Green x Digital Consortium

CO2 Visualization Framework

Edition 1.0

30th June 2023

Green x Digital Consortium

Data Visualization Project

Methodology SWG

Table of Contents

1. Introduction

- This chapter presents how the Green x Digital Consortium aims to visualize CO2.
- In order to capture the main elements of discussions on CO2 visualization conducted in the Methodology SWG, we have also included elements from our conceptual discussion and studies on the pros and cons in relation to the calculation and disclosure methods for CO2 data to be adopted.
- Readers who are interested in practical methods for calculating and disclosing CO2 data may simply skim this chapter and proceed to Chapters 2 and 3.

Positioning of the CO2 Visualization Framework

1-1. What is the CO2 Visualization Framework?

1-1-1. Positioning of the CO2 Visualization Framework

- The Green x Digital Consortium CO2 Visualization Framework (below, this document) is a framework document for CO2 visualization issued by the Green x Digital Consortium.
- It was created by the Methodology Sub-WG (SWG), a sub-group of the Green x Digital Consortium's Visualization WG.
  - The Carbon Data Visualization Project is a working group aiming to achieve visualization of CO2 data throughout the entire supply chain using digital technology and to establish a mechanism to appropriately reflect CO2 reduction efforts in data.
  - The SWG is in charge of examining methods for calculating CO2 data that are shared throughout the supply chain using digital technology, as well as items to be disclosed when data is shared.
- This document presents (1) methods of calculating CO2 data to be exchanged throughout the supply chain using digital technology, and (2) sharing methods (data quality disclosure methods). (The use of digital technology will be discussed in the Tech Specifications SWG.)
- Figure 1-1-2 provides an image of the supply chain CO2 visualization and data exchange which the Visualization WG aims to realize together with the Methodology SWG.

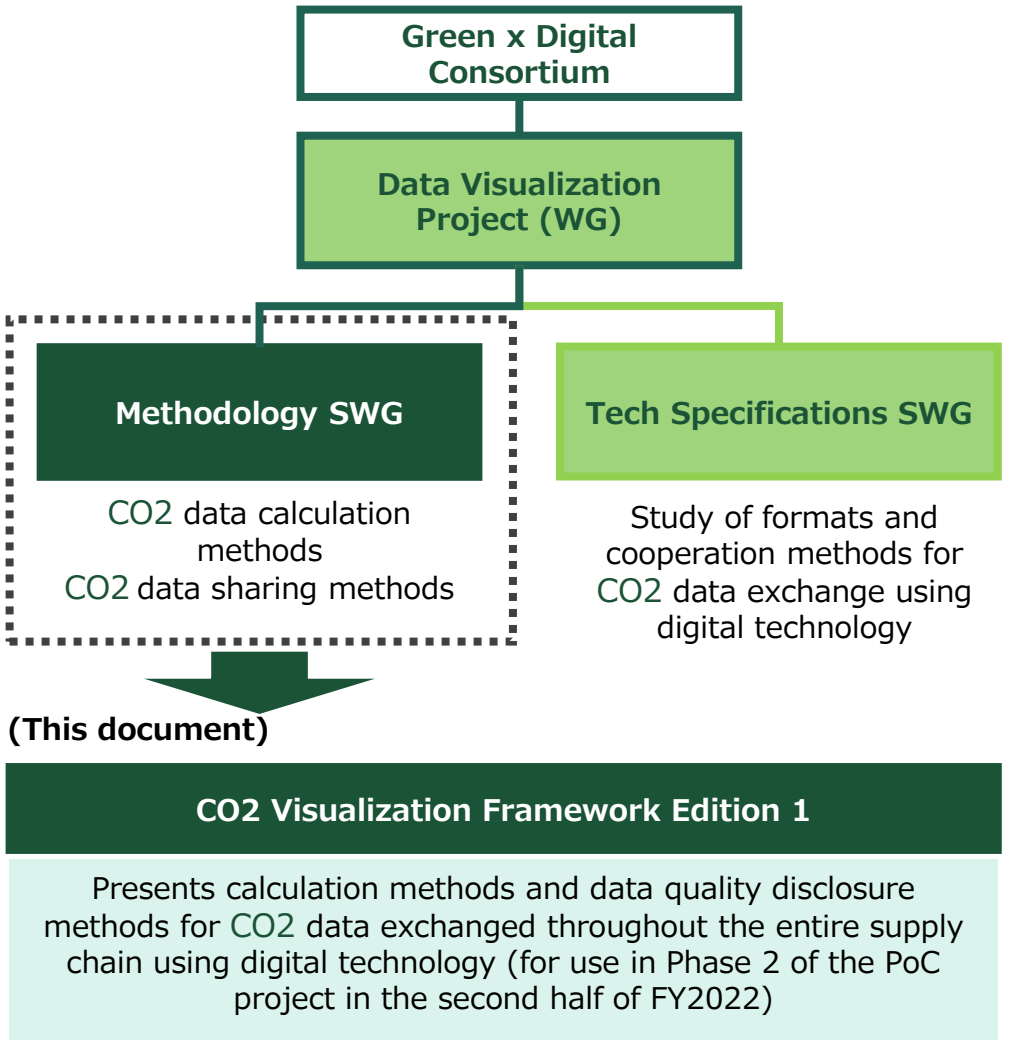


Figure 1-1-1 Positioning of the Methodology SWG and this document

Creating a Connected World

- The aims of the Green x Digital Consortium's Data Visualization Project are to use digital technology to visualize CO2 data throughout the entire supply chain and to build a mechanism that appropriately reflects CO2 reduction efforts in data.
- In this system, the data collection, calculation, and sharing solutions used by each company in the supply chain are connected by the solutions used by the other companies in the same chain so as to facilitate data exchange between companies.
  Each company's CO2 data is calculated in a way that reflects the company's actual emissions and reduction efforts based on common data collection and calculation methodologies and is shared in a unified data format.
- Companies downstream in the supply chain will be able to measure and monitor Scope 3 emissions while reflecting the emissions status and reduction efforts of suppliers.
- This data exchange can also be interlinked with major global frameworks/platforms, ensuring that the CO2 reduction efforts of Japanese companies are appropriately appreciated overseas.

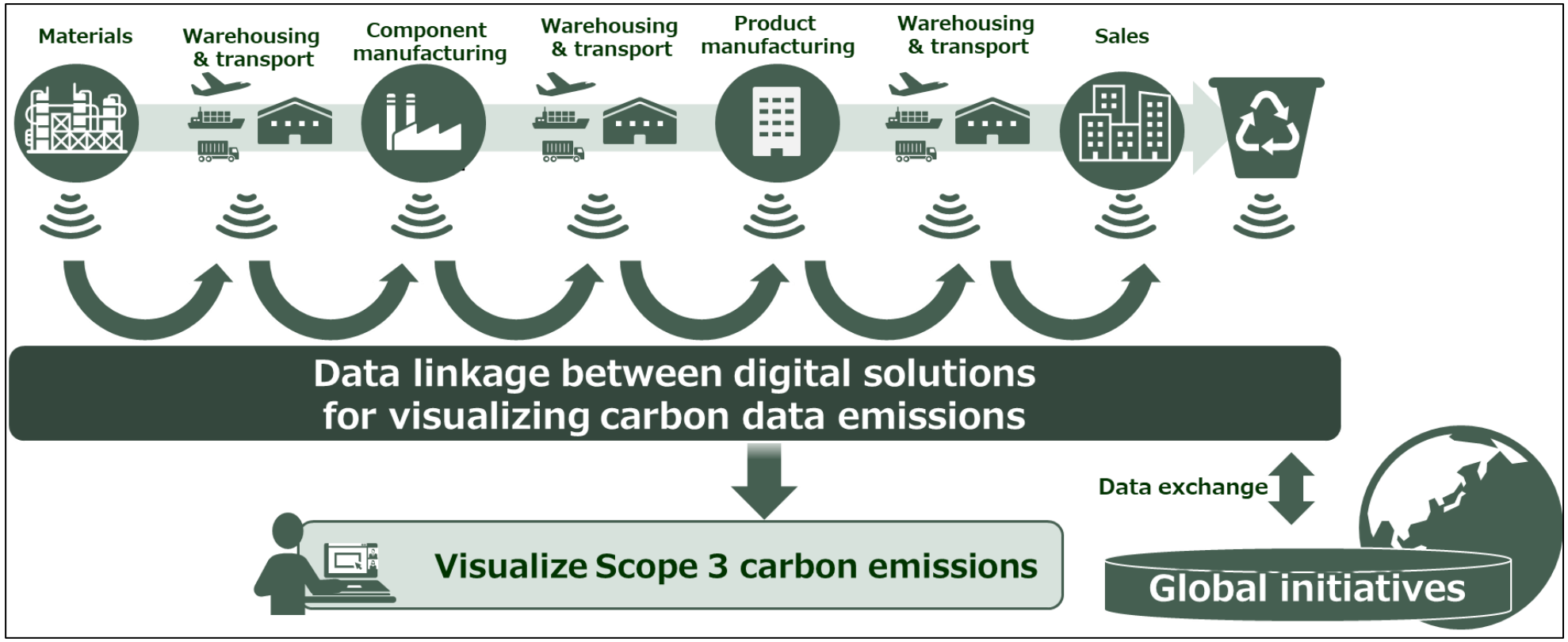


Figure 1-1-2 The connected world sought by the Visualization WG

Authors and document preparation steps

1-1-2. Authors of this document

- The authors of this document are shown in Figure 1-1-3. The leader and sub-leaders of the Methodology SWG were the main authors of this document, and SWG members cooperated in the study and offered their opinions.
- The contributions of each company in the preparation of this document are described separately at the end of this report.

Leader	Mizuho Research & Technologies
Sub-leaders	NTT DATA, Brother Industries
SWG Members	IHI, Asuene, Amazon Web Services Japan, NTT DATA, KAJIMA, Canon, Sumitomo Electric Industries, Zeroboard, Deloitte Tohmatsu Consulting, Toshiba, NAGASE, Nitto Denko, NEC, Microsoft Japan, Nomura Research Institute, Panasonic Holdings, Hitachi, PwC Advisory, PwC Consulting, Forval, Fujitsu, Brother Industries, Mizuho Research & Technology, MITSUI, Mitsubishi Electric, Murata Manufacturing, Yokogawa Electric

Figure 1-1-3 Document authors and co-authors

1-1-3. Steps involved in preparing this document

- The Methodology SWG completed this document in the schedule shown in Figure 1-1-4 through the following 3 steps.
  (a) Identification of issues and requirements based on the envisaged image
  (b) Examination of how to respond to issues and requirements based on prior methodology surveys
  (c) Preparation of draft documents based on the above

	Date	Issues and requirements	Prior methodology investigation	Document preparation
1	2022 April 19	• Presentation of each company's issues • Summary of issues in initial report	• Identification of existing methodologies to be investigated	
2	May 10	• Summary of issues • Handling of indirect sectors	• Preliminary methodology investigation results (1)	• Table of contents organization, identification of proposed items
3	June 7	• Validation • Treatment of comparability	• Preliminary methodology investigation results (2)	• Preparation and presentation of draft plan aiming at completion by 1/3
4	July 12	• Document positioning	• Preliminary methodology investigation results (3)	• Preparation and presentation of draft plan aiming at completion by 2/3
5	August 9			• Draft presentation (for comment)
6	September 20			• Revision based on comments received, presentation of revised draft

Figure 1-1-4 Steps involved in preparing this document

Potential users

1-1-4. Potential users

- Version 1 of this document is intended for use by companies participating in Phase 2 of the Green x Digital Consortium PoC project scheduled for the second half of FY2022.
- We envisage companies participating in the project using this document in the following manner:
  - User companies will seek to calculate and share their CO2 data with downstream companies in accordance with this document.
  - Solution companies will use digital technology to assist user companies in their efforts to calculate and share CO2 data in accordance with this document.

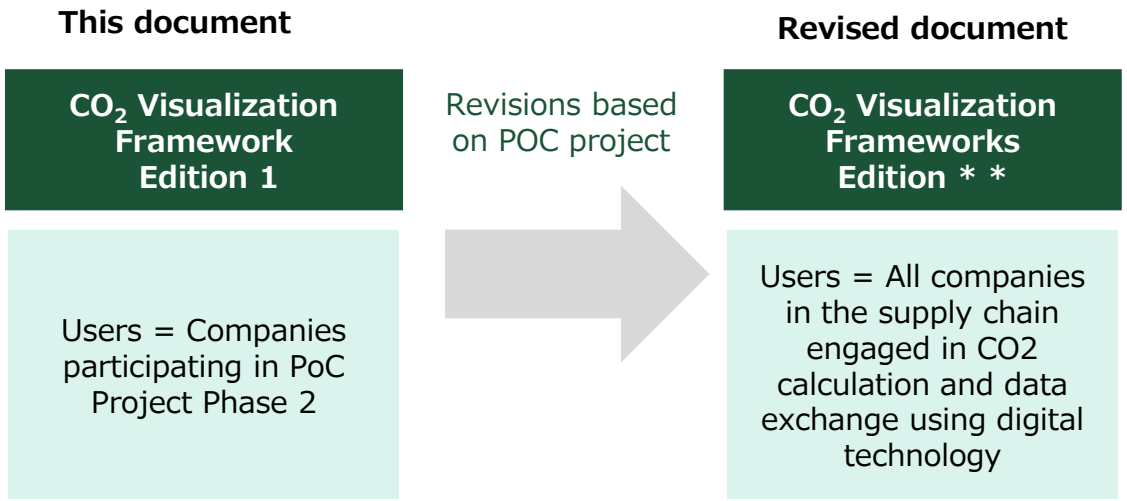


Figure 1-1-5 Users of this document

- The Green x Digital Consortium is considering revising this document based on the results of the PoC project and making it available to the public. (Revisions will also reflect revisions to partner frameworks overseas.)
- We are also considering making this document widely available to all companies in the supply chain that are working on CO_2 visualization and data exchange using digital technology.
- At present, the envisaged users of the revised version of this document are:

- **Suppliers that calculate and share CO2 data**
- **Solution companies that support the calculation and sharing of CO2 data**
- **Buyer companies receiving CO2 data**
- **Verification companies that verify and guarantee CO2 data**

- As the content of the PoC project and the handling of this document after the project has been conducted are beyond the scope of this document, please refer to the information separately issued by the Green x Digital Consortium.

Notes regarding CO2 data

1-1-5. Notes about the term “CO2 data"

- Unless otherwise specified, the definition of the term “CO2 data” is as follows:

  - **The CO2 equivalent (expressed as kg-CO2e, etc.) of greenhouse gas emissions (GHG emissions) specified by IPCC (i.e., not limited to CO2 emissions alone).**
  - It assumes a lifecycle boundary for emissions calculations of cradle-to-gate, covering emissions right up to the top of the supply chain in addition to a company’s own processes.
    (The reason for adopting the cradle-to-gate method will be explained later in 1-4-6.)

- In other words, “CO2 data” in this document corresponds to numerical information called “cradle-to-gate GHG emissions” in the worlds of LCA (life cycle assessment) and CFP (carbon footprint of product).
- Please note that use of the term “CO2 data” in this document reflects that:
  - The terms “CO_2 visualization” and “supply chain CO_2 visualization” are familiar to Japanese industries; and
  - The addition of “data” captures the emphasis of the Green x Digital Consortium on the use of digital technology.

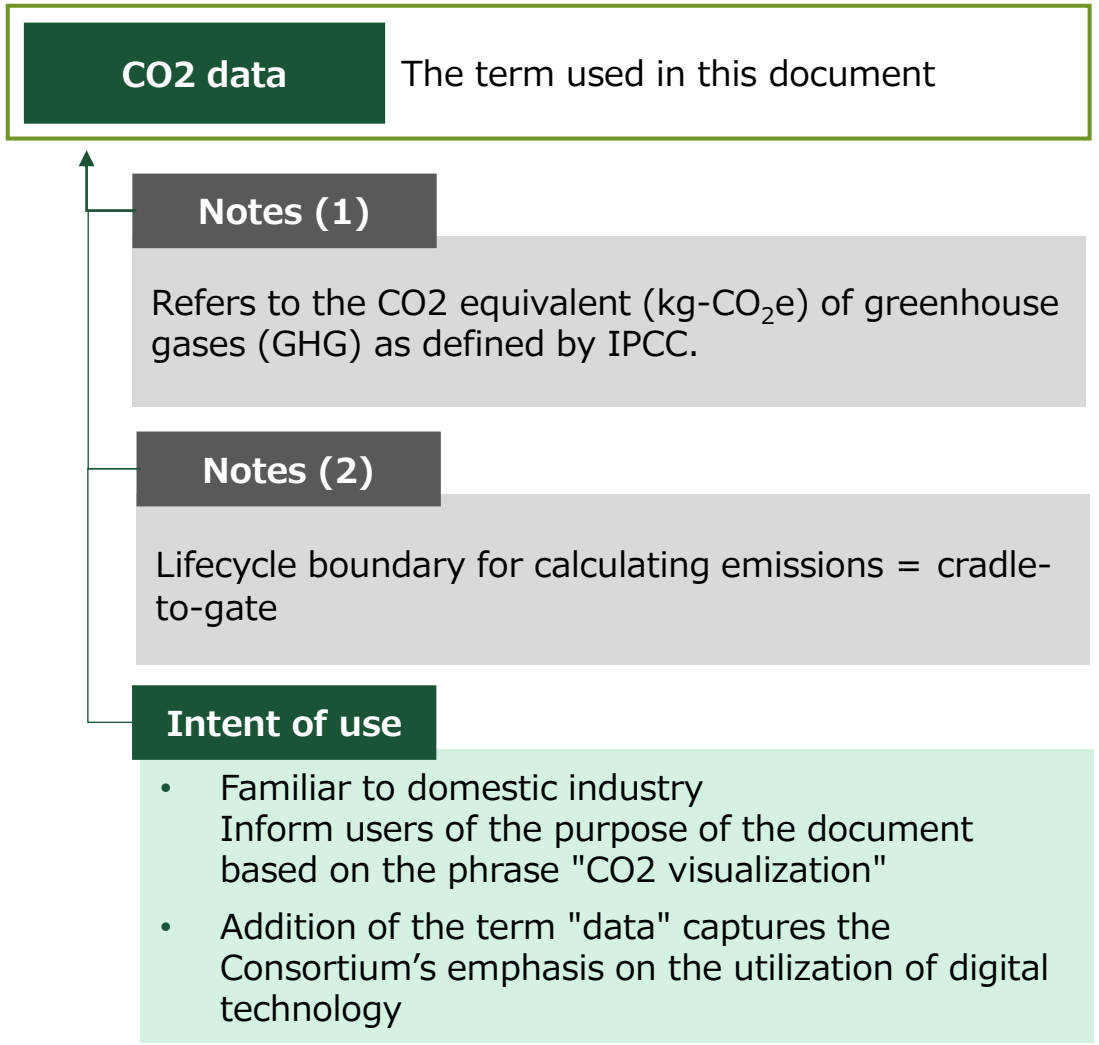


Figure 1-1-6 Notes and intention in using the term "CO2 data"

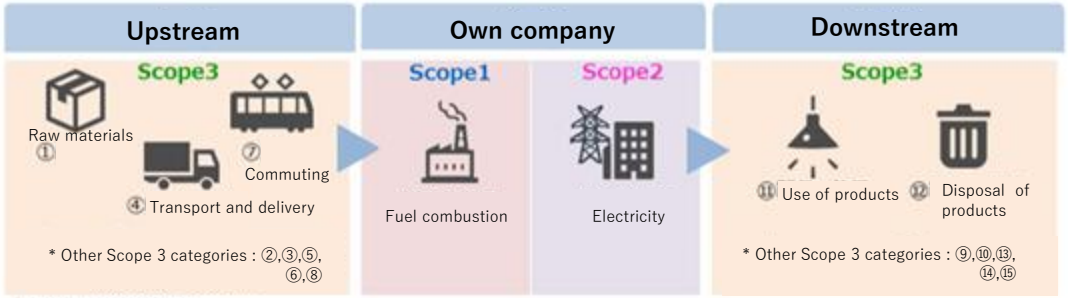
Background: (1) Progress and limitations of supply chain CO2 visualization

1-2 Background and purpose

- Summarize the background and purpose of the CO2 Visualization Framework.

1-2-1. Background: (1) Progress and limitations of supply chain CO2 visualization

- Visualization of CO2 across the supply chain has been rapidly spreading in Japan, as companies are required to calculate and report their greenhouse gas emissions (Scope 1, 2 and 3) based on the GHG Protocol in various information disclosure frameworks such as TCFD.
- For companies, it is Scope 3 that corresponds to greenhouse gas emissions in the supply chain.
- However, in many cases, CO2 visualization in the supply chain is based on the calculation of activity × CO2 emission factor. In this case, secondary data such as industry averages and model estimates are often applied as the emission factors, and the reduction efforts of suppliers are not taken into account.
- Calculations using the GHG Protocol-recommended data specific to individual supplier companies (primary data) are rare, and it is common that supplier companies' efforts to reduce emissions are not reflected in Scope 3 calculations for companies downstream in the supply chain.



Numbers in circles indicate Scope 3 categories.

Scope1 : **Direct emissions of greenhouse gases by business** (Fuel combustion and industrial processes)

Scope2 : **Indirect emissions from the use of electricity, heat and steam supplied by other companies**

Scope3 : **Indirect emissions other than Scope 1 and Scope 2** (emissions by other companies related to business activities)

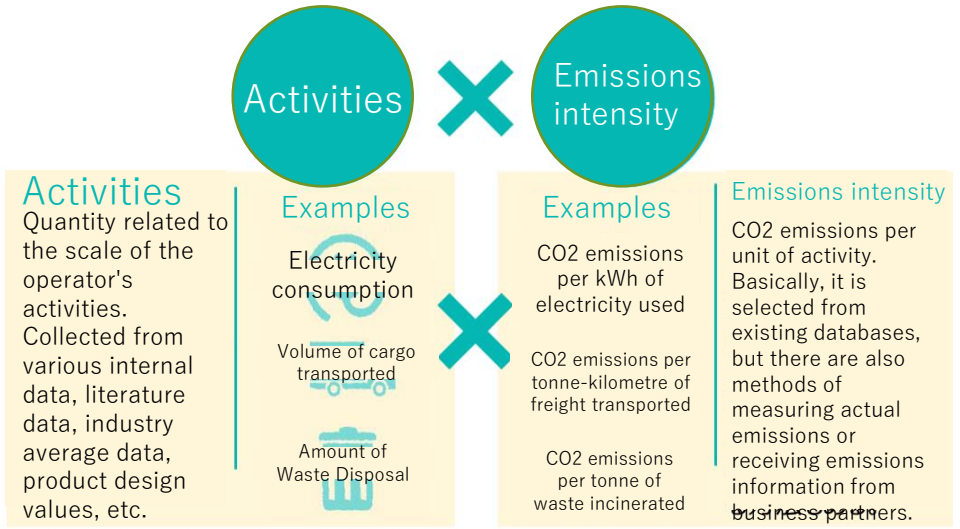


Figure 1-2-1 Definition of Scope 1, 2, and 3 and approach to CO2 emission factors

Source: Ministry of the Environment/Mizuho Research & Technologies, "Calculating and Reducing Supply Chain Emissions"

Background: (2) CO2 visualization in an era of carbon neutrality

1-2-2. Background: (2) CO2 visualization in a carbon-neutral era

When the calculation of "emissions = activity data × secondary data emission factor" is used for CO2 visualization, the main means of reducing emissions is to reduce the amount of activity (energy and raw material procurement amount, etc.). Specifically, reducing production loss and slimming down parts through improved design were the main approaches to Scope 3 reduction.

- However, in an era in which Japan aims to reduce greenhouse gas emissions to "carbon neutral" (net zero emission) by 2050, "efforts to reduce activities" alone are insufficient.
- As long as the formula "activity data × secondary data emission factor" is used, achieving zero emissions requires reducing activity to zero, but this means companies ceasing their business, which is not a realistic solution.
- Attention has turned instead to the use of "primary data emission factor" using "primary data" (defined as company-specific data in this document).
- If suppliers reduce emissions and downstream companies incorporate these effects into their emissions by calculating the amount of activities multiplied by the primary data emission factor, the reduction of activities and the improvement of emission factor (supplier's efforts) will produce synergies (Figure 1-2-2).
- In addition, the spread of renewable energy in recent years has made it possible for companies to significantly reduce emissions while maintaining their business activities. If each company in the supply chain visualizes the effects of these efforts and provides them as primary data emission factor to companies downstream in the supply chain, it will also pave the way for decarbonization of the entire supply chain (Figure 1-2-2).

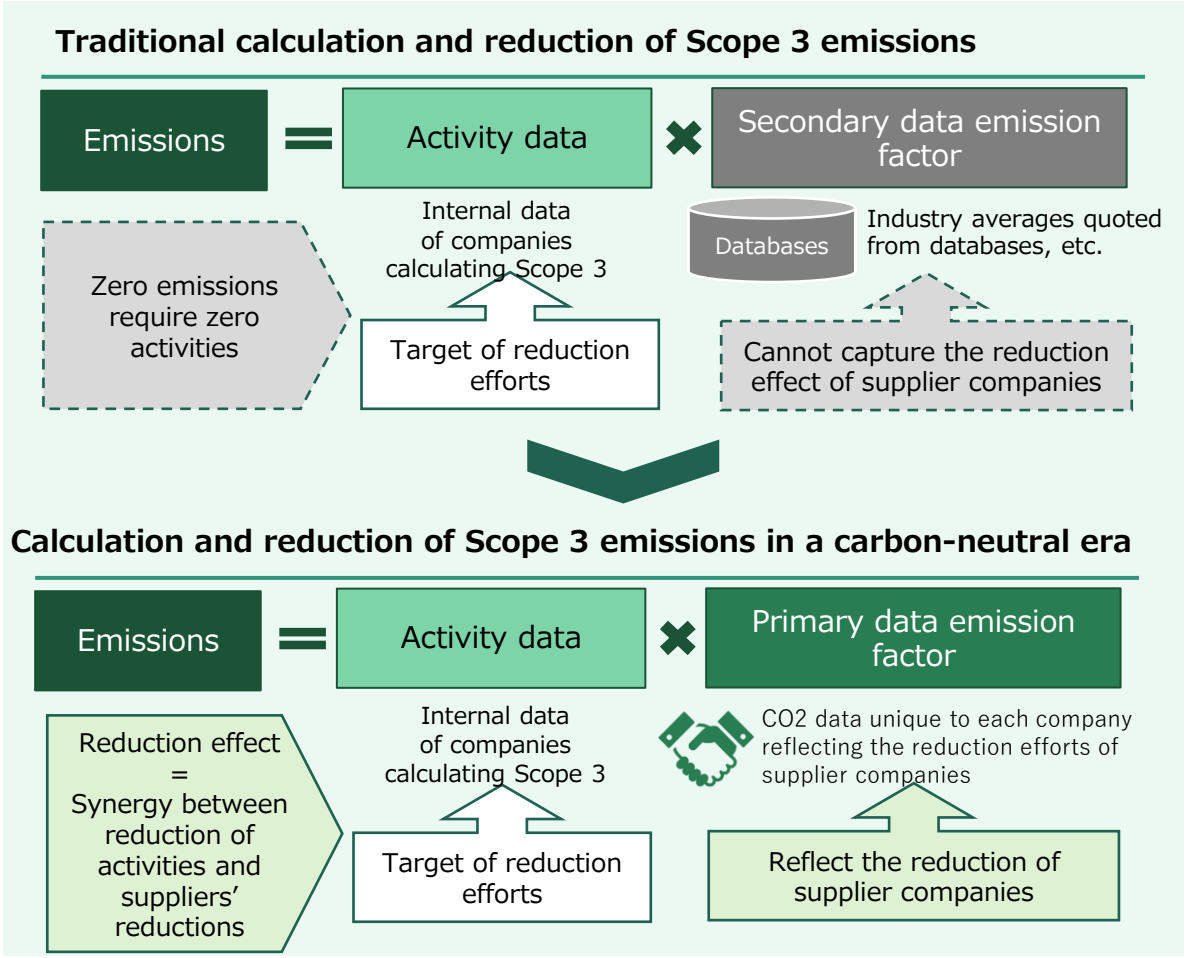
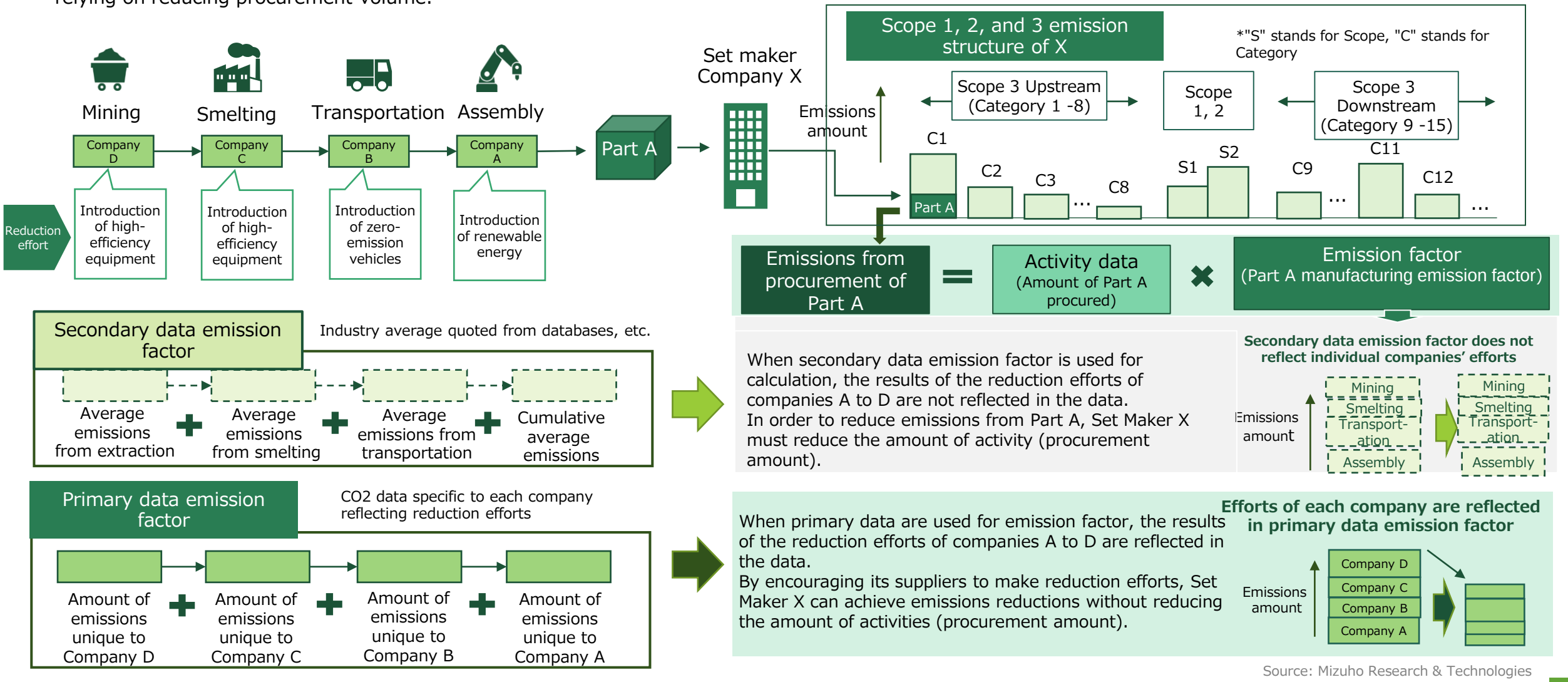


Figure 1-2-2: Significance of using "activity data x primary data emission factor"

Source: Mizuho Research & Technologies

[Illustration] Significance of tackling “activity data × primary data emission factor”

- Assumes that Set Manufacturer X procures Part A provided from a supply chain consisting of mining, refining, transportation, and assembly.
- For Company X, emissions from the procurement of Part A are part of Scope 3 Upstream Category 1 "procured goods and services".
- If the CO2 emissions specific to each supplier A to D can be obtained from primary data, reductions can be achieved through the efforts of each supplier rather than relying on reducing procurement volume.



Source: Mizuho Research & Technologies

Figure 1-2-3: Significance of using “activity data x primary data emission factor”

Definition of “primary data”

- In this document, “primary data” is defined as “company-specific data” as indicated in 1-2-2. This is in line with the definition in the Pathfinder Framework (PACT powered by WBCSD, discussed later in 1-4-3), which aims to calculate and harmonize CO2 data of an internationally acceptable quality.
- In addition to the Pathfinder Framework, the Methodology SWG investigated existing standards and confirmed definitions of primary data. These can be broadly divided into (a) ISO 14067, which emphasizes direct measurement of source data and (b) the GHG Protocol and Pathfinder Framework, which emphasize whether data is unique to processes, activities, and companies.

Methodology and Standards	Defining Primary Data
ISO 14067	Quantified value of a process or an activity obtained from a direct measurement or a calculation based on direct measurements
GHG Protocol	• Data derived from the lifecycle specific process of the product being evaluated (Product Standard) • Data from specific activities within a company's value chain (Scope 3 Standard)
Pathfinder Framework	Company specific data

Figure 1-2-4 Primary data definitions for major standards

- However, the above definition, which is modeled after the Pathfinder Framework, was challenged by SWG members. The issue was whether data quality criteria should be established for accreditation as primary data.
- Behind this is the fact that while this document calculates internationally acceptable CO2 data, it also adopts a policy of allowing calculation methods with low data quality on the premise of information disclosure (to be described later in 1-4-2). Specifically, this document adopts a policy that not only allows for methodologies that use Life Cycle Assessment (LCA) and Product Carbon Footprint (CFP or PCF) methodologies on a product-by-product basis, but also allows for methodologies such as Scope 1, 2, and 3 to derive emissions data from organizations by allocation, etc. to specific destinations.
- The CO2 data obtained by these two calculation methods are expected to differ greatly in terms of data quality. On the other hand, it is possible to calculate and display the "use ratio of primary data to emission data" (to be described later in 1-4-5), which indicates data quality. A simple comparison cannot be made between the two, but if numerical values are shown, they may be used for comparative evaluation.
- In order to avoid such confusion, it was proposed that the CO2 data obtained from the allocation of Scope 1, 2, and 3 emissions should not be regarded as primary data even if the data is unique to the company.
- We decided not to adopt the proposed guidance, because (a) there is no precedent guidance that sets data quality standards for primary data recognition, and (b) confusion can be avoided if a mechanism is introduced that flags differences in calculation methods before comparing primary data usage ratios.
- In this document, data specific to an enterprise is considered to be primary data, and differences in calculation methods and data quality (even primary data can be of low quality) are separately disclosed.

Achieving “activity amount × primary data emission factor”

1-2-3. Purpose: Realization of “activity amount × primary data emission factor”

- The objective of this document is to provide a supply chain CO2 visualization system based on the “activity amount × primary data emission factor” that has been discussed so far.
- However, adopting this calculation method raises new issues. For example, if the method of calculating CO2 data varies widely among suppliers, CO2 data of varied quality will be distributed. Following Gresham’s principle of bad money driving out good money, there may be cases of unreasonably low calculation of a company’s product CO2 data.
- In order to prevent such situations, this document establishes ① a calculation method based on primary data and ② sharing methods (methods for disclosing data quality) for CO2 data subject to data exchange throughout the supply chain using digital technology.

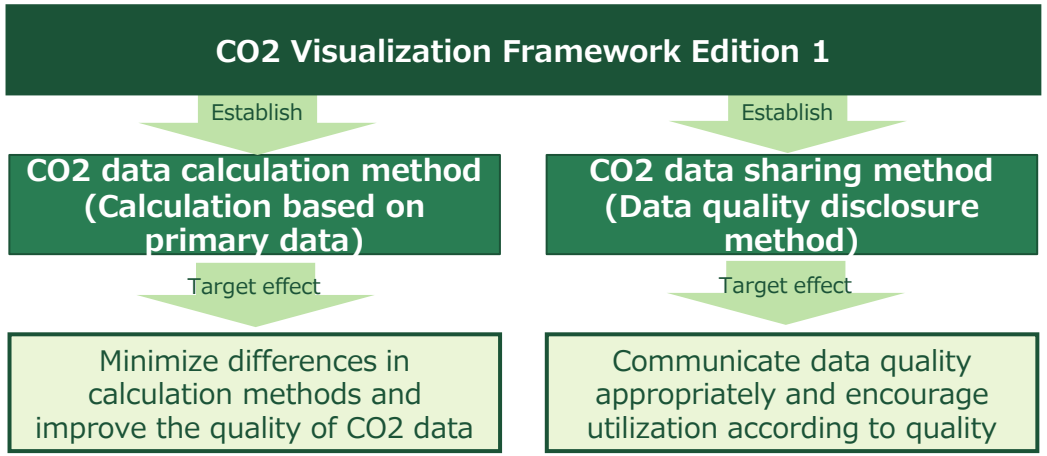


Figure 1-2-5 Two methods implemented by the CO2 Visualization Framework

- The purpose of developing an approach to CO2 data calculation based on primary data is to minimize as much as possible the variations and differences in CO2 data calculation methods used by suppliers, and to improve the data quality of CO2 data exchanged using digital technology. Details are given in Chapter 2.
- However, in a situation where each supplier calculates CO2 data based on its own primary data, the CO2 data groups distributed in the future will have a certain variation in calculation methods and data quality. Therefore, it is necessary to establish methods for sharing CO2 data (methods for disclosing data quality).
- The purpose of developing data quality disclosure methods is to create an environment in which companies downstream in the supply chain that use CO2 data can correctly understand the quality of the data provided, as well as to encourage users to make appropriate use of the data according to its quality. With this preference for high-quality CO2 data, we aim to achieve a situation where “good money drives out bad money.” Details are given in Chapter 3.

CO2 data calculated and shared by suppliers

1-3. Scope of this document

1-3-1. Targeted at supplier companies

- Scope 3 accounting and disclosure methodologies are defined by the GHG Protocol Scope 3 Standard. However, sufficient guidance has not been provided for companies downstream in the supply chain that perform Scope 3 calculations on how companies (suppliers) upstream should calculate CO2 data and what information should be attached and submitted.

- This document focuses on supplier efforts.
- This document describes how suppliers calculate and share CO2 data as the primary data emission factor used by downstream companies in calculating Scope 3.

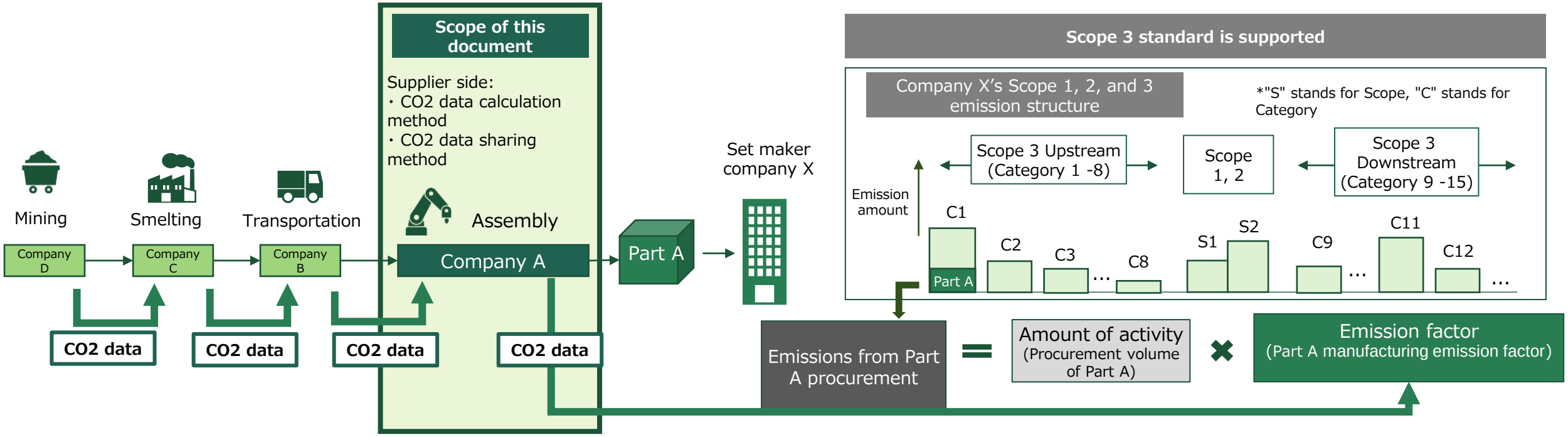


Chart 1-3-1: Scope of this document = Efforts by suppliers

Source: Mizuho Research & Technologies

Scope 3 Category 1 for downstream operators

1-3-2. Scope of this document

- Scope 3 upstream areas are classified and structured into Categories 1-8 according to the GHG Protocol. Suppliers (including service providers) exist for each category.
- Of these, this document covers methods for calculating and sharing CO2 data of suppliers corresponding to Category 1 “Purchased goods and services.”
- This document addresses Category 1 because it has the following characteristics:
  - It is often the largest source of Scope 3 upstream emissions, regardless of industry.
  - This category covers the chain of activities of many supplier companies across multiple industries, including manufacturing, such as the procurement, processing, and transportation of raw materials, appropriate to the expression "supply chain" (supply network).
    (Categories 2 and 3 have similar characteristics.)
- The Scope 3 upstream emissions categories are roughly divided into 1, 2, and 3, which cover the activity chains of multi-industry supplier companies, manufacturing included, and 4, 5, 6, 7, and 8, which cover activities in specific industries (mainly service industries). The concepts of this document for Category 1 may be applicable to the similar Categories 2 and 3.
- For Categories 4-8, which are of a different nature, the concepts in this document are conceptually applicable, but the provisions for primary data collection should be considered by industry.

