

End-to-End GHG Reporting of Logistics Operations

Guidance

January 2023



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Knowledge partner



Scaling partner



About Smart Freight Centre

Smart Freight Centre is an international non-profit organization focused on reducing greenhouse gas emissions from freight transportation. Smart Freight Centre's vision is an efficient and zero-emission global logistics sector. Smart Freight Centre's mission is to collaborate with the organization's global partners to quantify impacts, identify solutions, and propagate logistics decarbonization strategies. Smart Freight Centre's goal is to guide the global logistics industry in tracking and reducing the industry's greenhouse gas emissions by one billion metric tons by 2030 and to reach zero emissions by 2050 or earlier, consistent with a 1.5°C future.

About GLEC

The Global Logistics Emissions Council (GLEC) was established in 2014. GLEC has grown into a voluntary partnership of more than 150 companies, industry associations, programs, experts and other organizations dedicated to driving widespread, transparent, and consistent calculation and reporting of logistics GHG emissions. GLEC works to identify common problems, remove barriers and above all, share a conviction that emission reduction in freight is urgent. GLEC members developed the GLEC Framework to offer multinationals and their suppliers a harmonized, efficient and transparent way to calculate and report logistics emissions. GLEC is a Smart Freight Centre-led initiative.

About WBCSD

The World Business Council for Sustainable Development (WBCSD) is the premier global, CEO-led community of over 200 of the world's leading sustainable businesses working collectively to accelerate the system transformations needed for a net zero, nature positive, and more equitable future. Our member companies come from all business sectors and all major economies, representing a combined revenue of more than \$8.5 trillion and 19 million employees. Our global network of almost 70 national business councils gives our members unparalleled reach across the globe. Together, we are the leading voice of business

for sustainability, united by our vision of a world in which 9+ billion people are living well, within planetary boundaries, by mid-century.

About PACT

The Partnership for Carbon Transparency (PACT) is seeking to accelerate decarbonization through the creation of transparency on product-level emissions in the value chain. To achieve this, it provides a forum for stakeholders to jointly tackle this challenge, uniting businesses from across industries, technology players, industry-focused initiatives, standard-setting bodies, reporting organizations, and regulators in their shared mission. Jointly, the PACT community defines and publishes the necessary methodological and technological basis for primary emissions data exchange, integrating existing standards and approaches and creating a trusted and holistic foundation. PACT is hosted by the WBCSD.

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Executive Summary

Action on logistics emissions is needed but the transparency challenge needs to be resolved first

To limit global warming and reach the Paris Agreement climate targets, supply chains need to be decarbonized. Logistics operations are a central part of all supply chains and play a crucial role in achieving the necessary emissions reductions across industries. Companies are therefore under increasing pressure to calculate, monitor, and report their emissions from logistics operations.

However, companies face an emissions transparency challenge: a lack of granular, verifiable, and consistent emissions data from logistics operations. While standards like the Global Logistics Emissions Council (GLEC) Framework and forthcoming ISO 14083 provide guidance on how to calculate emissions from logistics operations, many businesses face data quality and availability difficulties, particularly for complex logistics operations. This Guidance therefore seeks to enable organizations to understand greenhouse gas (GHG) logistics emissions incurred from supplier to end customer, end-to-end, by increasing the consistency and quality of data, clarifying how and when to use primary data and creating performance indicators that businesses can use in their decision-making.

This Guidance establishes core principles for logistics emissions disclosures

To limit global warming and reach the Paris Agreement This Guidance is based on several core principles:

- 1 Providing a step-by-step practical approach to calculate logistics emissions end-to-end – from an initial supplier to a final customer – compliant with existing methodologies.
- 2 Reflecting reality and organizational use cases to ensure solutions can be embedded today in daily practices for reporting and reducing logistics emissions.
- 3 Creating logic for ambition levels that encourage companies to improve data granularity, quality, and reliability over time.

Companies can take concrete steps to prepare to calculate logistics emissions

Companies wishing to calculate logistic operations emissions should begin by defining the use case for their emissions disclosures, such as reporting, business decision-making, or granular optimization. The use case will inform which data the reporting company should collect, at what level the data should be collected (company, transport chain, or transport-chain element), and which data attributes will need to be shared with the stakeholders that will use the emissions data. While this Guidance provides an overview of the minimum data attributes to be shared, companies should align with their data users to ensure that every involved party understands the shared emissions data.

As a second step, companies should define which metrics they are going to calculate, disclose, and monitor. This Guidance suggests four required metrics for any emissions logistics disclosure on a transport-chain element basis:

Metrics measuring emissions

- Absolute well-to-wheel (WTW) emissions
- Emission intensity per ton-kilometer (tkm) or tonnes.¹

Metrics measuring data quality

- Data quality indicator with the conforming use case.

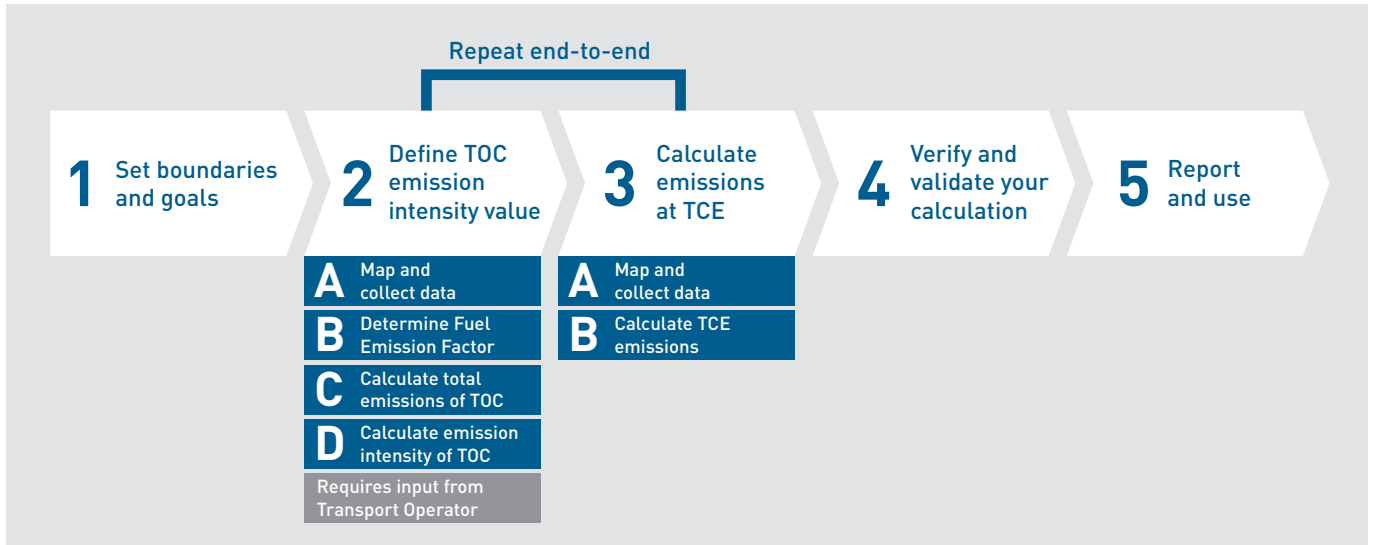
This approach enables both emissions and data quality transparency, thus facilitating data users' understanding of any possible data limitations and unlocking data quality improvements over time.

Companies should prioritize primary data in their calculations where feasible

To calculate end-to-end emissions from logistics operations, this Guidance details different approaches depending on the available data. If primary data is available, companies should follow the steps below:

¹ In case of containerized maritime transport, this can be expressed in twenty-foot equivalents (TEUs) and for mail and parcel, this can be expressed per item.

Figure 1: Steps to calculate emissions



However, in many cases, primary data will not be available. Companies may therefore refer to modeled or default data to calculate logistics emissions. If secondary data is used, the applicable steps depend on the transportation mode and the extent to which individual primary data points may be available. The Guidance therefore introduces a decision tree for each transportation mode to help companies undertake calculations using the best available data. The newly introduced data quality indicator provides the user with an understanding of the quality of the input data used to calculate the emissions.

Assurance and verification are crucial to establish trust in emissions disclosures

Finally, companies seeking to share logistics emissions data should ensure rigorous assurance and verification to increase trust in and reliability of the data. This Guidance defines three ambition levels around assurance and verification, depending on the data user’s needs and the reporting company’s readiness:

- **Bronze:** a minimum level of assurance providing a baseline of trust in shared emissions data
- **Silver:** an intermediate level of assurance increasing the granularity and scope of the assured emissions data
- **Gold:** a North Star ambition level for logistics emissions assurance, providing strong trust in the exchanged emissions data.

