessment** | *[Results, key drivers and a short qualitative description of the uncertainty assessment, if applicable]* |

| Allocation | |
|---|---|
| **Standards used for the measurement, estimation or calculation of primary data, calculation or allocation of GHG emissions and any additional approaches used** | *[Allocation rules and corresponding standards used]* |
| **Recycled material allocation approach** | *[Disclosure of the recycled material allocation method used (recycled content method or closed-loop approximation method), whether the product is recycled during its end-of-life or whether recycled material is used as an input]* |

| Inventory results | |
|---|---|
| **Product-specific PCF** | *[$CO_2e$ per declared unit]* |

# Endnotes

[1] United Nations (2021, September 22): Climate Action Fast Facts. Retrieved from: https://www.un.org/en/climatechange/science/key-findings.

[2] Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.) (2021): IPCC: Summary for Policymakers. Cambridge University Press.

[3] UNEP, UNEP DTU Partnership (2020): UN Environment Programme Emissions Gap Report.

[4] Science Based Targets initiative (2021, October): The SBTi's Net-Zero Standard. Retrieved from https://sciencebasedtargets.org/resources/files/Net-Zero-Standard.pdf.

[5] 1,878 companies are taking action within the Science Based Targets initiative network by setting science-based targets or committing to 1.5°C; Science Based Targets initiative (2021, October 4): Companies taking action. Retrieved from https://sciencebasedtargets.org/companies-taking-action)

[6] Based on more than 50 selected stakeholders, including Shell, adidas, Pfizer, 3M, Volkswagen, GreenGauge, CDP and McKinsey & Company.

[7] Any reference in this document to the term "technology" shall be taken to refer to IT (as opposed to production technology).

[8] Note, the Partnership is not creating a technology platform nor an individual technology solution.

[9] Emissions data from upstream and downstream product life cycles is used as source data by a reporting company for Scope 3 Categories 1 to 5 and 9 to 12 of the GHG Protocol Scope 3 standard.

[10] World Resources Institute/World Business Council for Sustainable Development, GHG Protocol (2013). GHG Protocol Product Life Cycle Accounting and Reporting standard.

[11] Existing overarching methods and standards, in contrast, do not provide a sufficient level of specificity. For instance, under the GHG Protocol Product standard, two companies producing similar products can choose two different methods for allocating emissions, leading to results being incomparable.

[12] Prior to commencement, the list of work-in-progress PCRs by relevant program operators shall be consulted to avoid duplication. Any new development activities should further be brought to the attention of the Carbon Transparency Partnership.

[13] To further help drive consistency, any business applying sector-specific rules is also strongly encouraged to inform the Carbon Transparency Partnership accordingly, so that a list of frequently-used rules can be created for other stakeholders to refer to.

[14] Note equivalent methods have been developed with regards organizational declarations.

[15] World Resources Institute/World Business Council for Sustainable Development, GHG Protocol (2013). Required Greenhouse Gases in Inventories; Accounting and Reporting Standard Amendment.

[16] This Pathfinder Framework uses a value chain perspective to account for and exchange product life cycle emissions. As such, the Framework organizes a company's emissions into three major categories: (i) upstream emissions: indirect GHG emissions that occur in the value chain prior to the processes owned or controlled by the reporting company – all upstream transportation emissions are also included as part of upstream emissions; (ii) direct emissions: GHG emissions from the processes that are owned or controlled by the reporting company; (iii) downstream emissions: indirect GHG emissions that occur in the value chain following the processes owned or controlled by the reporting company.

[17] Accounting for and reporting for transportation emissions is described further in Section 5.2.

[18] Version 2 of the Pathfinder Framework may include these stages.

[19] Considering the current challenges associated with collecting primary and verifiable data on consumer product use, guidance on the use stage is not included in this version of the Pathfinder Framework. Version 2 will look at this topic in more detail.

[20] World Resources Institute/World Business Council for Sustainable Development, GHG Protocol (2011): Product Life Cycle Accounting and Reporting Standard.

[21] GHG impact is the product of GHG emissions and relevant global warming potential.

[22] The term is used in ISO 14044 and PEFCRs.

[23] If bioenergy biomass is used as a feedstock material, additional rules need to include and allocate the biogenic $CO_2e$ emissions. This topic will be considered within the context of Version 2.