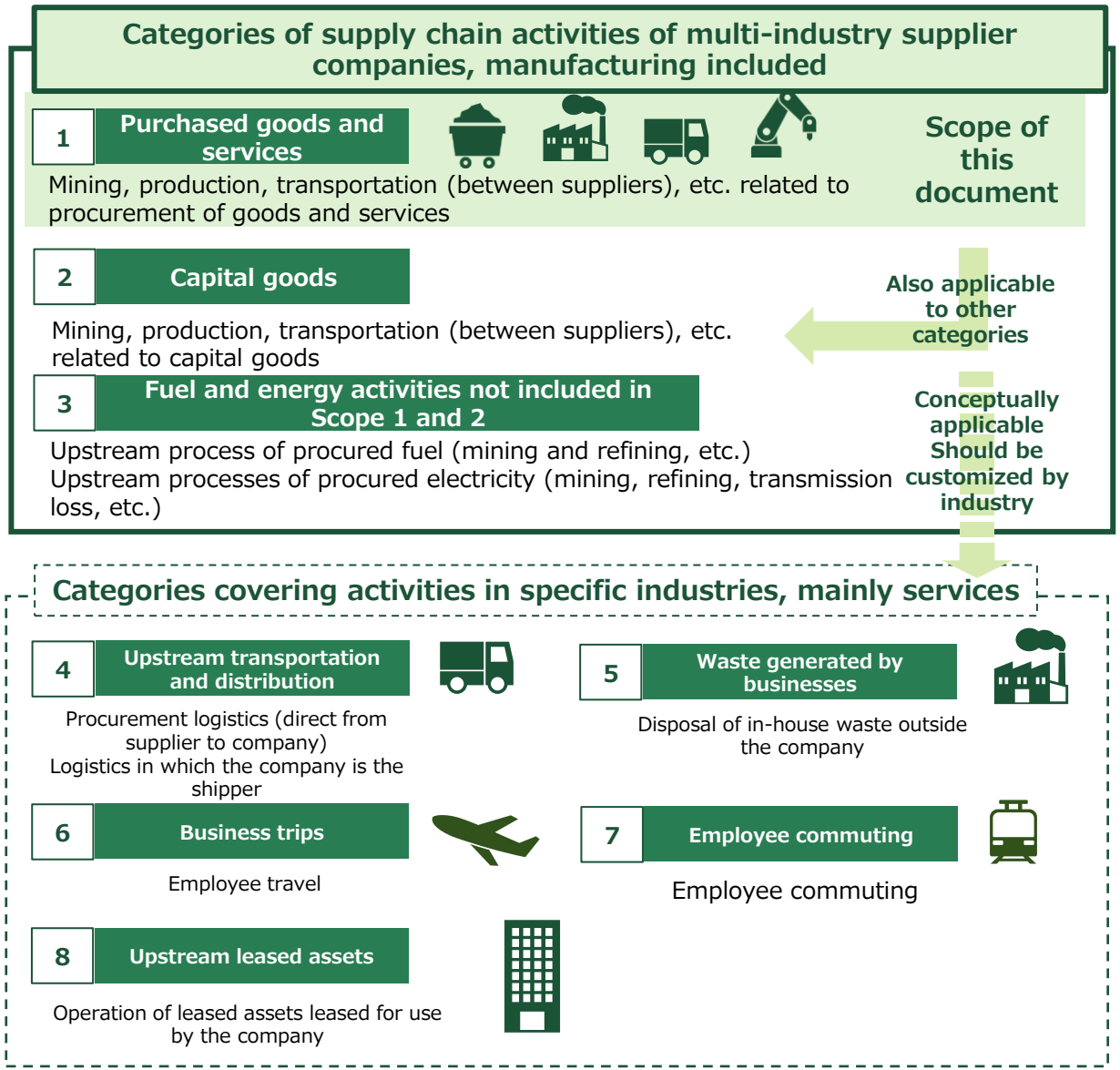


Figure 1-3-2 Scope 3 upstream categories and the scope of this document

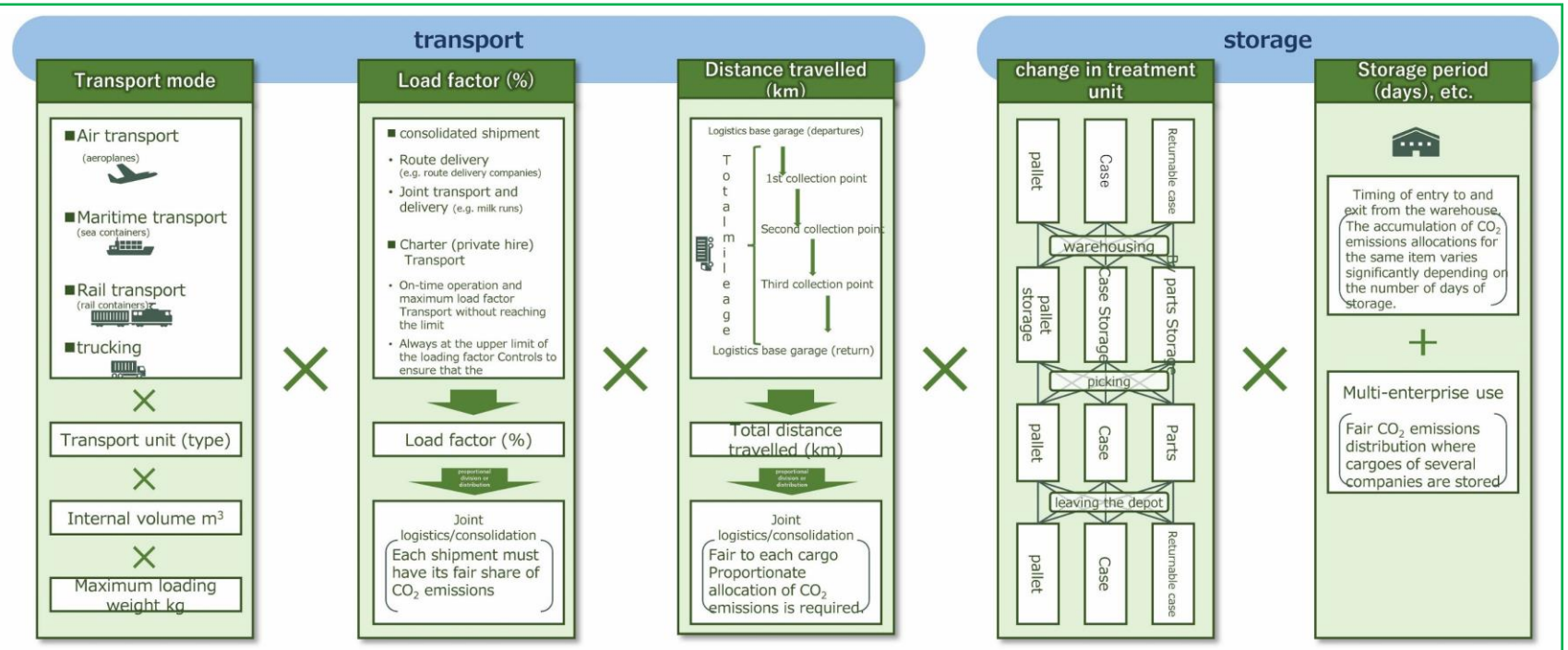
Source: Mizuho Research & Technologies

Calculation method for the service category

1-3-2. Scope of this document (continued)

- For example, as pointed out in the initial report of the Carbon Data Visualization Project, in addition to the diversity of forms of upstream transportation and distribution covered by Category 4, the pursuit of cooperation and consolidation in the coming years is expected to further complicate upstream transportation and distribution. Fair guidance needs to be established to deal with various cases, considering the issue in light of the specific circumstances of each industry.
- Category 5 "Waste from business", Category 6 "Business trips", Category 7 "Employee commuting", and Category 8 "Upstream leased assets" should also be organized separately in light of the specific circumstances of each industry.

"In short, logistics = transportation + storage, but in reality, these are classified into multiple forms and change as the business environment changes. In addition, green logistics is expected to become increasingly cooperative and consolidated in terms of transportation and distribution. Therefore, fair guidance needs to be established to deal with various cases. "



Source: Green x Digital Consortium Data Visualization Project (2022) 'Study Preparation Phase/Primary Report for Establishment of Mechanism for Visualization of Supply Chain CO2'

Figure 1-3-3 Category 4 "Upstream transport and delivery issues

Ideal CO2 Visualization Framework

1-4. Ideal shape and direction of realization

- In addition to the purposes described above, there were many views within the Methodology SWG regarding the ideal form of this document.
- These can be roughly classified into the following six items.
- Some of these items are clearly contradictory (1 and 2, 3 and 4, etc.).
- The following sections describe the implementation methods adopted by the SWG.

1 Aim for an internationally applicable methodology and data quality

- Don't create guidance limited to Japan
- Aim for consistency with international frameworks/platforms for supply chain CO2 data exchange to enable data exchange and collaboration

1-4-1 1-4-3 1-4-4

2 Enable the participation of diverse businesses

- Instead of enforcing detailed calculation methods, each company should be allowed to calculate CO2 in a realistic manner.
- Create a mechanism facilitating participation by companies with limited capabilities and those which use other methodologies for CO2 visualization.

1-4-1 1-4-2

3 Achieve both primary data utilization and protection of confidential information

- Establish a mechanism to promote the use of primary data so as to reflect the reduction efforts of supplier companies.
- Also establish a mechanism to protect supplier companies' confidential information (raw material composition, suppliers, etc.).

1-4-5

4 Cover emissions right up to the top of supply chain

- Data traceback will stop if there are suppliers that do not participate in CO2 data calculation and sharing.
- Even in this situation, CO2 emissions at the top of the supply chain should be covered.

1-4-6

5 Coexistence with existing standards

- There are various methodologies and standards in the world of CO2 visualization, and many companies that perform their calculations using them.
- The manner of coexistence and division of roles with existing methodologies and standards must be clarified.

1-4-7

6 Enable some level of data analysis

- While it is important to protect supplier companies' confidential information, it is also important to allow companies that use data to analyze to some extent the emission structure and potential for reduction upstream in the supply chain.

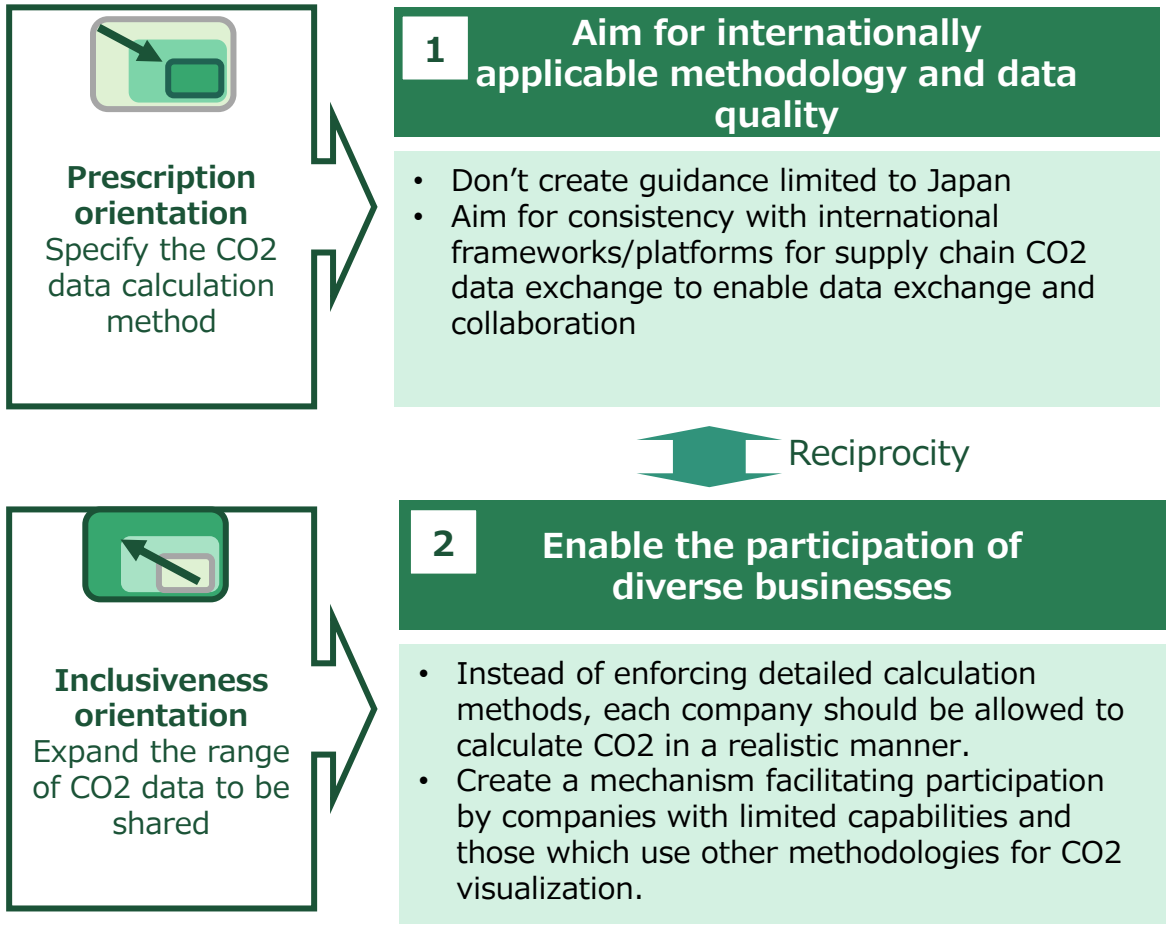
1-4-8

Figure 1-4-1 Ideal CO2 Visualization Framework

Balancing prescription and inclusiveness

1-4-1. Balancing prescription and inclusiveness

- Of the ideal forms shown in Figure 1-4 -1, there is a certain degree of conflict between "1" and "2".



- The former calls for a higher level of prescription in the CO2 data calculation method (prescription orientation).
- The latter calls for a broader scope of CO2 data to be shared in terms of calculation methods and data quality (inclusiveness orientation).
- These two contradictory orientations need to be reconciled.
- In this document, based on the discussion within the SWG, we aim to achieve a balance between the two orientations through the following approach.

- **The calculation methodology recommended in this document aims for a level of quality acceptable for international supply chain CO2 data exchange (prescription orientation).**

- **In sharing, constraints will not be place on the CO2 data to be shared, subject to appropriate disclosure of calculation methods and data quality (inclusiveness orientation).**

- In other words, this is a two-tiered approach whereby (a) hurdles for participation in supply chain CO2 data exchange are lowered by providing inclusiveness in "sharing" while (b) internationally acceptable calculation methods and data levels are recommended, and companies with the necessary capacity for high-level CO2 calculation are encouraged to do so.

Figure 1-4-2 Prescription and inclusiveness in CO2 data calculation and sharing

[Illustration] Compatibility of prescription and inclusiveness

This document provides a roadmap for companies that want to reduce the barriers to participation by suppliers and to calculate and share CO2 data at a high level:
① Calculation and compliance methods must be disclosed in sharing CO2 data, but the origin of that data is not restricted (inclusiveness orientation).
② The new CO2 calculation method presented in this document aims for an internationally accepted calculation method and data quality (prescription orientation).

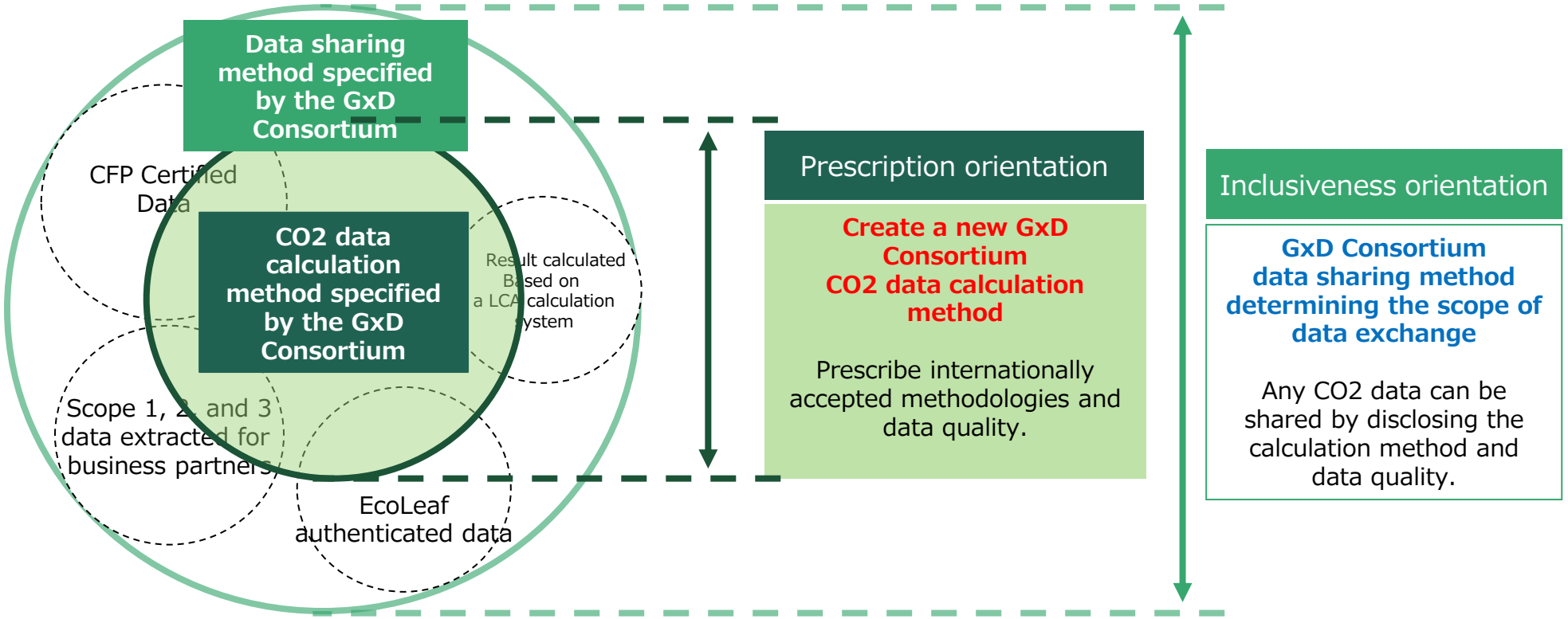


Figure 1-4-3 Approach to balancing prescription and inclusiveness of CO2 data calculation and sharing

Source: Mizuho Research & Technologies

Scope of CO2 data that can be shared

1-4-2. Scope of CO2 data that can be shared

(1) Examples of CO2 data that can be shared

- In line with the concept presented in the previous section of not placing constraints on the CO2 data to be shared, subject to appropriate disclosure of calculation methods and data quality, this document also takes the position of allowing the sharing of the following CO2 data: (Examples in Figure 1-4-3)

a. Product carbon footprint conforming to methodological standards (e.g., ISO 14040/14044, 14067, GHG Protocol Product Standard, etc.) other than those described in this document (Section 2)

b. Greenhouse gas emissions data under Type III environmental labels (quantitative environmental information on product life cycles) (shown in the figure as CFP and EcoLeaf in the SuMPO Environmental Labeling Program)

c. CO2 data calculated at the organizational level (Scope 1, 2, and 3, etc.) extracted in the calculation of distribution, etc. to customers

- It should be noted that all of these correspond to so-called “cradle-to-gate” CO2 data, in which emissions are traced right back to the start of the lifecycle. The reason why this document adopts the cradle-to-gate method in principle is described later in 1-4-6.

(2) Product-level calculation and organization-level calculation

- As indicated on the left, this document includes CO2 data calculated with “organization” as an evaluation target (Scope 1, 2, and 3, etc.) in addition to CO2 data calculated with “product” as an evaluation target.
- In order to describe the methodology in the future, these two CO2 data are defined and called as follows (Figure 1-4-4):

– **As shown in (a) and (b) on the left, cradle-to-gate greenhouse gas emissions for products are called “product-level CO2 data.”**

– **As shown in (c) on the left, the amount of greenhouse gas emissions from cradle-to-gate that is evaluated by the organization is extracted by calculating distribution, etc., to customers, and this is called “organization-level CO2 data.”**

[Illustration] Product-level calculation and organization-level calculation

- "Product-level calculation" and "organization-level calculation" in CO2 data calculation are arranged as follows.
- However, this arrangement highlights the differences between the two, whereas in some cases, it is difficult to distinguish between the two in the practice of calculating CO2 data. This will be discussed later in 1-4-2 (4).

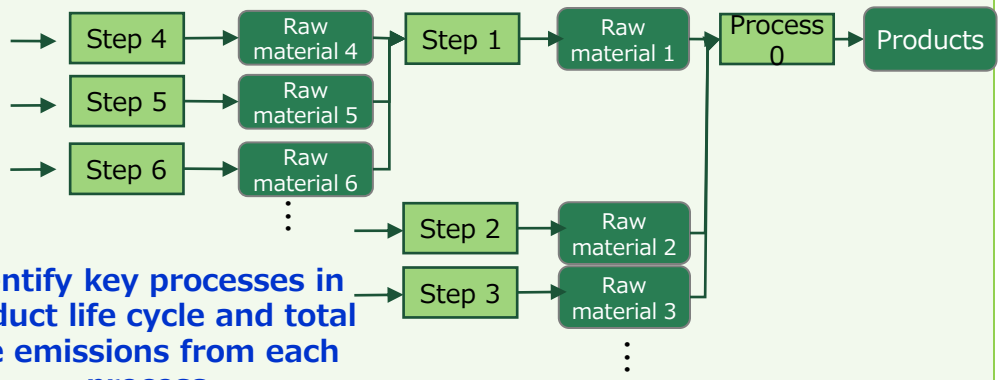
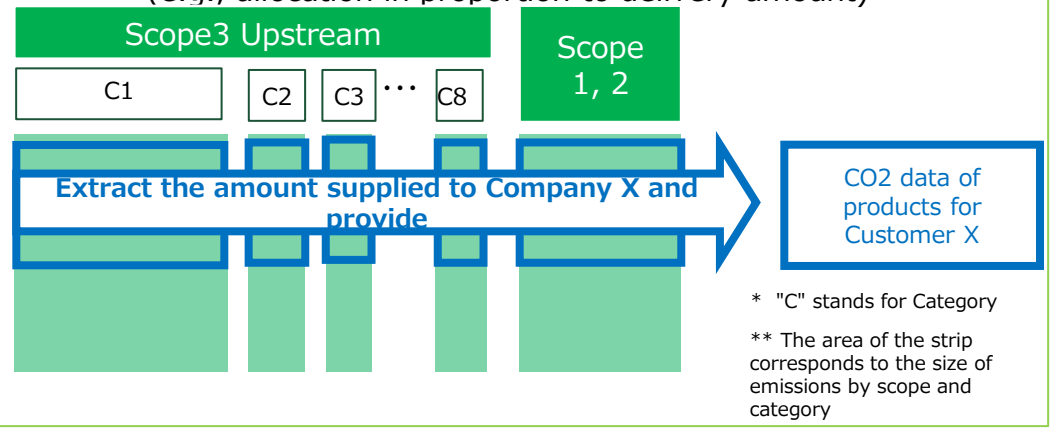
	Product-level CO2 data calculation	Organization-level CO2 data calculation
Overview	Conduct a lifecycle inventory analysis of greenhouse gas emissions by product and service 	Allocate supplier's Scope 1, 2, and 3 data to its customers in proportion to each transaction scale (e.g., allocation in proportion to delivery amount) 
Existing calculation standards	PCR (rules by product category), PEFCR ISO 14067, GHG Protocol Product Standard, etc.	GHG Protocol Scope 3 Standard (Chapter 8) (However, priority is placed on product-level calculations.)
Platforms/ frameworks	Catena-x, PACT Pathfinder, CDP Supply Chain Program	CDP Supply Chain Program (Also handles CO2 data reporting for product-level calculations)
Special features: Accuracy	The accuracy of calculation results is generally considered to be low.	The accuracy of calculation results is generally considered to be low.
Special features: Operational load	The operational load tends to be low because some allocation methods allow lump-sum calculation.	Operational load tends to be low because some allocation methods allow lump-sum calculation.

Figure 1-4-4 Product-level calculation and organization-level calculation in CO2 data calculation

Source: Mizuho Research & Technologies

Scope of CO2 data that can be shared

1-4-2. Scope of CO2 data that can be shared

(3) Debate on organization-level calculation

- There is an argument that CO2 data calculated at organization level should not be accepted for sharing because the calculation method and data quality are very different from product-level calculation CO2 data.
- In this regard, the Methodology SWG states:
  - "The CDP Supply Chain Program, an international supply chain CO2 data exchange program, has adopted reporting based on CO2 data through the allocation of Scope 1, 2, and 3, and many companies related to the program have already reported CO2 data based on this method to their suppliers."
  - The GHG Protocol Scope 3 Standard allows suppliers to provide organization-level CO2 data to their suppliers.*

* The Scope 3 Standard requires that the following permit the distribution of Scope 1, 2, and 3 data by supplier (Chapter 8):
(1) Use product-specific lifecycle GHG emissions data,
(2) Allocated processes can be broken down into smaller pieces for data collection
(3) Data by product can be estimated by model calculation, etc.

In light of the above, the following policy shall be adopted:

① Given that this is in widespread practice, **calculation and sharing of organization-level CO2 data will be allowed** to the extent that it is made explicit that this is not product-level CO2 data.

② However, **organization-level calculation will be positioned as a provisional response, with a phased transition to product-level calculation recommended.**

- In the SWG, regarding clarification of the difference between product-level calculation and organization-level calculation, it was pointed out that in some cases, the difference between the two is not always clear in the practice of CO2 data calculation.
- Regarding the concept of the distinction between product-level calculation and organization-level calculation, the results of the Methodology SWG are introduced in (4) below.

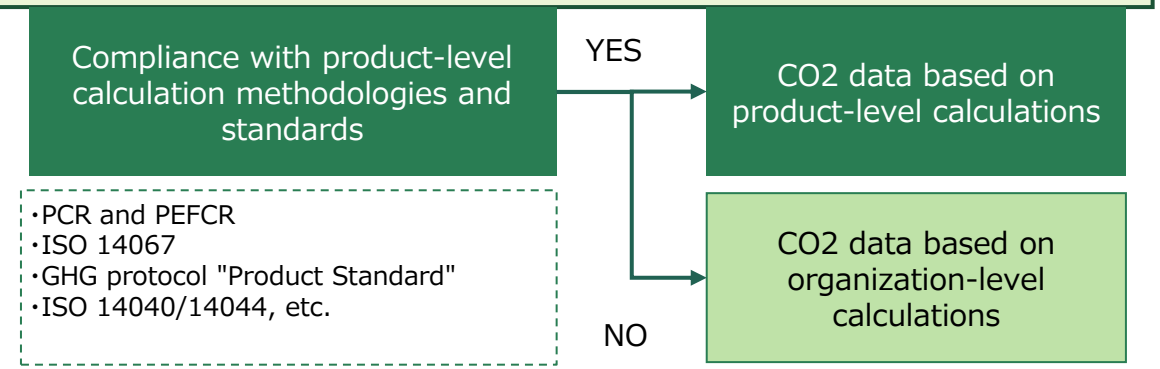
Distinguishing between product-level and organization-level calculation

1-4-2. Scope of CO2 data that can be shared

(4) Boundary between product-level and organization-level calculation

- In the SWG, many participating companies pointed out that the difference between product-level calculation and organization-level calculation was narrowing in a practical business scene. (See (1) from SWG discussion.)
- In this context, this document adopts the following concepts:

- **Product-level calculation and organization-level calculation will be distinguished by CO2 data calculation methodologies and standards.**
- **Cases in which product-level calculation methodologies and standards are used shall be deemed as product-level calculation. Other cases shall be deemed in this document to be organization-level calculation.**



- The main product-level calculation methodologies and standards are as follows:
  - Product classification rules such as PCR (Product Category Rules) and PEFCR
  - Cross-industry carbon footprint standards for products such as ISO 14067 and the GHG Protocol Product Standard
  - Standards that organize product-level LCA frameworks and requirements, such as ISO 14040/14044
- See 3 -1 -2 (3) for a specific list of methodologies and standards for product-level calculation.
- If the calculation is considered to be based on the methodologies and standards of product-level calculation, a product-level calculation shall be deemed to have been made. The utilized data may be the collected data from Scope 1, 2 and 3 calculations.

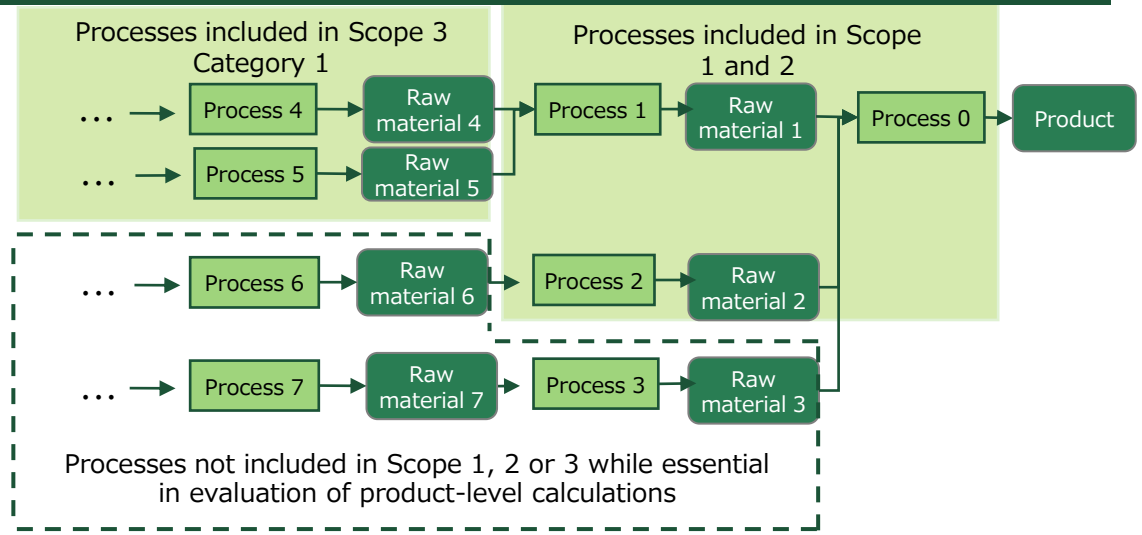
Figure 1-4-5 Distinction between product-level and organization-level calculation

Distinguishing between product-level and organization-level calculation

(4) Boundary between product-level and organization-level calculation (continued)

- When calculating Scope 1, 2, and 3 emissions by adding calculation processing such as allocation, etc., and tailoring them to emissions by product or service unit, compliance with product-level calculation methodologies and standards will be determined by the completeness of the lifecycle boundary and the validity of the allocation calculation.
- Completeness of the lifecycle boundary: If the underlying Scope 1, 2, and 3 emissions do not include processes for which evaluation is required by product-level calculation methodologies and standards, the CO2 data obtained by these allocation calculations cannot be regarded as product-level calculation.
- Validity of allocation calculations: Considering that many of the methodologies and standards for product-level calculation adopt the concept of allowing the allocation of emissions only when it cannot be avoided by such means as process segmentation, where avoidable allocation calculations are implemented, it is difficult to regard these as product-level calculations.
- The final decision will be left to third-party verification, but these two points will be important factors in determining whether CO2 data using Scope 1, 2, and 3 data can be regarded as product-level calculations.

① Compulsory evaluation processes are not included in Scope 1, 2, and 3



② Performance of avoidable allocation calculations

Calculation of emissions of specific products by allocating emissions for the entire group to the total production volume of all products in the group under conditions where data can be collected at each site

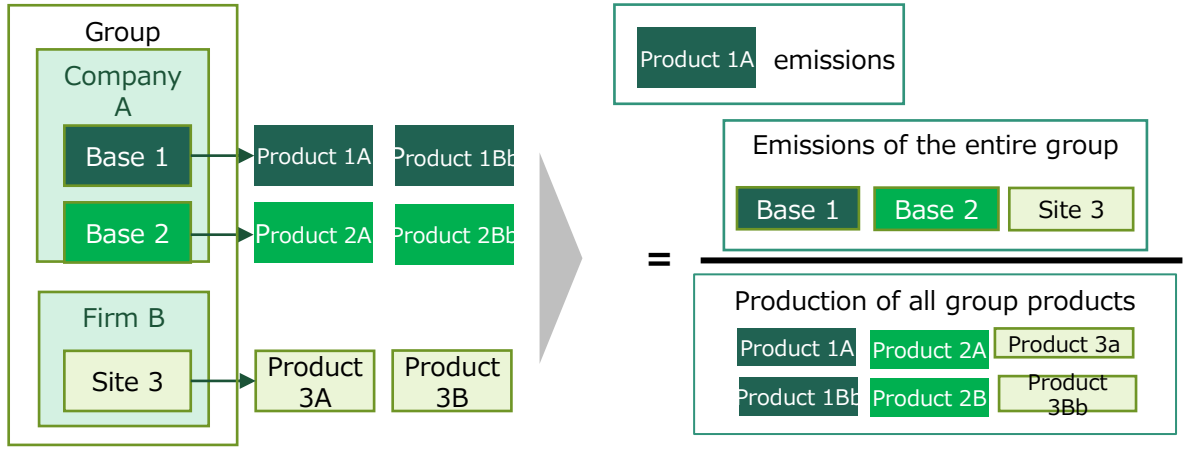


Figure 1-4-6 Cases in which the allocation of Scope 1, 2, and 3 emissions cannot be regarded as product-level calculation

Source: Mizuho Research & Technologies

[From SWG discussion (2)] Boundary between product-level and organization-level calculation (1/2)

- In the Methodology SWG, it was pointed out that there are practical cases in which it is difficult to find clear differences between the two. Since this discussion includes important points in the practice of calculating CO2 data, it is outlined below.

① Bringing organization-level calculation closer to product-level calculation through digitization

- The reason why organization-level calculation is generally considered to be less than that of product-level calculation is that it was assumed that the combined Scope 1, 2, and 3 emissions at the enterprise or group consolidated level would be allocated to the production of all products and services produced at the enterprise or group consolidated level.
- Today, however, with the advent of digitization, original data collected for calculating emissions at the organizational level (e.g., CO2 data on a site or line basis) is often retained and easily accessible.
- In this case, even if the data is collected and managed using organization-level calculation, it is possible to distribute emissions on a site or line basis by the production volume of products and services produced at the site or line. These calculations are also commonly performed in product-level calculations.
- When such calculation processing is performed using organization-level calculation, it is difficult to tell the difference from calculation using product-level calculation.

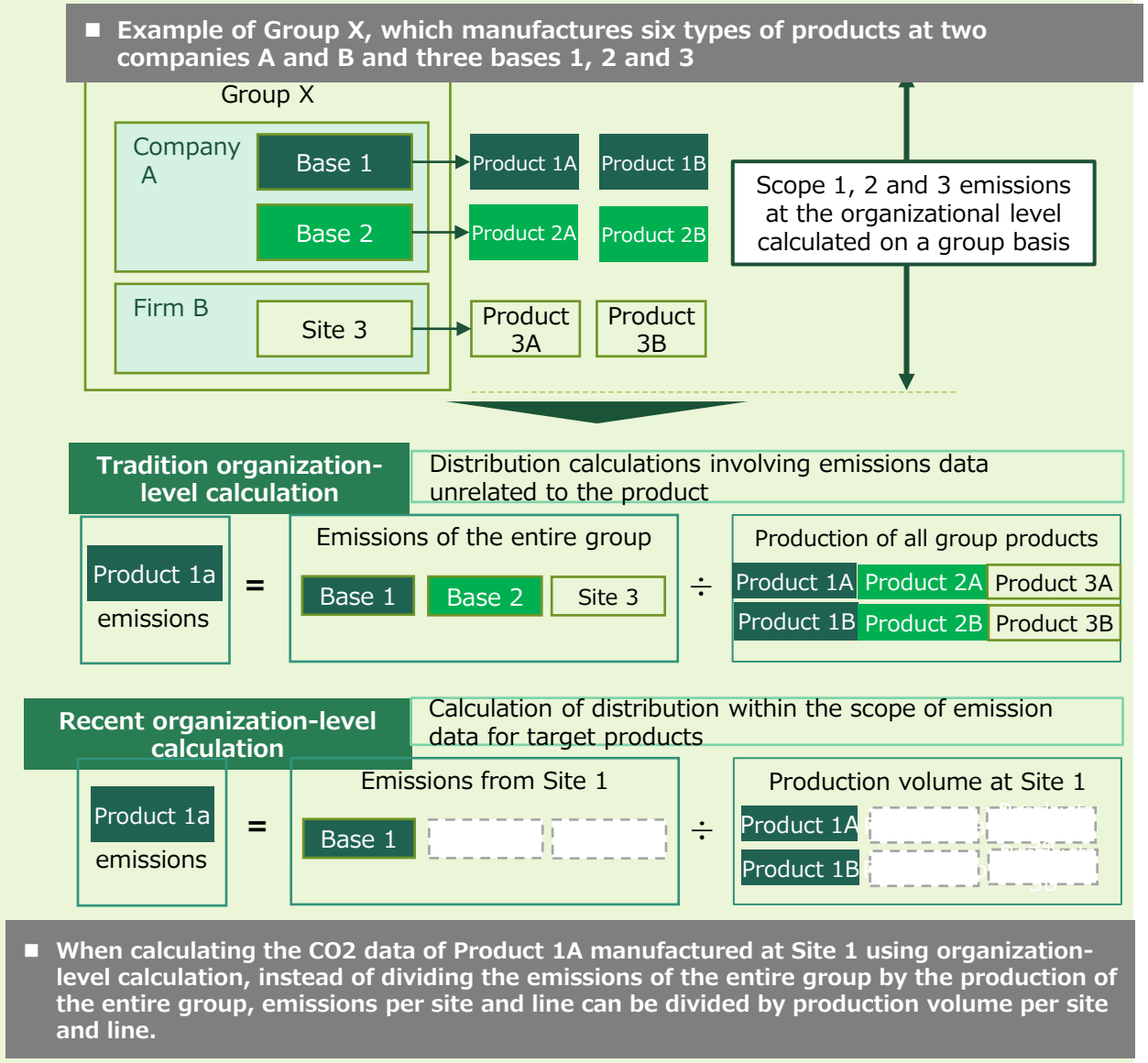


Figure 1 -4 -7 Refining organization-level calculation

Source: Mizuho Research & Technologies

[From SWG discussion (2)] Boundary between product-level and organization-level calculation (2/2)

② Organization-level calculation ≒ product-level calculation in SMEs

- In addition, many SMEs have only one manufacturing site and produce a small number of items.
- In this case, the CO2 data in the organization-level calculation is equivalent to the CO2 data in which the emissions per site or line are allocated by the production volume of products and services produced at the site or line, and it is difficult to tell the difference from product-level calculation.

③ Changes in product level calculation

- At the same time, the product-level calculation side is also changing.
- Recently, the process of identifying the major processes in the product life cycle, collecting data on each process, and calculating total emissions recognized as characteristic of product-level calculation is often omitted.
- This is due to the fact that with the enhancement of the LCA database, secondary data emission factor that goes back to the most upstream processes (mining, etc.) related to manufacturing has been improved for many products and services.
- Without collecting data for each process upstream in the lifecycle, LCA practitioners can calculate emissions right up to the top of the supply chain using the secondary data emission factor.
- In product-level calculation, too, only the activity data of the input/output of the company's processes should be collected, and emissions from upstream and downstream processes are increasingly calculated by multiplying the activity data by the secondary data emission factor obtained from the LCA database.
- This calculation method of “activity × secondary data emission factor” is similar to the calculation method used in Scope 1, 2, and 3, which are the emissions of organizations. It shows that the difference between product-level calculation and organization-level calculation is not clear even in the treatment of upstream processes, and that such cases are increasing.

④ Boundary between product-level and organization-level calculations

- Given that the distance between product-level and organization-level calculations has been closer than previously thought, a member of the Methodology SWG suggested that if Scope1, 2, or 3 emissions are reconsidered at the site or production line level and allocation calculations are made at the site or production line level, they should be considered as product-level calculations.
- However, it was also pointed out that since there are cases such as (1) in Figure 1-4-6, it is not possible to certify product-level calculation only by the implementation level of allocation.
- In the end, the categorization of product-level calculation and organization-level calculation was based on the comprehensive criteria of whether or not the calculation could be regarded as conforming to the product-level calculation methodology and standards, including the appropriateness of determining lifecycle boundaries and allocation.

Alignment with international frameworks/platforms

1-4-3. Alignment with international frameworks/platforms

- As confirmed in 1-4, this document aims to develop methods for calculating CO2 data that are consistent with international frameworks/platforms in order to realize the ideal form “1. Aim for an internationally applicable methodology and data quality.”

(1) About product-level calculation

- The Pathfinder Framework, a methodology for calculating and sharing CO2 data published by the Partnership of Carbon Transparency (PACT) hosted by WBCSD, was selected as an international framework aiming for consistency in product-level calculation.
- We chose PACT’s Pathfinder Framework as the alignment framework because:

  - It is operated by GHG Protocol co-organizer WBCSD and is considered to have considerable influence as a methodology for calculating Scope 3 emissions.
  - In fact, many leading supply chain data sharing platforms such as Catena-X and many global companies participate in this framework.
  - It provides a methodology for suppliers creating CO2 data based on primary data and sharing it across the supply chain using digital technology that is consistent in purpose and means with this document.

- Section 2-2 provides guidance on the concept of the Pathfinder Framework and how to apply it as a Japanese company, positioning it as a product-level CO2 data calculation method that ensures internationally acceptable data quality.
- The Green x Digital Consortium is a member of PACT’s Pathfinder ecosystem and regularly exchanges views with PACT.
- This document has been reviewed for consistency with the Pathfinder Framework v1.

Figure 1-4-8 Pathfinder Framework v1

Source: Pathfinder Framework v1 (PACT powered by WBCSD)

Alignment with international frameworks/platforms

(2) About organization-level calculation

- The CDP Supply Chain Program is known as an international program for exchanging CO2 data obtained through organization-level calculation, but the program does not provide rules or regulations on data generation methodology.
- Currently, Chapter 8: Allocation, of the GHG Protocol Scope 3 Standard is the only document that can be called guidance in terms of a methodology for organization-level calculation.
- Therefore, this document presents a methodology for calculating higher quality CO2 data at the organization level based on Section 8 of the GHG Protocol Scope 3 Standard (2-3).
- However, unlike the Pathfinder Framework of PACT, Section 8 of the GHG Protocol Scope 3 Standard only provides recommendations (“should”) and does not include requirements (“shall”). This document also recommends a gradual transition from organization-level calculation to product-level accounting (1-4-2).
- Based on the above, the methodology for organization-level calculation presented in the CDP Supply Chain Program comprises no more than recommendations for the purpose of improving data quality.
- Figure 1-4-9 reflects the above based on the original Figure 1-4-3 on prescription and inclusiveness in CO2 data calculation and sharing.