Over time, companies are encouraged to increase the assurance ambition level to reach assurance practices

similar to that of financial data, requiring regular assurance to ensure a reasonable level of confidence. Nevertheless, companies may choose the assurance ambition level that best suits their objectives, as long as companies transparently communicate what level of verification is associated with the shared emissions data.

Collaboration and adaptability will be central to scaling up logistics emissions disclosures and ensuring ecosystem convergence

This Guidance was developed in a collaborative effort between GLEC, hosted by Smart Freight Centre, and the Partnership for Carbon Transparency (PACT), hosted by the World Business Council for Sustainable Development (WBCSD), as part of a wider effort to increase transparency on (primary) emissions data across supply chains. It is the result of a collaborative development process, gathering input from 30 stakeholders in the logistics industry, representing shippers, logistics service providers (LSPs), carriers, and technology solution providers. While this Guidance constitutes a best effort toward supporting companies’ calculation journeys, the evolving data-capture technology and decarbonization landscape will require all logistics stakeholders to adapt the best available approaches as they change over time. Similarly, as the emissions disclosure ecosystem grows, collaboration and exchange will become ever more important. All logistics stakeholders are encouraged to foster methodological alignment across the logistics industry, ensuring that the industry “speaks the same language” and collectively unlocks the required decarbonization transformation.

1. Introduction



1. Introduction

1.1 Setting the stage

There is a mutual understanding: to reach 2050 climate goals it is essential that supply chains are decarbonized. A core prerequisite is the availability of high-quality emission-related data at the point of decision-making. With more granular and consistent data on activity and energy use, organizations can better measure actual emissions and use this to design, monitor, and adjust decarbonization strategies.

The Global Logistics Emissions Council (GLEC) Framework and the forthcoming ISO 14083 standard are supporting organizations on the journey toward supply chain emissions transparency, setting international recognized methodological standards on how to calculate greenhouse gas (GHG) emissions from logistics operations. However, companies still experience challenges: a lack of emission-related data, uncertainty about the approach to take when this is the case, and complexity arising from the use of different technologies.

To address these challenges and help create greater transparency on emissions, Smart Freight Centre, and World Business Council for Sustainable Development (WBCSD) started a collaborative project with the ultimate goal of defining more detailed guidance on how to calculate GHG emissions from freight transport. This Guidance advances and builds on existing methodologies with the aim of increasing consistency and clarity of different calculation approaches across a complete supply chain from end-to-end. This Guidance delivers a clear methodology for calculating emissions from a multimodal supply chain and provides a framework to assess input data quality and assurance of the results.

This project is part of a wider effort to increase transparency on (primary) emissions data across supply chains, known as the Partnership for Carbon Transparency (PACT), which is hosted by WBCSD.

1.2 Objectives

This Guidance aims to enable organizations to understand the GHG logistics emissions incurred from supplier to end customer.

Specifically, the objectives of this Guidance are to:

- Increase the consistency and quality of data to enable better comparability of logistics GHG emissions
- Clarify how and when to use primary data across end-to-end logistics supply chains
- Create performance indicators to be used in procurement processes.

This Guidance builds on a series of existing standards and guidance to help organizations quantify and reduce emissions from logistics operations. This Guidance is explicitly designed to complement the [GLEC Framework](#) and the [Pathfinder Framework](#) (developed by PACT) on questions such as the operational application of emissions quantification in logistics, the quality of data, and assurance requirements. In version 3 of the GLEC Framework, the newly introduced concepts of this Guidance will be reflected.

Other standards referenced and recognized in the design of this Guidance are:

- ISO14083:2023 (forthcoming) for details on the quantification and reporting of logistics emissions
- EN17837:2023 (forthcoming) for details on the mail and parcel sector
- AFNOR Spec X43-072 for operationalization of the calculations
- Clean Cargo methods for containerized maritime transport
- GLEC Low Emission Fuels and Vehicles Work for additional guidance on emission factors
- GLEC Data Access for Logistics Emissions Accounting and Reporting for the data model requirements.

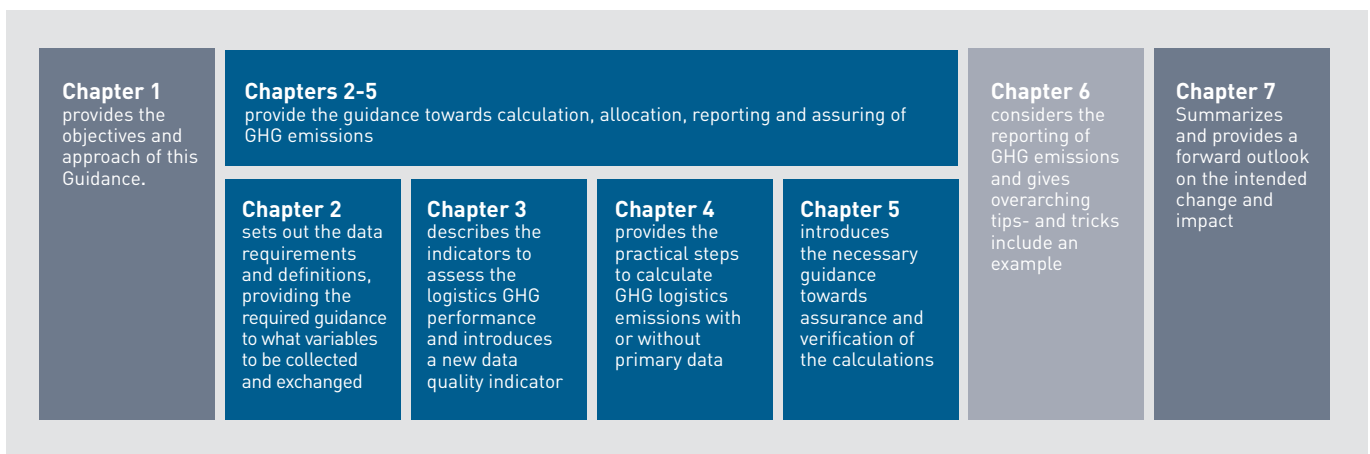
1.3 Approach

This Guidance has been developed in collaboration with over 30 partners from across the logistics industry, representing shippers, logistics service providers (LSPs), carriers, and technology solution providers. Each partner was invited to share a use case for an end-to-end logistics supply chain and identify core challenges faced in reporting GHG. On this basis, ten workshops were conducted to discuss the main challenges. Together, we identified the following five challenges:

- Reporting emissions at the level required by customers (e.g., product, parcel, pallet, and unit of sale)
 - Reporting from network operations
 - Data visibility for road, sea, air, and rail transportation services operated by third-party subcontractors, specifically operational data on last-mile delivery and empty mileage
 - Combining and comparing Scope 3 data with varying levels of granularity and differing reporting methodologies used
 - Uncertainty regarding the usage of emission factors for the fuels and energy carrier used.
- Participants then jointly identified potential solutions to these challenges, forming the basis for this Guidance.

1.4 Structure of the Guidance

Figure 2: Structure of the Guidance



1.5 Scope of the Guidance

It is important to note that the landscape of carbon accounting and reporting is evolving fast. The introduction of direct data-capture technology and digitization across many parts of the global transportation industry – while providing access to better data – increases the complexity of emissions calculation, comparison, and reporting. However, the challenge is not uniform, as the capture of and access to primary data is still problematic in some transportation sectors.

This Guidance is written with these considerations in mind and aims to support the calculation journey to ensure the highest level of accuracy possible from the data sources available.

Given the increasing industry-wide focus on the need to decarbonize transportation and the significant investment in digitization of this sector, further improvements in the availability, quality, and timeliness of transportation-related data can be expected in the years ahead. It may, therefore, be necessary to issue further guidance updates to reflect this in the future, which readers are requested to take into account.

2. Data requirements and definitions



2. Data requirements and definitions

The first step in any effort to calculate emissions is to identify and collect the relevant data for the required use case. This section therefore introduces the key definitions of logistics GHG emissions accounting and provides some reflections on data granularity and approaches to capture the required data.