[24] The Pathfinder Network will help facilitate direct access to these.

[25] For details, see: World Resources Institute/World Business Council for Sustainable Development, GHG Protocol (2011): Product Life Cycle Accounting and Reporting Standard.

[26] This is in line with the GHG Protocol Product standard as well as the PCRs by the International EPD System.

[27] Data-sharing requirements for end-of-life emissions will be further defined in Version 2 of the Pathfinder Framework.

[28] See EPD International for detailed criteria on when the end-of-waste state is achieved.

[29] Including the emissions generated during the transportation of waste is optional, according to the GHG Protocol Scope 3 standard.

[30] Referred to as Category 5 in the GHG Protocol Scope 3 standard.

[31] The Pathfinder Network will help facilitate access to such emission factors.

[32] World Resources Institute/World Business Council for Sustainable Development, GHG Protocol (2013): Technical Guidance for Calculating Scope 3 Emissions.

[33] This method is also known as the cut-off method or 100-0 method.

[34] World Resources Institute/World Business Council for Sustainable Development, GHG Protocol (2013): Technical Guidance for Calculating Scope 3 Emissions.

[35] World Resources Institute/ World Business Council for Sustainable Development, GHG Protocol (2013): Technical Guidance for Calculating Scope 3 Emissions.

[36] If the recycled material output has the same inherent properties as virgin material input in the same supply chain, the closed-loop method may be applicable instead. This is relevant for specific sectors such as metals. If the closed-loop method is used, this shall be flagged in the PCF data and PCF Questionnaire to ensure consistent allocation across players within the supply chain.

[37] Specific guidance focused on data sources for transportation can be found in Section 5.2.

[38] A list of proposed quality criteria for secondary databases and data sets to be used within the context of the Pathfinder Network will be provided in Version 2 of the Pathfinder Framework.

[39] UN Statistics Division (2021, September 22): Economic statistics. Retrieved from https://unstats.un.org/unsd/classifications/Econ/cpc.

[40] The PCF Questionnaire contains the minimum required data elements plus additional information.

[41] Additional guidelines on frequency of reporting may, however, be added in Version 2 of the Pathfinder Framework, following further.

[42] The term "technological" as used here refers to the technology of specific production processes. Throughout the rest of the Framework, this term is used to refer to IT.

## DISCLAIMER

The Pathfinder Framework is designed to ease GHG accounting and encourage businesses to exchange verified primary data on product carbon emissions across the supply chain. It has been developed in a multi-stakeholder process, including experts from business, industry initiatives, standard-setting and reporting bodies, government and nongovernmental organizations. The process was led by the World Business Council for Sustainable Development (WBCSD), within the context of its Carbon Transparency Partnership. McKinsey & Company, the global management consulting firm, provided analytical insights and support to the Carbon Transparency Partnership.

While WBCSD encourages use of the Pathfinder Framework by all corporations and organizations, the preparation and publication of reports or program specifications based fully or partially on these guidelines is the full responsibility of each entity producing them. Neither WBCSD nor any other individuals who contributed to these guidelines assume responsibility for any consequences or damages resulting directly or indirectly from its use in the preparation of reports, program specifications or the use of reports based on these guidelines.


## ACKNOWLEDGEMENTS

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## ABOUT WBCSD

WBCSD is the premier global, CEO-led community of over 200 of the world's leading sustainable businesses working collectively to accelerate the system transformations needed for a net zero, nature positive, and more equitable future.

We do this by engaging executives and sustainability leaders from business and elsewhere to share practical insights on the obstacles and opportunities we currently face in tackling the integrated climate, nature and inequality sustainability challenge; by co-developing "how-to" CEO-guides from these insights; by providing science-based target guidance including standards and protocols; and by developing tools and platforms to help leading businesses in sustainability drive integrated actions to tackle climate, nature and inequality challenges across sectors and geographical regions.

Our member companies come from all business sectors and all major economies, representing a combined revenue of more than USD $8.5 trillion and 19 million employees. Our global network of almost 70 national business councils gives our members unparalleled reach across the globe. Since 1995, WBCSD has been uniquely positioned to work with member companies along and across value chains to deliver impactful business solutions to the most challenging sustainability issues.

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