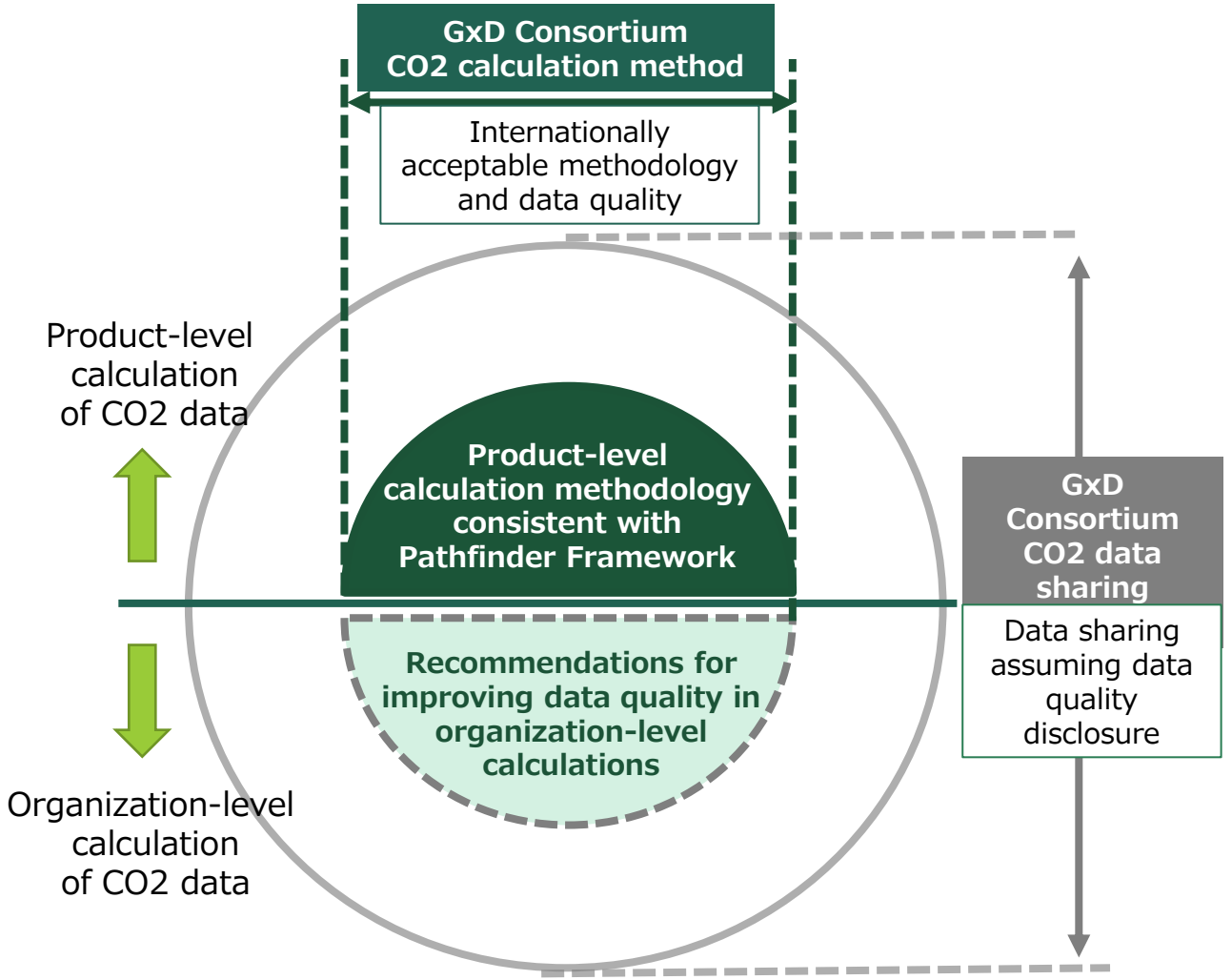


Figure 1-4-9 Prescription and inclusiveness in CO2 data calculation and sharing

Source: Mizuho Research & Technologies

Target level of CO2 visualization

1-4-4. Target level of CO2 visualization

- The Methodology SWG had two views about the aim of developing a method for calculating CO2 data using primary data:
  - (1) For downstream companies that purchase similar goods and services from different supplier companies to compare which goods and services were provided with lower CO2 emissions (referred to as horizontal comparison in this document)
  - (2) To evaluate the degree to which CO2 reduction is progressing over time due to the reduction efforts of supplier companies that provide the same products and services (referred to as vertical comparison in this document)
- The Pathfinder Framework adopted in this document as an internationally accepted method for calculating CO2 data takes the position of aiming for both horizontal and vertical comparison.
- However, because (a) horizontal comparison would require establishing and sharing detailed calculation conditions, which could greatly reduce the number of companies able to participate, and (b) even if the Pathfinder Framework methodology is followed, it would not necessarily guarantee the feasibility of horizontal comparison, the SWG adopted the following approach:

  - For the time being, the target level of CO2 visualization should be a level that reflects supplier companies' efforts to reduce CO2 emissions through the use of primary data and enables evaluation of CO2 reductions over time (vertical comparison). The calculation method presented in Section 2 assumes a level consistent with this application.

- However, this does not preclude companies using CO2 data from performing horizontal comparisons at their own risk. A sharing method for communicating the data quality of CO2 data is presented so that it can be determined whether the data is cross-comparable.

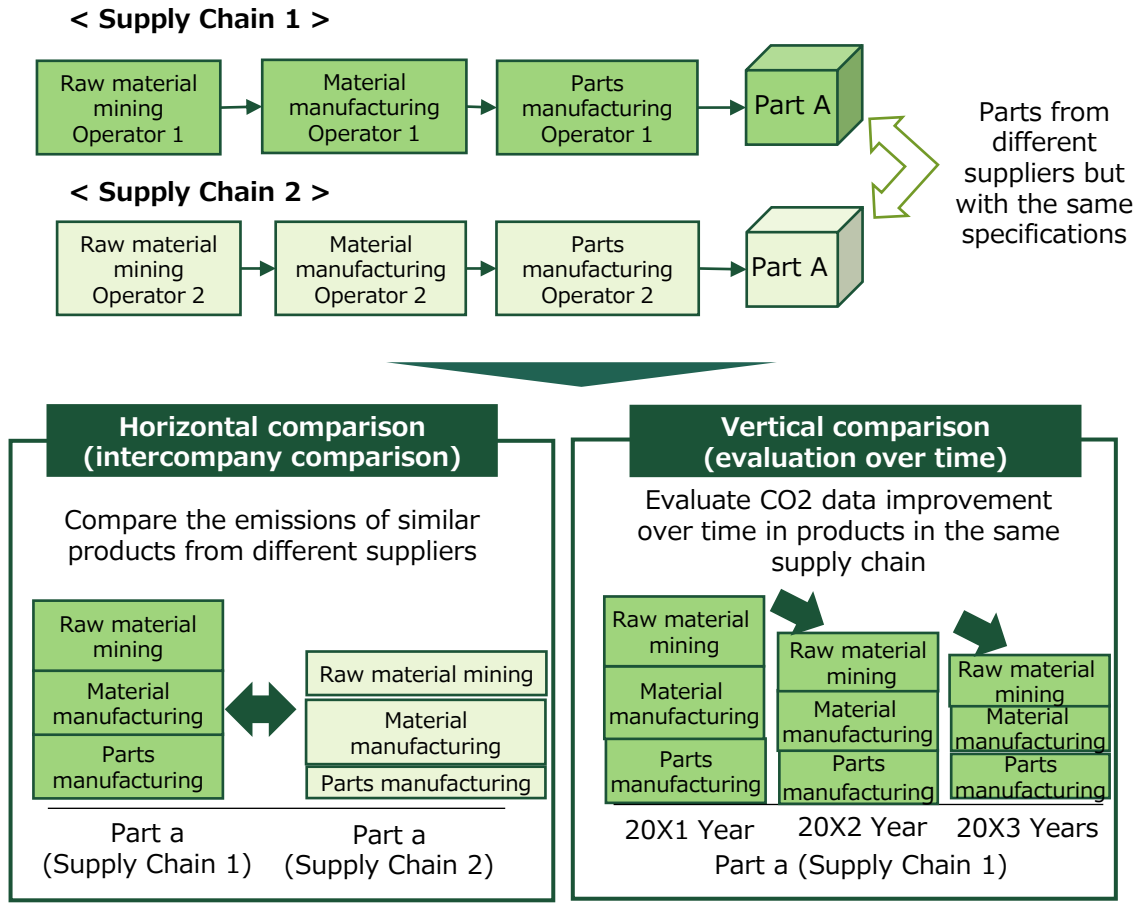


Figure 1-4-10 Vertical comparison and horizontal comparison

Source: Mizuho Research & Technologies

[From SWG discussion (3)] Strictness of the conditions that enable horizontal comparison

- As mentioned above, the SWG selected the Pathfinder Framework as an internationally accepted method for calculating CO2 data.
- However, the Green x Digital Consortium has concluded that it is too early at this point to aim for cross-product and cross-company comparisons of CO2 data. This is because the conditions under which horizontal comparisons can be made are very strict, and it is expected that even calculations based on the Pathfinder Framework will not satisfy these conditions.
- For example, the international standard ISO 14067, which sets out requirements and guidelines for quantification of the carbon footprint (CFP) of products, identifies system boundary equivalence and data quality requirement equivalence as the conditions for enabling CFP comparison.

■ Issues with system boundary equivalence

- In order to ensure system boundary equivalence in the CO2 data calculations performed by different enterprises, the processes to be included in the system boundary must be specified in advance. PCR and other calculation rules for each product category serve this role.
- However, while the Pathfinder Framework gives priority to the application of PCR, etc., as described below, CO2 data calculation using cross-industry standards such as ISO 14067 is also permitted in the absence of PCR. In this case, even if the CO2 data is based on the Pathfinder Framework, the system boundaries between products and between companies may not be aligned.

■ Data quality requirement equivalence issues

- With respect to data quality requirement equivalence, there are often differences in data collection methods among enterprises, except for cases where PCR specifies a data collection method that matches the characteristics of the product.
- As long as the Pathfinder Framework takes the position of allowing non-PCR-compliant CO2 data calculations, there may be cases where the quality of data used varies widely between products and between companies.

■ Toward the long-term realization of horizontal comparison

- Based on the above discussion, the SWG concluded that it was too early to pursue horizontal comparison in the current situation, as there could be cases in which the conditions for enabling horizontal comparison could not be satisfied even with calculations based on the Pathfinder Framework.
- However, as CO2 data calculation spreads, it is expected that boundary-setting and data collection will converge at a certain level. The use of digital technology will also make it easy to evaluate and exchange data quality, enabling poor-quality data to be avoided from the user side.
- It should be noted here that several SWG participants expressed the view that horizontal comparisons of CO2 data will become increasingly feasible over the long term.

Promotion of primary data utilization and protection of confidential information

1-4-5. Promotion of primary data utilization and protection of confidential information

(1) Provision of calculation results (output)

- When a supplier provides CO2 data using primary data to a company downstream in the supply chain, the challenge is to protect the supplier's confidential information.
- Data evoking "primary data for calculating CO2 data" includes activity data on the supplier side (energy and raw material procurement), but these are often data that the supplier side wants to keep confidential from the customer.
- This document takes the following approach:

- What suppliers provide (share) to customers is CO2 data (output information) as a result of calculations using primary data.
- The activity data (input information) used to calculate CO2 data need not be provided (shared).

- Of course, if the supplier wants to provide the customer with activity data, they are free to do so.
- This concept is consistent with the Pathfinder Framework.

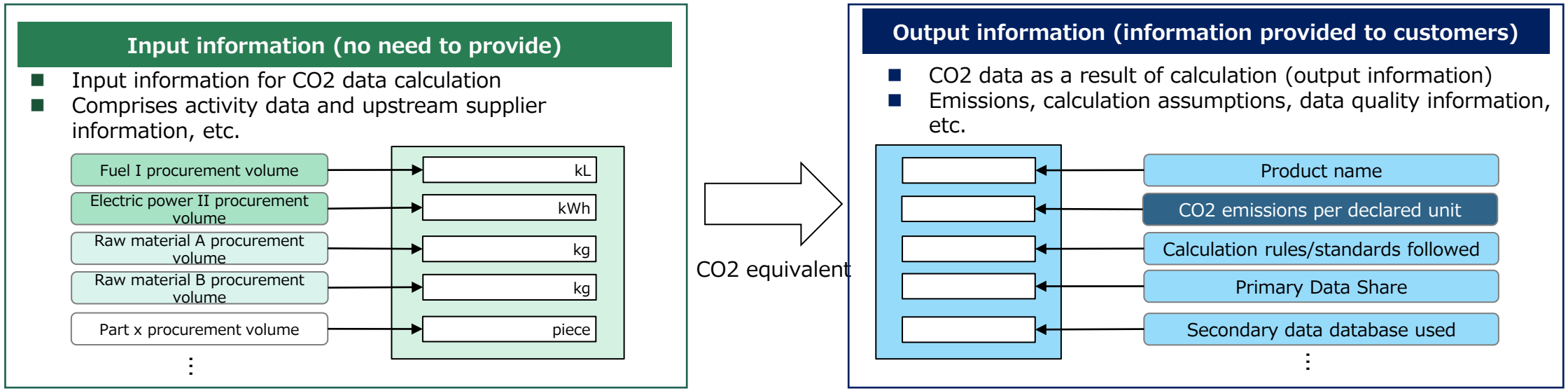


Figure 1-4-11 Input and output information related to CO2 data calculation

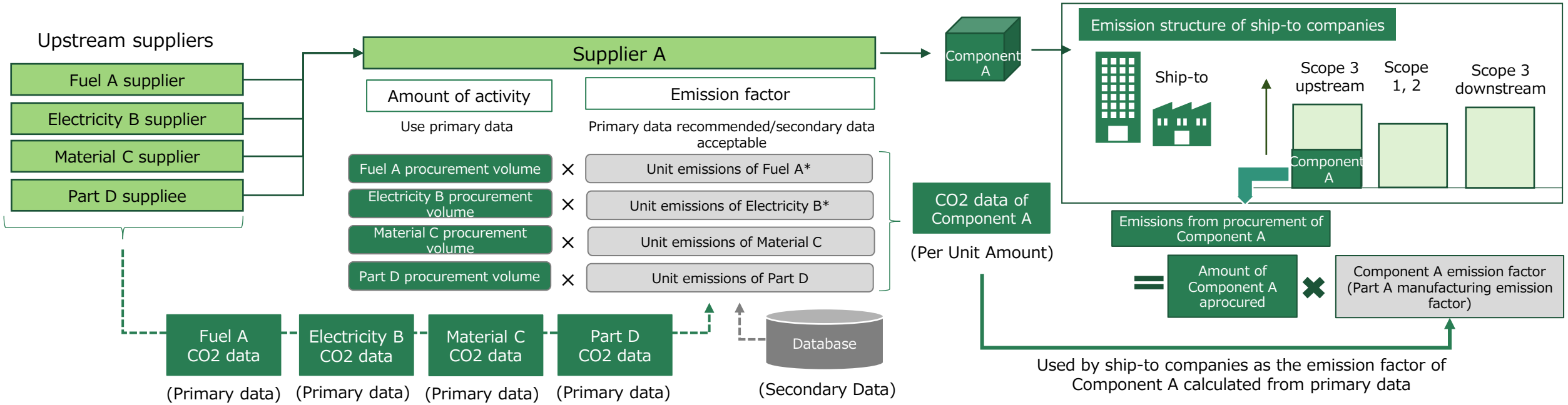
Source: Mizuho Research & Technologies

Image of CO2 data calculation using primary data

1-4-5. Promotion of primary data utilization and protection of confidential information

(2) Image of CO2 data calculation using primary data

- According to the arrangement on the previous page, when a company obtains data from an upstream supplier, in principle it receives the calculated CO2 data, not the upstream supplier's activity data.
- Based on this relationship, the figure below shows the image of the CO2 data calculation assumed in this document, taking the example of a supplier procuring fuel, electricity, materials, and parts.
- Suppliers who calculate CO2 data (Supplier A in the figure below) calculate CO2 data by multiplying their activity data (primary data in principle) by their emission factor.
- At this time, (i) when CO2 data based on the primary data can be obtained from upstream suppliers, these data will be adopted as emission factor, and (ii) when CO2 data cannot be obtained from upstream suppliers, secondary data will be cited from various databases and used as emission factor.



Source: Mizuho Research & Technologies

* There are 2 types of fuel and electric power emission factor: (i) emission factor related to fuel combustion and (ii) emission factor related to the combustion supply chain (Figure 1-4-16). That difference is omitted here.

Figure 1-4-12 Image of CO2 data calculation using primary data

Introduction of Primary Data Share (PDS)

1-4-5. Promotion of primary data utilization and protection of confidential information

(3) Introduction of Primary Data Share (PDS)

- To facilitate the use of primary data by suppliers, this document follows the Pathfinder Framework and introduces the calculation and disclosure of primary data share (PDS).
- PDS is an indicator of the percentage of CO2 data provided by a supplier to downstream entities based on primary data.
- As an indicator, the PDS level enables companies downstream in the supply chain to determine to what extent the CO2 data provided by supplier companies (used as emission factor) includes primary data.
- Higher PDS values are desirable in order to reflect the reduction efforts of upstream suppliers in the Scope 3 emissions of downstream enterprises. Therefore, PDS calculation and disclosure encourages downstream companies to request upstream suppliers to improve their PDS.
- The PDS definition formula will be described later in 2-2-3 (5)(for product-level calculation and 2-3-2 (5) for organization-level calculation.

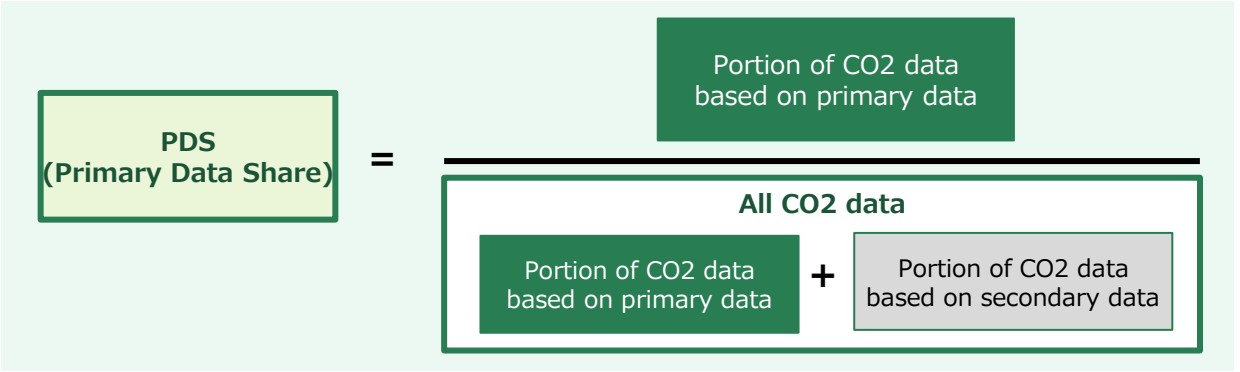


Figure 1-4-13 PDS concept

Source: Mizuho Research & Technologies

Adoption of the cradle-to-gate method

1-4-6. Adoption of the cradle-to-gate method

(1) What is the cradle-to-gate method?

- To achieve the ideal form in “1-4-4. Cover emissions right up to the top of supply chain,” this document adopts, in principle, the cradle-to-gate method as the CO2 data calculation method implemented by suppliers, as in the PACT Pathfinder Framework.
- Using this approach, CO2 data is calculated from cradle (resource extraction) to gate (factory gate).
- Other methods include the cradle-to-grave (disposal) method and the gate-to-gate method (assessment from the reception of raw materials to the completion of the production process).
- Normally, the cradle-to-grave method is assumed in product life cycle assessment. However, in the calculation and exchange of CO2 data in the supply chain, since the CO2 data after shipment is calculated by the downstream company, the supplier company is responsible for the calculation within the scope of gate-to-gate or cradle-to-gate.
- The cradle-to-gate method is adopted over gate-to-date because, when the gate-to-gate method is used, if any one supplier does not participate in CO2 data calculation and sharing, emissions up to the top of the supply chain will not be covered.

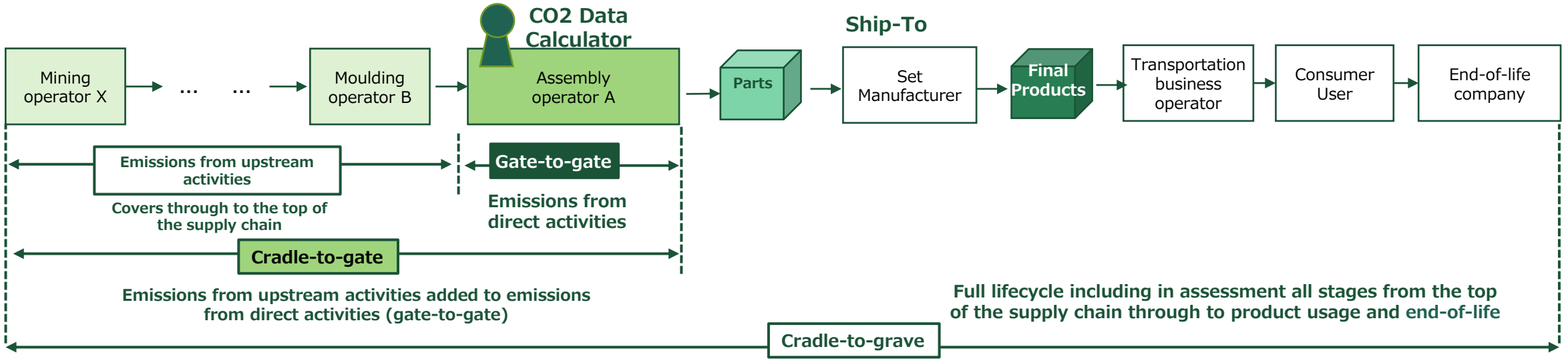


Figure 1-4-14 Cradle-to-gate and other systems

Source: Mizuho Research & Technologies

Benefits of the cradle-to-gate approach

1-4-6. Adoption of the cradle-to-cate method

(2) Benefits of the cradle-to-gate method

- By adopting the cradle-to-gate (C-to-G) approach, suppliers participating in the calculation and sharing of CO2 data will always cover right through to the top of the supplier chain.
- This is because the supplier company takes on the responsibility for calculating C-to-G emissions comprising the following components:

- **Gate-to-Gate (G-to-G) emissions)**

  Emissions from the supplier's own direct activities (G-to-G) emissions

- **Emissions from upstream activities (through to the top of the supply chain**

  (In the absence of upstream data, calculated using secondary data)

This concept is shown in Figure 1-4-15. In a four-tier supply chain, if companies in each tier calculate and share their own C-to-G emissions, emissions will be covered to the top of the supply chain, even if there are companies upstream that do not participate in data calculation.

- It can also be seen from the chart that if companies at all levels (tiers) work on calculating CO2 data and sharing it downstream, the C-to-G emissions data calculated and provided by the supplier companies furthest down in the supply chain will be the sum of the G-to-G emissions calculated by each supplier. The more companies involved in calculating and sharing CO2 data, the more that downstream C-to-G emissions will reflect the actual emissions and reduction efforts of each company.

- Example of a supply chain with Tier 4 as the top of the supply chain.
- If companies in each tier calculate and share their own C-to-G emissions, emissions are covered to the top of the supply chain even if some upstream companies do not participate in the data calculation.

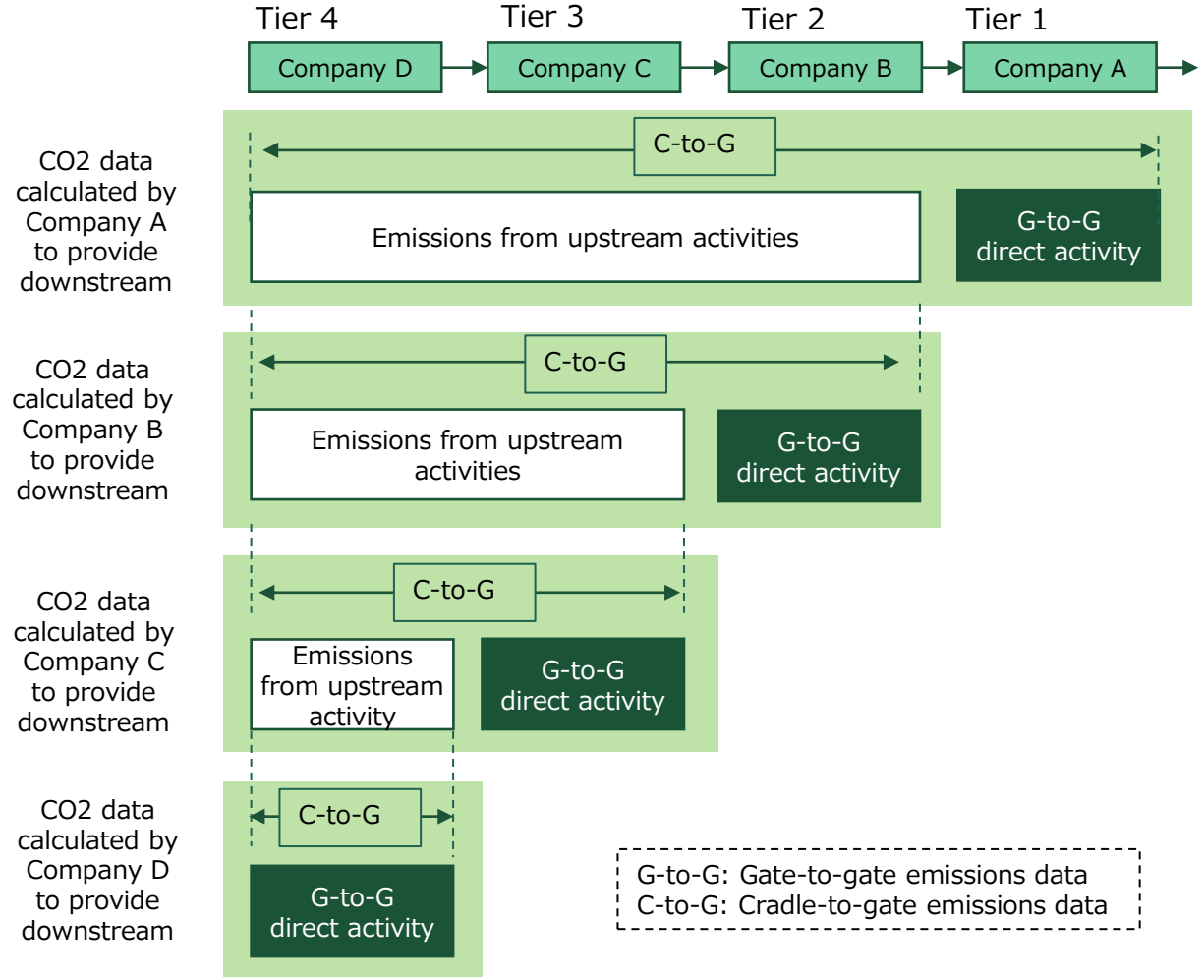


Figure 1-4-15 CO2 data structure in the C-to-G approach

Source: Mizuho Research & Technologies

CO2 data calculation using the cradle-to-gate method

1-4-6. Adoption of the cradle-to-gate method

(3) Cradle-to-gate CO2 data calculation

- As shown on the previous page, with the cradle-to-gate (C-to-G) method, gate-to-gate (G-to-G) emissions from direct activities and emissions from upstream activities need to be calculated. All of these are calculated by activity amount × emission factor.
- The calculation concept is shown in Figure 1-4-16.
- In the past, a supply chain without branches was adopted for simplification purposes, but to show the calculation image, here a supply chain with branches (multiple inputs) is assumed.
- Emissions from upstream activities are required to cover the top of the supply chain, which can be addressed by using the secondary data emission factor which includes the top of the supply chain provided by the various LCA-databases. It may also be used when upstream suppliers provide C-to-G emissions data.

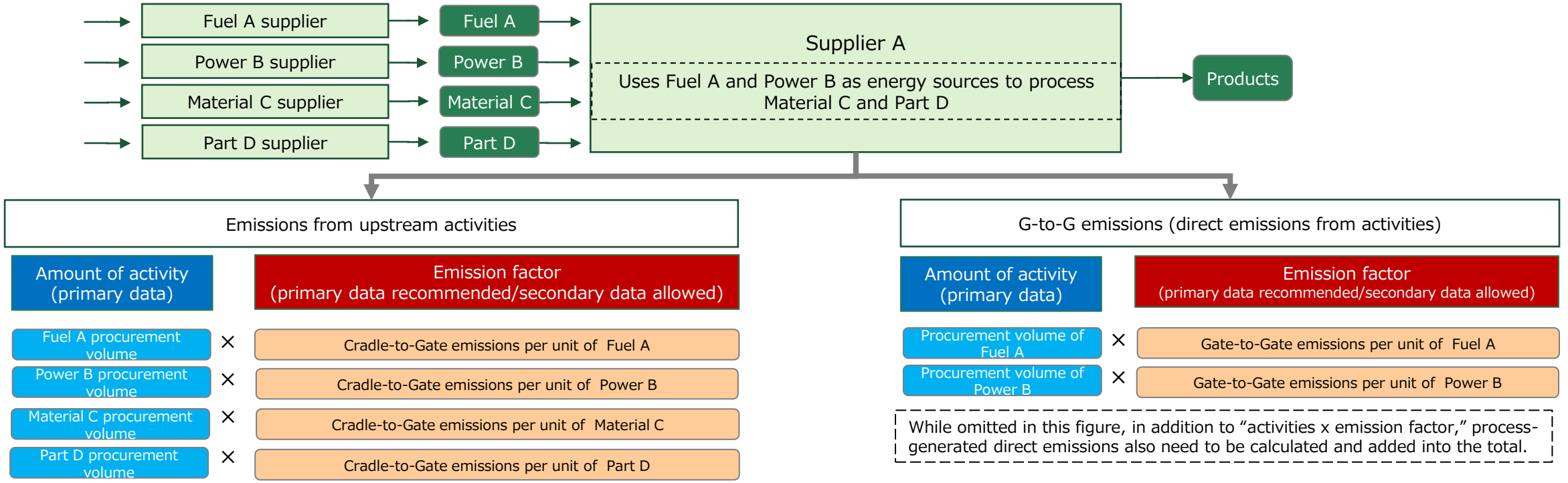


Figure 1-4-16 Calculation of G-to-G emissions using the C-to-G approach and emissions from upstream activities

Source: Mizuho Research & Technologies

CO2 data calculation using the cradle-to-gate method

1-4-6. Adoption of the cradle-to-gate method

(4) Getting started with the gate-to-gate approach

- Although this document uses the C-to-G method as its premise for calculating CO2 data, the Methodology SWG pointed out that the calculation of emissions from upstream activities required by this method is difficult, particularly for companies and SMEs that are addressing CO2 data calculation for the first time.
- Therefore, this document allows companies that cannot comply with the C-to-G method to calculate CO2 data using the gate-to-gate (G-to-G) method.
- However, since G-to-G CO2 data does not include emissions upstream from the supplier, downstream companies using the data cannot cover emissions upstream in the supply chain.
- Since Scope 3 Category 1 is calculated up to the top of the supply chain, Category 1 is not correctly calculated when G-to-G emissions data provided by suppliers is taken as the emission factor.
- When requesting suppliers that cannot comply with the C-to-G method to calculate and provide CO2 data using the G-to-G method, downstream businesses using the data must understand and utilize the imperfections of the boundary.
- Ideally, downstream entities using the data shall calculate the emissions from the supplier's upstream activities of on their behalf.

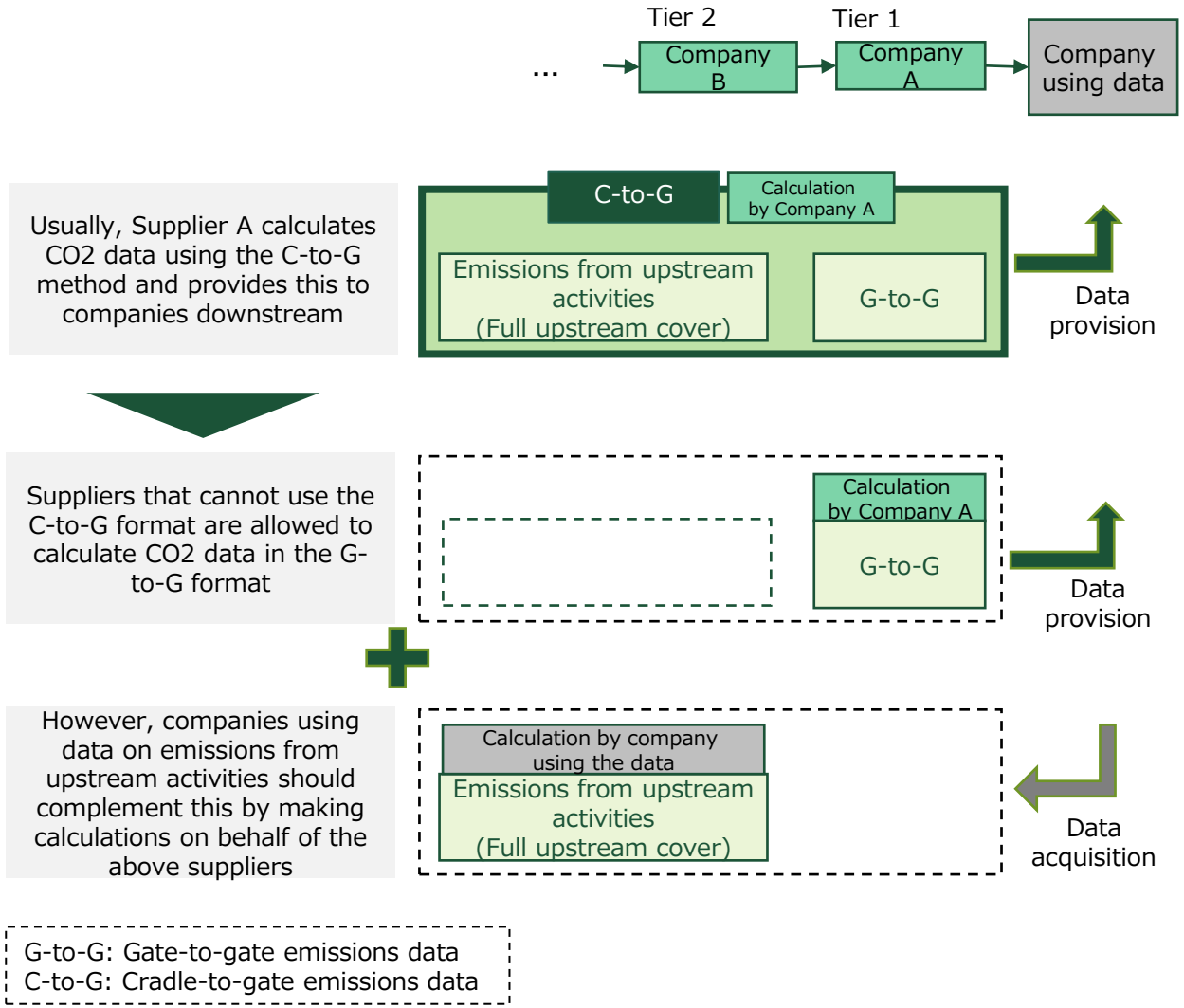


Figure 1 -4 -17 Cradle-to-gate method not supported

Source: Mizuho Research & Technologies

[From discussion at SWG (4)] Possibilities and issues with the G-to-G system

- While the gate-to-gate method has the problem of data loss, the idea of each company uploading its own G-to-G emissions data to the network and aggregating that data in some form is compatible with digital technology. In addition, unlike the C-to-G method, there is no need to calculate emissions from upstream activities and the burden on suppliers is limited. Some in the SWG felt that the G-to-G system should become the mainstream in the future.
- On the other hand, it was also pointed out that the accumulation of G-to-G data on the network entails the risk of leakage of confidential information from suppliers.
- In the case of calculating Tier 1 using the G-to-G method (Chart 1-4-18), in order to add Tier 2 companies' data to Tier 1 data, it is necessary for Tier 1 to identify which companies are designated as Tier 2 and to what extent they purchase products and services—that is, to provide highly confidential information on transactions to the network and thus risk the leakage of confidential information.
- In this regard, the upstream emissions data which the C-to-G approach provides to downstream companies comprises only the results of C-to-G emissions calculations and does not disclose trade information, so it has an advantage in terms of confidentiality.
- However, with the emergence of regulations such as the EU Sustainable Batteries Regulation that require the presentation of traceability information in the supply chain, there may be a limit to the C-to-G method that does not retain traceability information for upstream supplier companies.
- The G-to-G approach, which was not adopted in this document, may be reconsidered in the future if the regulations strongly require traceability.

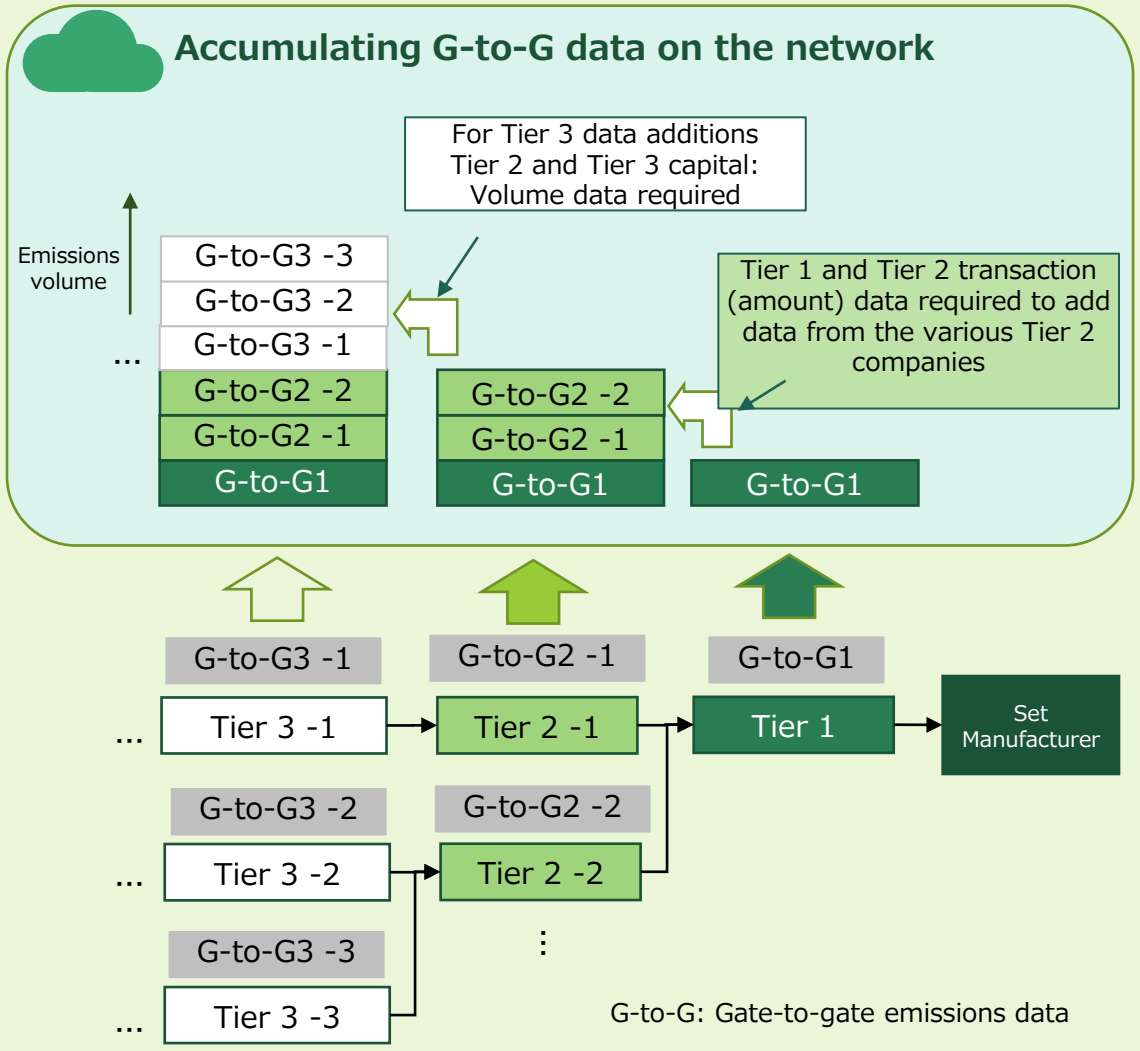


Figure 1-4-18 Gate-to-gate system and data concealment issues

Source: Mizuho Research & Technologies

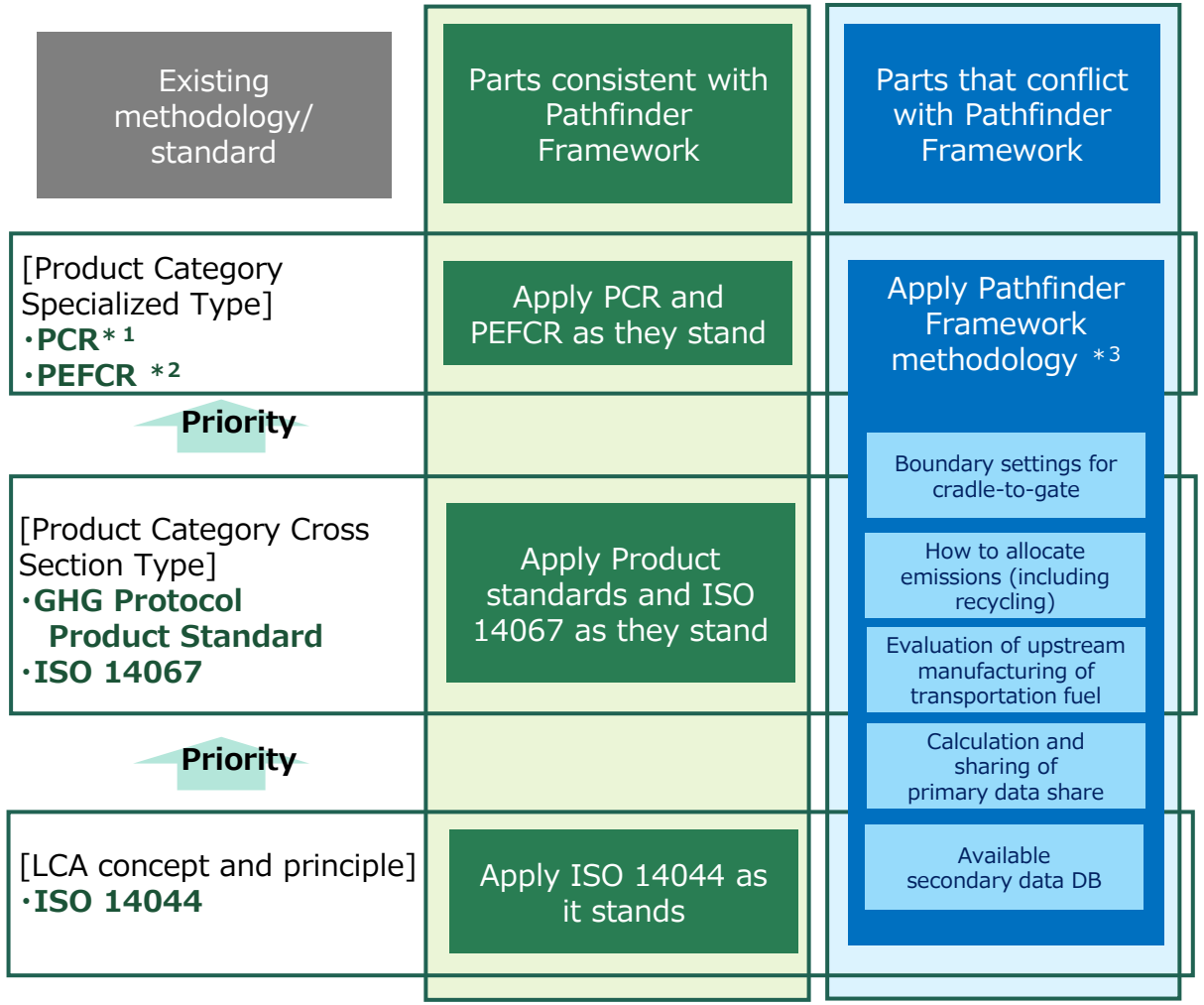
Coexistence with existing methodologies and standards

1-4-7. Coexistence with existing methodologies and standards

(1) Pathfinder Framework approach

- In 1-4, it was noted that clarification was needed as to how the CO2 data calculation method described in this document would coexist with existing methodologies and standards and what the division of roles would be. To achieve this vision, this document follows the PACT Pathfinder Framework concept.
- The PACT notes that the Pathfinder Framework method of calculating CO2 data must be read in conjunction with existing methodologies and standards for product carbon footprint assessment. In other words, the Pathfinder Framework was positioned as a document that complements existing methodological standards.
- The Pathfinder Framework then gave priority to applying existing methodology standards.
- Users of the Pathfinder Framework are required to:

- **Apply existing methodologies and standards in order of priority**
- **Where the standards are inconsistent, apply the Pathfinder Framework**



*1 PCR: Life cycle assessment method for each product category based on ISO 14025
*2 PEFCR: How to conduct life cycle assessments by product category as defined in the EU Environmental Footprint Policy
*3 Pathfinder Framework v2 (announced Jan. 2023) adds cutoff rules and a data quality assessment methodology, etc.