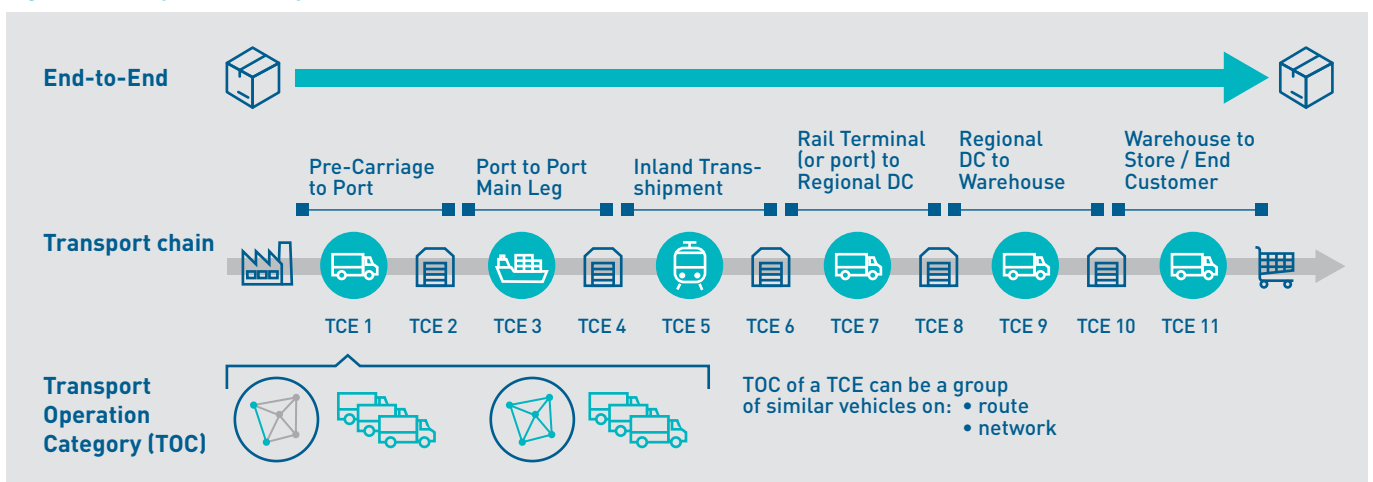
2.1 Definitions and concepts

There is a mutual understanding: to reach 2050 climate Throughout this Guidance, specific terms and concepts are used. These are defined in Table 1.

Table 1: Crucial definitions for concepts of logistics GHG emissions accounting	
Term	Definition
Transport operator/ reporting company name	Entity that carries out transport operations involving carriage of freight, passengers, or both.
Shipment	Identifiable collection of one or more freight items (available to be) transported together from the original shipper to the ultimate consignee.
Consignment	Separately identifiable amount of freight transported from one consignor to one consignee via one or more modes of transport.
Transport operation category (TOC)	Group of transport operations that share similar characteristics, based on mode, journey, freight, trade lane, or contract type. Aggregation to a TOC can be based on a specific round trip, vehicle class, or schedule. <i>E.g., maritime container transport or shared long-haul road freight of pallets.</i>
Transport-chain element (TCE)	Section of a transport chain within which the freight is carried by a single vehicle or transits through a single hub. <i>E.g., the journey from port A to port B or the processing in a distribution center are TCEs.</i>
Feedstock	Source of origin of the energy carrier(s) (such as grid electricity, renewable, soy, waste, or fossil; country or region specific).
Ton (t)	Unit of measurement for the mass of a consignment. Within the scope of this document, ton refers to a metric ton.

For example, for road, the TOC may include freight type, condition, journey type, and contract type, while for aviation it may include journey length and plane configuration. In addition, it groups different vehicles operating under the same network or lane together.

Figure 3: Example of a transport chain, TCE, and TOC



2.2 Data considerations

Company emissions reduction road maps must strike a balance between two elements:

- Calculating emissions with what is technically and operationally feasible based on the available data
- Being able to start implementing and monitoring reduction opportunities while communicating the limitations of the available data quality level.

For instance, a company that continues to quantify its emissions using financial data over the years will only be able to quantify an emission reduction if it lowers its expenses, while a methodology based on company-specific operational metrics would enable the tracking of reductions based on material, network, and/or supplier changes.

Since the type of data used for the calculations shall always be reported alongside the resulting emissions, companies are encouraged to gather operational data systematically from their operations. The more granular the data is, the more precise and reliable their emissions calculations will be. Primary data is therefore always preferable, and companies should work on improving data availability to this end.

At the same time, perfection should not stand in the way of progress. Other forms of data, such as modeled and default data, will have to be used along with less

granular operational data where primary data is not available to conduct emissions calculations and implement decarbonization actions. Companies should seek a balance between using these input data sources to cater to their needs and taking consistent steps to continuously improve the data quality in their systems.

Similarly, calculations of emission intensity should be performed at a frequency that is deemed useful to track improvements over time, seasonality, or change in overall demand profiles. Examples are showcasing the peak season in December for the mail and parcel sector, a change in routing, or the introduction of battery-electric trucks.

Tracking and using individual trip-level data for reporting emissions can provide specific insights for certain use cases related to a trip if benchmarked correctly but also risks accentuating potential outliers. Thus, when using trip-level data, an aggregation over time is necessary to avoid conclusions drawn on the basis of one or a few individual trips.

Where primary data is not available, consideration of the scope and intended purpose of emissions calculations can help guide data requirements and establish what data as a minimum is needed to perform the task at hand. Table 2 provides details of the respective data recommendations for each use case.²

Table 2: Use cases and respective requirements

Use case	Details	Examples	Data recommendation
Reporting	<ul style="list-style-type: none"> • Meeting regulatory or voluntary transparency requirements • Focusing on selected period and whole organization or parts of the supply chain 	<ul style="list-style-type: none"> • Corporate reporting (sustainability reports) • Disclosures to rating platforms 	<ul style="list-style-type: none"> • Preferred: granular (primary) data • Alternative: modeled or default data sets • Using: aggregated emission intensity factors
Business decision-making	<ul style="list-style-type: none"> • Analyzing past performance to make future changes • Reporting from carriers/LSPs to shippers 	<ul style="list-style-type: none"> • Mode switch • Collaboration with carriers • Horizontal collaboration • Selection of alternative fuels/vehicles • Identification of opportunities to reduce GHG emissions hot spots 	<ul style="list-style-type: none"> • Preferred: granular (primary) data • Alternative: detailed modeled data • Using: granular, disaggregated emission intensity data
Granular optimization	<ul style="list-style-type: none"> • Analyzing past performance to track and measure progress • Reporting from carriers/LSPs to shippers 	<ul style="list-style-type: none"> • Carrier-level optimization (driver training, routing per leg, and consolidation) • Quantification of the impact of idle times in GHG emissions • Quantification of the impact of already implemented modal switch (to assess initial targets vs actual) • Supply chain optimization to reduce GHG emissions 	<ul style="list-style-type: none"> • Preferred: granular (primary) data • Alternative: detailed modeled data • Using: granular, disaggregated emissions intensity data

² These use cases mirror those identified in the GLEC Data Access and Exchange project, which focuses on the most common uses of data when shared across a value chain. Additional use cases are highlighted in the GLEC Framework but not covered here.

2.3 Data variables

When collecting, using, and exchanging data, it is crucial that all parties use the same definitions for the data parameter in scope. The Guidance follows the definitions of the Smart Freight Centre Data Exchange Model (Data Access For Logistics Emissions Accounting and Reporting, or GLEC Data Access and Exchange project),³ which builds on the GLEC Framework.

Depending on which part of the logistics supply chain an organization operates in as well as its business model, different data variables will be required to be shared. It is therefore crucial to evaluate data needs with internal stakeholders before engaging in any GHG-related data collection and exchange activity. The Data Exchange Model categorizes which variables are mandatory to ensure compliance with the GLEC Framework and GLEC Declaration. However, companies should start from the minimum and aim to continuously work toward adopting more variables to achieve greater accuracy when calculating emissions from their supply chains.⁴

The Data Exchange Model also provides further information on data responsibilities per calculation or reporting case. Defining which of these are relevant can guide a company on what input data is sufficient and what data may be less crucial. The subsequent calculation approach will depend on the data available.

Specific information for end-to-end calculations

To understand end-to-end emissions in detail, total TCE emissions must be identified (see Chapter 4 for calculation approach). This requires TOC emission intensity to be identified first as a basis for further calculations.

Input data for calculation of TOC emission intensity

To define the input data, the principles of ISO 14083 shall be followed. This sets out the requirements for each mode, with this Guidance specifying that a TOC emission intensity will always be calculated at the level of a fleet of vehicles operating in a specific network.