Figure 1-4-19 Relationship between Pathfinder Framework and existing methodologies

Source: Created by Mizuho Research & Technologies based on Pathfinder Framework v1

Coexistence with existing methodologies and standards

1-4-7. Coexistence with existing methodologies and standards (continued)

(1) Pathfinder Framework approach (Continued)

- The main concepts of the Pathfinder Framework v1* that override existing methodology standards are:

  - Boundary settings for cradle-to-gate
  - How to allocate emissions
  - Evaluation of upstream manufacturing of transportation fuel
  - Calculation of primary data share
  - available secondary data DB

  * Pathfinder Framework v2 (announced Jan. 2023) adds a cutoff rule and a data quality assessment methodology, etc. These changes will be reflected in this framework when the framework is revised in summer 2023 based on the results of the PoC Project.

- These details are introduced in 2-2-2.

(2) Approach of this document

- As noted above, this document also applies the Pathfinder Framework concept in relation to existing standards and methodologies.

■ For product-level calculation

- **Apply the Pathfinder Framework approach (Figure 1-4-19) as it stands**
- Practical measures including introduction of PCR in Japan and internationally accepted PCR/PEFCR in other countries are introduced in 2-2-3.

■ For organization-level calculation

- Apply the Pathfinder Framework approach also in the case of organization-level calculation.
- However, in the case of organizational-level calculation, the only existing methodological standard is Chapter 8 of the GHG Protocol Scope 3 Standard.
- This document is based on Chapter 8 of GHG Protocol Scope 3 Standard and takes the position of recommending additional application of the preferred Pathfinder Framework.

Limitations of the cradle-to-gate method

1-4-8. Additional measures for analysing emissions upstream in the supply chain

(1) Limitations of the cradle-to-gate method

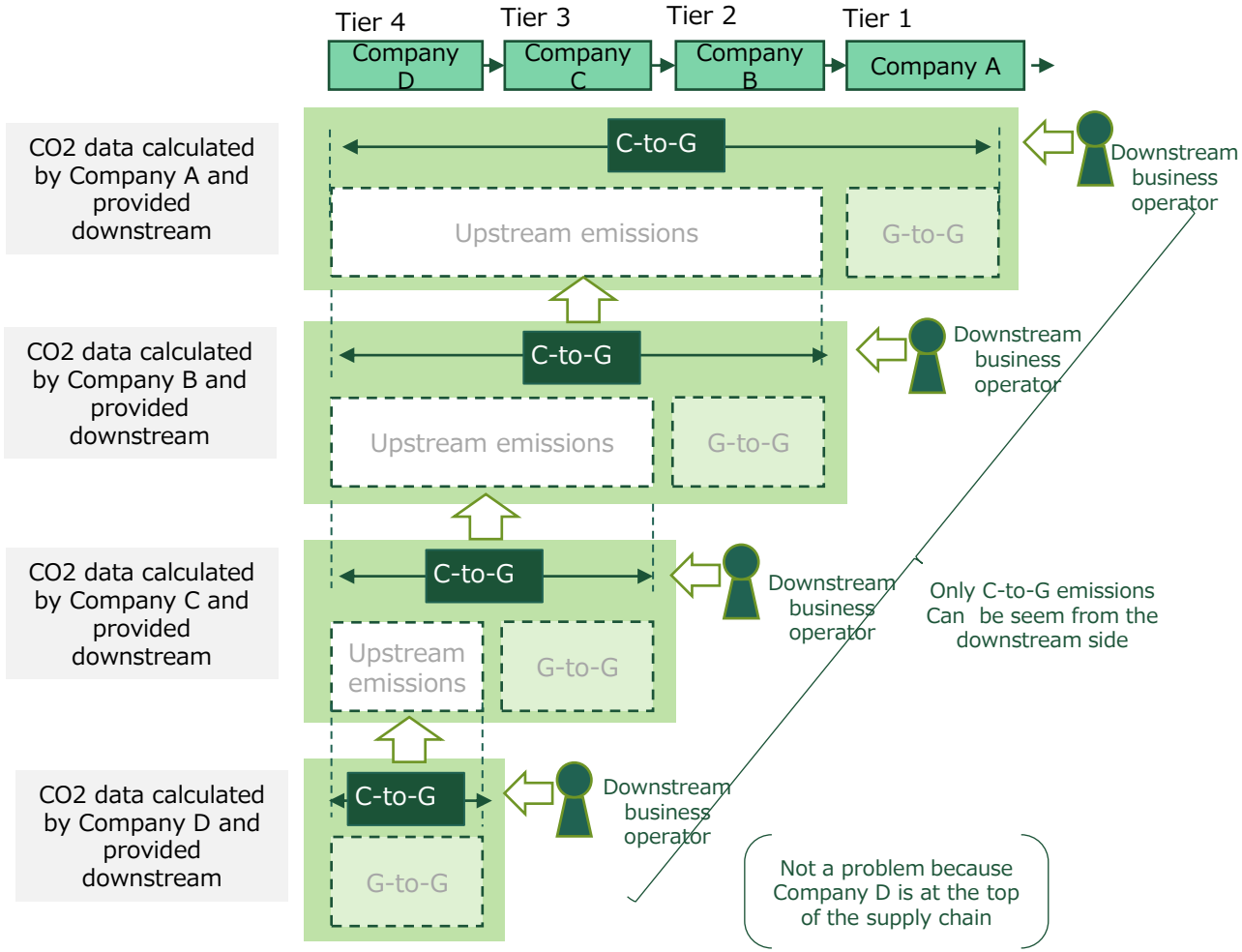
- While the ideal form "6. Allow some level of data analysis" of this document requires the protection of supplier companies' confidential information, it also suggests that companies using data should be able to analyze to some extent the emission structure and potential for emissions reduction upstream in the supply chain.

- Following in the footsteps of the Pathfinder Framework, the C-to-G approach employed in this document is well suited to protecting the confidential information of supplier companies but less suited to data analysis. This is because even if multiple suppliers provide CO2 data based on primary data, that data is aggregated into one value which data users cannot analyze.

- The structure of C-to-G CO2 data is shown in Figures 1-4-14 and 1-4-15, which illustrate the internal calculation structure (G-to-G + upstream emissions) when compiling C-to-G emissions data.

- However, only the calculated C-to-G emissions data is actually provided to downstream companies, and downstream data users cannot perform "hot spot analysis" to identify large emission sources.

- As in Chart 1-4-14, Tier 4 is assumed to be at the top of the supply chain.
- Example of a situation in which data is exchanged C-to-G



G-to-G: Gate-to-gate emission data; C-to-G: Cradle-to-gate emission data

Figure 1-4-20 Limitations of the cradle-to-gate approach

Source: Mizuho Research & Technologies

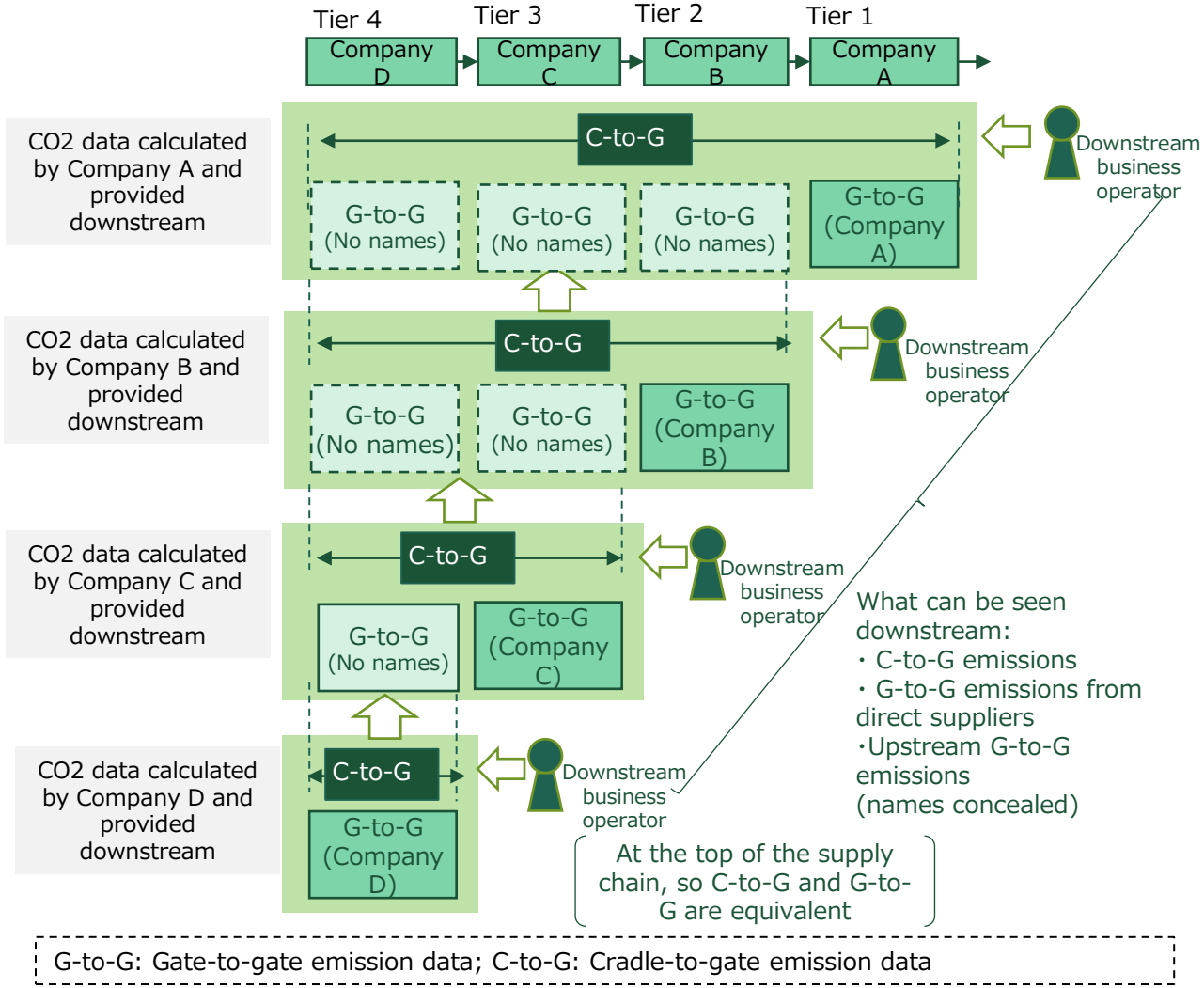
Gate-to-gate combination for upstream emission structure analysis

1-4-8. Additional measures for analysing emissions upstream in the supply chain

(2) Using the gate-to-gate method

- In order to solve the problem presented on the previous page of being unable to break down C-to-G data, this document introduces a method based on the C-to-G method that adds in G-to-G data provision.
- Specifically, when a supplier provides C-to-G data to downstream entities, it provides (i) its own G-to-G emissions data and (ii) G-to-G emissions data provided by upstream suppliers, withholding company names (Figure 1-4-21).
- As presented in 1-4-5, the data provided is only the output information (emissions, etc.) for CO2 data calculation and does not include input information (consumption of raw materials, etc.).
- This action provides downstream operators with the following data:
  (a) C-to-G emissions data
  (b) G-to-G emissions data for Tier 1 direct transactions
  (c) G-to-G emissions data from upstream suppliers (withholding company names to protect the confidentiality of Tier 1 transaction information)
- The provision of emissions data in a form that can be broken down along the tier structure of the supply chain makes it possible to conduct an upstream emissions structure analysis (Figure 1-4-22).
- This document positions this G-to-G combination approach as a recommendation.

- As in Chart 1-4-14, Tier 4 is assumed to be at the top of the supply chain.
- Example of a situation in which all suppliers provide G-to-G data in addition to C-to-G data



G-to-G: Gate-to-gate emission data; C-to-G: Cradle-to-gate emission data

Figure 1-4-21 Cradle-to-gate method + gate-to-gate method

Source: Mizuho Research & Technologies

Additional measures for analysing upstream emissions

1-4-8. Additional measures for analyzing upstream emissions

(3) Gate-to-gate benefits and challenges

- The G-to-G method presented on the previous page has the advantage of allowing Tier 1 suppliers to communicate upstream emissions structures to downstream companies while keeping Tier 2 supplier transaction information hidden.
- However, concerns were expressed in the SWG regarding the provision of the G-to-G data of upstream suppliers to downstream business operators without specifying company names, namely:
  - If the company name is unknown, G-to-G data provision can't be used as material in efforts to encourage emissions reduction; and
  - Even without company names, transactions with Tier 2 suppliers can be inferred from the size of G-to-G data and the number of transactions.
- The likelihood of these issues occurring varies depending on whether the G-to-G data of suppliers upstream of Tier 2 are communicated in (i) aggregate or (ii) non-aggregate form.
- The merits and issues of the G-to-G combination method, including a comparison of the aggregate and non-aggregate methods, will be verified in Phase 2 of the PoC project scheduled for the second half of FY2022.
- If it is confirmed that the merits exceed the problems, the Green x Digital Consortium will investigate making a counterproposal to the PACT Pathfinder Framework on this as an effective approach.

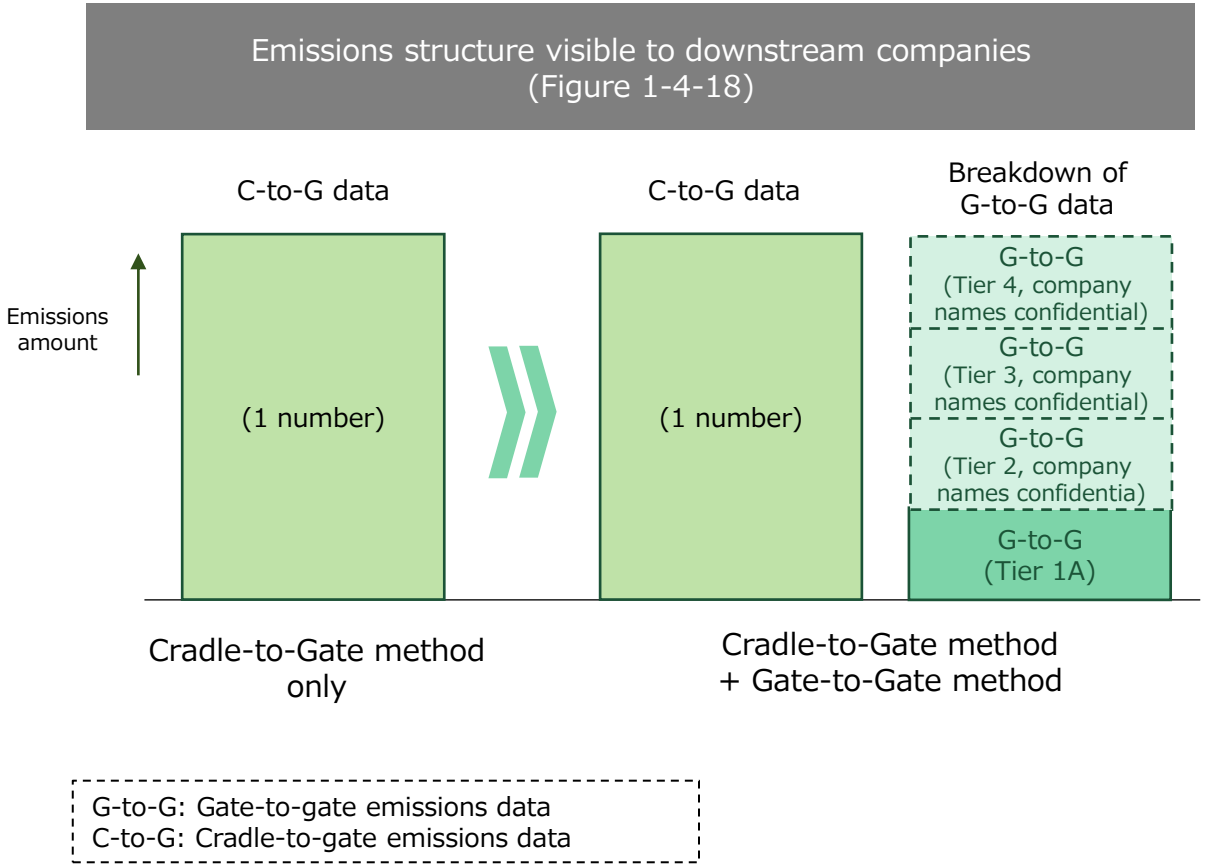


Figure 1-4-22 Emissions data seen from downstream in the case of C-to-G + G-to-G

Source: Mizuho Research & Technologies

CO2 Visualization Roadmap

1-5. CO2 Visualization Roadmap

- The SWG discussed the importance of considering a transition phase based on the current situation, in addition to describing the ideal form of CO2 calculation and sharing. Specifically, the following three points were raised:
  - Advances in CO2 data calculation methods
  - Expansion of tiers linked with primary data
  - Evolution of data collection methods within companies

1-5-1. Advances in CO2 data calculation methods

- As already indicated, product-level calculation is prioritized over organization-level calculation in CO2 data calculation, and when it comes to product-level calculation, the application of calculation methods based on the Pathfinder Framework is recommended.
- However, depending on the current situation of companies working on CO2 data calculation, the route to a calculation method based on the Pathfinder Framework will differ.

(1) Companies that have already implemented some form of product-level calculation

- For companies that have already made some product-level calculations, the first step would be to share their current calculations with downstream entities in line with the data disclosure items presented in Chapter 3 of this document.
- After participating in supply chain data exchange, they will likely move to the Pathfinder Framework based CO2 data calculation methodology described in Chapter 2-2 of this document.

(2) Companies that have already implemented some form of organization-level calculation

- For companies that have already made some organization-level calculations (calculation of production/transaction unit CO2 data using Scope 1, 2, and 3 emissions), the first step would be to share their calculations with downstream entities in line with the data disclosure items presented in Chapter 3 of this document.
- Subsequent transition is recommended, however, to the high-quality calculation method shown in Chapter 2-3 of this document (process subdivision, appropriate allocation) and the product-level calculation shown in Chapter 2.2.

(3) Companies that have not yet begun calculating CO2 data

- For companies that have not yet begun calculating CO2 data, there are two approaches:
- One is first to calculate the Scope 1, 2, and 3 emissions of the company as an organization, then proceed to organization-level calculation using that data, participating in data exchange within the supply chain. The company would then consider moving to product-level calculation in line with the wishes of downstream companies.
- The other is to undertake product-level calculation from the outset. In so doing, it would be best to calculate CO2 data in compliance with the Pathfinder Framework noted in Chapter 2.2, but where this is difficult, the company could begin with G-to-G calculation (see 1-4-6 (4). In this case, too, however, the emissions from upstream activities shall be complemented in order for downstream companies to account for their scope 3 emissions.

CO2 Visualization Roadmap

1-5-2. Expansion of tiers linked to primary data

- At the beginning of this chapter, Figure 1-1-2 showed an image in which all players in the supply chain calculate CO2 data and exchange data. This is the ultimate ideal image.
- In reality, most companies have yet to receive CO2 data based on primary data from Tier 1 companies, so their first step in the transition period will be to exchange data with Tier 1.
- Next, it will be important to aim for a situation where CO2 data can be collected based on primary data from Tier 2 and 3 upstream suppliers via Tier 1.
- Once connections have been created at the various points in the supply chain to exchange data over two or three tiers, these connections will connect with each other, leading to a stage in which data linkage progresses dramatically.

1-5-3. Evolution of data collection methods within companies

- Based on the theme of using digital technology for CO2 visualization, the Green x Digital Consortium's Data Visualization Project has discussed the ideal image of automatic and real-time data collection and CO2 data calculation using sensors.
- However, in the preceding standards survey, it was confirmed that even the Pathfinder Framework of PACT, which is at the forefront of this work, is still at the stage of reaffirming the traditional LCA approach of identifying the annual average value of activity data by sorting out the existing LCA methodology and standards for calculating CO2 data. It has not yet reached the stage of examining automation and real-time data collection.
- Instead, some SWG members argued that data collection from each in-house system/database (environmental management system, procurement database, etc.) is necessary to calculate CO2 data in the cradle-to-gate method of product-level calculation in accordance with the Pathfinder Framework, and that it is more important to build a mechanism utilizing digital technology for collection and aggregation.
- Therefore, as a roadmap for CO2 visualization, it will be important to promote cooperation with multiple systems and databases within a company using digital technology to calculate CO2 data, while promoting automation and real-time data collection on production lines, etc.
- In the future, the ideal form will be realized through the flow of real-time data collected by the center on top of the foundation created by this internal data linkage.

CO2 Visualization Roadmap

1-5-4. Creating a roadmap for CO2 visualization

- The CO2 visualization roadmap shown in Figure 1-5-1 draws on discussions to date, prepared from the three perspectives of progress in CO2 data calculation methods, expansion of layers linked by primary data, and evolution in data collection methods within companies.
- We hope that this will serve as a reference for progress in the efforts of each company.

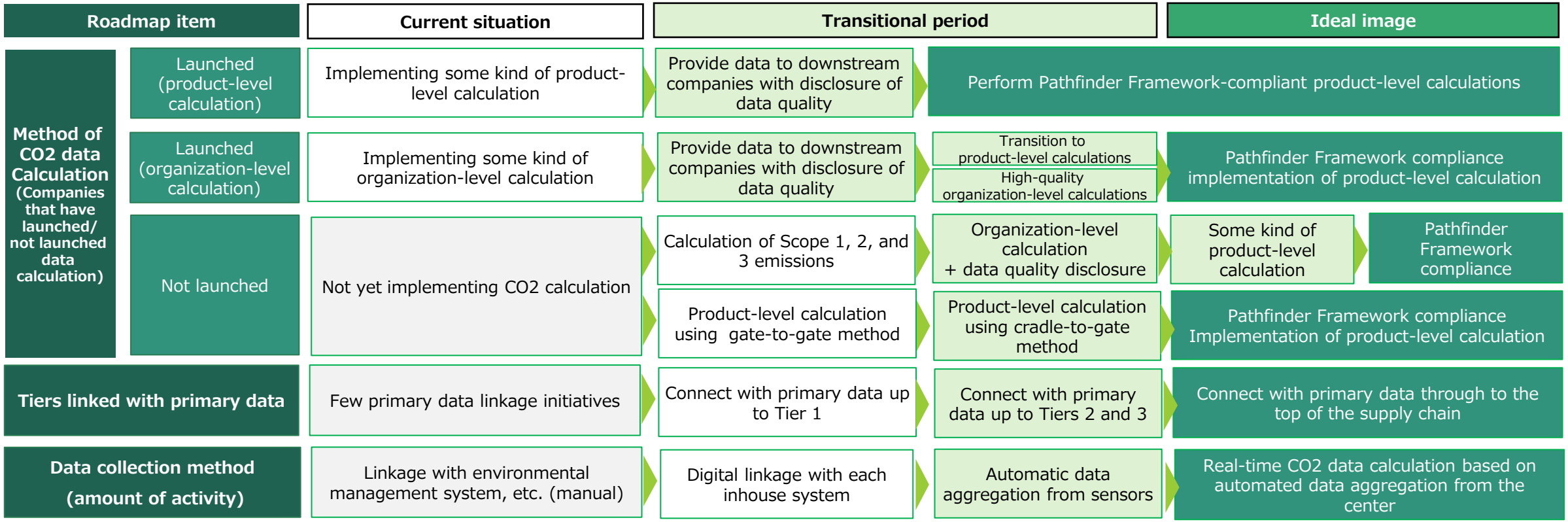


Figure 1-5-1 Roadmap for CO2 visualization progress

Source: Mizuho Research & Technologies

2. CO2 data calculation method

Two methods of calculating CO2 data

2-1. Two methods of calculating CO2 data

- This chapter presents the Green x Digital Consortium's recommended calculation methods for CO2 data provided by supplier companies for downstream companies to calculate Scope 3 Category 1.
- As shown in 1-4-2, calculation methods are shown for two types of calculation: product-level calculation and organization-level calculation.

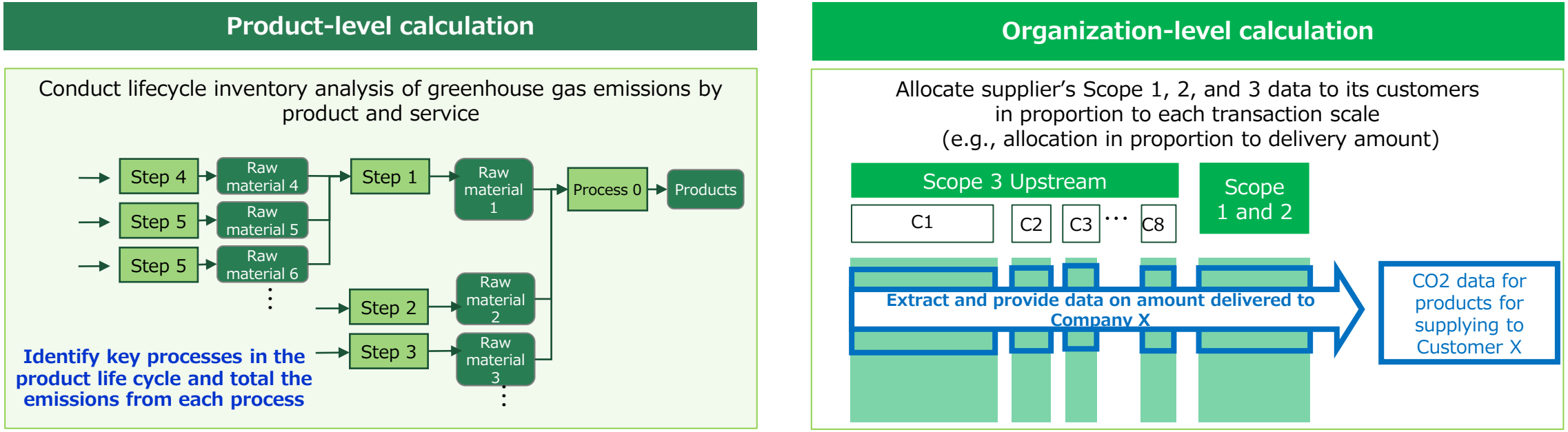


Chart 2-1-1 Overview of product-level calculation and organization-level calculation (Excerpt)

Source: Mizuho Research & Technologies

Two methods of calculating CO2 data

2-1-1. Product-level calculation

- Product-level calculation methods that comply with PACT's Pathfinder Framework are presented in 2-2 in order to realize calculation methods and data quality that are internationally acceptable.
- At present, PACT is in the process of revising the Pathfinder Framework and approval has not yet been obtained from PACT for extra guidance added for application in Japan towards the PoC project, so this is a provisional version.
- In the future, updates will be made based on the content of Pathfinder Framework v2 and discussions with PACT on additional guidance for application in Japan based on the PoC project.

2-1-2. Organization-level calculation

- For organization-level calculation, guidance for calculating CO2 data based on the level of data management in the digital age is presented in 2-3 based on Chapter 8 of the GHG Protocol Scope 3 Standard.
- However, because Section 8 of the Scope 3 Standard provides only recommendations and does not include requirements, and because this document also takes the position of recommending a gradual shift from organization-level calculation to product-level calculation (1-4-2), the methodology of organization-level calculation is positioned as a recommendation to improve data quality.

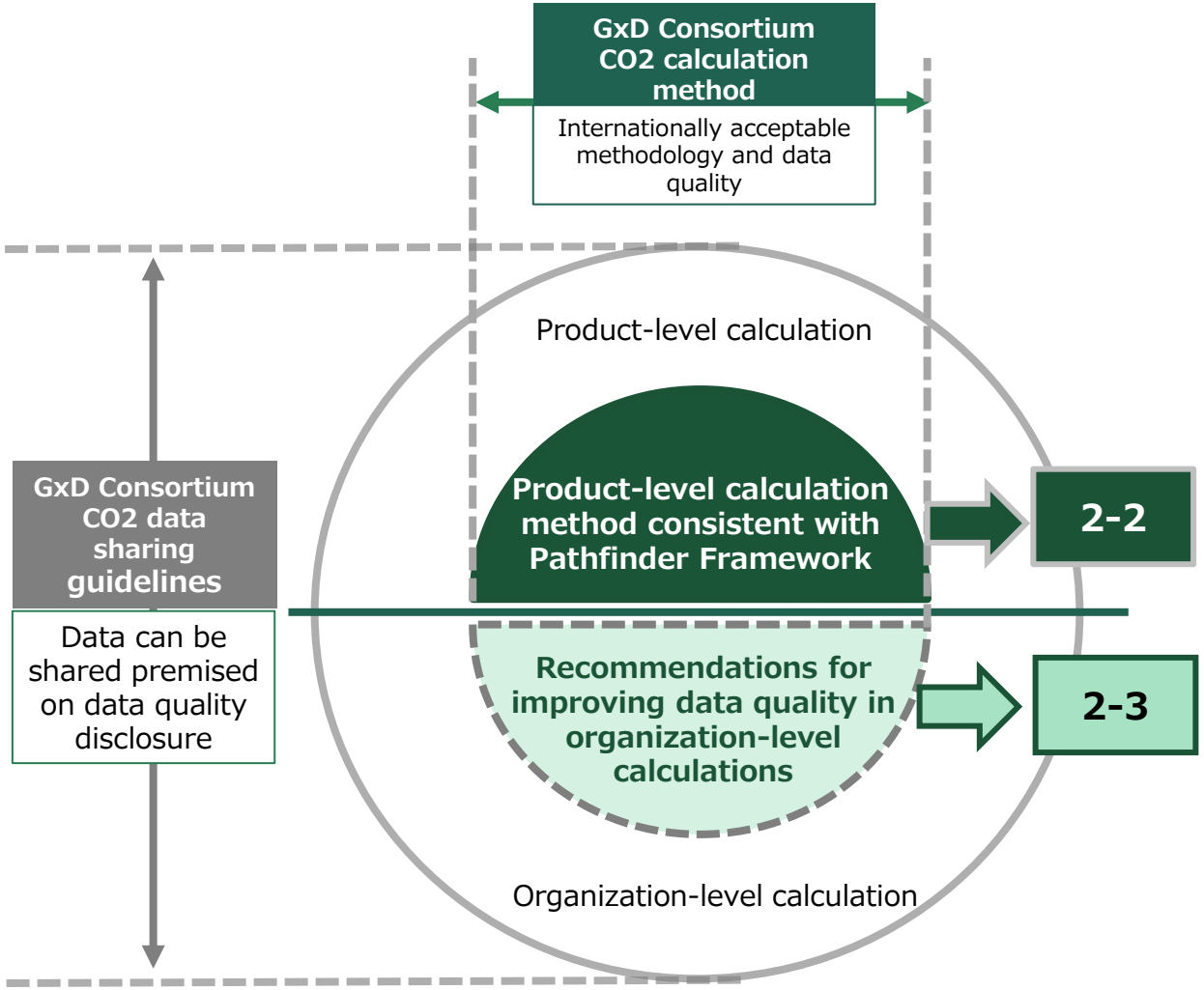


Chart 2-1-2 Positioning in this document of the product-level calculation and organization-level calculation methods

Source: Mizuho Research & Technologies

Two methods of calculating CO2 data

2-1-3. Priorities for product-level and organization-level calculations

- This document reaffirms the following positions on product-level and organization-level calculation priorities, as discussed earlier in 1-4-2.

> **① In view of the fact that it is a widespread practice, allow calculation and sharing of organization-level CO2 data to the extent that it is explicitly stated that this is not product-level CO2 data.**

> **② However, the organization-level calculation is regarded as a provisional response, and a phased transition to product-level calculation is recommended.**

2-1-4. Adoption of PCF label

- From this chapter onward, product-level cradle-to-gate GHG emissions, which have been referred to thus far as product-level CO2 data, will be referred to as Product Carbon Footprint (PCF), following the Pathfinder Framework of PACT.
- In Japan, this is often called CFP (Carbon Footprint of Products) in line with ISO 14067.

When only the gate-to-gate method is supported

2-1-5. When only the gate-to-gate method is supported

- As previously noted in 1-4-6 (4), this document allows companies that cannot comply with the cradle-to-gate approach to calculate CO2 data using the gate-to-gate approach.

- **The product-level calculation shown in 2-2 will be a gate-to-gate method calculation if it is calculated for direct activities.**
- **The organization-level calculation shown in 2-3 is a gate-to-gate calculation if the allocation target is only Scope 1 and 2 emissions.**

- However, since gate-to-gate CO2 data does not include emissions upstream from the supplier, downstream companies using the data cannot cover emissions upstream in the supply chain. Downstream operators using that data are required to understand and utilize the imperfections of boundaries.
- Downstream entities using the G-to-G data shall calculate emissions from the upstream activities of the supplier on their behalf.

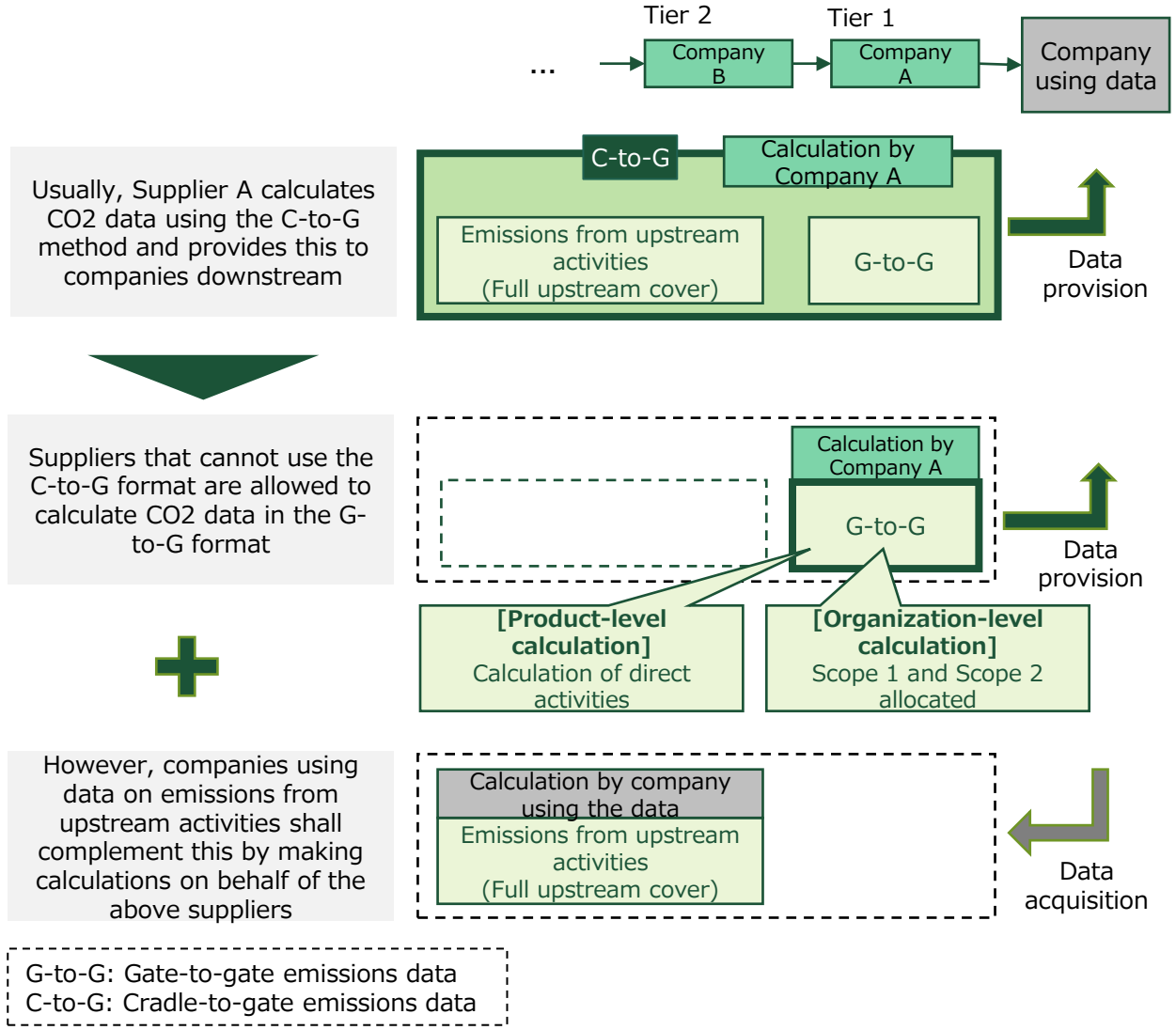


Figure 2 -1 -3 Cradle-to-gate method not supported

Source: Mizuho Research & Technologies

Requirements for the calculation and sharing methods described in this document

2-1-6. Requirements for the calculation and sharing methods described in this document

- The requirements for the CO2 data calculation and sharing method described in this document are as follows.

  “Shall”:
  The calculation method in this document must be followed.

  “Should”:
  Recommendations and as much compliance as possible

  “May”:
  The user may choose this option if they wish

- The level of requirement depends on the CO2 calculation and sharing method.
  - Product-level calculations are given as “shall,” “should,” or “may.”
  - Organization-level calculations are presented as “should” or “may” because they permit calculations from an inclusive perspective.
  - Responses to disclosure items when sharing calculation results are shown as either "shall" or "should" in both product-level and organization-level calculations.

Requirement level	Product-level calculation	Organization-level calculation	Response to data disclosure items
“Shall”	✓		✓
“Should”	✓	✓	✓
“May”	✓	✓	

Chart 2 -1 -4 Requirements for calculation and sharing methods

2. CO2 data calculation method

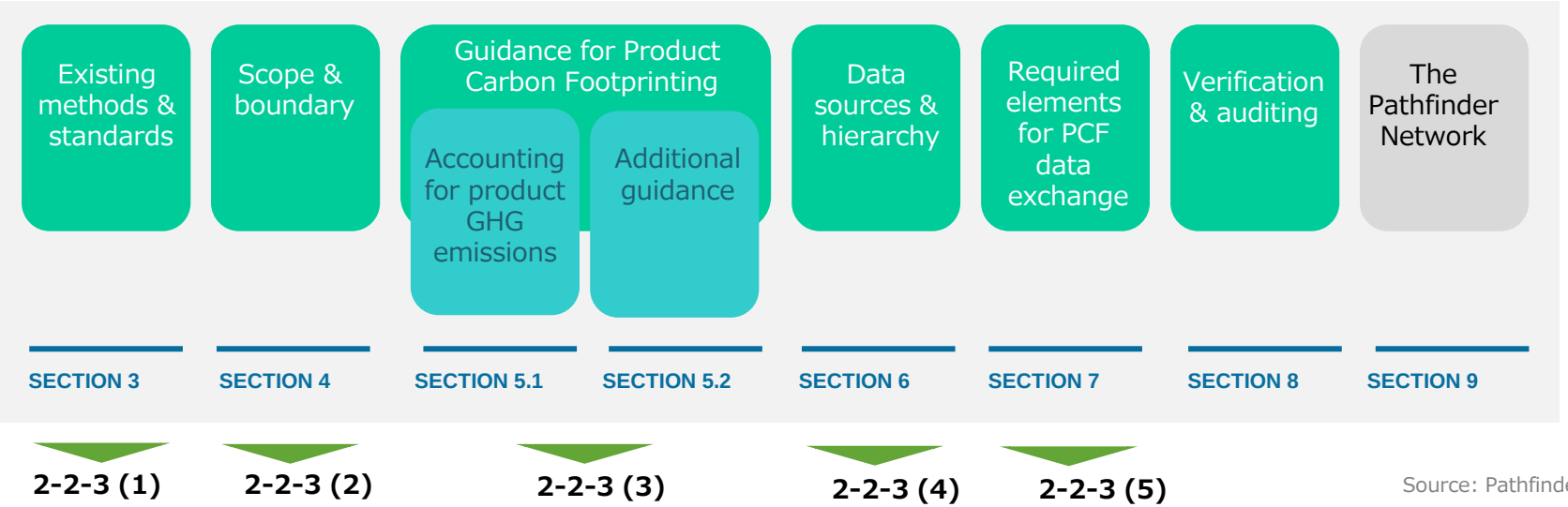
2-2. Product-level calculation method

Positioning of product-level calculation

2-2. Product-level calculation method

2-2-1. Positioning of product-level calculation

- 2 Section -2 presents the Green x Digital Consortium product-level calculation method.
- The calculation method is based on the Pathfinder Framework v1 described above. It describes the requirements of the framework and provides guidance for Japanese companies to apply it.
- In addition, we will present our own guidelines for use in Phase 2 of our PoC for calculation methodologies for which the Pathfinder Framework v1 did not provide requirements and guidance.
  - The Pathfinder Framework v1 requirements are shown in green.
  - The original guidelines for our PoC are shown in blue as tentative plans.
- The following descriptions are provided.
  - 2-2-2: Pathfinder Framework v1 Requirements
  - 2-2-3: Green x Digital Consortium Guidelines
- The explanation in 2-2-3 proceeds through (1) to (5) in line with the relevant section in Pathfinder Framework v1.



While this schema follows Pathfinder Framework v1, it will be updated to reflect Pathfinder Framework v2 announced January 26, 2023.

Source: Pathfinder Framework v1 (PACT powered by WBCSD)

Figure 2-2-1 Guidance correspondence to Pathfinder Framework v1 configuration

Overview of Pathfinder Framework v1 Requirements (1)

2-2-2. Overview of Pathfinder Framework Requirements

- The requirements for Pathfinder Framework v1 are as below.

(1) 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
(2) 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
(3) Guidance for Product Carbon Footprinting Accounting for product GHG emissions	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 factor • Multiplication of activity data with relevant emission factors (CO_2e/declared unit) • If necessary: allocation of emissions to outputs

Source: Pathfinder Framework v1 (PACT powered by WBCSD)

Overview of Pathfinder Framework v1 Requirements (2)

(3) Guidance for Product Carbon Footprinting

Additional Guidance

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

Source: Pathfinder Framework v1 (PACT powered by WBCSD)

Overview of Pathfinder Framework v1 Requirements (3)

(4) 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
(5) 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

Source: Pathfinder Framework v1 (PACT powered by WBCSD)

Existing methods and standards

2-2-3: Green x Digital Consortium Guidelines

(1) Existing methods and standards

Pathfinder Framework requirements

- 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

[Explanation] Positioning of existing methods and standards

- As indicated in 1-4-7, the Pathfinder Framework sets the priority on leveraging existing standards.
- If there are specific product or sector rules (PCR, PEFCRs, etc.), they take precedence, followed by comprehensive rules such as the GHG Protocol Product Standard and ISO 14067.
- The ISO order of priorities in ISO 14044 etc. follows these standards and are positioned as the basic document for LCA concepts and principles.
- If there is a conflict between existing standards and the Pathfinder Framework, the Pathfinder Framework will apply.
    - ISO 14067, which Japanese companies refer to in product LCA, is positioned as an existing standard. Existing LCA can be utilized if the requirements of Pathfinder Framework are applied to product LCA.
    - Japan's SuMPO Environmental Label Program contains certified PCRs but use outside the program is prohibited. If agreement from SuMPO is obtained, these PCRs may be utilized in the future.
- Information on the methods and standards provided for transparency and comparability should be shared downstream.
- Category rules that are not officially defined as PEFCR or PCR should be tested and validated.

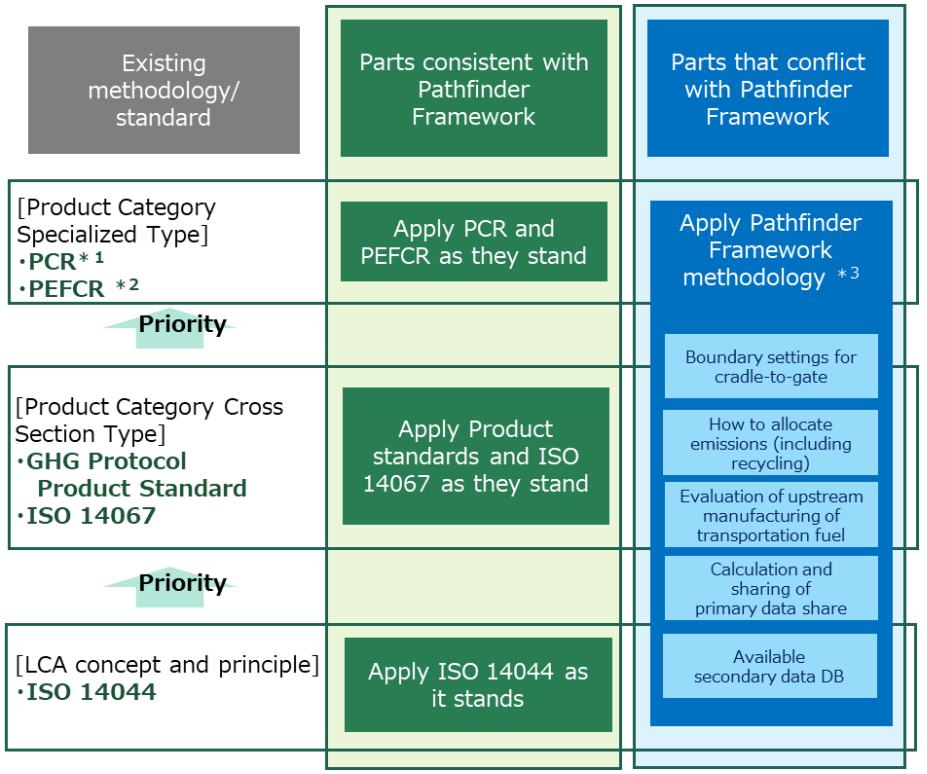


Figure 2-2-2 Relationship between existing methods and standards and the Pathfinder Framework

Source: Created by Mizuho Research & Technologies based on Pathfinder Framework v1 (PACT powered by WBCSD)

Scope and boundary

(2) Scope and boundary

Pathfinder Framework requirements

- 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

[Explanation] Process concept (attributional LCA approach)

- The Pathfinder Framework follows an attributional LCA approach.
- The attributational LCA approach combines the emissions of all attributable processes along a product's lifecycle and assigns them to a specific product unit.
- In this context, attributable process refers to a process comprising the flow of all services, materials, or energy flows that become, make, or carry a product throughout its life cycle.
- In other words, it is an idea that emissions related to direct products should be recorded, with indirect sectors excluded. Indirect sectors include production facilities, buildings and other capital goods, employees' business trips and commutes, and R&D activities.
- However, if data on indirect sector activities are available and relevant*, they should be included in the calculation.

- The Pathfinder Framework's attributional LCA approach can be mapped as follows to the Scope 1, 2, and 3 emissions in the GHG Protocol familiar to most companies.

* In Pathfinder Framework v2 (announced Jan. 2023), "relevant" has been changed to "material."

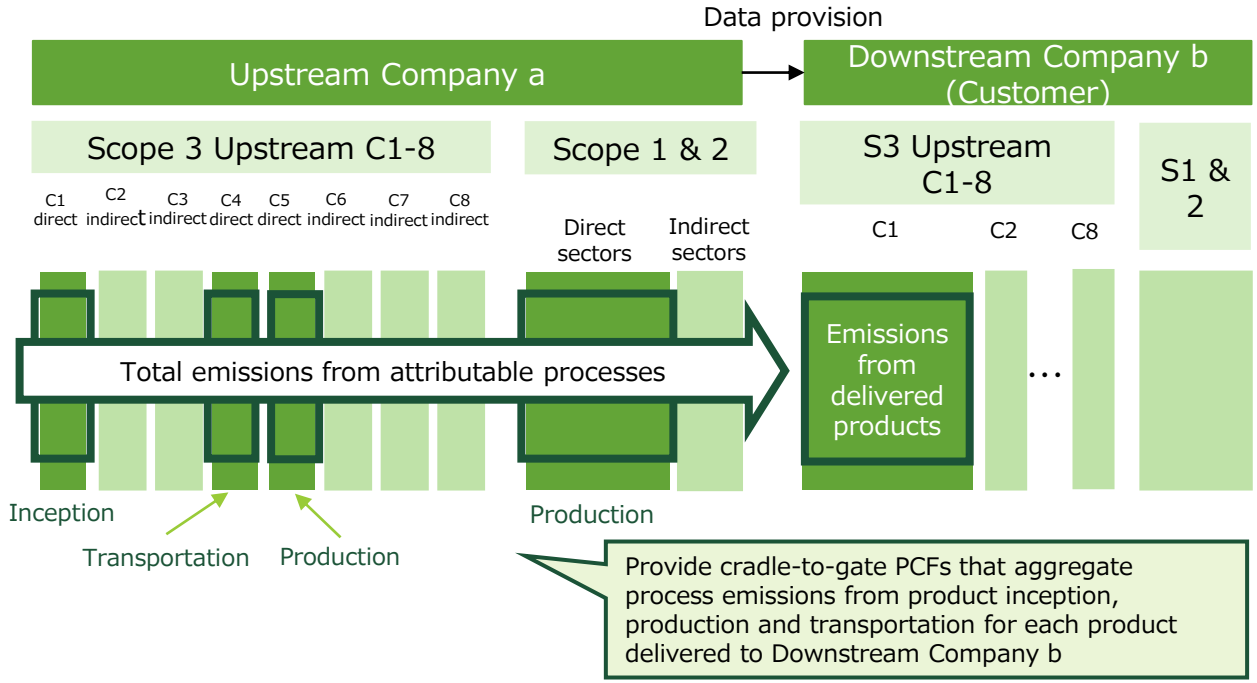


Figure 2-2-3 Relationship between the attributional LCA approach and an organization's emissions

Source: Mizuho Research & Technologies

Scope and boundary

(2) Scope and boundary

[Explanation] Boundary

- The Pathfinder Framework boundary—ie, the processes and their associated emissions that are to be counted and exchanged as part of a company's PCF—is the cradle-to-gate PCF.
- This includes all upstream and direct emissions from products, including all upstream transport activities.
- The gate of the cradle-to-gate is the at the gate of the company supplying the PCF. The transport from their facilities to the customer is not included.
- Product use and End-of-life also are considered to be outside the boundary.
- In calculating emissions, the cradle-to-gate boundary needs to be clarified by organizing the processes attributed to a product into lifecycle stages.

[Preliminary Proposal for PoC Phase]

- In some cases, it may be difficult to use primary data for calculations of emissions as of the shipment of the product. In such cases, we envisage a complementary method in which the transport company provides emissions information based on primary data.
- Transportation and storage will be excluded from calculations during the PoC phase because calculation of this data by transport companies will be investigated separately by the Logistics SWG.

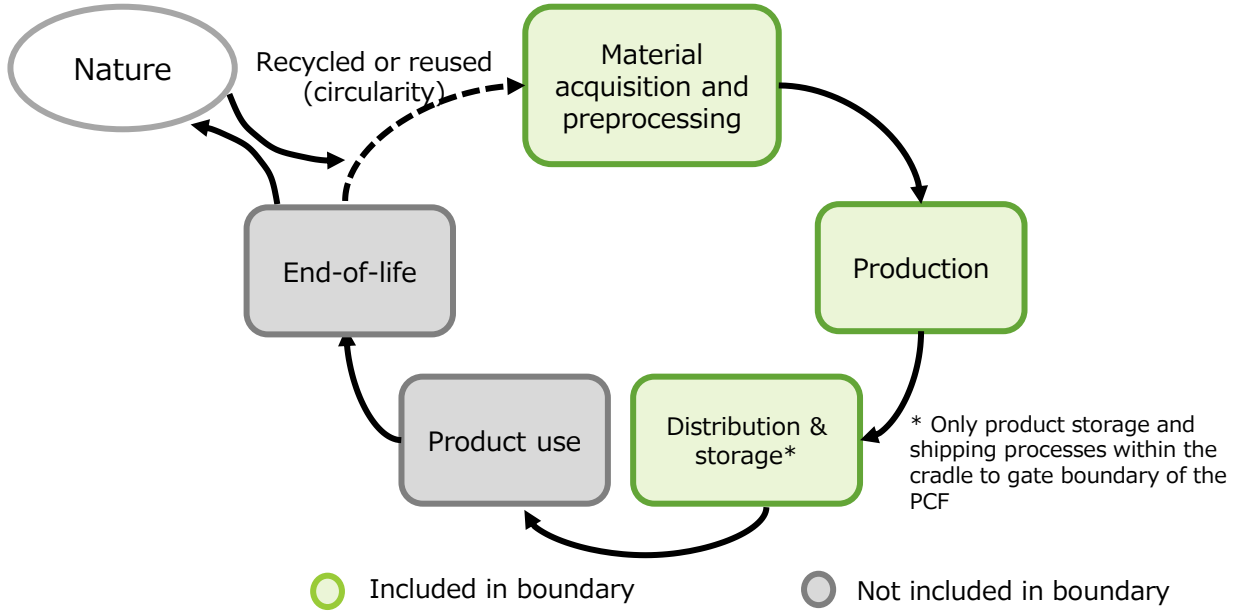


Figure 2-2-4 Product life cycle stages and boundary in Pathfinder Framework v1

Source: Created by Mizuho Research & Technologies based on Pathfinder Framework v1 (PACT powered by WBCSD)

Scope and boundary

(2) Scope and boundary

GHG and Global Warming Potential

- The Pathfinder Framework is a methodology for investigating GHG emissions. The GHG to be calculated is specified by the GHG Protocol “Required Greenhouse Gases in Inventories.”
- Target GHGs: CO2, CH4, N2O, HFCs, PFCs, SF6, NF3, etc.
- Adopts a 100-year Global Warming Potential time horizon to be derived from the IPCC Assessment Report AR 5.

[Preliminary Proposal for PoC Phase]

- The emission factor in the Act on Promotion of Global Warming Countermeasures, which is widely used in Japan, does not use the GWP in the IPCC Assessment Report AR 5. The use of emission factors from such domestic legislation will be permitted during the GxD Consortium’s PoC phase.
- GWP will be discussed separately with PACT.

* Pathfinder framework v2 (announced Jan. 2023) has been modified to apply the GWP in the latest version of the IPCC Assessment Report publication.

[Explanation] Use of primary data

- The Pathfinder Framework prioritizes the use of primary data.
- The use of a primary data share (PDS) is required in calculations disclosed when data is exchanged in order to increase the visibility of the receiving side of the PFC and encourage the use of primary data that is specific to the enterprise (PDS details will be described later).

[Explanation] Declared unit

- The final PCF inventory result must be disclosed as kg-CO2e per declared unit.
- Example: kg-CO2e/kg, kg-CO2e/L

[Preliminary Proposal for PoC Phase]

- PACT does not assume a product unit as a declared unit, but there are cases such as finished products where it is not appropriate to use weight, etc., as a unit. Therefore, in the PoC phase, the product unit may be used as a declaration unit.
- Declared units will be discussed separately with PACT.

PCF calculation steps

(3) PCF calculation steps

Pathfinder Framework requirements

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 factor
- Multiplication of activity data with relevant emission factors (CO_2e/declared unit)
- If necessary: allocation of emissions to outputs

[Explanation] PCF calculation steps

- PCF calculation steps in the Pathfinder Framework comprise (1) data identification, (2) calculation and (3) allocation (figure at right).
- (1) Data identification is performed in three steps.
- PCF is calculated by adding direct emissions and transport and waste emissions.
- The calculated PCF is shared with downstream operators.

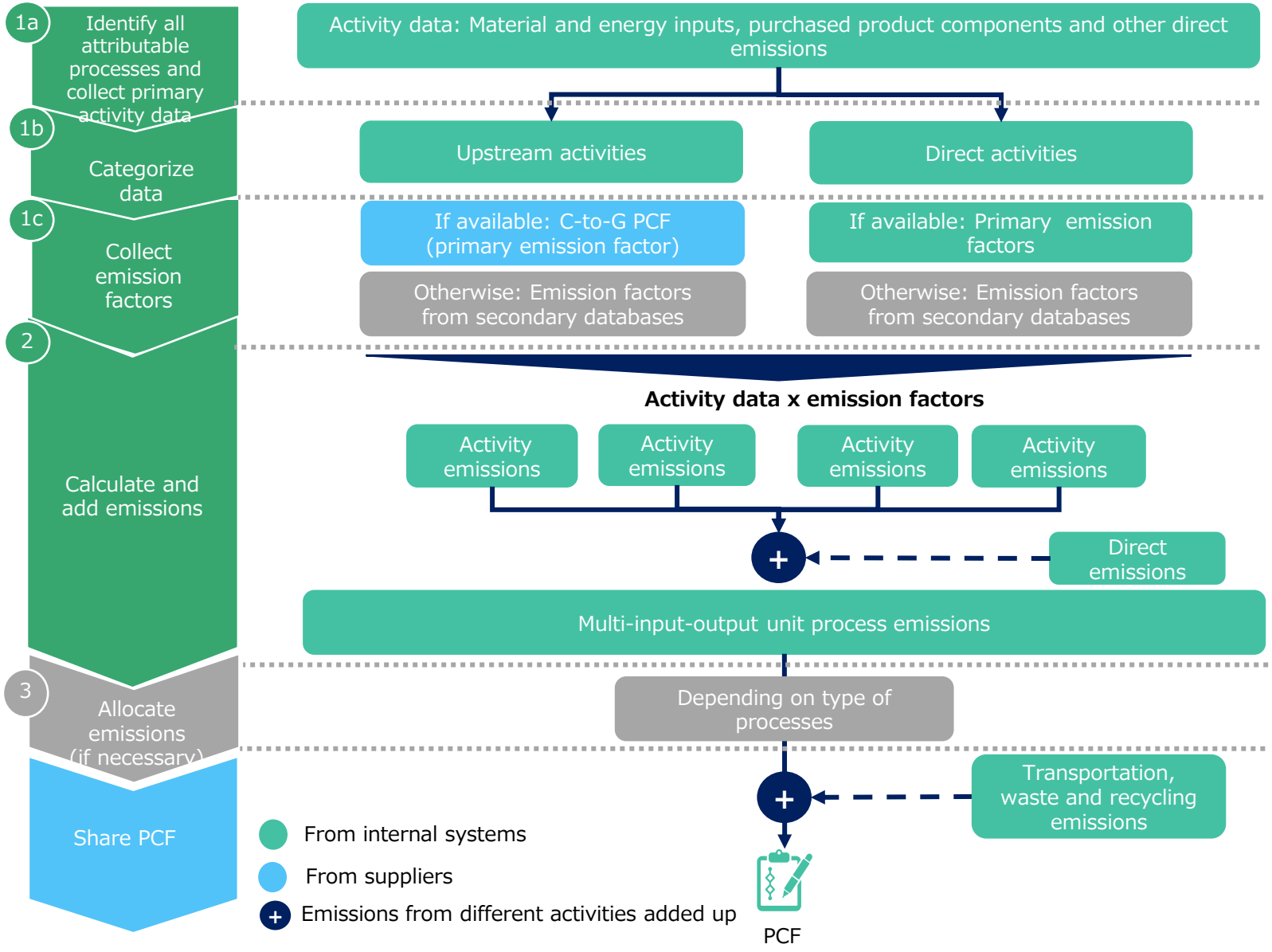
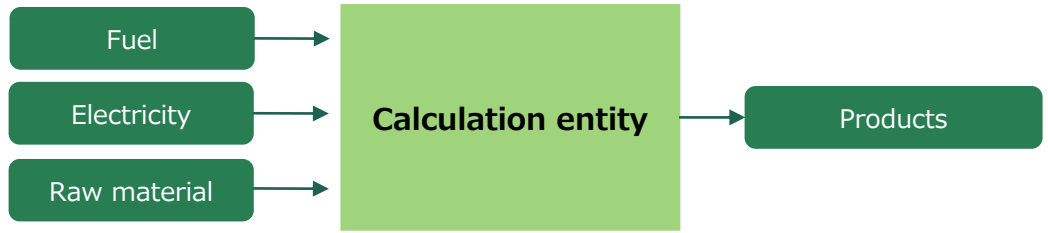


Figure 2-2-5 PCF calculation steps

Source: Created by Mizuho Research & Technologies based on Pathfinder Framework v1 (PACT powered by WBCSD)

[Illustration] PCF calculation steps

1a) Identify relevant processes and collect primary data activity



1b) Classify collected activity data into upstream activity and direct activity

1c) Collect emission factors

Upstream activities (processes upstream from the company)

	Activity data	Emission factor
Fuel	Fuel consumption	Cradle-to-gate emission factor (Upstream activities in fuel production)
Power	Power consumption	Cradle-to-gate emission factor (Upstream fuel activities at the time of power generation)
Raw material	Amount of raw materials used	Cradle-to-gate emission factor (raw material production)
	All activity data are primary data	**Primary data provided by supplier secondary data if not available**

Direct activities (internal processes)

Activity data	Emission factor
Fuel consumption	Fuel-burning emission factor
Power consumption	Electric power emission factor
All activity data are primary data	**Primary data provided by supplier/secondary data if not available**

2) Calculate emissions

	Activity data		Emission factor		Amount of emission
Fuel	Fuel consumption	×	Cradle-to-gate emission factor (Upstream activities in fuel production)	=	Emissions from upstream fuel activities
Power	Power consumption	×	Cradle-to-gate emission factor (Upstream fuel activities at the time of power generation)	=	Emissions from upstream electric power activities
Raw material	Amount of raw materials used	×	Cradle-to-gate emission factor (raw material production)	=	Emissions from raw material manufacturing

Activity data		Emission factor		Amount of emission
Fuel consumption	×	Fuel combustion emission factor	=	Emissions from fuel combustion
Power consumption	×	Electric power emission factor	=	Emissions from electric power generation

While omitted in this figure, in addition to "activities x emission factor," process-generated direct emissions also need to be calculated and added into the total.

Figure 2-2-6 PCF calculation steps

Source: Mizuho Research & Technologies

[Explanation] Differences between Pathfinder Framework and traditional LCA (1/3)

Differences between Pathfinder Framework and traditional LCA approach

- The Pathfinder Framework does not mention how it differs from traditional LCA or carbon footprint approaches, so the differences are confirmed in this guidance.

① Calculation Steps

- Although the PCF calculation steps described above are concise, they are organized in a way that is roughly consistent with carbon footprint throughout the Pathfinder Framework.
- For example, the figure on the right shows a comparison with the calculation steps in the GHG Protocol product standard as the traditional LCA calculation method.
- Since the Pathfinder Framework clarifies the setting of preconditions, etc., calculation steps are limited to some elements.
- The Pathfinder Framework v1 identifies uncertainty analysis as a data disclosure item (see 3-2). On the other hand, there is no mention of the method. This is probably because the Pathfinder Framework prioritizes the use of primary data and does not assume low-uncertainty data collection.
- Existing standards should be consulted when performing uncertainty analysis.

Product Standards	Pathfinder Framework v1
Goal Setting (Chapter 2)	No description in the calculation step for obvious reasons
(Review of Principles (Chapter 4))	
(Basic Review (Chapter 5))	
Scope Settings (Chapter 6)	Disclosure is made on a declarative basis and is not included in the calculation step.
Boundary Settings (Chapter 7)	Pathfinder Framework is defined as cradle-to-gate, so it is not mentioned in the calculation step.
Data Collection and Quality Assessment (Chapter 8)	Calculation Step (1) Data Identification
Implementing Distribution (Chapter 9)	Calculation Step (1) Data Identification, Calculation Step (3) Allocation
Uncertainty Analysis (Chapter 10)	None: No mention of uncertainty analysis in v1 stage
Calculating Inventory Results (Chapter 11)	Calculation Step (2) Calculation
Validate	Pathfinder Framework also defines implementation separately
Report	PCF is assumed to be shared downstream

Figure 2-2-7 Comparison between traditional LCA (product standard) and Pathfinder Framework in PCF calculation steps

Source: Mizuho Research & Technologies

Differences between Pathfinder Framework and traditional LCA (2/3)

② Data collection method for each process

- There are differences between the traditional LCA approach and the Pathfinder Framework in the retroactive collection of upstream process activity.

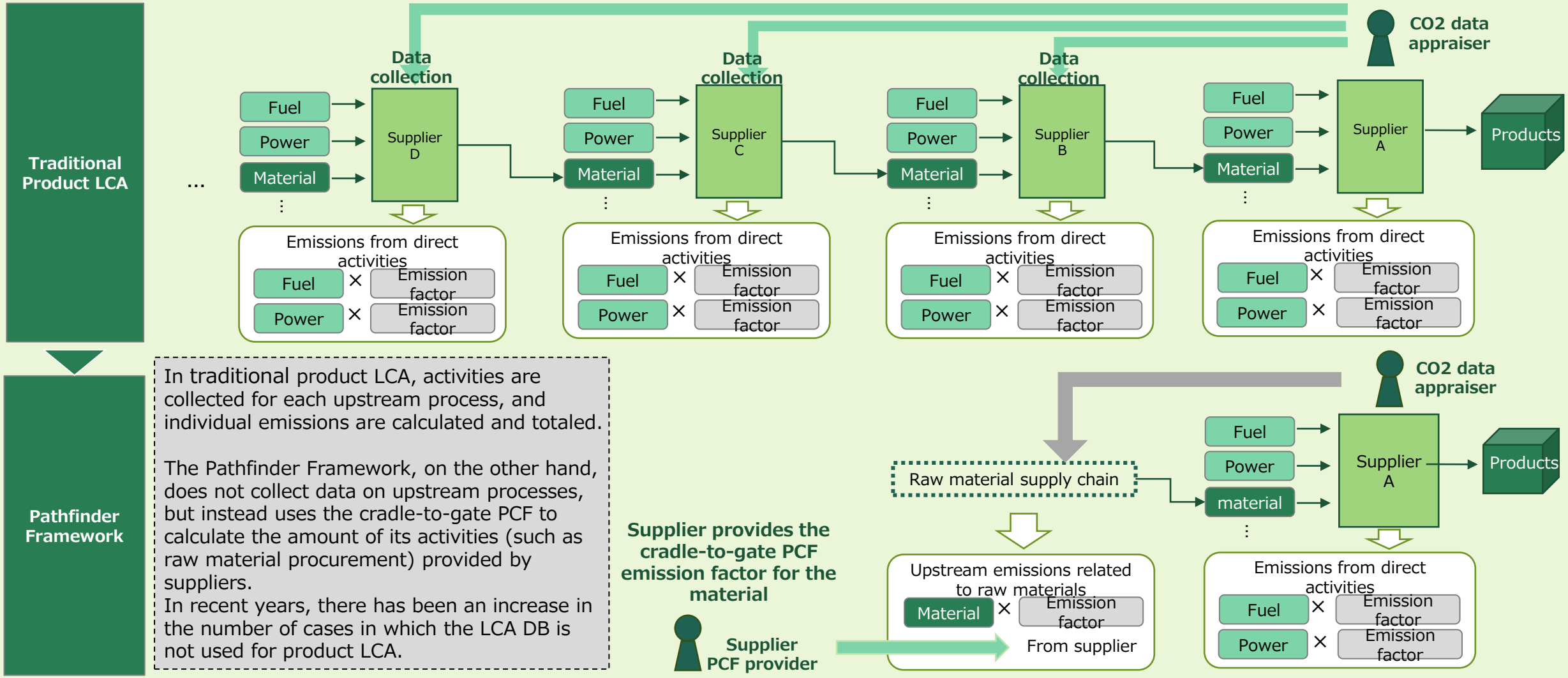


Figure 2-2-8 Differences in approaches to primary data collection between traditional LCA and Pathfinder Framework

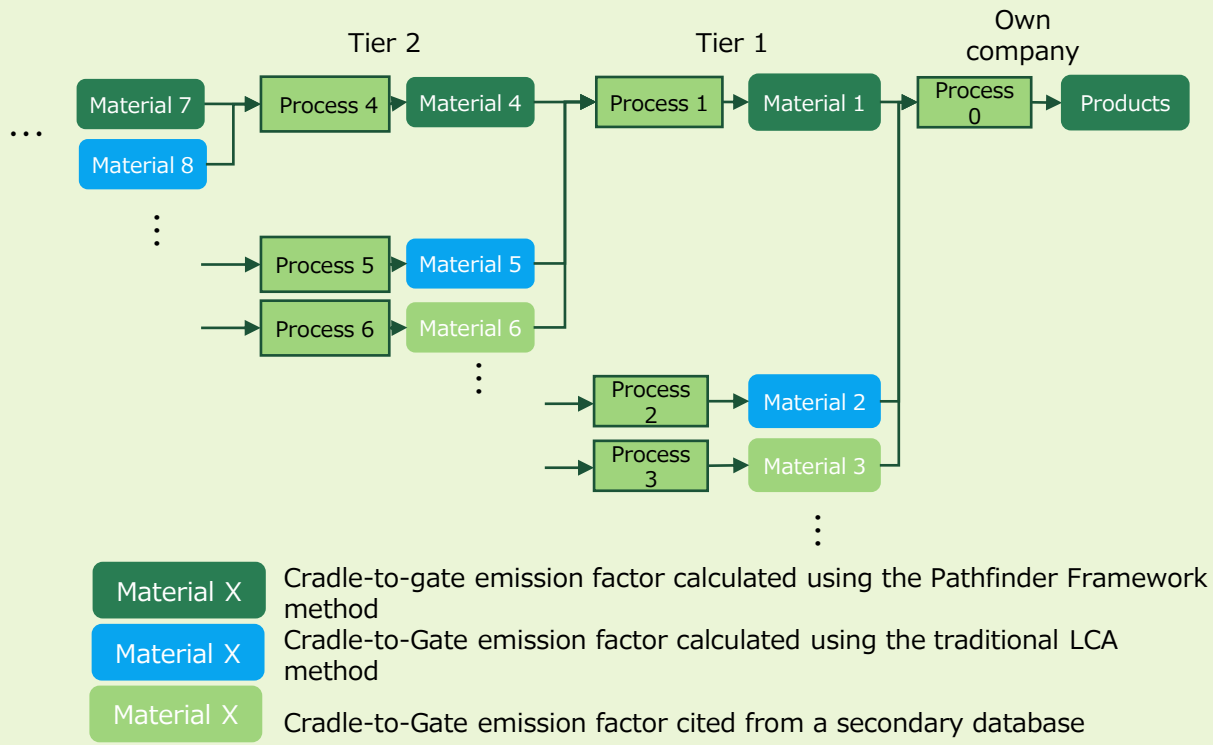
Source: Mizuho Research & Technologies

Differences between Pathfinder Framework and traditional LCA (3/3)

③ Coexistence of LCA with data exchange in the Pathfinder Framework

In ① and ②, we confirmed the differences between traditional LCA and the Pathfinder Framework, but they can be said to be equivalent to product-level calculation of cradle-to-gate emissions.

- The Pathfinder Framework is designed to pass the cradle-to-gate PCF downstream from the supplier. This cradle-to-gate PCF does not necessarily have to be calculated according to the Pathfinder Framework, and it can be used even if it is calculated by the traditional LCA method.
- Both traditional LCA- and Pathfinder Framework-based emission factor can be used, and they coexist (see figure below).
- However, among the differences between traditional LCA and the Pathfinder Framework is the information passed downstream (see “3. CO2 data sharing method”).
- A secondary database may be used for the calculation.



Source: Mizuho Research & Technologies

Figure 2-2-9 Coexistence of LCA with Pathfinder Framework in PCF calculation

PCF calculation steps ① Data identification 1a) Process identification

(3) PCF calculation steps ① Data identification

1a) Process identification

- First, identify all attributable processes and what data to collect.
- In LCA, system boundaries are defined and processes are specified by creating life cycle flow diagrams for the products under investigation.
- The Pathfinder Framework, on the other hand, can identify the raw materials and energy inputs that are directly related to the production process of the product under investigation and collect data on their activity (see p. 65).
- Therefore, it is assumed that activity data is company-specific, ie, primary data.
- Specific activity data is assumed as follows
  - Input materials (e.g., steel 10t, aluminum 300kg)
  - Purchased power, input energy such as heat (e.g., 100kWh of electric power)
  - Components of procured products (e.g., chemicals per unit volume)
  - Other direct GHG emissions not taken into account (e.g., CO2 from processes)
- As mentioned earlier, indirect sectors may be excluded if they are not relevant.

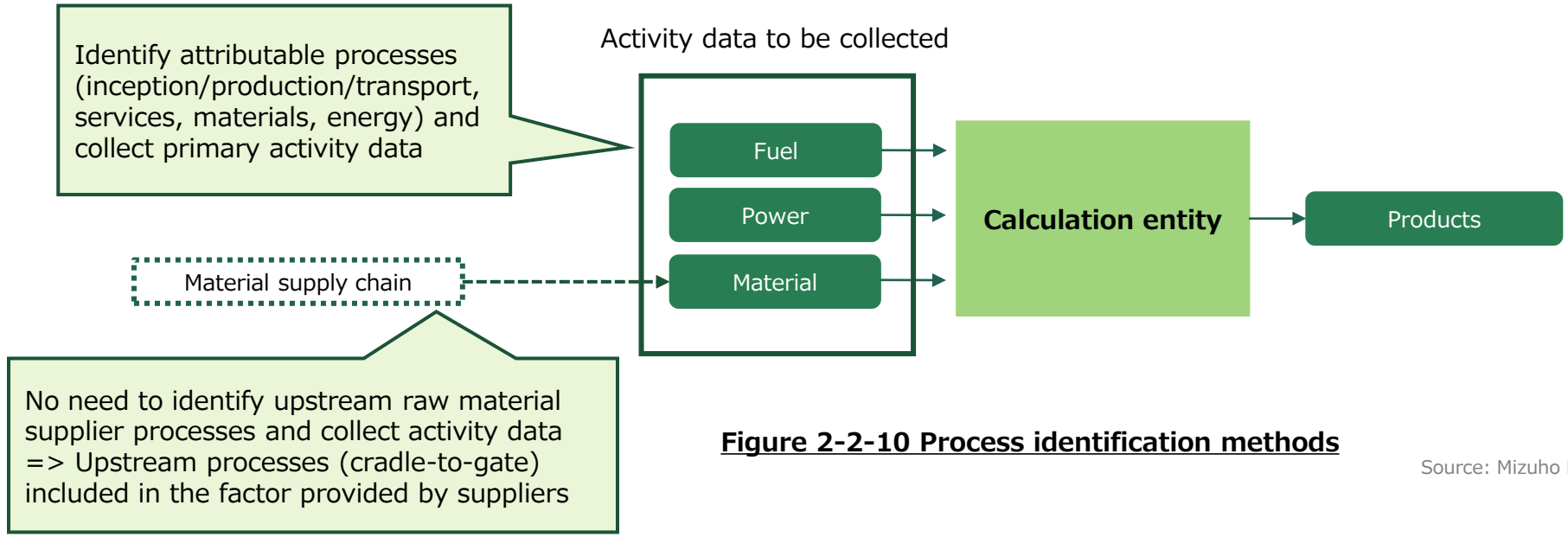


Figure 2-2-10 Process identification methods

Source: Mizuho Research & Technologies

PCF calculation steps ①Data identification
1b, 1c) Direct and upstream classification, emission factor collection

(3) PCF calculation steps ① Data identification

1b) Direct and upstream classification
1c) Emission factor collection

- The activity data collected are classified as direct or upstream activities.
- Collect the emission factor corresponding to the activity amount.
- For direct activities, use the primary data emission factor if available. If no primary data is available, use secondary data.
- For upstream activities, cradle-to-gate PCF data provided by suppliers are used where available. If primary data are not available, secondary or alternative data are used.
- The concept of primary data and secondary data in terms of emission factor will be described later.

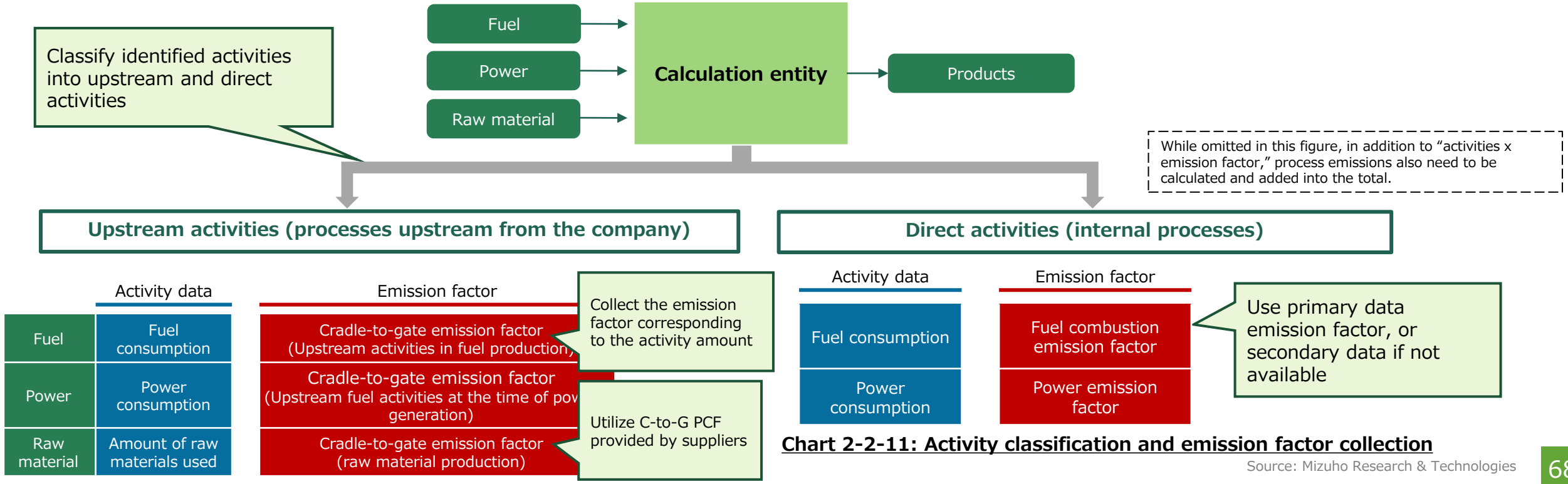


Chart 2-2-11: Activity classification and emission factor collection

Source: Mizuho Research & Technologies

PCF calculation steps ② Calculation

(3) PCF calculation steps ② Calculation

- Calculate GHG emissions from the process by multiplying the associated activities by the emission factor.
- Emissions are calculated for upstream activities and for direct activities.
- Upstream activities cover energy and raw materials.
- Since the scope of calculation is cradle-to-gate, emissions of energy such as fuel and power from activities upstream of fuel combustion are calculated (equivalent to Scope 3 Category 3).
- For raw materials, emissions are calculated by multiplying the amount of raw materials used in the process by the cradle-to-gate emission factor (equivalent to Scope 3 Category 1).
- Direct activities calculate emissions (equivalent to Scope 1 and Scope 2) by multiplying the consumption of fuel and purchased energy (power, etc.) by their respective emission factors.
- Process emissions, if any, are calculated by adding them to the emissions associated with each activity.

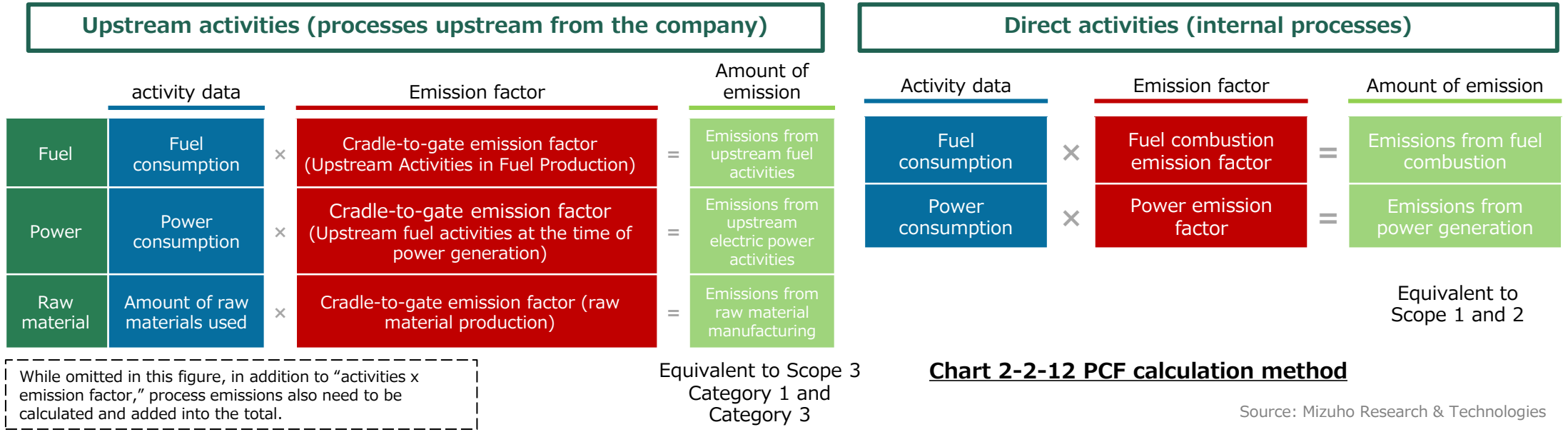


Chart 2-2-12 PCF calculation method

Source: Mizuho Research & Technologies

[Example] PCF calculation method

Example of PCF calculation

< Direct Activities >

Amount of activity collected as primary data

Emission factor is the primary or secondary data specific to the supplier.

Amount of activity					Emission factor		Source of emission factor		Amount of emission	
Fuel	A-grade heavy oil	1	L	×	2.71	kg-CO2e/L	Act on Promotion of Global Warming Countermeasures	=	2.71	kg-CO2e
	City gas	3	Nm3	×	1.18	kg-CO2e/Nm3	Act on Promotion of Global Warming Countermeasures	=	3.54	kg-CO2e
	Hydrogen (Company A)	0.1	Nm3	×	0	kg-CO2e/Nm3	Emission factor provided by Company A	=	0	kg-CO2e
Purchased energy	Electric power (Company B)	15	kWh	×	0.443	kg-CO2e/kWh	Emission coefficient by electric power company Company B adjusted emission factor (residue)	=	6.65	kg-CO2e
	Electric power (Company C)	10	kWh	×	0.000	kg-CO2e/kWh	Emission factor provided by Company C	=	0	kg-CO2e
							Total		**12.9**	**kg-CO2e**

< Upstream Activities >

Amount of activity					Emission factor		Source of emission factor		Amount of emission	
Raw material	Aluminum	5	kg	×	10	kg - CO2e/kg	Secondary Data DB	=	50	kg-CO2e
	Recycled resin (Company C)	3	kg	×	1.5	kg - CO2e/kg	PCF supplied by C	=	4.5	kg-CO2e
	Plain steel	2	kg	×	2	kg - CO2e/kg	Secondary Data DB	=	4	kg-CO2e
	Motor (Company D)	1	kg	×	3	kg - CO2e/kg	PCF supplied by D	=	3	kg-CO2e
							Total		**61.5**	**kg-CO2e**

Chart 2-2-13 PCF calculation example

*PCF calculations also include direct emissions from processes, transport emissions, and waste disposal emissions.

Source: Mizuho Research & Technologies

PCF calculation steps ③ Allocation

(3) PCF calculation steps ③ Allocation

[Explanation] Allocation

- The Pathfinder Framework should avoid allocation as much as possible by using process refinement, system extension, or redefinition of units of analysis.
- In practice, however, the process usually has multiple outputs, so allocation is often unavoidable. In these cases, emissions must be split between multiple inputs and outputs in an accurate and consistent manner. This is essential for PCF quality.
- Allocation rules are not specified in the Pathfinder Framework v1[*1] but follow the priorities of existing methodologies and standards in Figure 2-2-2.

[Explanation] Cutoff rules/exclusions

- There are no cutoff rules in the Pathfinder Framework v1[*2].

*1: Pathfinder Framework v2 lays out detailed allocation rules. See 3-3-1 (4).
*2: Pathfinder Framework v2 contains the following new cutoff rules.
- Individual attributable processes comprising less than 1% of total cradle-to-gate PCF can be excluded.
- The total of the excluded processes must be less than 5% of total total cradle-to-gate PCF.
- Excluded processes should be disclosed and the validity of the exclusion explained.

PCF calculation steps ④ Handling of transport process emissions

(3) PCF calculation steps

④ Handling of transport process emissions

Pathfinder Framework requirements

- 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

[Explanation] Emissions from transportation processes

- It is necessary to consider all upstream and direct transport emissions within the cradle-to-gate boundary, i.e., emissions associated with transport activities between different tiers of the supply chain, and the company's own transport.
- Self-transport may involve the transport of intermediate or finished products between different sections of the plant or of agricultural transport such as tractors.
- For transport fuels, it is necessary to calculate emissions in terms of well-to-wheel.
- Relevant data collected include fuel consumption, means of transport, volume transported, distance transported, and load specifications.

- Transportation emissions are generally calculated using the ton-kilometer method.

Fuel life cycle emissions well-to-wheel	Well-to-tank: Upstream fuel production and transportation Tank-to-wheel: Fuel combustion
Vehicle construction	Emissions related to construction of vehicle transportation equipment
Infrastructure construction and maintenance	Emissions related to maintenance of infrastructure for transportation services (e.g., road or port infrastructure)

Included in Pathfinder Framework v1 Boundary

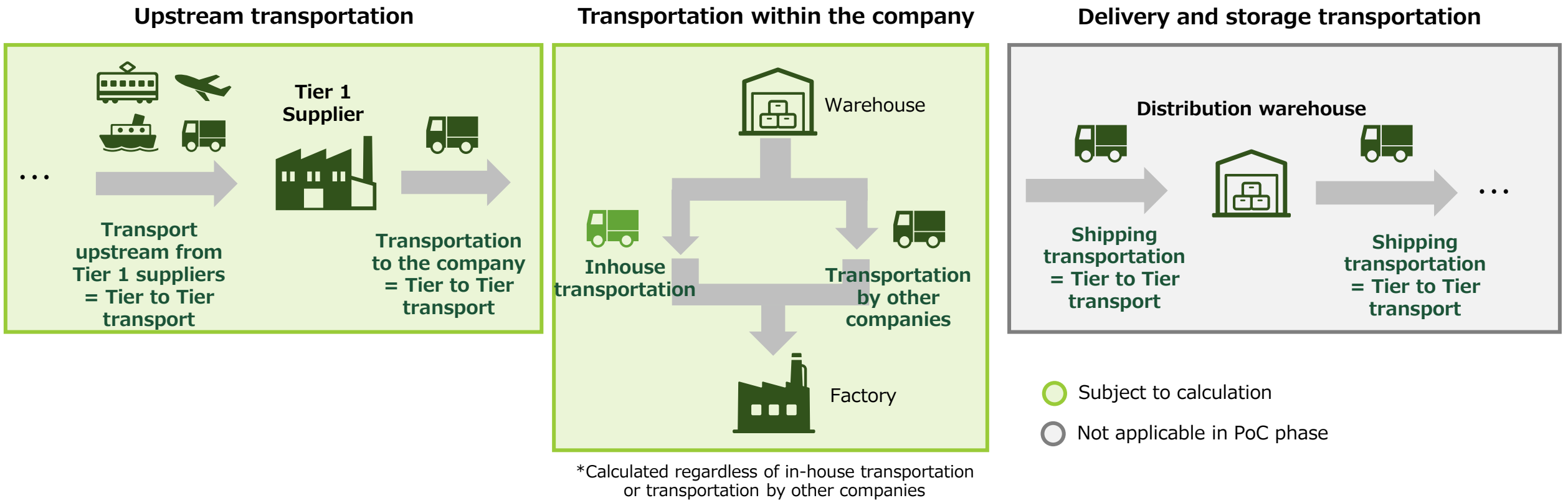
Not included in Pathfinder Framework v1 boundary

Chart 2-2-14 Calculation boundary for transport process emissions

Source: Created by Mizuho Research & Technologies based on Pathfinder Framework v1 (PACT powered by WBCSD)

[Illustration] Approach to handling of transport process emissions

- The Pathfinder Framework covers upstream and self-transportation emissions within the cradle-to-gate boundary.
- Transportation and storage are included in the scope of calculation, but in the PoC phase prior to Logistics SWG implementation, the relevant transportation will be excluded.