Input data for calculation of TCE emissions

Companies shall refer to Table 3 for a list of variables to consider at the TOC and TCE level. Collecting information at a granular scale (per TCE), simplifies the upward aggregation process and provides a sufficient foundation to perform data-intensive tasks that inform supply chain decisions. This table is meant to act as a guide and qualitative representation of the more technical work conducted within the GLEC Data Access and Exchange project. When companies wish to implement the data protocol, they shall refer to the latest data model, proposed in the second publication of the [GLEC Data Access and Exchange project](#), for more technical details.

³ For more details on the GLEC Data Access and Exchange project, please see [here](#). The quick download can be found [here](#).

⁴ Actors may choose not to share data they may consider to be commercially sensitive or confidential.

Note 1: The minimum requirements are defined for items marked with (*).

Note 2: For companies where the TOC level of aggregation and exchange is more meaningful, they can fill out and collect the data at that level.

Table 3: Variables to be considered for the data collection and exchange of GHG data on a TCE level

	Term	Definition
TOC-level information Transport information about a group of vehicles within a transport-chain element for a specific consignment	Transport operator/reporting company name/ID (*)	Identification code/name of the company submitting/reporting the data.
	Accreditation status (*)	Statement of accreditation of the calculation methodology.
	Verification status (*)	Statement of external verification of the input data.
	Transport operation category (TOC)	Group of transport operations that share similar characteristics, based on mode, journey, freight, trade lane, or contract type. Aggregation to a TOC can be based on a specific round trip, vehicle class, or schedule.
	Mode of transport (*)	Means of transport or type of transport (e.g., rail, sea, or road).
	Mode-specific asset type	Specific category of asset, such as 40t truck, 3.5t van, container vessel, or bulk vessel.
	Emission class (road)	Identification of the vehicle emission class (road).
	Load factor	Ratio of the actual load (mass) to the maximum legally authorized load of a particular vehicle.
	Empty distance	Ratio of the section of the route of a vehicle during which no freight is transported to the total distance of a vehicle on a TOC level.
	Temperature control	Status of freight being non-ambient.
	Energy consumption	Amount of energy consumed. Accompanied by a respective unit field. In case of multiple sources of energy, respective fields have to be defined.
	Energy Carrier	Category of energy carrier, such as diesel, HVO, petrol, CNG, LNG, LPG, HFO, MGO, aviation fuel, hydrogen, methanol, and electricity. In case of multiple energy carriers, respective consumption (e.g., liters or emissions) need to be disclosed.
	Feedstock	Source of origin of the energy carrier(s) (e.g., electricity, renewable, soy, waste, or fossil; country or region specific).
	Emission intensity (*)	Coefficient specifying transport activity's GHG emissions at the TOC level.
	TCE-level information Transport information about a single transport-chain element for a specific consignment.	WTW fuel emission factor (certified)
Data quality indicator		Categorical variable defining the level of data quality reflected in the calculated CO ₂ e.
Shipment ID (*)		Identifier of the shipment.
Consignment ID (*)		Identifier of the consignment of a shipment.
Transport chain element ID (*)		Identifier of the transport-chain element of a consignment.
Freight mass ⁵ (*)		Mass of the transported freight. The suggested unit is kg.
Packaging unit	Category of the packaging designed to contain one or more articles or packages or bulk material for the purposes of transport, handling and/or distribution. In this case, maritime and rail containers (e.g., twenty-foot equivalent or TEU, forty-foot equivalent or FEU) are considered as packaging unit, as well as acting as a functional unit for transportation used for reporting and analytical purposes. The number of units needs to be disclosed alongside unit category.	
Origin location (*)	Location of pick-up of the consignment.	

Table continued on the next page.

⁵ Freight mass: for the shipping industry, this should include container weight.

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Table 3: Variables to be considered for the data collection and exchange of GHG data on a TCE level		
	Term	Definition
TCE-level information Transport information about a single transport-chain element for a specific consignment.	Destination location (*)	Location of delivery of the consignment.
	Actual distance	Distance between the origin and the destination of a consignment of freight or a vehicle, measured by a telematics system.
	Activity distance	Distance between loading and unloading of the freight transported – distance provided should be the planned distance. Shortest feasible distance in ISO 14083 should be used for road, rail, inland waterways, and sea transport. Great-circle distance should be used for air.
	Departure date	Date of departure of the consignment.
	Arrival date	Date of arrival of the consignment.
	Transport activity (*)	Amount of freight multiplied by the assignment or allocation distance, expressed in ton-kilometers (tkm). For maritime movements, TEU-kilometers (TEUkm) are also permitted, and for the mail and parcel sector, item-kilometers (itemkm) can be used.
	Voyage number	Identification number of the specific voyage
	Flight number	Identification number of the IATA flight number.
	CO ₂ e TTW (*)	GHG emissions released to atmosphere as a result of vehicle operation (tank-to-wheel).
	CO ₂ e WTW (*)	GHG emissions released to atmosphere during the process of producing, storing, processing, and distributing an energy carrier for vehicle operation + GHG released to atmosphere as a result of vehicle operation (well to wheel).

2.4 Data exchange

Data requirements are further guided by the intended reporting level. The more granular the aggregation level, the more granular the data requirement. The exchange of emissions from a carrier to a shipper (or LSP) can take place at the level of:

- **Company:** GHG emissions produced by the carrier for the client
- **Transport chain:** GHG emissions of a consignment (from origin to destination)
- **TCE:** GHG emissions of a transport leg (at consignment level)

A carrier or shipper, for its own business reporting and analytical purpose, aggregate emissions to various levels, including:

- Allocation of emissions and calculation of emission intensity per location (origin, destination, trade lane)
- Allocation of emissions and calculation of emission intensity per TOC (group of assets)
- Split of emissions per energy source used in a TOC
- Allocation of emissions per carrier, LSP, or shipper to monitor and report performance
- Allocation and understanding of emissions per driver

In case of network operations, please note that for a shipper, a single TCE (point A-B) in the transport chain can actually consist of multiple TCEs (A-X, X-Y, Y-B) within the carrier network.

2.5 Adopting a new data structure

The structure variables summarized in Table 3 shall be followed for the collection and storage of data as closely as possible, for example, regarding naming conventions and respective units. The structure is designed to create consistency, facilitate data exchange between different stakeholders, and consider future reporting needs of the logistics industry. This will also decrease the time needed to handle and blend data and improve transparency in the use of semantics in emissions reporting.

In case this list of variables is too extensive considering each company's business scope and reporting needs, minimum variables (as shown in Table 3) should be tracked. We recommend to then start with monitoring and exchanging the mandatory variables and, as the IT systems mature, add more variables that stem from business needs. Companies can consider the following guiding questions when designing their data warehouses and collection systems. These questions are meant to provide an example of main questions to be answered and to enable the reverse engineering of needed variables for each company's use case. The questions originate from discussions that took place in the current and the GLEC Data Access and Exchange project.

Questions to consider

- What is the scope and purpose of data collection and reporting?
- Who is the audience of the reported emissions?
- With which preferred frequency shall data be aggregated? Annually, quarterly, monthly? Other?
- Who is the data owner and where is the data stored?
- Who is the party calculating the GHG emissions?
- What local/national regulations exist concerning data collection?
- Is there any information on the multimodal chains (e.g., knowledge on the ship or train cargo is transported in)?
- Is there any empirical data on empty distance and load factors?
- In case of lack of data, what are the minimum characteristics known for a TOC to navigate through default values selection?
- How are shipments versus consignments captured in the system?
- What are the unique IDs with which carriers can be identified with?
- What are the unique IDs with which consignments of a shipment can be identified with?

3. Performance indicators and data quality



3. Performance indicators and data quality

3.1 Logistics GHG emissions performance indicators

When evaluating the GHG emissions performance of logistics chains and activity, the following indicators shall be used:

- Emissions, expressed in WTW CO₂e (kg)
- Emission intensity, expressed as the emissions per activity (kgCO₂e/tkm)⁶
- Transport activity (tkm)

In specific circumstances, alternative allocations can be considered. This needs to be justified and documented. In the mail and parcel operations, the transport activity can also be expressed per item-kilometer. For containerized transport, the transport activity can be expressed in TEU-kilometers. This needs to be applied throughout the transport chain.

To allow for a complete supply chain and comparison across operations, conversion factors are provided:

- For conversion factors from TEUs to tons, a weight of 10 tons is considered average TEU, 14.5 tons is considered heavy cargo, and 6 tons is considered lightweight cargo. Please note that a TEU is a standard 20-foot container, meaning that a 40-foot container is 2 TEU and at 20 tons is considered standard weight. A 45-foot container is 2.25 TEU. Further details are specified in the GLEC Framework and the Clean Cargo Methodology.
- For conversion factors from items to tons, no standard conversion factors exist. Modeling and averaging of the weight associated with standard packaging categories is therefore recommended. This is meant to be performed at a company level.