*Calculated regardless of in-house transportation or transportation by other companies

Source: Mizuho Research & Technologies

Figure 2-2-15 Concept of transportation targeted in transport process emissions

PCF calculation steps ④ Handling of transport process emissions

(3) PCF calculation steps

④ Handling of transport process emissions

[Explanation] Emissions from in-house transportation

- All emissions from in-house transport must be included in the PCF.
- Use fuel consumption as primary data.
- Also calculate the actual transport mode, distance and, if available, vehicle load.
- Transportation covers round trips. When relevant, it shall include all fuels associated with the carriage of full, partial, or empty loads. Emissions are allocated based on the weight of the product.
- Where transport services are provided by third parties, the tier-to-tier emissions calculation method is applied.

[Explanation] Tier-to-tier transport in the upstream supply chain

- Primary fuel data, if available, are used to calculate product-specific emissions. Primary data is provided by the carrier. Emission factor is provided by ton-kilometer or product.
- If the amount of fuel used in the primary data is not known, but the amount of transport emissions by product is shared by a third party such as a transport company, that data will be used.
- If these are not applicable, collect and calculate primary data on transport volumes and distances. Emissions per ton kilometer (CO2 e/tkm) by type of transportation is applied. If emission factor is not available, it is taken from the secondary database.

- **If transport distance data are not available, use estimates, etc.**
- For the calculation of transport emissions, the Pathfinder Framework requires the adoption of the GHG Protocol and Global Logistics Emissions Council (GLEC) Framework.*

* Based on this framework, Smart Freight Centre issued the guidance “End-to-End GHG Reporting of Logistics Operations” (Jan. 2023), created jointly with PACT.

- The GxD Consortium Logistics WG will consider a calculation method for transport emissions. The calculation of transport emissions under product calculation rules will be reviewed based on the arrangement of the working group concerned.

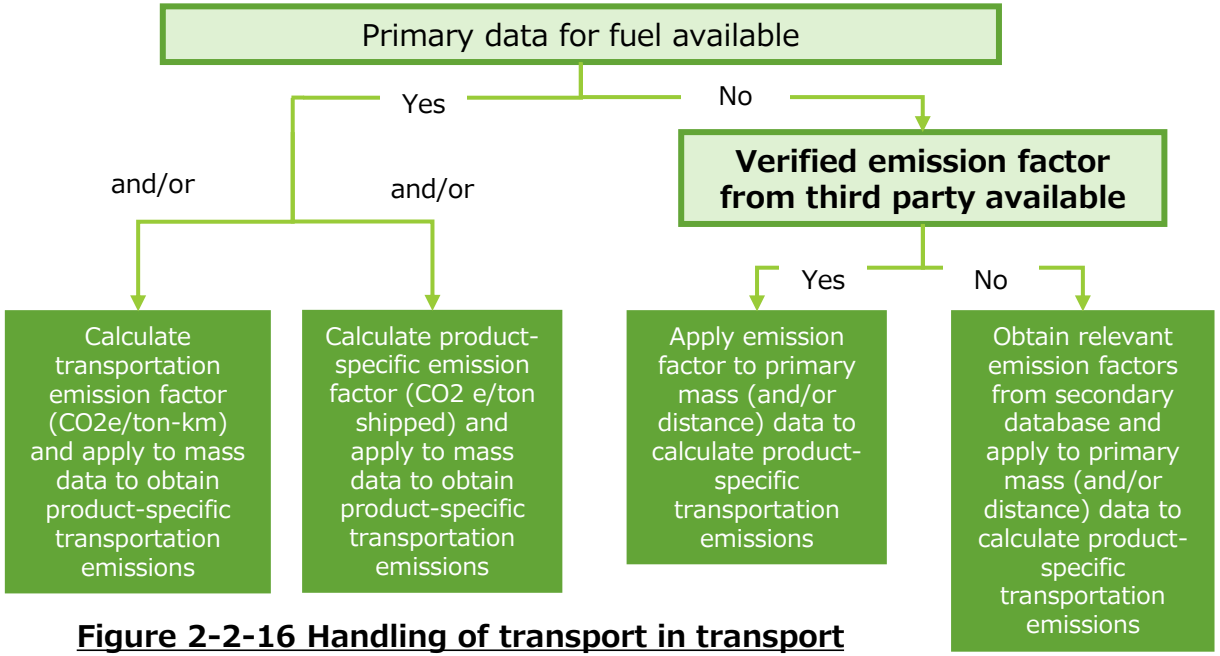


Figure 2-2-16 Handling of transport in transport process emissions

Source: Created by Mizuho Research & Technologies based on Pathfinder Framework v1 (PACT powered by WBCSD)

PCF calculation steps ⑤ Handling of waste disposal and discharge in manufacturing processes

(3) PCF calculation steps

⑤ Handling of waste disposal and discharge from manufacturing processes

Pathfinder Framework requirements

- 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

[Explanation] Handling of manufacturing process waste

- For each product that generates waste, it is necessary to decide whether the waste should be recycled or disposed of as waste.
- Responsibility for waste disposal rests with the company that generated the waste until it is returned to nature (e.g., incinerated) or reaches a final state (final disposal), e.g., used (recycled) in another product life cycle.
- If the recycling process continues after the final disposal of the waste, the company that uses the recycled material as the secondary material is responsible.

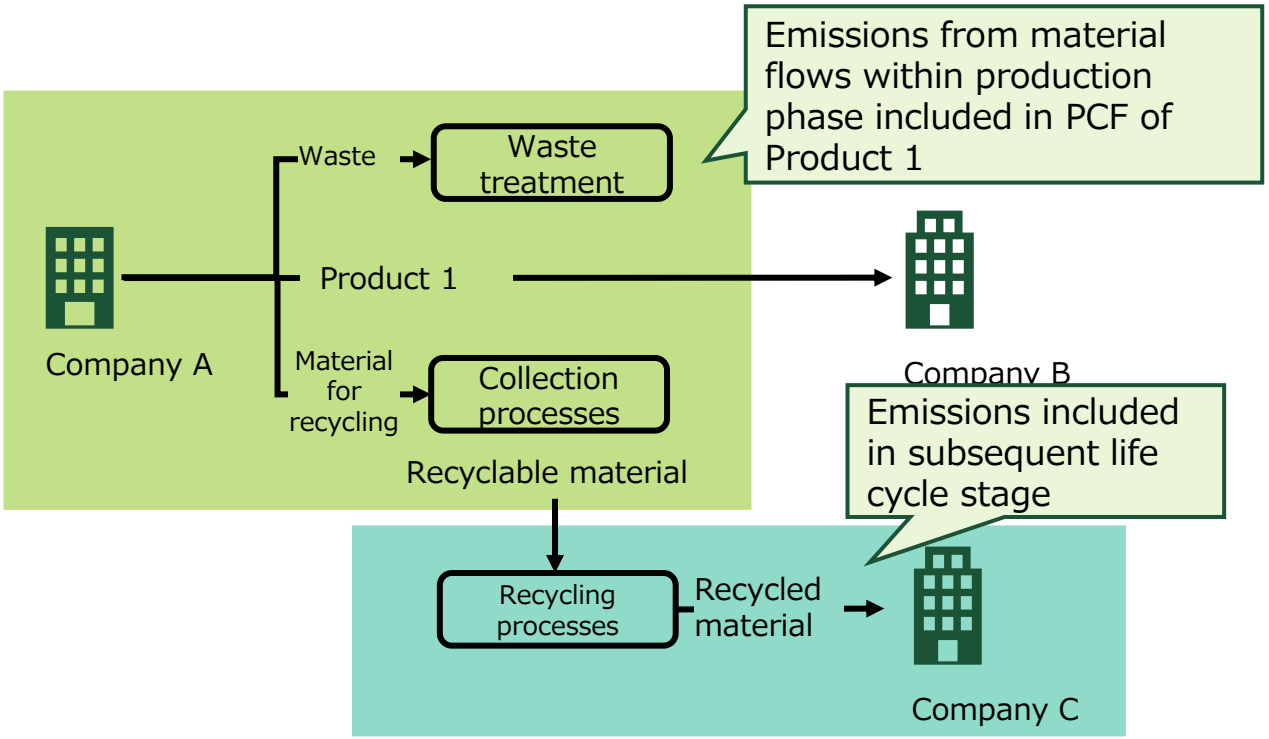


Chart 2-2-17: Waste disposal and recycling emissions

Source: Created by Mizuho Research & Technologies based on Pathfinder Framework v1 (PACT powered by WBCSD)

PCF calculation steps ⑤ Handling of waste disposal and discharge in manufacturing processes

(3) PCF calculation steps

⑤ Handling of waste disposal and discharge from manufacturing processes

[Explanation] Targets for emission calculation

- It is necessary to take into account all emissions arising from waste disposal.
- Collection for recycling
- Waste management
- Disassembly of parts
- Crushing and sorting
- Incineration and sorting of incinerated ash
- Landfill disposal and maintenance
- Wastewater treatment
- Composting
- Waste derived energy (e.g., refuse power generation)
- Waste transportation

- Emissions from the combustion process itself, which produces energy from waste, are not included. These must be accounted for by the company that purchases the energy (as part of the buyer's Scope 2 or PCF).

[Explanation] Calculation of waste disposal

A. If the company that created the waste processes this on its own

- Waste disposal calculated using primary data on waste type, composition and disposal method (incineration and landfill)
- Waste disposal emission factor calculated based on internal primary data may be used. However, the internal waste disposal emission factor shall be verified by an independent verification body.
- If the primary emission factor is not available, a secondary database may be used.

B. Cases where waste processing is entrusted to a third party

- Waste disposal facilities should calculate and verify the emission factor and contact the waste producer.
- Waste treatment facilities may share primary data with the waste producer in a specific manner. This includes collecting verified emissions data from waste treatment facilities and allocating emissions to products.
- If primary data from waste treatment facilities are not available, emissions shall be estimated using primary data on the type and composition of waste and emission factor according to the amount of waste and disposal method.

PCF calculation step ⑤ Handling of waste disposal and discharge in manufacturing processes

(3)PCF calculation steps

⑤ Handling of waste disposal and discharge from manufacturing processes

[Explanation] Allocation

- Discharge from waste treatment is allocated to main products or sub-products. Waste is regarded as a product with no economic value and is not distributed.

[Explanation] Handling of recycled materials

- In the Pathfinder Framework, it is necessary to divide the discharge in the recycling into (i) recycling preparation stage, (ii) recycling material utilization stage.
- Recycling should be allocated using the recycled content method in the GHG Protocol Product Standard (see figure below). The recycled content method is also referred to as the 100–0 method.
- In this method, waste emitters are subject to the boundary up to the stage of preparation for recycling (recovery), and the manufacturing load of recycled materials is subject to calculation by the users of recycled materials.
- The manufacturing load of recycled materials can be calculated by using the cradle-to-gate data of recycled materials in LCA-DB, etc.
- The proportion of material treated as waste shall be disclosed on the basis of the method of calculation and distribution used for waste emissions.
- Materials to be recycled at the time of disposal shall be disclosed separately and subject to the calculation and allocation method used for recycling.

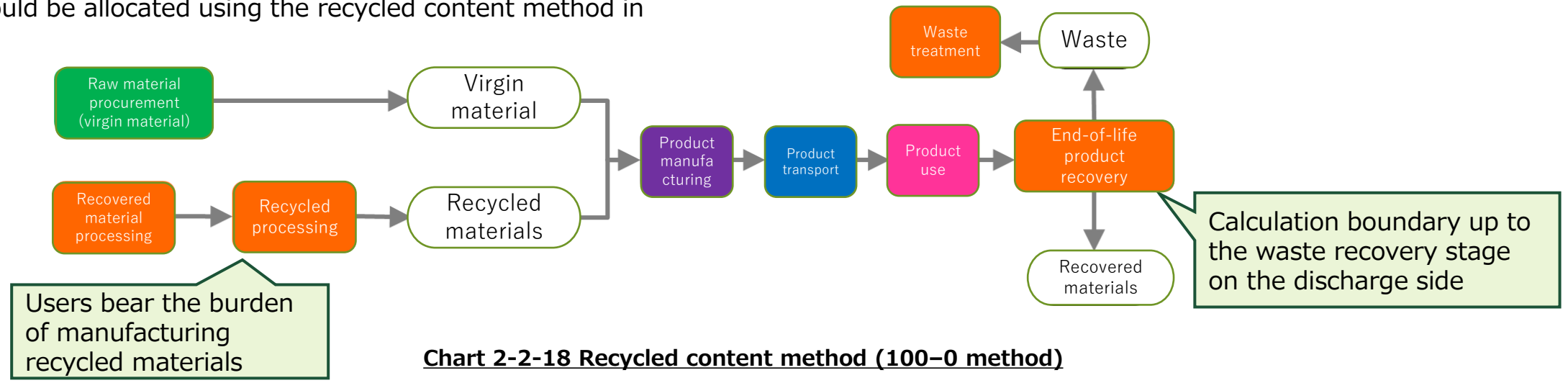


Chart 2-2-18 Recycled content method (100–0 method)

Source: Created by Mizuho Research & Technologies based on the GHG Protocol Product Standard

[Explanation] Explanation of closed-loop approximation method

- The GHG Protocol Product Standard also provides for closed-loop approximation of recycling, also called the 0-100 method.
- The Pathfinder Framework allows closed-loop approximation to be applied when virgin and recycled materials have the same properties.
- The use of closed-loop approximation must be communicated downstream in order to apply a consistent allocation method among suppliers in the supply chain.
- The closed-loop approximation approach is as follows.
  - Environmental impact is calculated based on the assumption that all raw materials input at the raw material procurement stage are virgin materials even if they actually contain recycled materials.
- Both the environmental impact of recycling and the indirect environmental impact reduction effect of recycling are accounted for 100% at the post-use processing stage (recycling material generation side.
- Instead of counting the total amount of waste generated from used products before they are recycled into recycled materials, the amount of input of new materials can be deducted by the amount of recycled materials obtained from the recycling process.
- Since the calculation method is based on a closed-loop recycling route, the raw materials input at the raw material procurement stage and the recycled materials obtained by the recycling process must have the same quality.

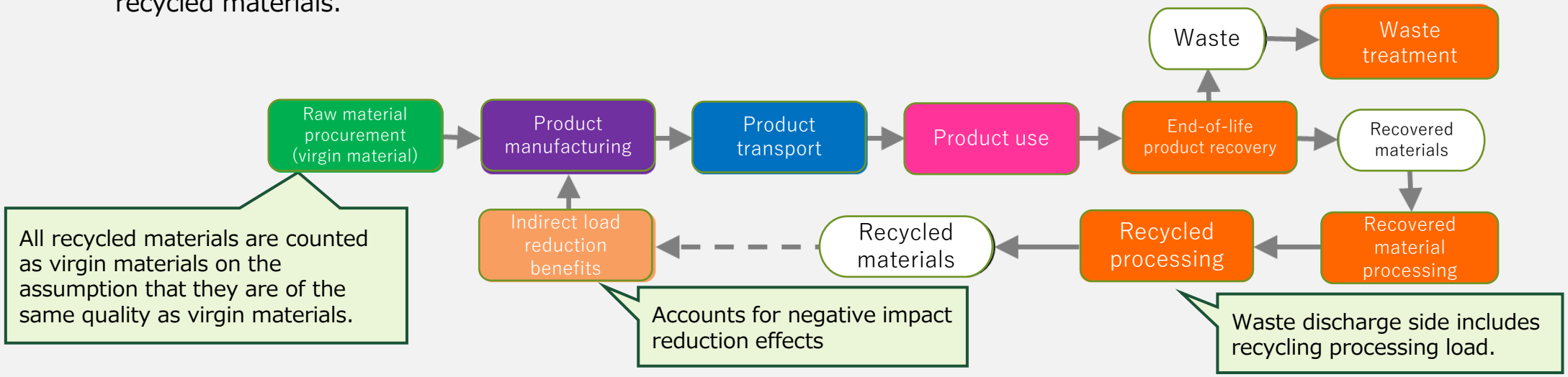


Figure 2-2-19 Closed-loop estimation method (0-100 method)

Source: Created by Mizuho Research & Technologies based on the GHG Protocol Product Standard

Data source and hierarchy

(4) Data source and hierarchy

Pathfinder Framework requirements

- 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

[Explanation] Selection of primary data

- In the Pathfinder Framework, the activity data used to calculate product-level GHG emissions must always be company-specific primary data.
- Prioritize data sources for activity data and emission factor.
- The best case is based on primary data for both activity data and emission factor. Cradle-to-gate PFC can be obtained through data exchange via the Pathfinder Network, etc. to treat raw material emission factor as primary data.
- The concepts of primary data and secondary data in energy emission factor will be explained in detail later.

Activity data are primary data

Primary data are prioritized for emission factor. Use of PCF supplied by suppliers is recommended for materials.

	Activity data source		Emission factor source	
	Energy	Material	Energy	Material
Best case	In-house/primary		For on-site production: In-house/primary For supplier-specific electricity: Primary/ guarantee of origin	From suppliers or via Pathfinder Network: Primary
Base case	In-house/primary		Secondary database	
Worst case	In-house/primary		Data proxies	

Figure 2-2-20 Data hierarchy

Source: Created by Mizuho Research & Technologies based on Pathfinder Framework v1 (PACT powered by WBCSD)

Data source and hierarchy

(4) Data source and hierarchy

[Explanation] Selection of secondary data

- The Pathfinder Framework uses secondary data only when primary data is not available and when the secondary data is available from an accepted global or national emission factor database.
- If secondary data are not available within the references listed in Figure 2-2-21, other sources or surrogates may be used. This is the worst case in Figure 2-2-20.
- Substitute data should be documented and communicated to auditors and recipients.
- The IDEA database, which is widely used in LCA calculations in Japan, is included in the UNEP Global LCA Data Access Network and is therefore a secondary database that can be used by the Pathfinder Framework.

[Preliminary Proposal for PoC Phase]

- **The list of emission factors in the SHK program based on the Act on Promotion of Global Warming Countermeasures can be used as an official national emission factor database under the Pathfinder Framework.**

Database	Sector	Link
Ecoinvent	All	https://ecoinvent.org/
Gabi (Thinkstep)	All	https://gabi.sphera.com/international/databases
Global Logistics Emissions Council (GLEC) database	Transport-ation	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/

Figure 2-2-21 Examples of secondary emission factor databases accepted under the Pathfinder Framework

Source: Created by Mizuho Research & Technologies based on Pathfinder Framework v1 (PACT powered by WBCSD)

Data source and hierarchy

Emissions and primary data concepts (Direct activities)

(4) Data source and hierarchy

[Explanation] Concept of Emissions and Primary Data (Direct Activities)

- Emissions as the product of activity data and emission factor can be treated as primary data only if both the activity data and the emission factor are primary data.

■ Emissions from fuel use

- Emissions from fuel use too are regarded as primary data when both the amount of fuel used (activity amount) and the emission factor at the time of consumption are both primary data.
- The SHK emission factor list and emission factors in IDEA and other databases treat emission factor during combustion as secondary data because it is the national average. Emission amounts calculated using this data will therefore be treated as secondary data even if the activity amount is primary data.
- It is the emission factor of purchased fuel during combustion that is regarded as primary data. However, it is currently extremely unusual in Japan for the fuel supplier to provide the emission factor during combustion of the fuel they supply.
- This document offers a preliminary proposal on a calculation method for fuel emission factor during combustion in Japan for the purposes of the PoC phase. The appropriateness of the proposal will be discussed with PACT.

■ Emissions from consumption of purchased power

- Emissions from the consumption of power purchased externally too will be considered as primary data when the amount of power consumed (activity amount) and the emission factor at the time of consumption are both primary data.
- The national average factor in the SHK program and the emission factor in IDEA and other databases are national averages and are consequently regarded as secondary data. Only the emission factor of purchased fuel during combustion is considered as primary data.
- In Japan, the SHK program provides coefficients by menu as the emission factor for purchased power but consultations are still underway as to whether this will be recognized as equating to primary data emission factor under the Pathfinder Framework.
- This document provides a preliminary proposal for a method of calculating emission factor during combustion for purchased fuel in Japan for the PoC phase (see 2-2-4).

[Preliminary Proposal for PoC Phase] Fuel emission factor during combustion

- During the PoC phase, the emission factor of purchased fuel during combustion will be calculated by identifying the amount of carbon in the fuel from the constituent information and assuming that all that carbon will become CO2 through combustion to calculate the CO2 amount per unit (kg and m3).
- In cases where the fuel supplier provides the emission factor of the fuel they supply, this will of course be considered primary data.

Data source and hierarchy

Emissions and primary data concepts (Direct activities)

[Preliminary Proposal for PoC Phase] Power emission factor during generation]

- It is currently uncertain whether the coefficients by menu in the SHK program will be recognized as equating to the primary data emission factor under the Pathfinder Framework
- This is because the the coefficients by menu in the SHK program have the following characteristics:
  - A) They allow the use of offset credits for factor adjustment.
  - B) Where energy certificates for non-fossil fuels, etc., are used for factor adjustment, the system applies the same method as for offset credit application.
- Offset credits cannot be applied under the GHG Protocol Standard on which the Pathfinder Framework is based (Issue A).*

  * The use of offset credits is explicitly excluded in Pathfinder Framework v2.
- Since the appearance of the GHG Protocol Scope 2 Guidance, it has become increasingly common to attribute certificates to purchased power by the amount of power (kWh). Following this approach, even where product-level CO2 data calculation is assumed, it is possible that the coefficients by menu in the SHK program may not be regarded as the emission factors using certificates for factor adjustment under the same rules in Europe and the United States (Issue B).
- Currently, however, it would be difficult for demand-side companies to change from the SHK approach (coefficients by menu) to the approach in Scope 2 Guidance.
- As a preliminary proposal for the PoC phase, this document positions the SHK coefficients by menu as the emission factor for purchased power.
- In addition, where retail utilities provide the emission factor for purchased power, this will be positioned as primary data emission factor.
- Some energy certificates may be directly purchased by the demand-side company which then adjusts the emission factor of the purchased power. (energy certificates purchased separately from actual power are called unbundled certificates.)
- Because demand-side companies can choose to apply unbundled certificates, like Scope 2 Guidance, the certificate attribute will be applied to the purchased power in kWh units.
- However, certificates must be procured in the same market where the power is consumed, and double counting of energy certificates is not permitted.
- The emission factor where unbundled certificates are applied will also be regarded as primary data (because it becomes the emission factor for purchased power).

	GHG Protocol Scope2 Guidance	SHK program Emission factor by utility
Offset credit	• Offsets not permitted	• Offsets permitted
Method of calculating emission factor when a power certificate is used	• Certificate attribute (emission factor attribute) applied to target power by power unit	• For emissions from power, the factor is adjusted by applying the equivalent reduction amount

Source: Created by Mizuho Research & Technologies

Figure 2-2-22 Differences in approaches to emission factor during power generation

【Illustration】Emissions and primary data from fuel and power use

- The main emissions from direct activities are fuel emissions during combustion and power emissions during power generation.
- These emissions are calculated as amount of fuel consumed (activity amount) x emission factor during fuel combustion and amount of power consumed (activity amount) x emission factor during power generation.
- With both, if both the activity amount and the emission factors are not primary data, the emission amount is not regarded as primary data.

		Data on activity amount		Emission factor		Emission amount
Fuel		Amount of fuel consumed	×	Emission factor during fuel combustion	=	Emissions from combustion
	Case 1	Primary data	×	Primary data (Value of fuel from supplier)	=	Primary data
	Case 2★	Primary data	×	**Primary data (emission factor calculated from carbon in fuel)**	=	**Primary data**
	Case 3	Primary data	×	**Secondary data(SHK program, IDEA and other databases)**	=	**Secondary data**
Power		Amount of power consumed	×	Emission factor during power generation	=	Emissions from power
	Case 1	Primary data	×	Primary data (provided by supplier, etc.)	=	Primary data
	Case 2★	Primary data	×	**Primary data (factor by menu for utility-specific emission factors under the SHK program)**	=	**Primary data**
	Case 3	Primary data	×	**Unbundled certificates**	=	**Primary data**
	Case 4	Primary data	×	**Secondary data (SHK national average factor, IDEA)**	=	**Secondary data**

★ The preliminary proposal for the PoC phase is that the emission factor in the starred cases be made primary data emission factor. This will need to be discussed with PACT.)

Source: Created by Mizuho Research & Technologies

Figure 2-2-23 Approach to primary data in fuel and power emissions

Data source and hierarchy
Emissions and primary data concepts (Upstream activities)

(4) Data sources and hierarchies

[Explanation] Emissions and primary data (raw materials) concepts

- Emissions of raw materials are calculated using cradle-to-gate emission factor.
- In the case of a cradle-to-gate PCF whose emission factor is provided by a supplier, the Primary Data Share of emissions is determined by the primary data share (PDS) used in the calculation of the PCF.
- In order to identify the PDS in the PCF calculations of downstream enterprises, suppliers need to provide their PDS. The method of calculating the PDS will be described later.
- When LCA databases such as IDEA are used for the cradle-to-gate emission factor, emissions are secondary data.
- The approach to primary data in upstream fuel and electric power is the same as that for raw materials.

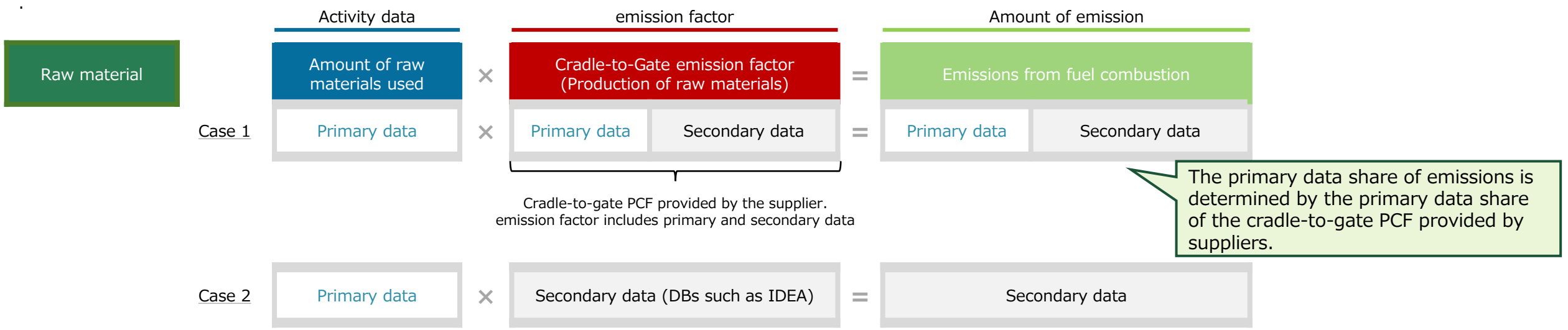


Figure 2-2-23 Primary data for emissions from raw materials

Source: Mizuho Research & Technologies

Data sources and hierarchy　Treatment of carbon credits

(4) Data sources and hierarchy

[Explanation] Treatment of carbon credits

- The Pathfinder Framework v1 does not specifically address the treatment of carbon credits. If the Pathfinder Framework has a version 2 or later specification, that should be followed.
- Therefore, the use rule is not specified independently as a product calculation rule.

- Pathfinder Framework v2 (issued Jan. 2023) clearly states that "This standard
- is also not designed to be used for quantifying GHG reductions from offsets," excluding offsets from GHG reductions.

- However, if the data provider applies carbon credits, the amount of carbon credits used may be provided as reference information in addition to the amount of product emissions when not applied. (This will make it easier to reflect carbon credits when the Pathfinder Framework is revised in the future.)

Treatment of carbon credits in the Pathfinder Framework and existing methodologies and standards

	Rules cutting across product categories			Rules specific to product categories		
	PACT Pathfinder framework	GHG Protocol Product Standard	ISO 14067: 2018	PEFCR IT equipment	Sumpo PCR	EPD international PCR
Treatment of carbon credits	• Not mentioned	• Offsets not covered by the product lifecycle inventory	• Carbon offsets not included.	• Not mentioned	• Offsets by carbon offsets, etc. not included	• Not mentioned

Chart 2-2-25 List of carbon credits

Source: Created by Mizuho Research & Technologies based on various sources

Data sources and hierarchy Treatment of bio-derived carbon

(4) Data sources and hierarchy

Bio-derived carbon

- The Pathfinder Framework should include bio-derived carbon emissions as information provided by the PCF. CO2 emissions from biofuel combustion are treated as bio-derived carbon emissions, not fuel-derived carbon emissions.
- Pathfinder Framework v1 notes the necessity of additional rules on the inclusion and distribution of bio-derived carbon when biomass is used as a raw material, with a study to be conducted in v2.*
- Because there are issues about the allocation method for bio-derived carbon, if these are resolved in v2 or later, the Pathfinder Framework will be followed.

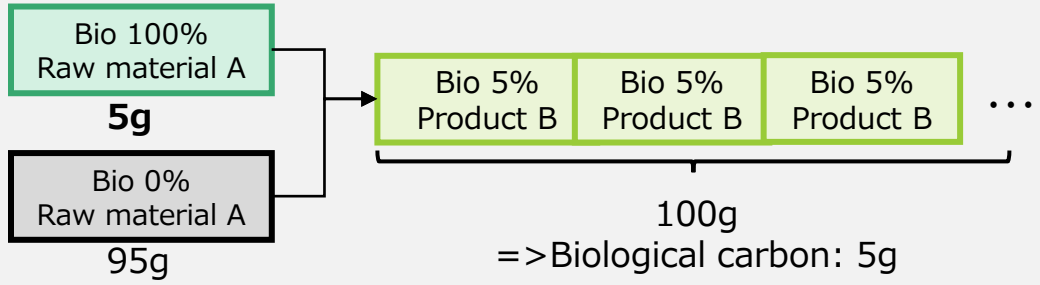
[Preliminary Proposal for PoC Phase]

- For the time being, bio-derived carbon is calculated by weight distribution among products. Even when by-products and waste are generated, bio-derived carbon is distributed by weight and not excessively distributed in the main product.
- Where the amount of bio-derived carbon is claimed using the mass balance approach shown in the figure here, the concept of allocation needs to be examined.

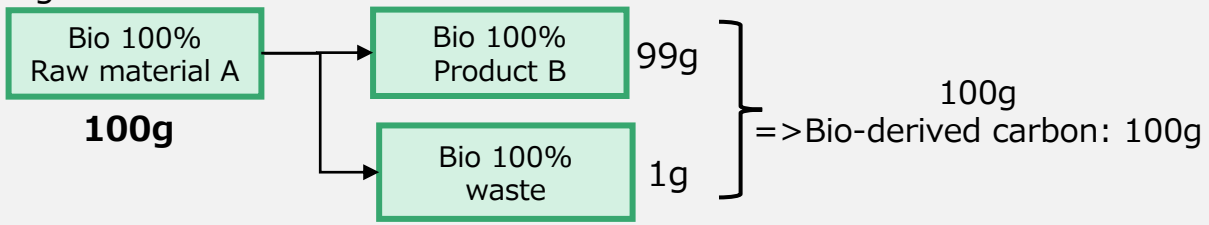
* Pathfinder Framework v2 (issued Jan. 2023) stipulates items to be provided for PCF data exchange in relation to the calculation of bio-derived emissions and exclusions. However, reporting will not become mandatory until 2025 so ensure that companies have time to understand the content of these calculations.

Allocation of bio-derived carbon

- When biomass materials are used, bio-derived carbon is distributed by weight.



- Bioderived carbon is also allocated when by-products and waste are generated.



- Mass balance approach to allocate bio-derived carbon in specific products.

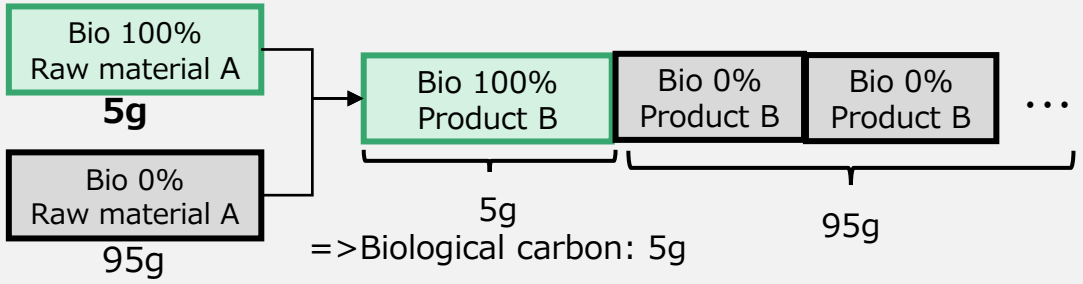


Figure 2-2-26 Allocation of bio-derived carbon

Source: Mizuho Research & Technologies

Required elements for PCF data exchange

(5) Required elements for PCF data exchange

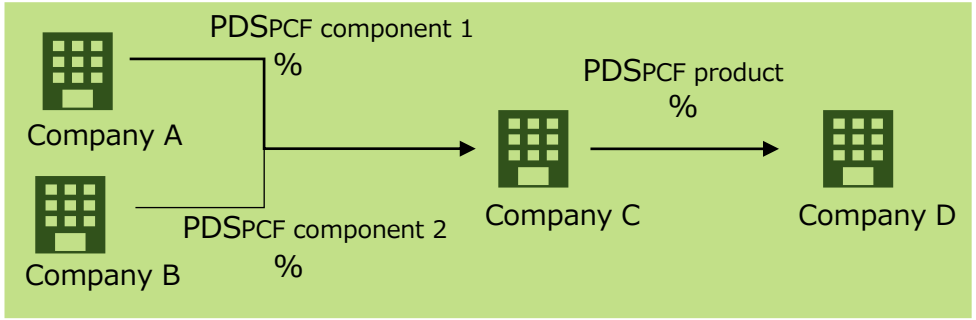
Pathfinder Framework requirements

- 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

- [Explanation] Primary Data Share
- The primary data share (PDS) must be used in emissions calculations and data exchange disclosure to increase the visibility of carbon footprint data receivers and encourage companies to use product-specific primary data.
- The PDS in each data set calculates the percentage of GHG emissions (CO2e) derived using the primary data.

$$\frac{\text{Part of PCF based on primary data (CO2e)}}{\text{PCF (CO2e)}} = PDS_{PCF}(\%)$$

- The PDS shared downstream is the sum of the individual PDS of the supplier for all inputs received multiplied by the respective emission ratio (%) of the product output to the PCF.
- Including an explanation of primary data sharing is encouraged in order to help companies mutually increase the amount of primary data flowing through the system and ensure a more accurate PCF.



PDS$_{PCF\ Product}$ = (PDS$_{PCF\ component\ 1}$ x Relative emission contribution to PCF(%))
+ (PDS$_{PCF\ component\ 2}$ x Relative emission contribution to PCF(%))

Weighted PDS components(%)

Source: Created by Mizuho Research & Technologies based on Pathfinder Framework v1

	Amount of emission	Emission ratio	PDS	Nature of data
Raw material a	4kg-CO2e	40%	0%	Secondary data
Part b	3kg-CO2e	30%	40%	Supplier supplied PCF
Fuel c	2kg-CO2e	20%	0%	Secondary data
Power d	1 kg-CO2e	10%	100%	Primary data

PDS 22%
40% x 0% + 30% x 40% + 20% x 0% + 10% x 100%

Source: Mizuho Research & Technologies

Figure 2-2-27 PDS calculation methods and examples

2. CO2 data calculation method

2-3. Organization-level calculation

Positioning of organization-level calculation

2-3. Organization-level calculation methods

2-3-1. Positioning of organization-level calculation

- The Green x Digital Consortium aims to eventually link data at the product level, but considering the current situation in which it is difficult for all companies to support product-level calculations, the Consortium will allow organization-level calculations in the transitional period.
- The GHG Protocol Scope 3 Standard allows suppliers to provide suppliers with CO2 data, including primary data, by calculating and reporting the portion of their Scope 1, 2, and 3 emissions attributable to activities targeted at a particular supplier (Chapter 8).
- The Green x Digital Consortium follows this approach and positions it as the basic concept of organization-level calculation. In other words, organization-level calculation comprises allocating supplier's Scope 1, 2, and 3 data to its customers in proportion to each transaction scale (e.g., allocation in proportion to delivery amount).
- Companies that have not been able to calculate their Scope 1, 2, and 3 emissions must first calculate these using the Ministry of the Environment's materials on supply chain emissions calculation before engaging in organization-level calculation. (The next page presents the flow of the calculation of Scope 1, 2, and 3 emissions and examples of data used for Scope 3 calculation.)

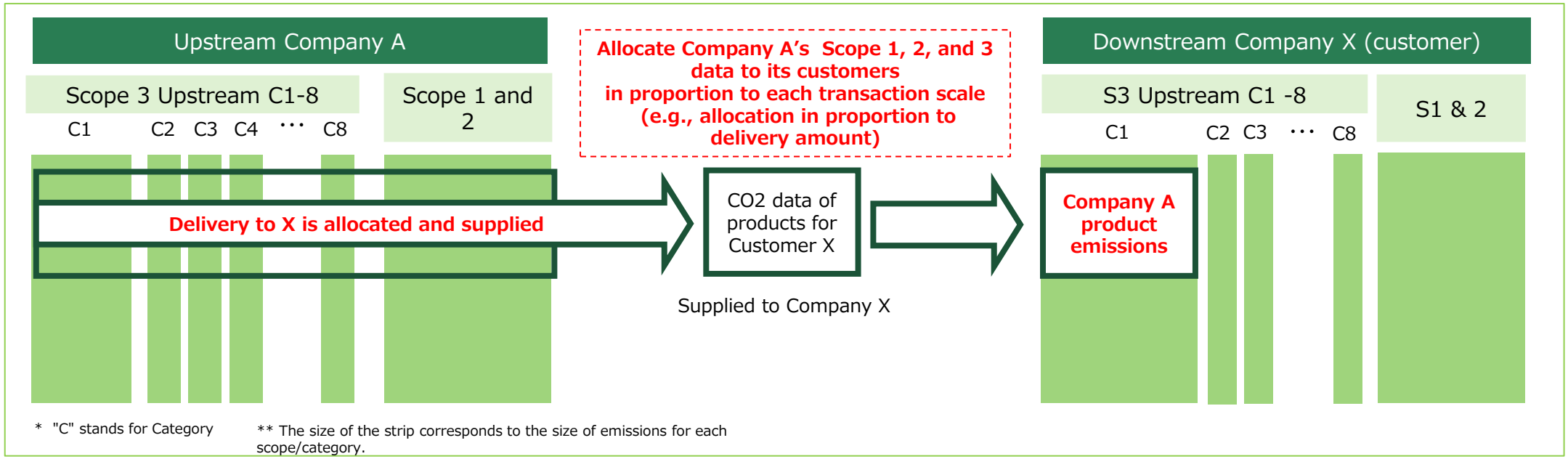


Figure 2-3-1 Organization-level calculation

Source: Mizuho Research & Technologies

[Reference] Outline of calculation method for Scope 1, 2, and 3 emissions

- Companies that have not been able to calculate Scope 1, 2, and 3 emissions need to calculate these using the Ministry of the Environment's materials on supply chain emissions calculation prior to conducting organization-level calculations.
- This section presents an excerpt from the calculation method, showing the flow of calculation of Scope 1, 2, and 3 emissions (supply chain emissions) and examples of data used for Scope 3 calculation.