With these metrics, the overall GHG performance of logistics operations can be assessed. However, a perfect calculation does not exist, and the performance of operations can be influenced by many factors that need to be considered when evaluating and comparing transport chains or even similar elements of different transport chains (i.e., comparing a middle-mile TCE). For example, route network, weather, and geography can all have a significant effect on the final emissions.

Further details of the calculation are provided in Chapter 4.

3.2 Evaluating input data quality for GHG calculation

Data quality is a composite indicator, approximating the extent to which information represents reality. The audience of any emissions report should be aware of the data type and quality involved in the calculation of GHG impacts. This is crucial as the communicated numbers are then placed in a concept of “confidence” as to how well they reflect reality.

Information on data quality is as crucial as the emissions information, as it fosters trust in the shared information and enables transparency on any assumptions made in the calculation process.

If, for example, data collection is extremely challenging for a specific TOC, then the calculation will probably be based on default data. When communicating the emissions of this TOC to the audience, the specifics of the calculation will be qualitatively characterized by the data quality indicator. Thus, the audience can correctly interpret the communicated output.

On top of this, different data inputs are required for different use cases. For instance, for annual reporting, a different level of granularity and detail is required for supply chain optimization. In perfect circumstances, the data quality needs to conform to the use case at hand to facilitate informed decisions. If an organization cannot meet the data-quality requirements of a specific use case, it is advised to take that into account when communicating the certainty or uncertainty of the output.

To create transparency on data quality, a tiered quality ranking indicator should be applied to the TOC and TCE variables (Table 4 and Table 5). This is a separate, more detailed indicator than the ISO 14083 “primary/modeled/default” qualification and follows the logic of the Pathfinder Framework for data quality, with adjustments to reflect the specificities of the logistics industry.

The resulting key performance indicator (KPI) will create more clarity on the various data sources and the level of confidence an audience can have in the communicated amount of total CO₂e within an end-to-end supply chain.

⁶ Distribution centers, warehouses, and transport nodes shall use tonnage, items or TEUs as the denominator for throughput.

Table 4: Data quality indicator at a TOC level

Data quality level	4 - Unsatisfactory	3 - Sufficient	2 - Good	1 - Excellent
Requirements of emission intensity	<ul style="list-style-type: none"> Proxy used (e.g., financial data or global default values) 	<ul style="list-style-type: none"> Default emission intensity factors for mode/freight type (e.g., GLEC or regional default data) 	<ul style="list-style-type: none"> Modeled emission intensity factor, using known TOC category with specific asset class, considering (i) empty distance and (ii) load factors or Carrier-specific annual average emission intensity factor for TOC or Green freight program 	<ul style="list-style-type: none"> Carrier-specific emission intensity factor for TOC, which is updated monthly or quarterly or as frequent as deemed necessary
Input data to obtain or calculate emission intensity	<ul style="list-style-type: none"> Modeling from invoice data Modeling without geographic adaptations in default factors 	<ul style="list-style-type: none"> Default GLEC factors for mode/freight Default regional factors for mode/freight 	<ul style="list-style-type: none"> Modeled energy-based factors for defined TOC (in conformance with GLEC Framework) or Primary data calculation for defined TOC using: <ul style="list-style-type: none"> - Energy type and fuel emission factor - Total energy consumption within chosen timeframe - Total transport activity within chosen timeframe 	<ul style="list-style-type: none"> Primary data calculation for defined TOC using: <ul style="list-style-type: none"> - Energy type and fuel emission factor - Total energy consumption within chosen timeframe - Total transport activity within chosen timeframe
Conforming use cases		<ul style="list-style-type: none"> Corporate reporting Customer reporting Corporate target setting and communication Mode selection 	<ul style="list-style-type: none"> Selection of alternative fuels/vehicles Horizontal collaboration LSP performance evaluation 	<ul style="list-style-type: none"> Carrier-level optimization (driver training, routing per leg, or consolidation), conducted by transport operator Supply chain optimization Carrier performance evaluation

Table 5: Data quality indicator at a TCE level

Data quality level	4 - Unsatisfactory	3 - Sufficient	2 - Good	1 - Excellent
Origin-destination	<ul style="list-style-type: none"> Country level 	<ul style="list-style-type: none"> City level 	<ul style="list-style-type: none"> Postal code or planned distance 	<ul style="list-style-type: none"> Postal code/ coordinates/ planned distance
Weight	<ul style="list-style-type: none"> Estimated 	<ul style="list-style-type: none"> Estimated 	<ul style="list-style-type: none"> Actual 	<ul style="list-style-type: none"> Actual
Emission intensity factor of TOC	<ul style="list-style-type: none"> Proxy 	<ul style="list-style-type: none"> Default value 	<ul style="list-style-type: none"> Modeled or carrier-specific annual emission intensity factor 	<ul style="list-style-type: none"> Carrier-specific emission intensity factor updated monthly or quarterly or as frequent as deemed necessary

To interpret and decide where a data set stands on this quality assessment, the above measures shall be seen as a checklist where all conditions must be satisfied (“and” relationship) to meet the required tier. For example, a data set cannot rank “good” if all other conditions are met but the fuel type is unknown and thus a default is assumed.

The ranking “unsatisfactory” has been included to reflect current realities and approaches undertaken by the industry, but the ranking is neither ISO 14083 compliant nor recommended.

Increasing the data quality level will require organizations to invest significant time and multistakeholder effort to gradually move toward a “good” or “excellent” data quality ranking. It is understood that progress toward better data quality will likely be made over time and require financial commitment, human resource allocation, and IT system upgrades. However, perfect data is not necessary for all decisions. Instead, the required data quality needs to be matched with the corresponding use case and reporting requirements (see below for further details).

If an organization cannot meet the data quality requirements of a specific use case, it is advised to take that into account when communicating the certainty or uncertainty of the outputs. It is crucial to communicate the data quality KPI along with the emissions results to enable clarity for the audience regarding the data input of each use case. It is highly advised to perform the respective actions with the recommended data quality ranking for the input data.

3.2.1 Defining TOC and sample size to calculate emission intensity

There are three main characteristics to define a TOC: mode of transport accompanied by an asset type or class, the operational characteristics (temperature control, contract type, etc.) and the journey type (geography, routing, and distance). For rail transport, the propulsion type is also required. In other modes of transport, the energy source could be used to characterize a TOC but it is not a necessary requirement. By defining a TOC with a mixed energy source and as the fleet gradually decarbonizes, this will be reflected by a decreasing emission intensity over time as long as the carbon intensity of the energy source decreases. On the other hand, a TOC defined with a single energy source can help in understanding and comparing other factors, such as driver efficiency and utilization rates.

When assessing the quality ranking of an emission intensity, ideally 100% of the data stemming from the TOC under study shall be used. The data quality will then represent the full population and all its features. When asset data is missing within the same TOC, it is suggested to at least try to quantify what share of total assets have missing information. The aim is to understand exactly how much knowledge exists at the TOC level and to be confident when communicating the TOC description and its emission intensity to other stakeholders.

To decide on a sample to calculate the emission intensity when data from the full population of the TOC is not known, the recommendation is to employ the following five steps:

- 1 Consider the energy source(s) of the TOC. If there are multiple energy sources, the TOC can either be split into different, single-energy-source TOCs or be treated as one TOC with multiple energy sources.
- 2 Count the assets and their total contribution to the total emissions of the TOC. When the assets have been split into multiple TOCs, ensure that the population of each TOC is bigger than 30 or over 80% of the data is covered through the sample. Having less than 30 assets in a TOC will mean that this population is very small to sample from and derive statistically significant assertions. In that case, monitoring primary data from all assets is recommended. If that is not possible, using at least 80% to derive the emission intensity is deemed necessary.
- 3 In cases where more than 30 assets exist, the transport operator can choose to take a statistically relevant sample size from the total number of assets (total TOC fleet size). The sample should reflect the total TOC fleet size and be representative of the assets within the TOC. Ensure the sample is reflecting all required operation features (e.g., transport activity, loading rates, and energy consumption). Only then will the operator be able to confidently generalize the results of the sample to the population.
- 4 Compute the emission intensity of the sample, based on primary data and assume the same value for the full population of the TOC.

- 5 Compute the total emissions, and data quality of the TOC using the guidance of Section 3.2.2. and Section 4.1.

Example: if both Euro 5 and 6 vehicles are in a composed TOC and the population's transport activity is 60%-40%, then that ratio shall also be reflected in the sample. The same applies to other characteristics defining the TOC (e.g., the energy source or size).

The key takeaway is that the method chosen to reach an emission intensity value and respective data quality indicator shall be methodologically sound and respect the features of a TOC. In addition, by being transparent and communicating those choices to the relevant stakeholders, the context of how the emission intensity

was derived is clear and the audience using these values will be confident in making decisions for their supply chain.

3.2.2 Data quality assessment of an end-to-end transport chain

The data quality of an end-to-end transport chain shall be calculated using a weighted average of the individual data quality indices of each TCE based on the respective emissions of each TCE within the total transport chain. With this approach, the transport-chain element's data quality with the highest emissions will be of most significance to the aggregated data quality value of the full transport chain. See the formula below, which will result in a data quality index of 1-4:

Data quality of transport chain (end-to-end)

$$= \text{data quality of TCE}_n * \sum_1^n \frac{\text{emissions of TCE}_n}{\text{emissions of the transport chain}}$$

4. Calculation guidance: Using primary data



4. Calculation guidance: Using primary data

4.1 Introduction: Calculation with primary data

Many shipments have multiple transport legs in their transport chain, and each TCE may include a different mode or carrier performing the transport. As a result, the calculation of logistics freight emissions for Scope 3 reporting can be very complex.

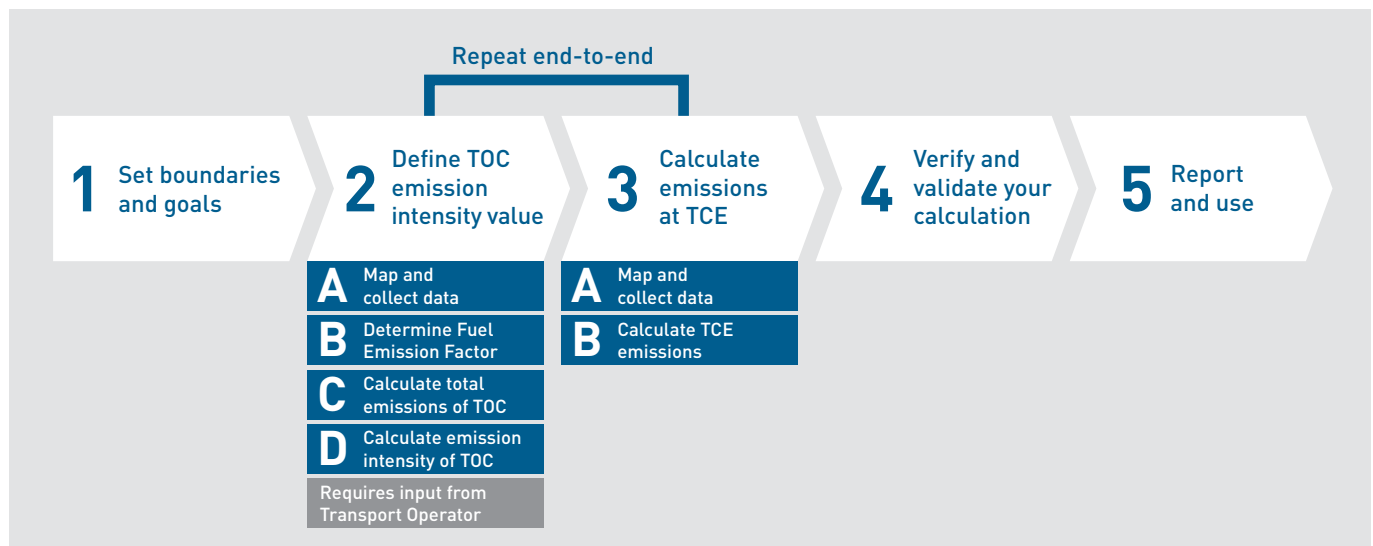
The reader is encouraged to read the GLEC Framework and ISO 14083 to understand further details.

This section sets out the five calculation steps required to determine GHG emissions across the supply chain using primary data that corresponds to a “good” or

“excellent” quality level (Figure 4). To maximize calculation consistency, required data variables and calculation method to be used are specified.

Since it is not always easy to collect useful primary data from transport service providers, Chapter 5 covers how to deal with such a lack of information per mode. To increase understanding of the Guidance, this includes a recommendation on who should undertake the calculation for each step. In addition, it is suggested and recommended to utilize a Smart Freight Centre accredited partner to ensure calculations are compliant with the GLEC Framework.

Figure 4: Flowchart representing the calculating and reporting steps



4.1.1 Set boundaries and goals (Step 1)

The first step is to identify the scope of logistics activities that will be included in the calculation process. For this purpose, it is essential to determine the main objective, namely what the results will be used for and with whom the emission intensity values will be shared and what their reporting activity level is (i.e., internal, B2B, or external reporting). Based on this information and given a single end-to-end supply chain, qualitative selection criteria for TOCs can be established and TOCs can be composed.

Details on the main features of the transport equipment and journey can be used to help define the TOC. Some of the characteristics to be considered are:

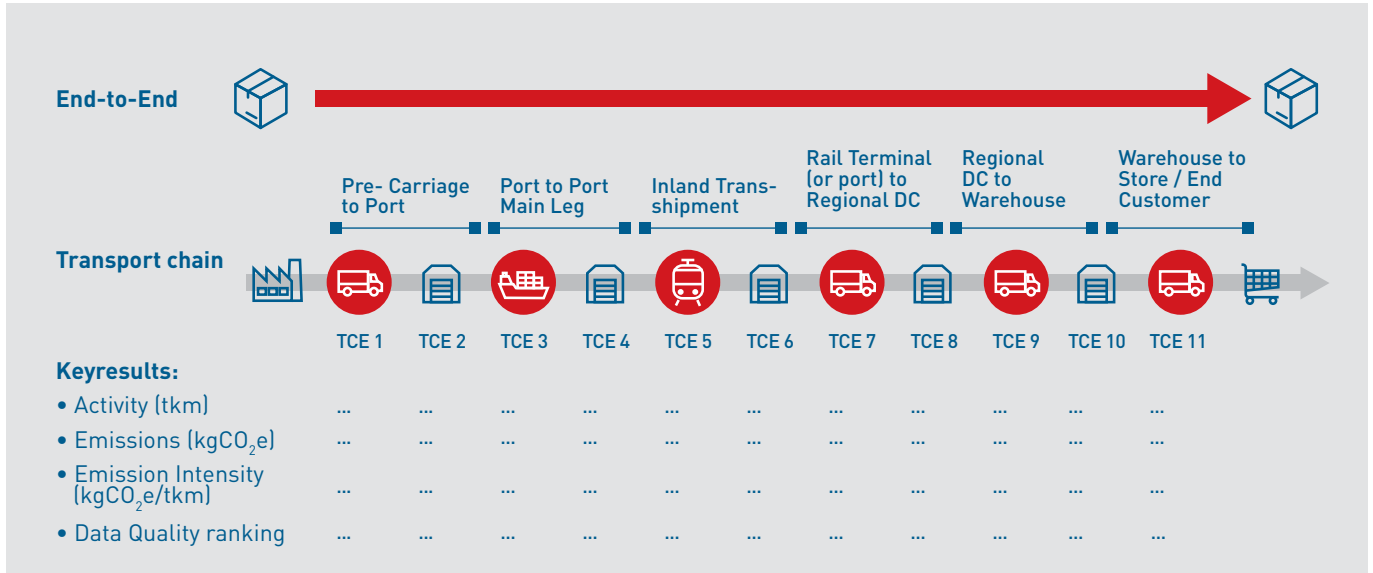
- Freight type (dry bulk, containerized, parcel, volume limited, etc.)

- Condition (ambient, refrigerated, etc.)
- Journey type (long haul, multimodal, short sea shipping, last mile, etc.)
- Contract type (full-truck load, less-than-truck load)

Further information regarding definition of the TOC per transport mode can be found in the mode-specific sections (Section 4.2).

The transport chain shall be the complete transport activity to move the freight from origin to destination, broken into sequential TCE and including logistics site operations. Figure 5 shows an example of how to break down a transport chain in the individual elements based on the TOC they belong in.

Figure 5: Example transport chain



4.1.2 Calculate the emission intensity for the TOC and hub operation category (HOC) (Step2)

Summary

The transport operator calculates the CO₂e emission intensity for the transport activity of a TOC or HOC. A TOC or HOC consists of groups of similar round trips or logistics sites that are considered over a predetermined period of a quarter, month or other frequency, to provide a representation of how freight transportation services are purchased and delivered. A TOC or HOC emission intensity value should reflect all emissions incurred. This means a TOC includes empty trips within the chosen period of observation.