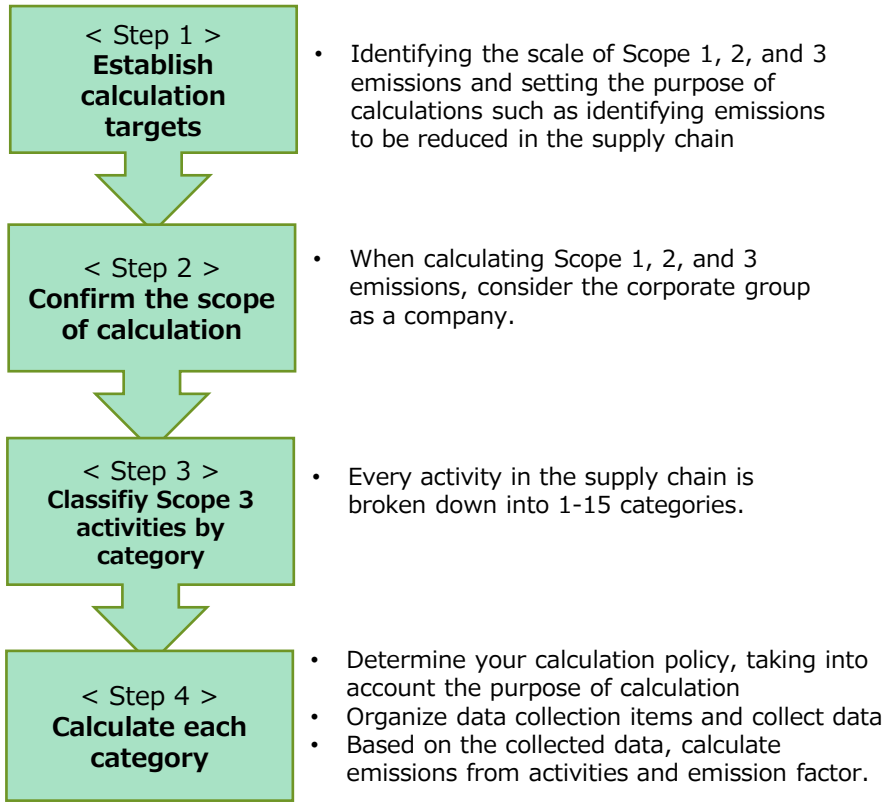


Chart 2-3-2 Flow of Scope 3 emission calculations

Scope 3 Category		Applicable activities (examples)	emission factor (examples)
1	Purchased products and services	• Procurement of raw materials, outsourcing of packaging, procurement of consumables	• Emissions per unit of volume
2	Capital goods	• Expansion of production facilities	• emission factor per capital goods price by capital formation sector
3	Fuel and energy activities not included in Scopes 1 and 2	• Upstream processes of procured fuel (mining and refining, etc.) • Upstream processes of procured electricity (mining and refining of fuel used for power generation)	• Emissions per unit of procurement by fuel and energy type
4	Transportation and delivery (upstream)	• Procurement distribution, horizontal flow, shipping distribution (shippers' own)	• Emissions per unit of transport
5	Waste generated by the business	• Transport and disposal of waste (excluding valuable waste) outside the company	• Unit emissions during treatment by type of waste
6	Business trips	• Employee travel	• Emissions per unit of travel expenses
7	Employer's commute	• Employee commuting	• Unit emissions per commuting allowance
8	Leased assets (upstream)	• Operation of leased assets held by the company	• emission factor by energy type
9	Transportation and distribution (downstream)	• Shipping (after the shipper's shipment), warehousing, retail sales	• Emissions per unit of transport
10	Processing of sold products	• Processing of intermediate products by business operators	• emission factor by energy type
11	Use of sold products	• Use of the product by the user	• Energy used during operation per unit of emission
12	Disposal of sold products	• Transportation and disposal of products at the time of disposal by users	• Unit emissions during treatment by type of waste
13	Leased assets (downstream)	• Operation of leased assets owned by the company as a lessor and leased to others	• emission factor by energy type
14	Franchise	• Activities that fall under Scope 1 and 2 of franchisees organized by the company	• emission factor by energy type
15	Investment	• Investment in stocks, bonds, project finance, etc.	• Unit emissions per share of investee (annual Scope 1 and 2 emissions/total number of shares issued by investee)

Chart 2-3-3 Scope 3: Activities and emission factor by category

Source: Ministry of the Environment and Mizuho Research & Technologies

Methodology of organization-level calculation

2-3-2. Methodology of calculation

- Today, it is possible to collect data using sensors and to manage data in a precise manner using digital technology.
- In other words, even with organization-level calculation, it has become possible not only to make rough calculations for the allocation of the whole corporate group's total Scope 1, 2, and 3 emissions, but also to calculate the amount of emissions from specific group companies and sites that manufacture specific products.
- In light of this situation, the Green x Digital Consortium proposes a more detailed calculation method based on the Scope 3 Standard allocation method.
- During the transitional period, the results of product-level and organization-level calculations are expected to be mixed in the supply chain. Since the results of the organization-level calculation are regarded as substitutes for the results of the product-level calculation, it is necessary to adopt the Pathfinder Framework and the provisions for product-level calculation as part of the organization-level calculation to bring the two approaches to calculation as close as possible.
- Based on the above, this section presents the Green x Digital Consortium's methodology for organization-level calculation in relation to the following items.

(1) Scope 1, 2, and 3 data review

Notes points to keep in mind when using Scope 1, 2 and 3 emissions data to conduct organization-level calculations.

(2) Boundary

Presents the Consortium's approach to boundary-setting in organization-level calculation based on the Pathfinder Framework's cradle-to-gate formula and attributional approach.

(3) Allocation

Proposes a method for making more detailed calculations by collecting detailed activity data (process segmentation) based on Section 8: Allocation in the Scope 3 Standard, which provides guidance for organization-level calculations.

(4) Handling of credit and energy certificates

Presents the results of discussions on the feasibility of applying purchased electricity certificates and carbon credits to the calculation results of the organization-level calculation.

(5) Calculation and sharing of primary data share

Presents a methodology for organization-level calculation of the primary data share, a mechanism that promotes the use of primary data.

Scope 1, 2, and 3 data review

(1) Review Scope 1, 2, and 3 data

- Organization-level calculation calculates emissions by customer and product by allocating calculated Scope 1, 2, and 3 emissions.
- However, the Scope 1, 2, and 3 emissions used as the basis for calculating emissions at the organizational level are not calculated for the purpose of understanding emissions by customer and product. Therefore, it is desirable to review the purpose and boundary of the calculation (i.e., what emissions are excluded) in advance when using the data for provision to customers.
- The main points to note are as follows:

■ Confirm excluded emissions

- Some emissions may be excluded from Scope 1, 2, and 3 calculations.
- Whether or not the excluded emissions include emissions that are important to products and services for the customer providing the CO2 data determines whether organization-level calculation- can calculate appropriate CO2 data for that customer (see Figure 1-4-6).
- It is recommended that emissions excluded from Scope 1, 2, and 3 calculations be identified prior to any allocation calculations.

■Confirm Scope 2 calculation method

- Scope 2 emissions are calculated using two approaches—location-based and market-based—based on the GHG Protocol Scope 2 Guidance.
- The guidance states that when providing a portion of Scope 2 emissions to downstream entities, emissions data calculated using either approach may be provided, but the approach used should be communicated (Appendix B).
- It is advisable to consider whether to allocate Scope 2 emissions on a location-based or market-based basis before implementing organization-level calculation.

■Review Pathfinder Framework requirements

- As indicated in 1-4-7, this document also recommends that when existing methodologies and standards are used for organization-level calculations, the concepts of the Pathfinder Framework should be applied for any areas inconsistent with the Framework.
- The categories to which the Pathfinder Framework applies include: cradle-to-gate boundary setting; the method of allocating emissions for recycling; the treatment of waste from the manufacturing process; assessment of the upstream production of transport fuels; and the available secondary data databases.
- It should be noted that the assessment of upstream production of fuel for transportation and available secondary data databases are not consistent with the concept of Pathfinder Framework in the calculation of Scope 1, 2, and 3 emissions.

Scope 1, 2, and 3 data review

(1) Review Scope 1, 2, and 3 data

■ Review Pathfinder Framework requirements (continued)

- The manufacturing upstream of transport fuel that the Pathfinder Framework requires to be included within the boundary is not included in the Scope 3 Category 4 minimum boundary. Therefore, calculation results in Category 4 may be inconsistent with the concept of the Pathfinder Framework.
- In calculating emissions, it is possible that the factor is obtained from a secondary data database, which is not allowed in the Pathfinder Framework v1.
- Companies should examine how they handle their Scope 1, 2, and 3 emissions in regard to these items and also deepen their understanding of the Pathfinder Framework approach with a view to the additional application thereof.

Boundary ① Cradle-to-gate in Scope 1, 2, and 3

(2) Boundary

① Cradle-to-gate in Scope 1, 2, and 3

- As in the Pathfinder Framework, this document as a rule uses the cradle-to-gate method ito calculate CO2 data for suppliers.
- The cradle-to-gate method is also used for organization-level calculation.
- The relationship between the Scope 1, 2, and 3 frameworks used in organization-level calculation and the cradle-to-gate framework is as follows:

> - **Scope 1 and 2 are gate-to-gate**
> - **Scope 3 Upstream (Categories 1-8) corresponds to emissions from upstream activities**

- Therefore, in organization-level calculation, emission data from the upstream portion (Categories 1-8) of Scope 1, 2, and 3 is allocated to each customer by using the allocation procedure described later.
- However, when all the upstream categories (1-8) of Scope 3 are included within the boundary in organization-level calculation, that boundary is different from the boundary in product-level calculation. Which Scope 3 category is included in the boundary will be described later in ② Boundary determination for each Scope 3 category.

Scope 1: Direct emissions of greenhouse gases by business (Fuel combustion and industrial processes)
Scope 2: Indirect emissions from the use of electricity, heat and steam supplied by other companies
Scope 3: Indirect emissions other than Scope 1 and Scope 2 (emissions by other companies related to business activities)

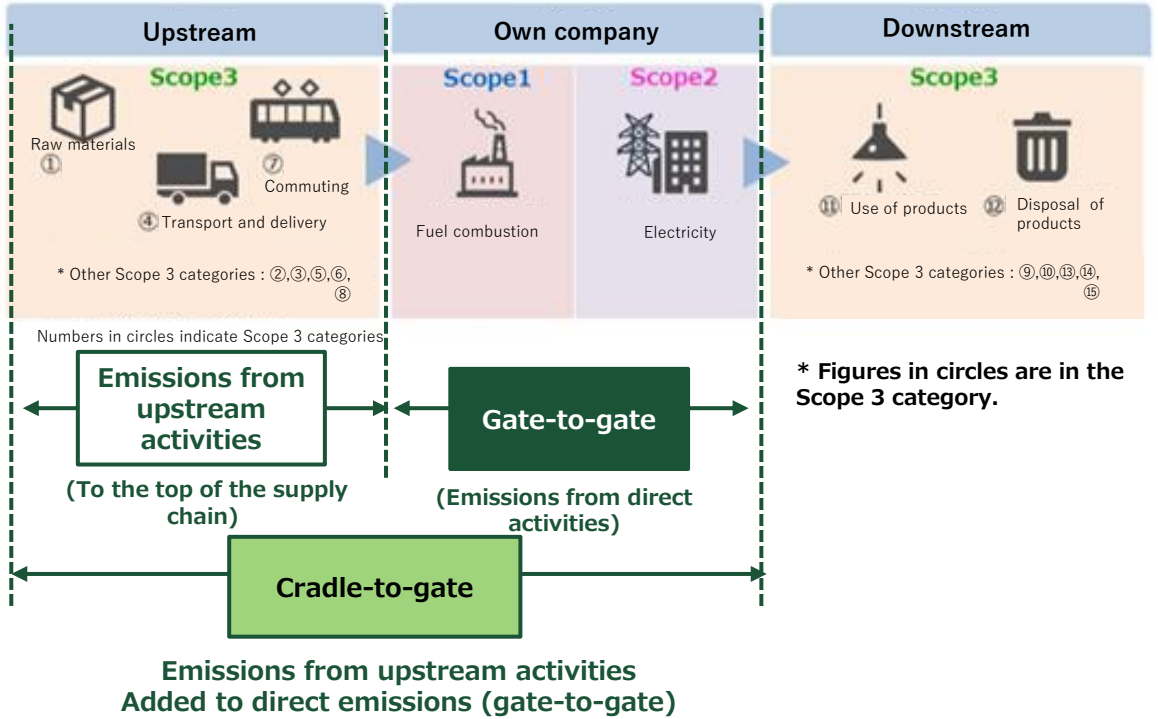


Figure 2-3-4 Correspondence between Scope 1, 2, and 3 and cradle-to-gate

Source: Created by Mizuho Research & Technologies based on Ministry of the Environment

Boundary (2) Boundary determination for each Scope 3 category

(2) Boundary

② Boundary determination for each Scope 3 category

- The Pathfinder Framework uses an attributional approach, requiring all attributable processes (product inception, manufacturing, and transport, services, materials, and energy flow throughout the product's life cycle) to be included in the boundary to calculate emissions. On the other hand, processes that are not related to products, such as indirect sectors, are defined as non-attributable processes and do not need to be included in the boundary. The boundary for product-level calculation follows this concept. (Reference: 2-2-3 (2))

- Therefore, in organization-level calculation, as in the case of the product-level calculation, it is not necessary to include Scope 3 categories such as indirect sectors that fall under non-attributable processes and have low relevance to the relevant product in the boundary.

- When this concept is applied to Scope 1, 2, and 3 emissions, Categories 1, 4, and 5 (Category 4 excludes shipments of own goods) of Scope 1, 2, and 3 correspond to attributable processes. This range should basically be included in the boundary in organization-level calculation.

- For the remaining Scope 3 categories, it is necessary to individually determine whether they correspond to an attributable process based on the contents of the products and services for CO2 calculation.

- However, this does not apply to cases where the indirect sector to be included in the boundary is specified by PCR, etc.

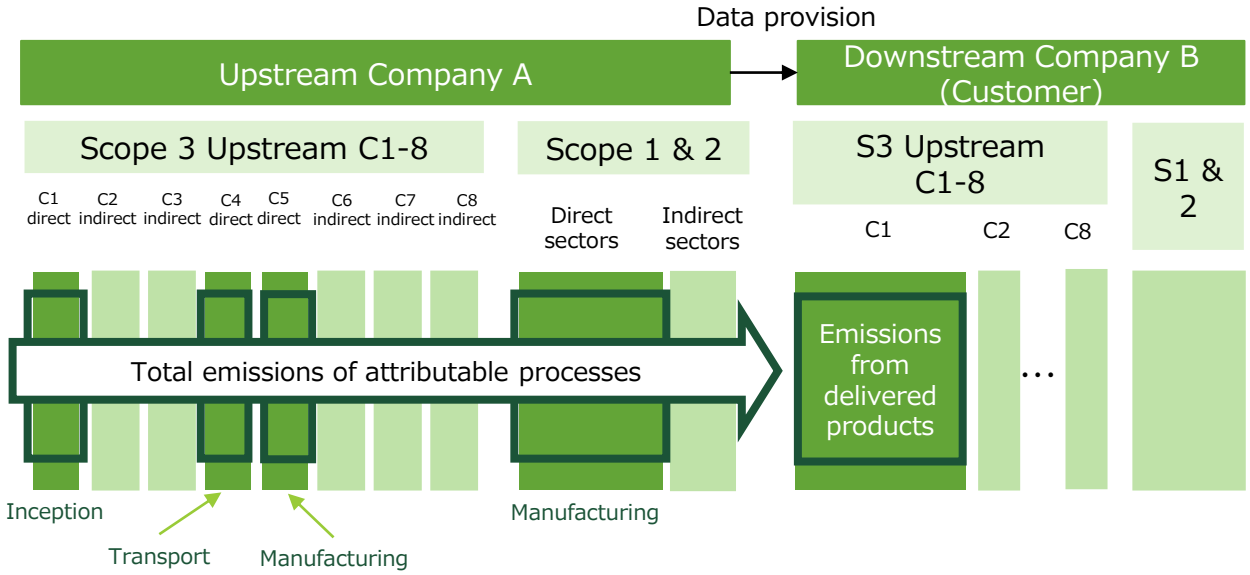


Figure 2-3-5: Relationship between attributable processes and Scope 1, 2, and 3 emissions

Allocation

(3) Allocation

- Currently, Chapter 8: Allocation, of the GHG Protocol Scope 3 Standard is the only document that can be called guidance for an organization-level calculation methodology (see 1-4-3 (2) in this document). Therefore, the allocation calculation methodology here is based on Chapter 8 of the Scope 3 Standard.
- Section 8 of the Scope 3 Standard divides the allocation process into two stages: avoiding and minimizing allocation and implementing allocation.

- **First, to avoid and minimize distribution, companies will collect more detailed activity data (process subdivision) and try to avoid or minimize allocation if possible.**
- **If allocation is still unavoidable, it will be implemented.**

- As process segmentation has become easier with the progress of digitization, the allocation methodology in organization-level calculation shows how (1) avoiding and minimizing allocation and (2) implementing allocation should be carried out when process segmentation is carried out.
- However, as described in 2-1-2 of this document, considering the Green x Digital Consortium's positioning of organization-level calculation, the methodology presented here is positioned at the level of recommendation for improving data quality.

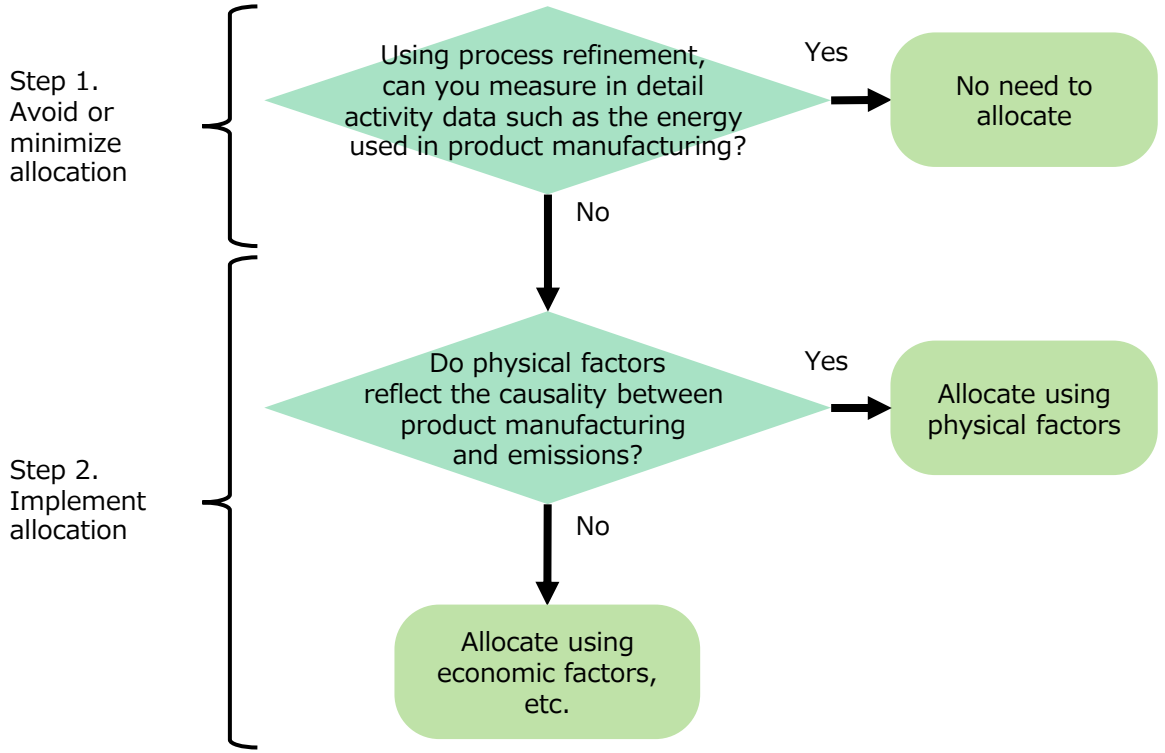


Figure 2 -3 -6: Allocation decision tree in the Scope 3 Standard

Source: Created by Mizuho Research & Technologies based on GHG Protocol Scope 3 Standard

Avoiding and minimizing allocation (Process subdivision)

(3) Allocation

① Avoiding and minimizing allocation (Process subdivision)

Allocation is a calculation method whereby emissions from a single facility or systems are partitioned among the various outputs thereof.

- Therefore, if the amount of emissions from one output among multiple output is to be obtained through an allocation calculation, the emissions data for other output will be mixed in.
- Therefore, the Scope 3 standard, like the product-level calculation standard, recommends that allocation be avoided whenever possible:

Allocation is necessary when:

- **a single facility or other system produces multiple outputs; and emissions are only quantified for the entire facility or system as a whole.**
- **Companies should avoid or minimize allocation by collecting more detailed data through, for example, separately sub-metering energy use and other activity data**

(Scope 3 Standard Chapter 8)

- Process subdivision is the act of dividing a common process that produces multiple products into sub-processes that correspond to individual products.
- For example, in the case of an organization having multiple manufacturing sites, the common process can correspond to the production activity of the entire organization (the sum of the production of multiple sites), and the sub-process can correspond to the production activity of each site.
  - It is also possible to define the production activities of the entire site as a common process and the production activities of each production line within the site as sub-processes.
- At this time, when the emissions of the common process (production totals of multiple sites) are distributed among all the products of multiple sites, and when the emissions of the sub-processes (the production of each site) are distributed among the products of each site, the accuracy of the calculation results will differ greatly (illustrated in Figure 2-3-7 on the next page).
- This document also follows Scope 3 Standard Chapter 8 in recommending the following in organization-level calculation.

- **If it is desired to improve the accuracy of calculation results, process subdivision should be performed prior to the allocation calculation and organizations (companies, facilities, production lines, etc.) that are not related to the products for a certain business partner should be excluded from the emissions covered under the allocation calculation.**

How process subdivision affects allocation

- Assumes a situation in which the emissions of Product A1 are calculated using organization-level calculation. "Product A1" is assumed to be manufactured only at the company's site (Site 1).
- (Left) No process subdivision: Emissions of Product A1 are calculated based on Scope 1, 2, and 3 emissions data for the entire organization.In other words, emissions from fuels and raw materials not directly related to the production of Product A1 are also used to calculate emissions of Product A1.
- (Right) With process subdivision: Accuracy in calculating Product A1 emissions through allocation improved by more pinpointing of the amount of activities related to the production of Product A1.

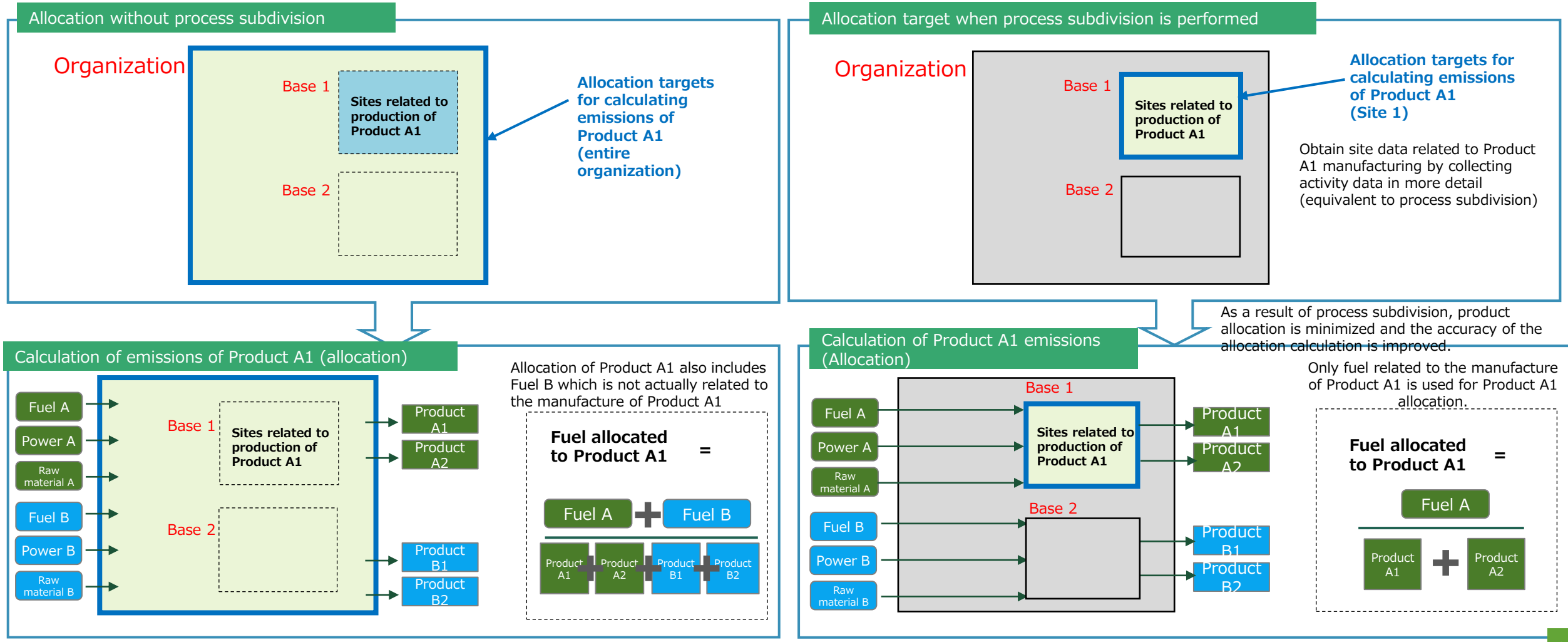


Figure 2-3-7 Avoidance and minimization of allocation by process subdivision

Source: Mizuho Research & Technologies

Implementation of allocation

(3) Allocation

② Implementation of allocation

- This document uses the recommendations of the Scope 3 Standard in performing allocation calculations:

> - If avoiding allocation is not possible, companies should first determine total facility or system emissions, then determine the most appropriate method and factor for allocating emissions.
> - Companies should select the allocation approach that best reflects the causal relationship between the production of the outputs and the resulting emissions; results in the most accurate and credible emissions estimates; best supports effective decision-making and GHG reduction activities; and otherwise adheres to the principles of relevance, accuracy, completeness, consistency and transparency.
> - Companies may use a combination of different allocation methods and factors to estimate emissions from the various activities in the Scope 3 inventory. However, for each individual facility or system, a single, consistent allocation factor should be used to allocate emissions throughout the facility or system.
> - The sum of the allocated emissions for each output of a system should equal 100 percent of emissions from the system. The use of multiple allocation methods for a single system can result in over-counting or under-counting of total emissions from the system.
>
> (Scope 3 Standard Chapter 8)

- This document organizes the recommendations of the Scope 3 Standard into three areas:

> - **Factors used for allocation should best reflect the causal relationship between product manufacturing and emissions**
> - **The factor used for allocation should be one consistent factor (e.g., production volume, production value) for each allocation calculation**
> - **The sum of the results of the allocation and the total amount before the allocation should match**

- It should be noted that the consistency of the factors used for allocation may be secured for each allocation calculation.
- For example, if emissions from sites A and B are obtained by process subdivision, and the allocation is made by the products of each site, it is not necessary to use the same allocation factor for sites A and B.

Declared unit

(3) Allocation

③ Declared unit

- Either of the following may be used as the declared unit of CO2 data provided to downstream operators as the result of organization-level calculation:

- Product unit (kg-CO2e/piece, kg-CO2e/unit weight, etc.)
- Transaction unit based on transaction volume, amount, etc. (kg-CO2e/transaction value, kg-CO2e/transaction value)

- See 3-2 in this document for the data disclosure method.

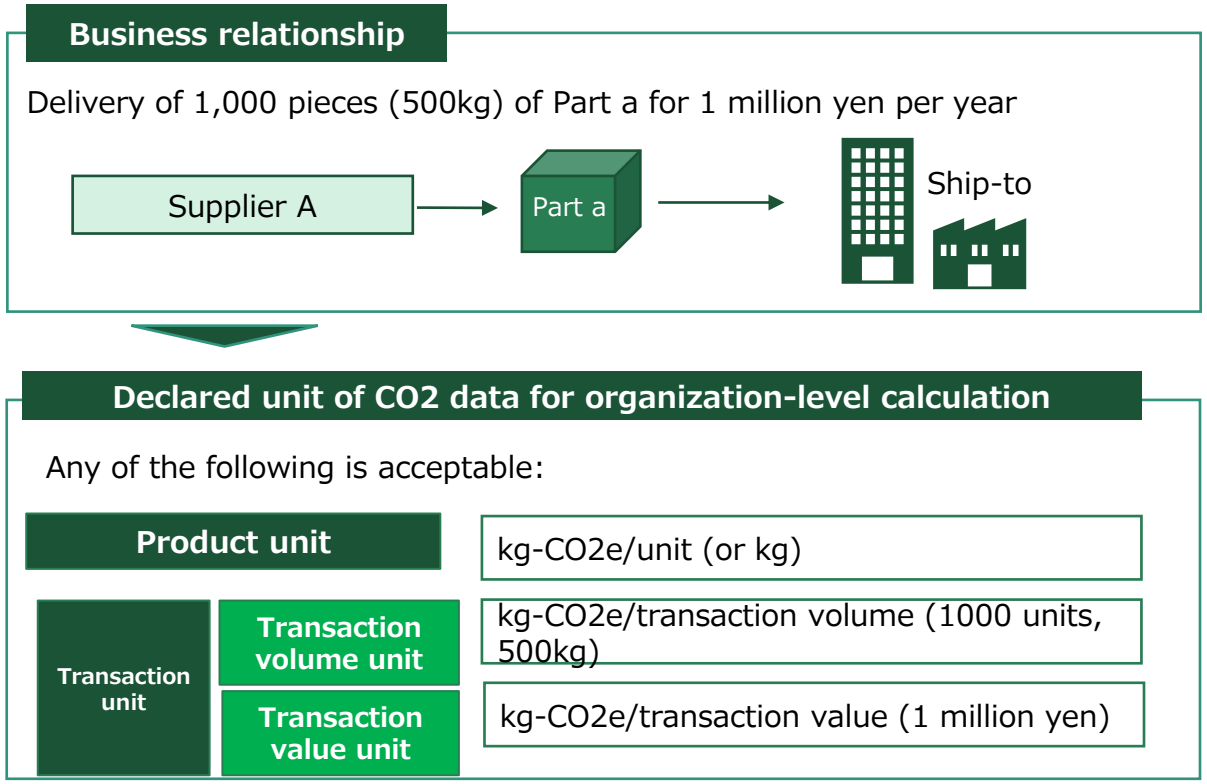


Figure 2-3-8 Declared units for organizational-level calculation

Source: Mizuho Research & Technologies

Handling of credit and energy certificates

(4) Handling of credit and energy certificates

- The procedure for calculating CO2 emissions data for delivery destinations from Scope 1, 2, and 3 emissions data by process subdivision and allocation calculation is presented in all of (3).
- The members of the SWG discussed the possibility of applying additional purchased electricity certificates and carbon credits to the CO2 data obtained from organization-level calculations to reduce carbon emissions.
- In light of the GHG Protocol standards and guidance related to organization-level calculation, this document presents an approach to credit and power certificate processing that does not violate the rules.

① Handling of carbon credits

- Currently, GHG Protocol regulations do not allow reductions in Scope 1, 2, or 3 emissions using carbon credits.
- Therefore, even if carbon credits are applied (amortized) to the CO2 data in the organization-level calculation and offset, the effect is not reflected in the Scope 3 calculation of the downstream company that received the data. It can be concluded that the application (write-off) of carbon credits is ineffective for the purpose of contributing to the reduction of Scope 3 emissions by downstream businesses.
- However, the GHG Protocol is currently reviewing its rules.
- In the GHG Protocol Land Sector and Removals Guidance under development, carbon credits derived from carbon removal may be treated differently than before.
- When the guidance is released, the treatment of carbon credits will be updated in accordance with this document's arrangement.

② Handling of energy certificates

- Energy certificates are allowed to be used when the GHG Protocol's Scope 2 Guidance uses a market-based approach to calculate Scope 2 emissions. The Scope 2 Guidance states that when providing Scope 2 emissions data to recipients, emissions data calculated using either the location-based approach or the market-based approach may be provided.
- From the above, it can be concluded that energy certificates can be reflected in the CO2 data provided to the customer by:

a. By adopting a market-based approach and reflecting energy certificates in the company's Scope 2 emissions calculation results;

b. Disclosing the use of the market approach to suppliers; and

c. Supplying the allocation result for Scope 2 emissions data.

Handling of credit and energy certificates

(4) Handling of credit and energy certificates

② Handling of energy certificates (continued)

- The method shown on the previous page is a general method for applying electric energy certificates. However, SWG members also discussed whether or not the following electric energy certificates can be applied.

- **The GHG Protocol takes the view that the reduction effect of emissions from energy certificates is achieved by overwriting the attributes of purchased power with attributes such as renewable energy power held by the certificate side (Scope 2 Guidance). In many cases, power contracts are made on a site basis, and the minimum unit for overwriting power attributes by energy certificates is also often on a site basis.**
- **In the application of certificates of electricity at each site, is it possible to achieve 100% renewable energy by applying them only to electricity supplied to specific production lines or products manufactured at certain times?**

- The GHG Protocol does not provide explicit guidance on the applicability of such energy certificates. The Pathfinder Framework also makes no mention of this issue.
- This document proposes the following concepts as a tentative draft for the PoC project.

[Preliminary Proposal for PoC Phase]

- **Allow the application of centralized energy certificates for power input to specific production lines or products manufactured at a given time.**
- **However, double application of energy certificates shall not be carried out and the total number of certificates applied shall be equal to the total number of certificates procured.**
- **Only unbundled certificates (purchased separately from actual power) purchased directly by consumer companies can be used for this process.**

- In the tentative plan for the PoC phase, certificates that can be intensively applied to specific lines and products were limited to unbundled certificates (certificates purchased separately from actual power) because the amount of energy certificates included in the electricity menu purchased from retail electricity providers is difficult for consumer companies to understand and for third parties to verify.
- The effectiveness of this proposal will be examined in the PoC project.

Calculation and sharing of primary data share

(5) Calculation and sharing of primary data share

- Promoting the use of primary data is one of the ideal forms of the CO2 visualization framework, and it is important to promote the shift to CO2 data calculation based on primary data.
- As a mechanism for this, the Pathfinder Framework calls for the calculation and sharing of the primary data share (PDS), comprising the percentage of the CO2 data provided by a supplier to downstream entities that is based on primary data. Product-level calculation too applies this approach. (See 2-2-3 (5))
- In principle, it is desirable to calculate and share the PDS at the organizational level in the same manner. At present, however, there are many practical challenges.
- A consensus was reached in discussions with Methodology SWG members that the PDS of CO2 data derived through organization-level calculations should be the weighted average of the PDS of the respective scope and category after the allocation calculation comprising the data according to the scope of the emissions of each.
- However, it was confirmed that there was a practical problem in the calculation method of the PDS of each scope and category after the allocation calculation.
- One issue is that PDS calculation results may differ between cases where process subdivision is performed or not performed (see Figure 2-3-9). This indicates that it is possible to increase the PDS value by intentionally avoiding process subdivision.

Even if the data received from the supplier is the same, the results of the PDS delivered to the downstream company will differ depending on whether or not the company has its own process subdivision.

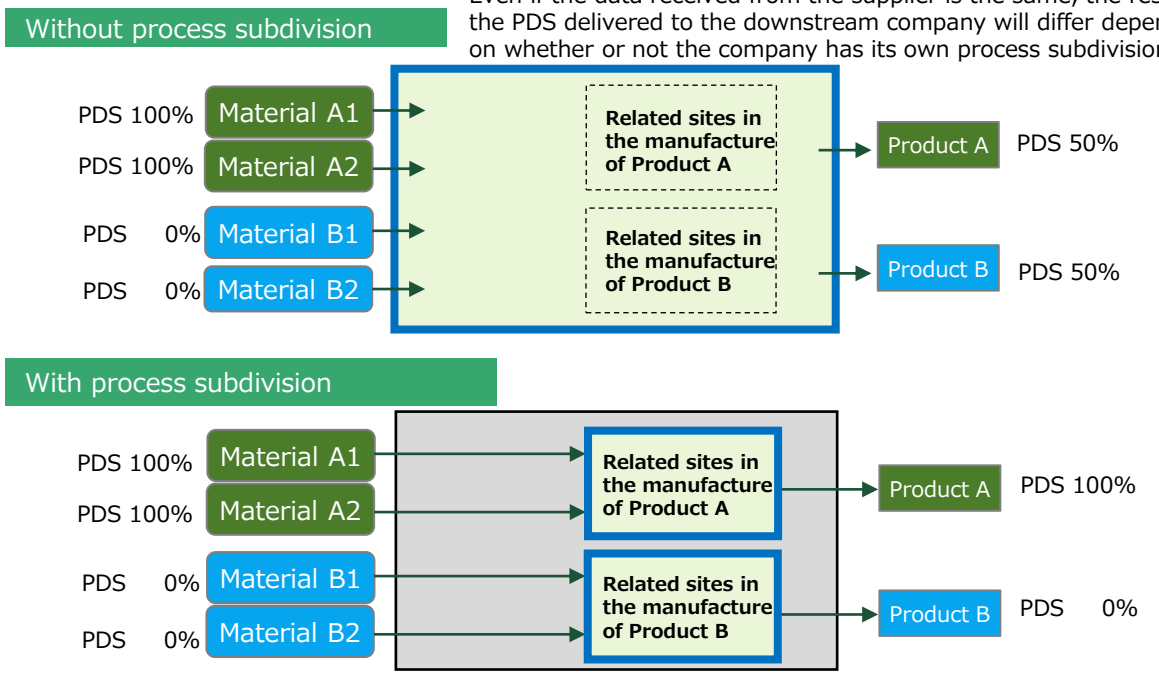


Figure 2-3-9 Image of the impact on PDS calculation of the presence or absence of process subdivision

Source: Mizuho Research & Technologies

- Another challenge is the existence* of a PDS calculation method that differs from the Pathfinder Framework method and has already been adopted by many companies in Scope 3 disclosure. The PDS disclosure of organization-level calculation may mix these alternative calculation results.

* An approach whereby CO2 data provided by suppliers that is used as emission factor by downstream companies is regarded 100% primary data compared to data cited from secondary data databases. With the Pathfinder Framework, even with data provided by a supplier, the emissions of the portion for which secondary data is used are treated as secondary data. The former delivers a higher PDS.

Calculation and sharing of primary data share

(5) Calculation and sharing of primary data share (continued)

- Under these circumstances, the PDS for organization-level and product-level calculations should be separate concepts and should not be mixed. In product-level calculations, PDSs based on a consistent calculation method have been inherited through the supply chain. Therefore, the mixing of PDSs for organization-level calculations with different calculation methods may hinder efforts.
- Also, if different companies use different methods of calculating PDS, promoting primary data through the supply chain may not work effectively. On the other hand, some SWG members felt that even if PDS calculation methods differ among companies, the progress of each company's efforts can be evaluated if each company continues to calculate PDS in a consistent manner.
- With this in mind, this document adopts the following concepts as a preliminary proposal for the PoC phase:

- [Preliminary Proposal for PoC Phase]
- In consideration of the load and feasibility of the system implementation side, the introduction of PDS in organization- level calculation will be postponed in the PoC project (no corresponding column in the data format used for the project).
- The introduction of the system shall be reconsidered based on the results of the project.

[Discussion with SWG members]

- SWG members had three major views from on how to handle PDS calculation and sharing in organization-level calculations.
- The first view is that it is not necessary to calculate and share PDS when organization-level calculation is adopted. Behind this is the idea that organization-level calculation is a provisional methodology leading to product-level calculation, and that the shift to product-level calculation should be addressed rather than PDS calculation.
- Second, while recommending the same PDS approach as the Pathfinder Framework, the calculation and sharing of alternative PDSs should also be allowed. The emphasis in this case is on reducing the burden on the calculation entity of having to calculate two different types of PDSs by allowing different methods. There was also a view that if each supplier consistently adopted one method and reported their PDS accordingly, it would allow vertical comparison (evaluation over time) of PDS improvement.
- The third is that the same PDS approach as the Pathfinder Framework should be applied to organization-level calculation, and a different PDS approach should not be allowed. It is also important to increase the PDS in organization-level calculations, and the idea behind this is to avoid confusion on both the calculation and receiving sides by specifying one calculation method.
- The PDS for organization-level calculation will continue to be discussed.

3. CO2 data sharing method

Positioning and structure of data disclosure items

3-1. CO2 data sharing concept

3-1-1. Positioning of data disclosure in this document

- This section presents information (data disclosure items) that suppliers disclose when sharing data with suppliers.
- Consistent with the product-level methodology in this document, the PACT Pathfinder Framework is paired with the Pathfinder Network, and the technical requirements are presented in the Pathfinder Network. Technical specifications and details can be found in the Pathfinder Network Technical Specifications, which include information on data items, API, and licenses for data sharing.
- The GxD Consortium Visualization WG set up a Tech Specifications SWG in conjunction with the Methodology SWG (see 1-1) to examine CO2 data exchange formats and cooperation methods using digital technology.
- The data disclosure items presented in this document (CO2 Visualization Framework v1) are intended to present the necessary items for data sharing. For the digital technology format and specifications, please refer to the release of the Data Format Linkage SWG study.
- This document is assumed to be used in Phase 2 of the PoC project (scheduled for the latter half of FY2022). It will be updated as necessary in response to the results of the PoC project and revision of the methodologies of the overseas frameworks of partner companies.

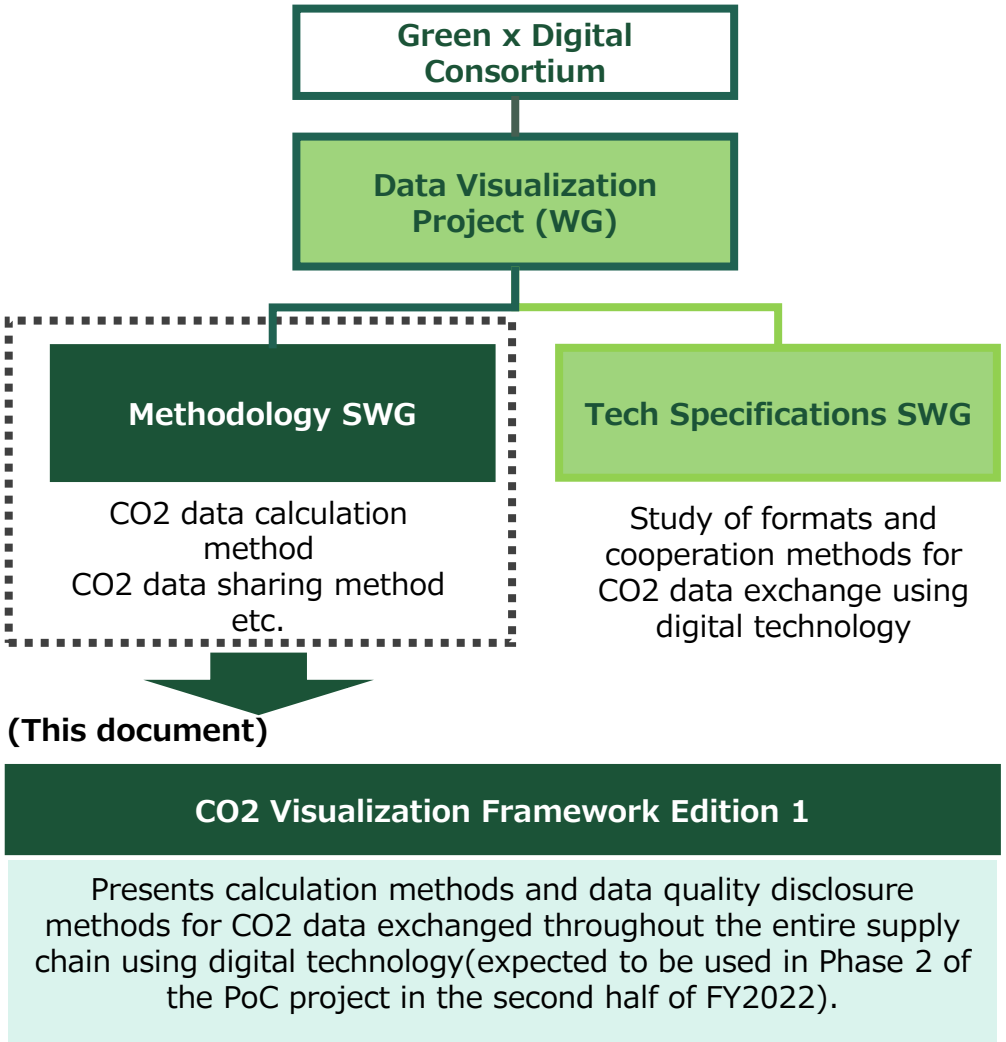


Figure 3 -1 -1 Review of the Methodology SWG and the positioning of this document

Positioning and structure of data disclosure items

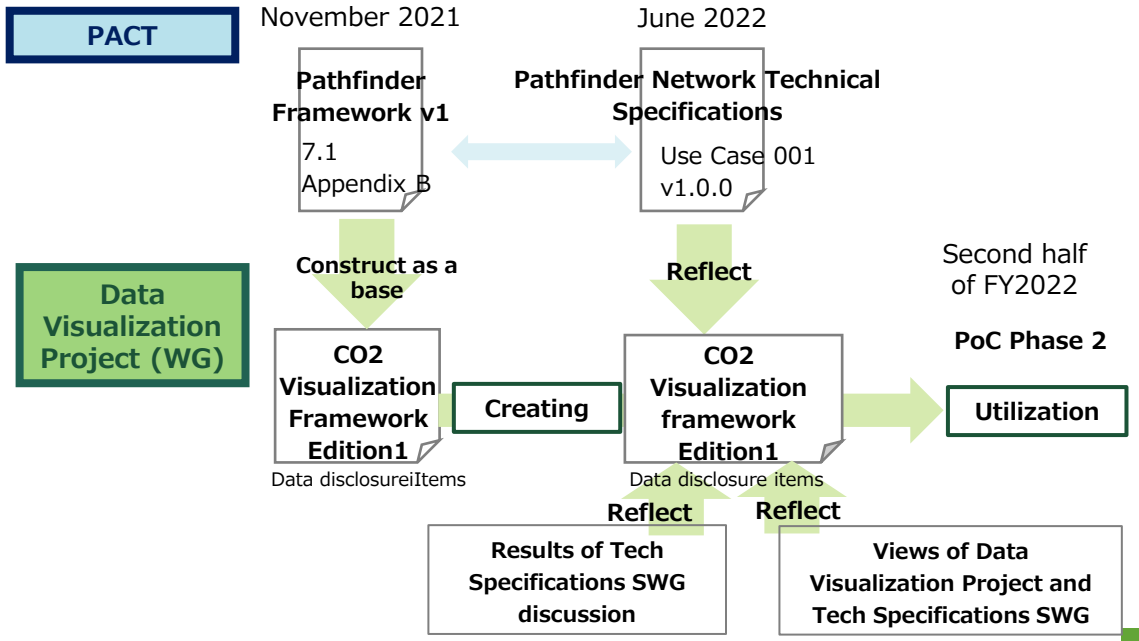
3-1-2. Composition of data disclosure items

(1) Process of preparing data disclosure items in this document

- This document aims to develop methods for calculating CO2 data consistent with international frameworks/platforms. Product-level calculations are consistent with the PACT Pathfinder Framework v1.
- Pathfinder Framework v1 lists items where data sharing is desired in 6.1 Required elements for data exchange and Appendix B: PCF Questionnaire.
- The product-level data disclosure items in this document were initially constructed based on the relevant descriptions in the Pathfinder Framework v1 (November 2021) but have been revised following the publication of the Pathfinder Network (June 2022).
- The data disclosure items presented in this document are based on the mandatory items of PACT Pathfinder Network Technical Specifications v1.0.0.
- In addition, necessary items were added based on the results of discussion in the methodology SWG. The items related to the organization-level calculation are all items constructed on the basis of SWG discussion results.
- The reasons for reorganizing the data disclosure items in this document from Pathfinder Network Technical Specifications v1.0.0 are as follows:
  - This is a current document based on Pathfinder Framework v1
  - To align the technical requirements for Phase 2 of the PoC project
- In addition, there was a view in the SWG discussion that as many disclosure items as possible should be set from the viewpoint of data analysis for the purpose of encouraging reduction activities.
  - Data provider (data entry side) load
  - System implementation load and feasibility

  In the end, the minimum items required for data sharing were presented.