If there is no or limited access to primary data, the calculation method by modality should be followed.

In detail

2A: Collect the data that is needed to calculate the emission intensity

TOCs are decided on and based on the available data. The quality of the data can be classified into four categories: unsatisfactory, sufficient, good, or excellent. Refer to Section 3.2.2 for the minimum calculation requirements.

Transport operators must update the values for the defined TOCs/HOCs regularly. This data should, depending on the use case, be collected monthly or quarterly or as frequent as deemed required.

2B: Determine the Fuel Emission Factor (FEF)

Since the modalities and the corresponding fuel types used in the TOC/HOC are known, the FEF (kgCO₂e per L/kg/kWh) of consumed fuel – which indicates how many kg of CO₂e is emitted per unit of fuel – should be obtained from energy producers. Extra attention is needed when matching the fuel consumed with a fuel emission factor; the same units need to be respected. For example, if the fuel is measured in liters, then the FEF has to be expressed in liters too as in kgCO₂e per L. Alternatively, matched values should be obtained from approved sources.⁷ It is important to consider the FEF for the whole life cycle of the consumed fuel, that is, for WTW emissions. This includes extraction, production, transmission, and usage. FEFs shall be expressed in CO₂e.

Emission factors can be obtained from the following sources (in order of priority):

- 1 FEF provided by the energy/fuel provider, with associated third-party assurance certificate
- 2 National or regional emission factors from reputable sources (e.g., UK BEIS, US EIA data, French ADEME, or IEA)
- 3 FEFs provided by the GLEC Framework (Module 1).

⁷ See Chapter 3 for list of approved sources of emission factors.

2C: Calculate the total CO₂e emissions for the TOC or HOC

The CO₂e emissions for the TOC and HOC are calculated by multiplying the fuel/energy consumed with the FEF (WTW). It is assumed in this section that the fuel consumption is measured in liters, but other measures are common practice (e.g., kwh or kg). The empty distance and loading factor attributes for transport are automatically included in the calculations as their basis is primary data.

$$\text{C1 Emissions [kgCO}_2\text{e]} = \text{fuel consumed [L]} \times \text{fuel emission factor} \left[\frac{\text{kgCO}_2\text{e}}{\text{L}} \right]$$

If various fuel types are used in the TOC, the following method should be applied to determine the total emissions:

$$\begin{aligned} \text{C2 Transport emissions [kgCO}_2\text{e]} \\ &= (\text{fuel 1 consumed [L]} * \text{emission factor fuel 1 [kgCO}_2\text{e/L]}) + (\text{fuel 2 consumed [L]} \\ &* \text{emission factor fuel 2 [kgCO}_2\text{e/L]}) + \dots + (\text{fuel N consumed [L]} \\ &* \text{emission factor fuel N [kgCO}_2\text{e/L]}) \end{aligned}$$

2D: Allocate the emissions to the transport activity and calculate the emission intensity of TOC

The emission intensity is used to indicate how polluting the transported shipments in the considered TOC are. In order to calculate the emission intensity, the total transport activity shall be calculated first. The transport activity is the sum of the mass and activity distance of each shipment within the TOC considered (alternative with the same result: total mass shipped multiplied by average transport activity distance or average mass multiplied by total activity distance traveled).⁸ For hub activity only the transported mass is taken into account. The weight is considered the cargo including packaging as received from the consignor. Additional packaging materials used by the transport operator to support transportation should not be considered. The transport activity shall be calculated as follows (where n is the number of TCE considered within the TOC or HOC):

$$\text{D1 Transport activity[tkm]} = \sum_1^n \text{transported mass [t]}_n \times \text{transport distance [km]}_n$$

$$\text{D2 Hub activity[t]} = \sum_1^n \text{transported mass}_n$$

In the mail and parcel sector, the transport weight can also be expressed by number of items; in that case, the formula would multiply the average number of items by the total transport distance to obtain the transport activity. In the maritime sector, the transport weight can be calculated by the number of TEUs, meaning that the number of TEUs can be multiplied by the transport distance to obtain the transport activity.

Next, the emission intensity can be calculated by dividing the total emissions by the transport activity.

$$\text{D3 Emission intensity of TOC [kgCO}_2\text{e/tkm]} = \sum_1^n \frac{\text{total Transport Emissions [kgCO}_2\text{e]}}{\text{total transport activity [tkm]}}$$

⁸ If the planned distance is not available and only the actual total distance is known, ensure the distance is corrected with a distance adjustment factor to avoid underreporting and ensure compliance with ISO 14083. See the modal sections and ISO 14083 for details on distance.

$$\mathbf{D4} \text{ Emission intensity of HOC [kgCO}_2\text{e/t]} = \sum_1^n \frac{\text{total hub emissions [kgCO}_2\text{e]}}{\text{total hub activity [t]}}$$

The emission intensity resulting from equation 3 is an aggregate value for all shipments included in the TOC. This value can now be shared with shippers whose shipments are represented by the TOC along with the data quality index.

Repeat step 1 and step C1-D4 to calculate the emission intensities for all TOCs in the transport network.

4.1.3 Calculate emissions for the TCE, the transport chain, and allocate emissions at a product unit level (Step 3)

Summary

Shippers⁹ should collect emission intensity values for the TOCs and logistics sites representing the TCEs of their shipments from their transport operators. Using the collected emission intensity values, shippers can calculate the emissions for each of the TCEs of their own shipments and aggregate to the required transport chain and subsequently allocate the emissions at a desired reporting level (e.g., packaging unit or product unit).

In detail

Step 3A: Calculate the emissions for the TCE

For transport operations, the TOC emission intensity shall be collected from the transport operator for the TCE of the shipment and multiplied with the weight of the consignment and the TCE distance.

A1 Emissions per TCE [kgCO₂e] for hub operations

$$= \text{TOC emission intensity} \left[\frac{\text{kgCO}_2\text{e}}{\text{t}} \right] \times \text{mass of consignment[t]}$$

For hub operations, the HOC emission intensity shall be collected from the transport operator for the TCE of the shipment and multiplied with the weight of the consignment.

A2 Emissions per TCE [kgCO₂e] for transport operations

$$= \text{TOC emission intensity} \left[\frac{\text{kgCO}_2\text{e}}{\text{tkm}} \right] \times \text{mass of consignment[t]} \times \text{TCE distance [km]}$$

Repeat this for each TCE within a transport chain.

Step 3B: Aggregate the emissions to the transport chain: end-to-end

For a full end-to-end transport chain, the data needed to calculate logistics emissions on a single TCE shall be collected, which consists of the TOC, the TOC emission intensity, the transport activity (planned distance and mass), and the data quality as mentioned in Table 5.

For each of the TCEs, calculation steps 3a shall be performed. After calculating the emissions for all TCEs, all TCE emissions shall be added up to obtain the value of total emissions for the transport chain (Figure 5).

⁹ Shippers are referred to here; however, this also includes LSPs and other freight buyers who act as shippers.

The total emissions of a transport chain – end-to-end supply chain – are calculated by aggregating the individual emissions of each TCE. The emission intensity of the transport chain is obtained by dividing the total transport-chain emissions to the total transport activity.¹⁰ The data quality is calculated using a weighted average, weighing for the respective emissions of each TCE.

$$\begin{aligned}
 \text{B1 Emissions of transport chain (end-to-end) [kgCO}_2\text{e]} &= \sum_1^n \text{emissions of TCE}_n \\
 \text{B2 Transport activity of transport chain (end-to-end) [tkm]} &= \sum_1^n \text{transport activity of TCE}_n \\
 \text{B3 Emission intensity of transport chain (end-to-end) [kgCO}_2\text{e/tkm]} \\
 &= \frac{\sum_1^n \text{emissions of TCE}_n}{\sum_1^n \text{transport activity of TCE}_n} \\
 \text{B4 Data quality of transport chain (end-to-end)} \\
 &= \text{data quality of TCE}_n^* \sum_1^n \frac{\text{emissions of TCE}_n}{\text{emissions of the transport chain}}
 \end{aligned}$$

Step 3C (optional): Allocate the total emissions at desired product unit level

In addition, for companies that operate in parcel or product-oriented industries, the packaging unit and amount of product transported will be needed to answer the question of emissions per product or parcel.