Chart 3-1-2 Data disclosure process



Source: Mizuho Research & Technologies

Positioning and structure of data disclosure items

3-1-2. Composition of data disclosure items

(2) Calculation method and data disclosure items

- This document allows for the sharing of CO2 data calculated in two ways: product-level and organization-level calculations.
- Because of the existence of these two methods, the following may arise in terms of the structure of data disclosure items:
  - Items common to both calculation methods
  - Items expressed differently depending on the calculation method
  - Items which both calculation methods require to be shared

- 3-2: Data disclosure items in this document indicates the applicable calculation method. The data provider shall confirm the calculation method used for each data disclosure item and share the data according to the calculation methods implemented by the company.

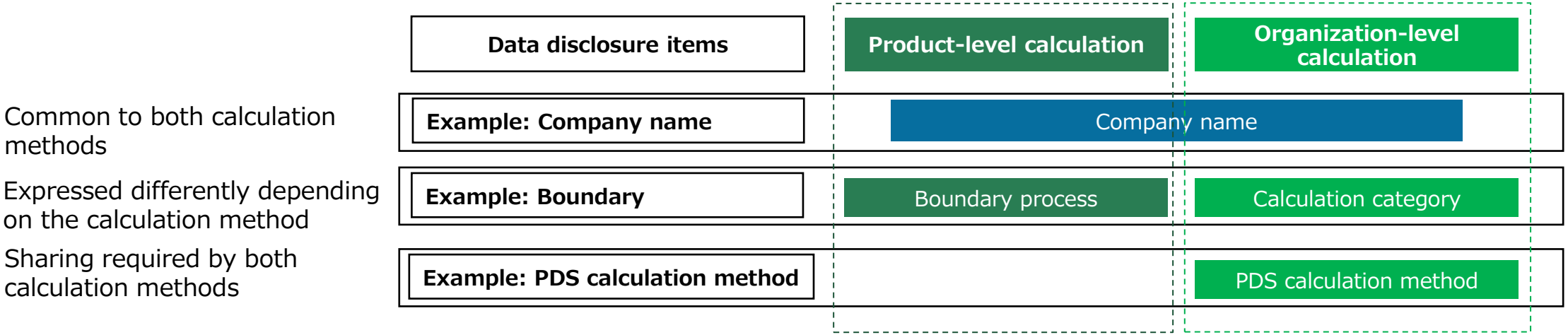


Chart 3-1-3 Calculation methods and data disclosure

Source: Mizuho Research & Technologies

Positioning and structure of data disclosure items

3-1-2. Composition of data disclosure items

(3) Determination of product-level calculation and organization-level calculation

- Determination of product-level calculation and organization-level calculation is made in the referred standard guidance of the data disclosure items.
- Figure 3-1-4 shows the relationship between the standard guidance used for calculating CO2, product-level calculation, and organization-level calculation.
- Product-level calculation or organization-level calculation is determined when the data provider inputs this as the method of calculating the provided data into the referred standard guidance, which is a data disclosure item.

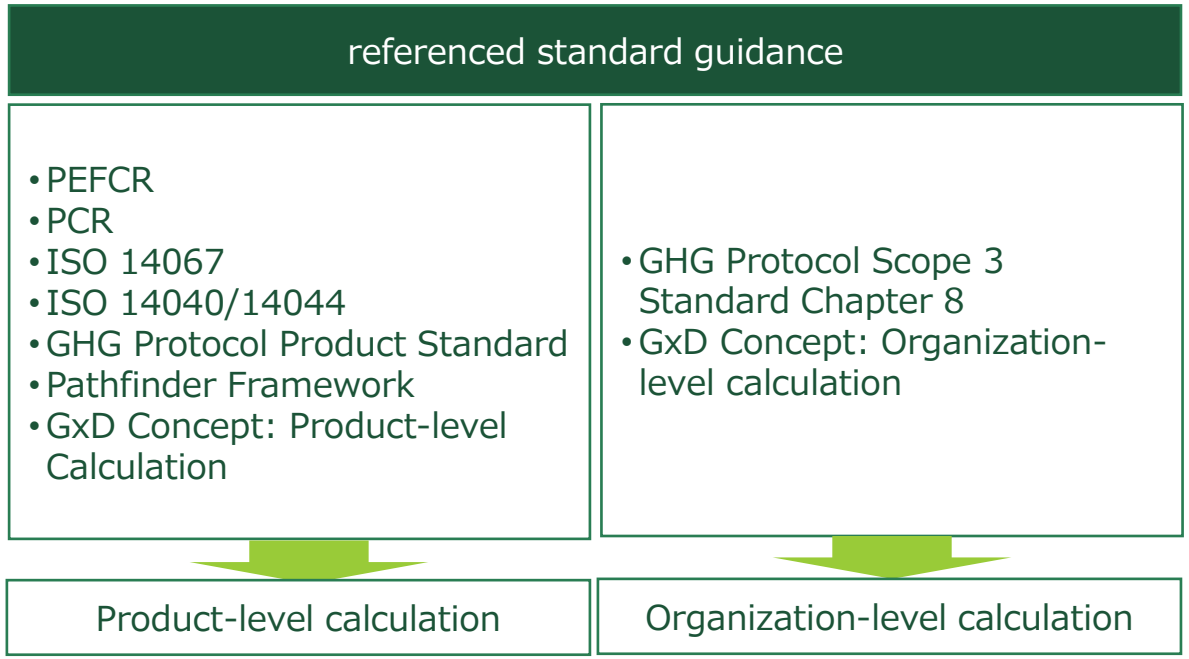


Figure 3-1-4 Determination of product-level calculation and organization-level calculation

Source: Mizuho Research & Technologies

Data disclosure items

3-2. Data disclosure items

3-2-1. Required level of data disclosure items

- The required level of data disclosure is indicated in three levels: M, R, and O.
  "M" is Mandatory.
  "R" (Recommended) and "O" (Optional) shall be optional items.
  Among "R" and "O", "R" indicates an item for which data sharing is strongly desired. The data provider should disclose the "R" item whenever possible.

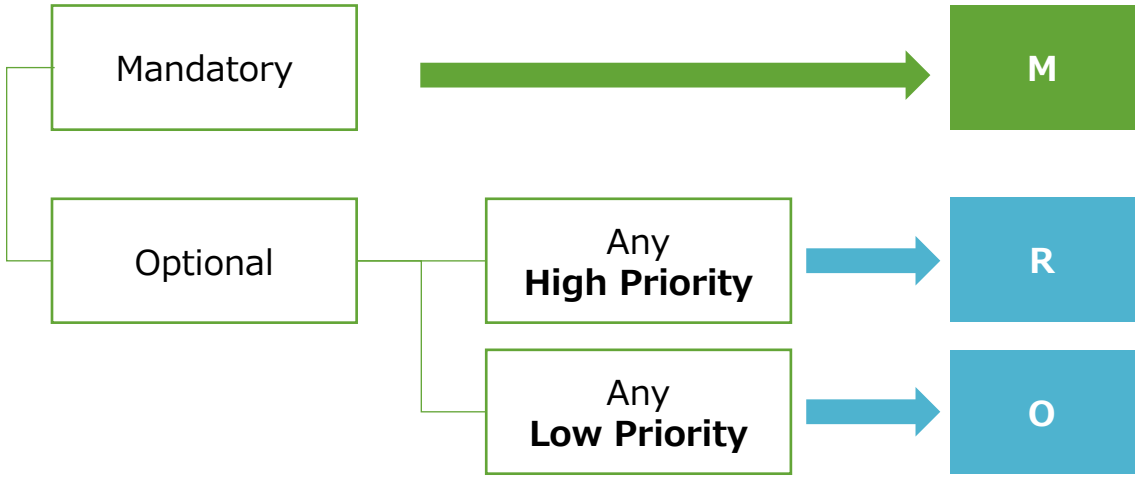


Figure 3-1-5 Data disclosure requirements

Source: Mizuho Research & Technologies

Data disclosure items

3-2-2. List of data disclosure items

- Data disclosure items are shown. Again, the purpose of this document is to present necessary items for data sharing. Please refer to the Data Format Linkage SWG study for digital technology formats and specifications.

Data disclosure items			Calculation method	Demand level (M, R, O)	Description
Basic information	Corporate information	Company name	Common	M	Company name
		Company ID	Common	M	Uniquely identifiable company IDs, such as DUNS Number/ISIN/Ticker codes
	Product information	Product name	Common	M (O if CO2 data provided is not in product units)	Product name
		Product ID	Common	M (O if CO2 data provided is not in product units)	Product ID
		Product classification (CPC code)	Common	M (O if CO2 data provided is not in product units)	Product classification (CPC Code)
		Product description	Common	O	Product description

Data disclosure items

3-2-2. List of data disclosure items (continued)

Data disclosure items			Applicable calculation method	Demand level (M, R, O)	Description
Basic information	Basic information for the CO2 data provided	Referenced standard guidance	Common	R	referenced standard guidance ・ Product-level calculation PEFCR, PCR, ISO 14067, ISO 14040/14044, GHG Protocol Product Standard, Pathfinder Framework, GxD component Product-Level Calculation ・Organization-level calculation GHG Protocol Scope 3 Standard, GxD component Organization-Level Calculation
		Declared unit of the CO2 data provided	Common	M	Declared units of CO2 data to be provided, such as product units (kg-CO2e/piece, kg-CO2e/kg) and customer units based on transaction volume, amount, etc. (kg-CO2e/yen) *Details will be described later.
		Transaction volume	Common	M	Declared unit of CO2 data to be provided based on the total volume of transactions with suppliers
		Data creation date	Common	M	Date the data was created
		Data ID	Common	M	ID to identify the created data
		Data version (Update count)	Common	M	Version of the data created

Data disclosure items

3-2-2. List of data disclosure items (continued)

Data disclosure items			Applicable calculation method	Demand level (M, R, O)	Description
Boundary		Boundary process	Product-level calculation	R	Process name contained within the boundary
		Calculation target category	Organization-level calculation	R	Category number to be calculated
Data collection and quality	Primary data share	Primary data share	Product-level calculation	M	Ratio of primary CO2 data provided
		Primary data share	Organization-level calculation	O	
		Calculation method of primary data share	Organization-level calculation	O	Calculation method of primary data share
	Data sources	Secondary data source	Common	R	Secondary data source such as a database used
	Data collection period	Data collection period	Common	M	Period of data collection
	Geographic scope of data collection	Geographic scope of data collection	Common	O	Geographic extent of data collection
	Validation-related information		Common	R	Validation-related Information
Allocation	Standards used for accounting or allocation of GHG emissions and additional approaches		Product-level calculation	O	Standard used for allocation
	Level of allocation		Organization-level calculation	M	Organizations, bases, buildings, etc.
	Allocation factor		Organization-level calculation	M	Physical factors (volume, number, etc.); production (currency unit)

Data disclosure items

3-2-2. List of data disclosure items (continued)

Data disclosure items			Applicable calculation method	Demand level (M, R, O)	Description
Results of CO2 calculations per declared unit of CO2 data provided	CO2 emissions per declared unit of CO2 data provided (Cradle-to-gate or gate-to-gate)	Carbon emissions from fuel (per declared unit of CO2 data provided)	Common	M	Fuel carbon emissions per declared unit of CO2 data provided (Cradle-to-gate or gate-to-gate)
		Bio-derived carbon emissions (per declared unit of CO2 data provided)			Bio-derived carbon emissions per declared unit of CO2 data provided (Cradle-to-gate or gate-to-gate)
	Scope of calculation	Cradle-to-gate or gate-to-gate	Common	M	Cradle-to-gate or gate-to-gate
	CO2 emissions per declared unit of CO2 data provided (for companies that can provide gate-to-gate in addition to cradle-to-gate)	Carbon emissions from fuel (per declared unit of CO2 data provided)	Common	R (For companies that can offer G-to-G in addition to C-to-G)	Fuel carbon emissions per declared unit of CO2 data provided
		Bio-derived carbon emissions (per declared unit of CO2 data provided)			Bio-derived carbon emissions per declared unit of CO2 data provided
	Per declarative unit of CO2 data provided Cradle-to-gate emissions	Credit usage	Common	O	Credit usage * Details described later.
		Certificate usage	Common	R	Certificate usage status * Details described later.

Data disclosure items

3-2-2. List of data disclosure items (continued)

Description of declared units of CO2 data provided

- Declare units of CO2 data to be provided to the customer.

■ Product-level calculation

- For product-level calculations, the declared units of CO2 data provided are the weight (kg-CO2e/kg) and volume (kg-CO2e/L) of the product.

■ Organization-level calculation

- In the case of organization-level calculation, the CO2 data to be provided is assumed to be the transaction volume of the weight and mass of the product as well as the unit based on the transaction value.
  - In organization-level calculation, Scope 1, 2, and 3 data as an organization are distributed and calculated for each supplier.
  - Allocation methods include allocation based on the weight or mass of the product as well as allocation based on the transaction value.
- Example of input

Product weight and volume units: kg-CO2e/kg, kg-CO2e/L

Trading volume unit: kg-CO2e/trading volume

Transaction amount unit: kg-CO2e/transaction amount

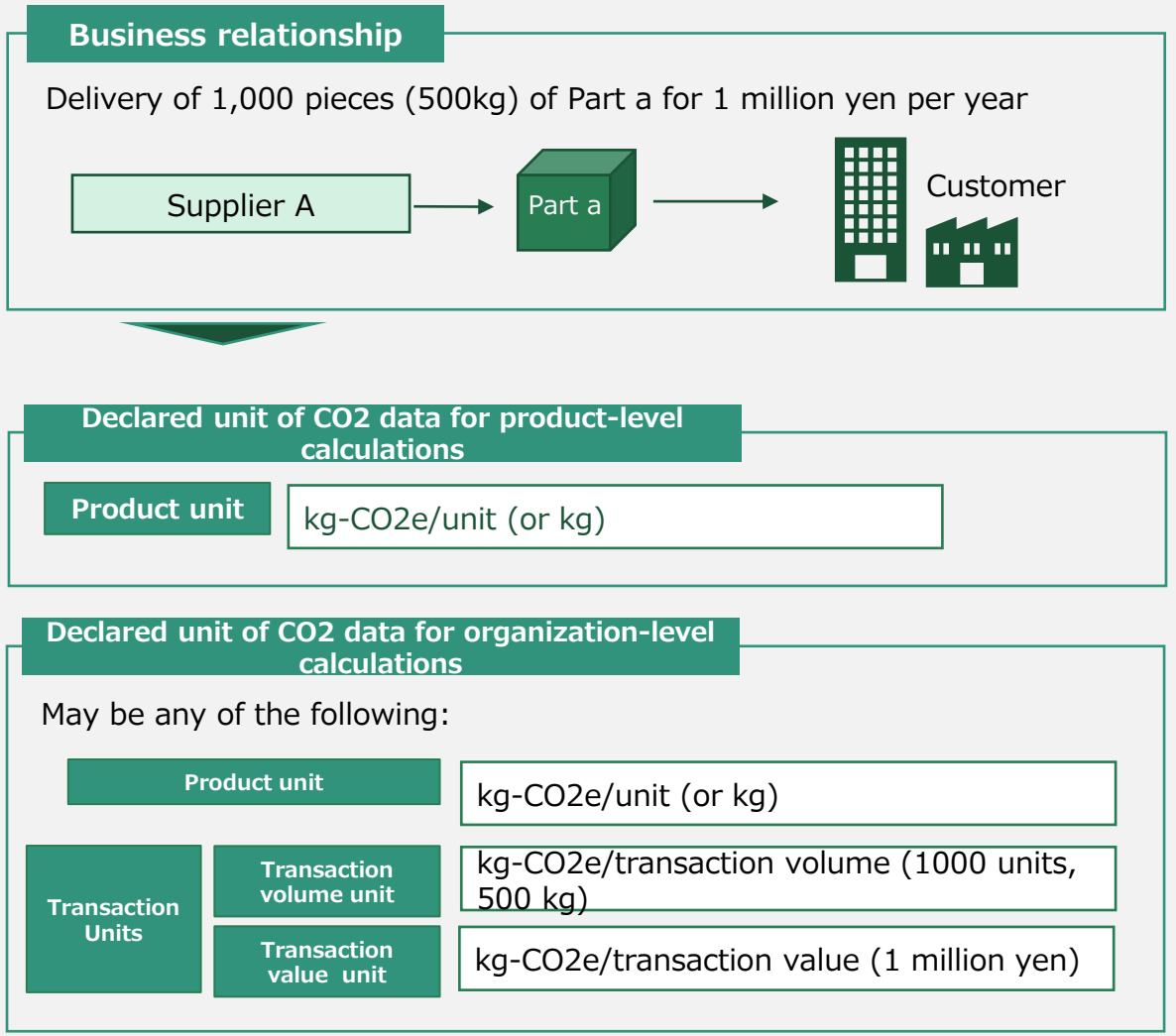


Figure 3-1-6 Declared data disclosure requirement levels

Data disclosure items

3-2-2. List of data disclosure items (continued)

Description of credit and certificate usage

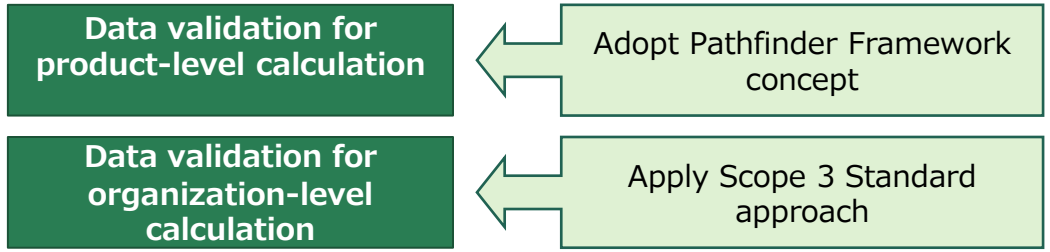
- The purpose of this report is to report the amount of credit and certificate usage that the data disclosing party has procured and adjusted.
- “Credit usage” refers to the amount of carbon credits that were procured and used to offset (carbon offset) product emissions.
- However, even if carbon offsetting is performed as described above, emissions before offsetting should be reported instead of emissions after offsetting. The disclosed items are “credit usage” when offset.
- The name of the system that generated the credit and the serial number of the credit are not assumed to be disclosed.
- “Certificate usage”" refers to the usage of unbundled certificates (purchased separately from actual power) procured by the disclosing party, which is adapted to the power consumption in direct activities.
- Since it is difficult for power users to grasp the amount of energy certificates adjusted by retail power providers, the amount of energy certificates is not assumed as a disclosure item.
- Refer to the relevant items in product-level calculation and organization-level calculation for cautions when applying unbundled certificates only to specific products.
- It is not assumed that the attribute information for used electric energy certificates is disclosed.

4. Verification of CO2 data

Verification of CO2 data

4-1. Verification of CO2 data

- As we enter an age where CO2 data is exchanged in the supply chain using digital technology, data verification by a third party is expected to become more important than ever.
  - Companies that have calculated their CO2 data in accordance with the Pathfinder Framework, an international framework presented in Section 2-2 of this document, want to demonstrate to others that their calculation results are internationally valid. Obtaining third-party verification is an effective means of achieving this.
  - Downstream operators would also prefer to have a guarantee that the CO2 data received were calculated in accordance with authoritative methodology standards.
- This chapter develops an approach to verification for the calculation method (Chapter 2) and the sharing method (Chapter 3) for CO2 data presented so far, as well as for product-level calculation and organization-level calculation.
- The concept of the Pathfinder Framework is used for data validation in product-level calculations.
- Data calculation for the organization-level calculation is the only standard that provides guidance on this methodology and follows the approach of the GHG Protocol Scope 3 Standard.



- The Pathfinder Framework V1 on which this edition 1 document was developed, does not have sufficient provisions for verification, such as emission cutoff rules. More detailed verification rules and guidance that the Pathfinder Framework V2 has provided, will be reflected in the coming edition 2 of this document.

- In this document, acquisition of third-party verification is recommended but not required, following the Pathfinder Framework and Scope 3 standards.
- Using the sharing method in Section 3 means that the data quality of CO2 data has been self-declared, and businesses are deemed to have guaranteed data quality as a minimum obligation for CO2 data exchange.

Product-level CO2 data verification: Verification requirements and targets

4-2. Product-level CO2 data verification

- This document defines verification of product-level CO2 data in accordance with the Pathfinder Framework v1.
- Any changes in the verification methodology in Pathfinder Framework v2 shall be reflected*.

* Pathfinder Framework v2 (issued Jan. 2023) explicitly refers to evidence backing for the purpose of data guarantees, making the process of verification easier to envisage. When the CO2 Visualization Framework is updated to v2, adoption of the Pathfinder Framework v2 evidence backing will be considered.

4-2-1. Pathfinder Framework v1 Requirements

- The Pathfinder Framework v1 does not require third-party verification to be performed.
- The framework requires one of the following:
  (a) sharing self-declarations on data quality; or
  (a) verification by a third party
  This document mandates disclosure of data quality information (presented in Section 3), which can be followed to meet the above Pathfinder Framework v1 requirements.
- However, obtaining third-party verification is more desirable.

4-2-2. Data requiring verification

- The Pathfinder Framework v1 verifies CO2 data against four types of data:

  - **Activity data and emission factors related to direct activities**
  - **Activity data and emission factors related to upstream activities**

- However, the Pathfinder Framework v1 does not require verification of emission factor data.
  - If emission factor data is the primary data emission factor provided by the supplier and has already been verified by a third party, the data receiver does not need to verify it again.
  - If the emission factor data is secondary data derived from an LCA database, etc., verification of individual data is not required if the database itself is approved by Pathfinder Framework v1. However, in the calculation of the activity amount × emission factor, it is necessary to confirm the conformity of both. (For example, it must be confirmed that the amount of activities related to resin procurement is not multiplied by the emission factor of manufacturing other materials.)
- If the primary data emission factor provided by the supplier has not been verified, it is recommended that the verification be performed by the data user.
- This document also follows the Pathfinder Framework concept.

[Illustration] Subject of product-level CO2 data verification

This figure indicates data items to be verified, using the example of the model suppliers from Figure 1-4-16.

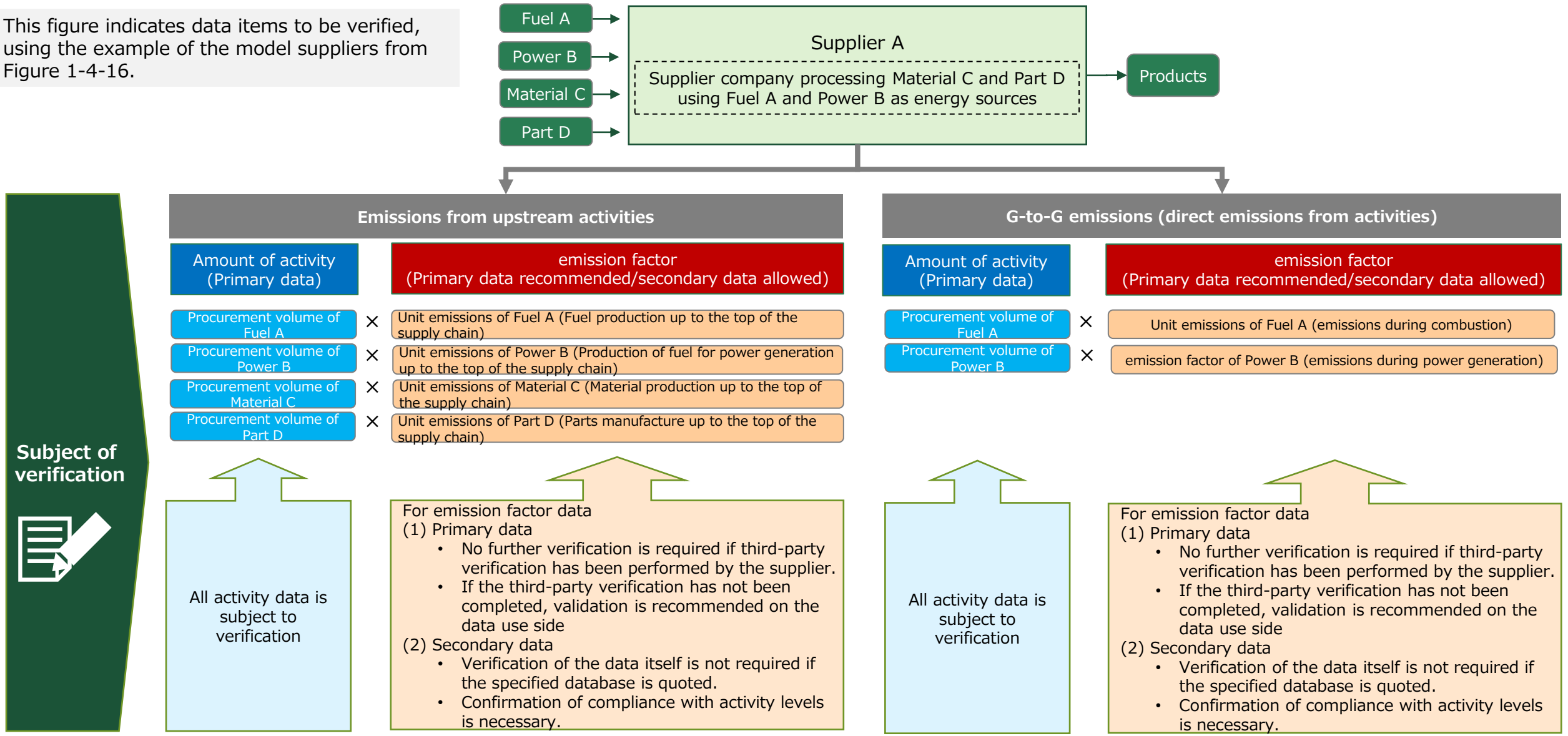


Chart 4-2-1 Scope of product-level CO2 data verification

Source: Mizuho Research & Technologies

Product-level CO2 data verification: Data collection and data quality

4-3. Aspects of implementing verification

- In the verification of product-level CO2 data, the Pathfinder Framework v1 should be verified from three aspects: (1) data collection and data quality, (2) methodology for calculation, and (3) data evidence.
- Each aspect is explained below based on Pathfinder Framework v1 with some additional examples to assist user understanding.

4-3-1. Data collection and data quality

- The Pathfinder Framework v1 requires verification in accordance with the ISO 14040 standard as to whether (a) data has been collected and presented and (b) data quality is appropriate for (1)-(8) below.
- This document also follows this concept.
  - The Pathfinder Framework v1 contains a data quality verification perspective but does not provide criteria for conformance or inappropriateness.

(1) Minimum data elements required

- The Pathfinder Framework v1 specifies minimum data elements required and requires verification of disclosure of each item.
- The following nine items are defined as minimum data elements required:
  - Data provider’s company name
  - Product name, short description of the production technology (if relevant), and unique UN Central Product Classification code
  - Declared unit (e.g., mass or energy, depending on the product)
  - Reporting period and geography
  - Standards used for calculating or allocating GHG emissions and any additional approaches used
  - Product specific carbon footprint covering cradle-to-gate fossil emissions (in the language of this document, CO2 data for product-level calculations)
  - Primary data share (PDS)
  - Boundary, including a description of all attributable processes per life cycle stage, as well as exclusions, if any
  - Certificate of audit or verification or completed questionnaire (corresponding to the data format described in Section 3 of this document)
- For the above items, it is sufficient to confirm that the data is disclosed. For verification of the contents, see (2) and later.

(2) Reviewing boundaries and processes

- Ensure that each unit process in the boundary includes all associated attributable processes.
- Ensure ad hoc processes (maintenance and downtime) are included.

Product-level CO2 data verification: Data collection and data quality

(3) Data collection period

- Confirm the target period for the data used in the calculation.
- The Pathfinder Framework v1 takes the position of recommending the most recent year possible.

(4) Data collection method

- Check the data collection method.
- The Pathfinder Framework v1 lists data sampling and measurement of process-specific data as data collection methods, and mainly assumes confirmation of the activity data collection method.
- Desirable data collection methods are not described in Pathfinder Framework v1 but are expected to be addressed in Pathfinder Framework v2.

(5) Data sources

- Confirm the data sources for primary data and secondary data.
- For primary data, confirm the application destination of the data collection method in (4).
- For secondary data, check the referenced database. Pathfinder Framework v1 provides a list of available LCA databases (see Figure 2-2-21) and checks to see if they apply.

(6) Technical representativeness

- Confirm that the data collected and utilized is representative of the target process (involves both industrial and biological processes).
- For example, in the case where a CO2 calculation is performed using only data collected from some sites for products manufactured at many sites, if the sites excluded from the data collection use different technologies, the technical representativeness of the calculation will be evaluated as low.
- However, Pathfinder Framework v1 does not provide a measure of technical representativeness, so we are waiting for the Pathfinder Framework v2 description.

(7) Geographic and temporal representativeness

- Verify that the data collected and utilized are not geographically or temporally biased.
- For example, if CO2 calculations are performed using data from one country for products manufactured at sites in each country, geographical representativeness is evaluated to be low. In addition, when CO2 data using data collected several years ago is applied to products manufactured last year, temporal representativeness is evaluated low.
- However, Pathfinder Framework v1 does not provide evaluation criteria for either, and it is expected that they will be applied as described in Pathfinder Framework v2.

Product-level CO2 data verification: Data collection and data quality

(8) Impact of exclusions and assumptions

- Confirm that the exclusion of specific emissions from the calculation and the assumptions on data that cannot be measured do not significantly affect the CO2 data value.
- In particular, it is important to ensure that the exclusion of specific emissions has a limited impact on the overall CO2 data so as not to cause an underestimation of emissions.
- So-called cutoff rules, which allow exclusion of up to a certain percentage on an emissions basis, are often used to determine that the impact is limited.
- Pathfinder Framework v1 does not provide cutoff rules, so we are waiting for the Pathfinder Framework v2 description.

Product-level CO2 data verification: Calculation methodology

4-3-2. Calculation methodology

- The Pathfinder Framework v1 also states that the verification should confirm that the CO2 data calculations are made in accordance with the methodology presented by the Pathfinder Framework.
- The following six items should be checked.

(1) Completeness of life cycle stage

- Confirm the integrity of the life cycle stage of the manufactured product.
- Pathfinder Framework v1 defines a product cycle as comprising five stages: (1) raw material collection, (2) manufacturing, (3) transport and storage, (4) product use, and (5) end-of-life.
- The CO2 data covers all five processes and requires confirmation that there are no defects or inconsistencies.

(2) Appropriateness of declared units

- Declared units serve as guidelines for the collection of activity data and the selection of emission factor. Therefore, it is necessary to confirm the appropriateness and appropriateness of unit selection.
- Typical units used are per kg, per L, per circle, etc.

(3)Appropriateness of data aggregation, data polishing, modeling, etc.

- Confirm the method of integrating primary data used in the calculation and the appropriateness of data refining and modeling.
- Data integration requires uniformity of data format and processing of target data such as detection and correction of missing values and abnormal values. In addition, the appropriateness of data fluctuation and modeling methods for calculating primary data is also questioned.

(4) Appropriateness of calculation formulas and allocation calculations

- Confirm the appropriateness of the calculation formula used for calculation and the allocation calculation to products.
- In the guidance, it is recommended to use activity x emission factor as a calculation formula, and weight ratio, volume ratio, and (in some cases, market value such as price) as allocation methods.

Product-level CO2 data verification: Calculation methodology

4-3-2. Calculation methodology (continued)

(5) Use of characterisation factors and emission factor in accordance with guidance

- Confirm that the latest characterisation factors and emission factor are used in accordance with the calculation guidance.
- The Pathfinder Framework v1 requires conformance with the Global Warming Potential (GWP 100) based on IPCC AR5 as a characterization factor, with the EcoinventGabi and GLEC DB as emission factor, and with each country's published factor, DB, PEF and GLAD.

(6) Appropriateness of PDS calculation in line with guidance

- The appropriateness of the calculation method of the primary data share (PDS) needs to be confirmed in accordance with the calculation guidance.
- The Pathfinder Framework v1 assumes CO2 data and is calculated using a weighted average of the primary data volume for each ingredient.

4-3-3. Data evidence

- When verifying primary data such as activity data, evidence such as bills of materials, usage statistics, reports, invoices, and equipment and equipment data should also be provided to the verification body. In the verification, the validity of the data is confirmed using the random sampling procedure.
- In data verification in the digital age, it is likely to be necessary to examine the adequacy of anti-tampering measures for the data provided in the verification process. However, this is considered to be out of scope of this document.

Verification of organization-level CO2 data

4-4. Verification of organization-level CO2 data

- Although this document also recognizes organization-level CO2 data for inclusiveness, the quality of CO2 data is as important as in product-level calculation.
- There are differences in the calculation methods between organization-level calculation and product-level calculation, and these differences are also related to the concept of verification.
  - At the organizational level, CO2 data is calculated (allocated) and shared based on Scope 1, 2, and 3 emissions. Scope 1, 2, and 3 emissions are important items for companies to disclose non-financial information and require third-party verification. Therefore, many companies have already obtained verification of Scope 1, 2, and 3 emissions.
  - Verification of Scope 1, 2, and 3 emissions is regarded as one of measures for companies to disclose non-financial information, and therefore is not included in the verification required in this document. The validation required by this document is the adequacy of the allocation for CO2 data sharing.
  - However, it is important to understand Scope 1, 2, and 3 emissions, which are assumptions for organization-level calculation, in order to verify the appropriateness of allocation.
- Based on the above, the following results are presented for the verification of CO2 data in organization-level calculation.
  ① Understanding Scope 1, 2, and 3 emissions as a prerequisite
  ② Validity of process segmentation and allocation

4-4-1. Understanding Scope 1, 2, and 3 emissions

- Scope 1, 2, and 3 emissions are intended to deepen understanding as a prerequisite and to lead to the formulation of reduction measures and to supplier cooperation and are not subject to verification when sharing CO2 data as presented in this document.
- Specific items for understanding Scope 1, 2, and 3 emissions include reporting boundaries, calculation methods, emission factor, and primary data usage ratio.

Verification of organization-level CO2 data: Validity of data division and allocation

4-4-2. Verification of appropriateness of allocation

- The Government of Japan requests the Government of the United States to verify the appropriateness of allocation in the following:

(1) Validity of process subdivision

- In 2-3-2: Organization-level calculation methods, process subdivision is recommended for avoiding and minimizing allocation.
- Assume an approach to avoid or minimize allocation on a customer-by-customer basis that is limited only to the extent relevant to the transaction and validate the approach.

(2) Is the target category included?

- The GHG Protocol Product Standard categorizes indirect sectors as non-attributable processes as being outside the boundary (but notes that where a non-attributable process is determined to be product-related, it should be included in the boundary).
- Taking this approach into account, the organization-level calculation presented in this document suggests that the scope of emissions, which is the denominator for allocation to a customer, should be excluded from the scope of emissions in the Scope 3 category, which is less relevant to products targeted at a customer, such as indirect sectors.
- Are they excluded for reasonable reasons based on their relevance to customer transactions?

(3) Allocation factors

- If physical factors reflect a causal relationship between product manufacturing and emissions, they are allocated using physical factors; otherwise, they are allocated using economic or other factors.
- Confirm whether the allocation factors have been determined in accordance with the approach in line with the approach in 2-3-2: Organization-level calculation methods.

(4) Consistency of emissions before and after allocation

- If allocations are to be implemented, emissions before and after allocations must match.
- Confirm that the total value of the allocation result matches the total amount before allocation.

(5) Appropriateness of certificate allocation

- Verify that the certificate allocation is done properly, as shown in 2-3-2.
- Check for double counting.

Appendix

Appendix 1. Glossary

(1) Terms appearing in Japanese translation, katakana notation or Japanese mixed notation

Term	Definition
Primary data	Company-specific data
Inventory	A list of the levels of release and absorption of specific substances from which sources and sinks during a given period of time
Cutoff	Exclusion from calculation
Green x Digital Consortium	A consortium established by JEITA in October 2021 to promote activities for the creation and implementation of new digital solutions that lead to the promotion of corporate carbon neutrality and changes in industry and society.
GxD Consortium	Abbreviation for Green x Digital Consortium
CO2 data	In this document, used in the context of cradle-to-gate GHG emissions data
Declared unit	Unit for quantifying and sharing greenhouse gas emissions
Unit process	The smallest unit for which input and output data are quantified
Direct emissions	Emissions from processes owned or controlled by the reporting company
Data quality	Characteristics of data showing compliance with requirements
Secondary data	Data from industry averages and model estimates
emission factor	Greenhouse gas emissions per unit of activity
Allocation	The process of allocating greenhouse gas emissions from one facility or other system (for example, vehicles, businesses and companies) to different products
Boundary	Boundary for calculating and reporting greenhouse gas emissions
Visualization WG	One of the working groups under the Green × Digital Consortium, considering a mechanism for visualizing CO2 emissions throughout the supply chain
Lifecycle	Sequential and interrelated stages from raw material extraction to end-of-life
Life Cycle Assessment (LCA)	Compilation and assessment of inputs, outputs, and potential environmental impacts throughout the life cycle
Life cycle emissions	Total greenhouse gas emissions at all stages of the life cycle

Appendix 1. Glossary

(2) English terms

Term	Definition
Attributable Process	Product inception, manufacture, transportation, service, material, and energy flow throughout the life cycle
Attributive LCA approach	LCA method that adds up the environmental impact of all attributable processes in the current life cycle and assigns it to the target product
CO2e	Amount equivalent to CO2. Greenhouse gases differ in the magnitude of their impact on global warming, and this is a common measure for expressing them in a unified manner.
CFP	The carbon footprint of a product. Total amount of greenhouse gases generated during the life cycle of a product. Also known as Product Carbon Footprint (PCF). ISO 14067 adopts the "CFP" notation, and the Pathfinder framework adopts the "PCF" notation.
Cradle-to-gate	From the most upstream processes in the life cycle such as raw material mining to the gate. A type of boundary configuration in a life cycle.
Gate-to-gate	A type of boundary configuration in a life cycle
GHGs	Greenhouse gases. Includes CO2, CH4, N2O, HFCs, PFCs, SF6, and NF3.
PACT	Partnership for Carbon Transparency. An initiative established by the WBCSD to ensure the transparency of Scope 3 emissions by enabling companies to exchange primary data on GHG emissions across industries.
Pathfinder Framework	Methodology for calculating and exchanging emissions data issued by PACT
Pathfinder Network	An open network for the confidential and secure exchange of emissions data. A PACT initiative.
PCF	Product Carbon Footprint. The carbon footprint of the product. Total amount of greenhouse gases generated during the life cycle of a product There is also an expression, Carbon Footprint of Products (CFP). ISO 14067 adopts the "CFP" notation, and the Pathfinder framework adopts the "PCF" notation.
PCR	Product Category Rule. Standards for calculating PCFs for the same product type.
PEFCR	Product Environmental Footprint Category Rules. A set of product-category rules for the environmental footprint (results of life cycle assessment covering not only greenhouse gas emissions but also various environmental impacts) developed under the EU Environmental Footprint Policy.

Appendix 2. Contributions to the writing of this document

- As shown in 1-1-2, this document was prepared with research cooperation and views from SWG members.
- All SWG members (Figure 1-1-3) contributed to the preparation of this document through discussion at WG meetings.
- In addition to the above, the following table shows the companies that participated in additional work such as writing each part and individual discussions and reviews.

Overall writing		Mizuho Research & Technologies
Full discussion review		Brother Industries, NTT DATA
Cooperation in discussion of the draft		Deloitte Tohmatsu Consulting, NEC
Cooperation in answering questionnaires (in alphabetical order)		Brother Industries, Canon, Deloitte Tohmatsu Consulting, Hitachi, KAJIMA, Mitsubishi Electric, NEC, Nitto Denko, Nomura Research Institute, Panasonic, Toshiba, Zeroboard
Cooperation in the writing of individual parts	**2-2. Method of product-level calculation**	Brother Industries
	2-3. Method of organizational-level calculation	Zeroboard
	3-2. Data disclosure items	NTT DATA
	4-2. Verification of product-level CO2 data	Asuene
	4-4. Verification of organization-level CO2 data	Zeroboard
Cooperation in existing standards investigation	**GHG Protocol Product Standard**	Microsoft Japan
	PEFCR	Hitachi
	SuMPO PCR	Brother Industries
	EPD International PCR	Mizuho Research & Technologies
	ISO 14067	Mizuho Research & Technologies
	PACT Pathfinder Framework v1	Mizuho Research & Technologies
	CDP Supply Chain Program	NTT DATA

Green x Digital Consortium

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