Emissions of a transport chain shall be divided by the number of product units to derive the emissions on a product level:

$$\text{C1 Emissions per product unit [kgCO}_2\text{e]} = \frac{\text{emissions per transport chain [kgCO}_2\text{e]}}{\text{number of product units}}$$

prEN 17837:2023 provides further guidance on how to allocate emissions to a specific parcel based on that parcel's weight and volume, allowing for more accurate and granular allocation.

4.1.4 Verify and validate (Step 4)

The next step is to verify and validate the inputs and outputs of the logistics emissions calculation and reporting so that a company, its customers, and external stakeholders can have confidence in the accuracy of the reporting. Please see Chapter 5 (Assurance) for details.

4.1.5 Use the results for desired reporting purposes (Step 5)

Once the emissions have been calculated, the reader is encouraged to refer to Chapter 4 of the GLEC Framework. The company responsible for reporting has the option to communicate their emissions in a GLEC-conformant way. If the company chooses to stay GLEC conformant, then the GLEC Declaration (GLEC Framework, Chapter 4) shall be used as guidance when declaring the emissions with the addition of the data quality indicator. The aesthetic interpretation (design choices, sequence of presenting emissions data) of the GLEC Declaration in a report or a

¹⁰ Hub emissions are included in the total emissions of a transport chain. The hub activities are not included in the total transport activity of a transport chain.

dashboard is up to the judgement of the stakeholder creating the report. However, there is the prerequisite of transparently showing the minimum variables and metrics as stated by the GLEC Declaration.

Specifically, in the GLEC Declaration section, various cases of communicating the results can be found (e.g., B2B and to external stakeholders). The party who communicates the results is also responsible for clarifying the origin of this information and the extent of accuracy the amounts of CO₂e have with the real system they represent. Thus, we advise that the following data quality index (Section 3.1.2) is added to the GLEC Declaration as a mandatory element. In addition, it is welcomed to build on these and include more details as deemed appropriate by each company when communicating its results to interested parties. In case of deviations from the mandatory variables, a company cannot claim GLEC conformity.

4.2 Calculation without primary data (per mode)

In Section 4.1, we explained the calculation steps of logistics emissions using actual primary data. However, in practice it can be difficult to obtain primary data; therefore, alternative calculation methods based on modeled or default data can be used. The calculation steps when using modeled or default values are somewhat different than when using primary data and, in addition, modality-specific approaches are required. We will therefore highlight the calculation methods and particularities that arise at mode level if the data variables required in Step 2A are not fully available.

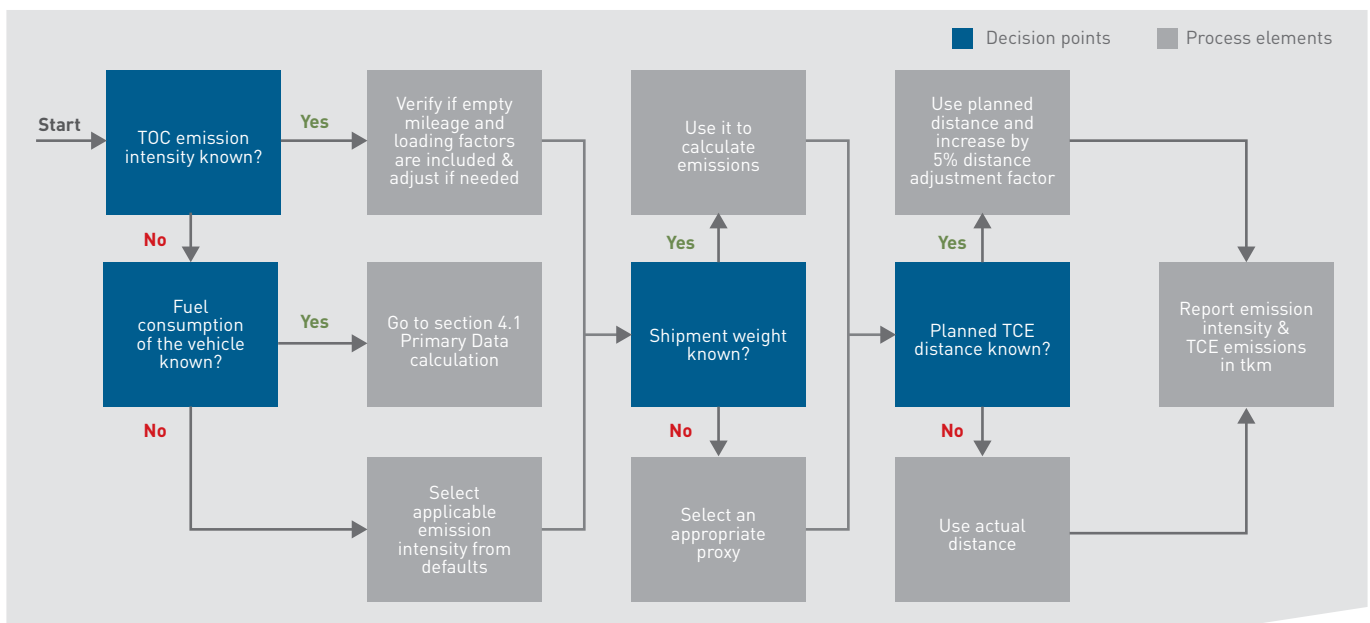
In case the primary data variables are known, the emissions can be calculated directly. However, if primary data variables are missing, modeled or default WTW emission intensity values should be used:

- Companies should work with carriers to get the actual fuel efficiency or CO₂e emission intensity per TOC that represent the load factor and empty distance for that network.
- If this is not feasible, then companies can model these data variables using accredited calculation tools.
- Use default factors only if there is no access to more accurate data. Default factors in the GLEC Framework cover standard values for empty distance and load factors.

4.2.1 Road

Road transportation is used in nearly every transport chain. Due the highly fragmented nature of the road transport sector, it might be difficult to obtain primary transport data from carriers and/or LSPs. In such cases, the logistics emissions can be calculated using modeled or default values. This is reflected in the following diagram:

Figure 6: Road freight flowchart for calculation



Prerequisite is to have a specific time period defined
 *conversion from TEU to tonnes is possible
 ** ensure the applicable distance adjustment factor are applied if actual transport distances are used

Specific country programs, such as SmartWay EPA, provide annual emission intensity performance of road freight operators.

In the GLEC Framework, Module 2, the road emission intensity values [gCO₂e/tkm] for WTW are provided for Europe and South America based on the following standardized characteristics:

- Vehicle type and size
- Empty distance factor
- Consumption factors
- Load factor
- Fuel type

If limited or no information is known about the actual transportation, the intent is to use the tables to select the default road emission intensity factors for WTW that come closest to the vehicle used to transport the shipment. In this case, the emissions calculation's data quality is classed as "sufficient."

For road freight, the planned distance increased by 5% to correct for incidental deviations shall be used, or the actual distance can be used if the planned distance is not known. In case of known deviations, 30% shall be added to the planned distance. In case of calculating empty distance, then the formula to be used is:

$$\text{Empty distance (\%)} = \frac{\text{Empty distance (km)}}{\text{Empty distance (km)} + \text{Loaded distance (km)}}$$

$$\text{Empty distance (km)} = \frac{\text{GLEC default \% for empty distance} * \text{loaded distance (km)}}{1 - \text{GLEC default \% for empty distance}}$$

TOCs should be composed based on similar characteristics of certain transport activities. In Table 6, we list some characteristics that can be used when selecting shipments for a TOC for road transport.

Table 6: Recommended road freight TOC characteristics

Freight type	Condition	Journey type	Contract type
<ul style="list-style-type: none"> • Dry bulk • Liquid bulk • Containerized • Palletized • Mass limited, general freight (heavy cargo) • Volume limited, general freight (light cargo, mail, and parcel) 	<ul style="list-style-type: none"> • Ambient • Temperature controlled 	<ul style="list-style-type: none"> • Point to point (long haul) • Collection and delivery 	<ul style="list-style-type: none"> • Shared transport • Dedicated contract (charter)

Mail and parcel sector

In the mail and parcel sector, where knowledge of the weight of individual consignments may be limited, the weight can be estimated to enable consistency of the calculation through an end-to-end transport chain. This can be done on the basis of standard product categories used.

Alternatively, the emissions can also be allocated per item and consider volume in conjunction with weight in the allocation mechanism. In this case, the total emissions incurred on a journey are allocated based on their volume, potentially weight, and the number of items transported. The performance indicator would also need to reflect the GHG emissions or item-kilometers and needs to be applied throughout the transport chain.

The distance for road freight shall be the planned distance between the loading and unloading point – this also applies to the mail and parcel sector.

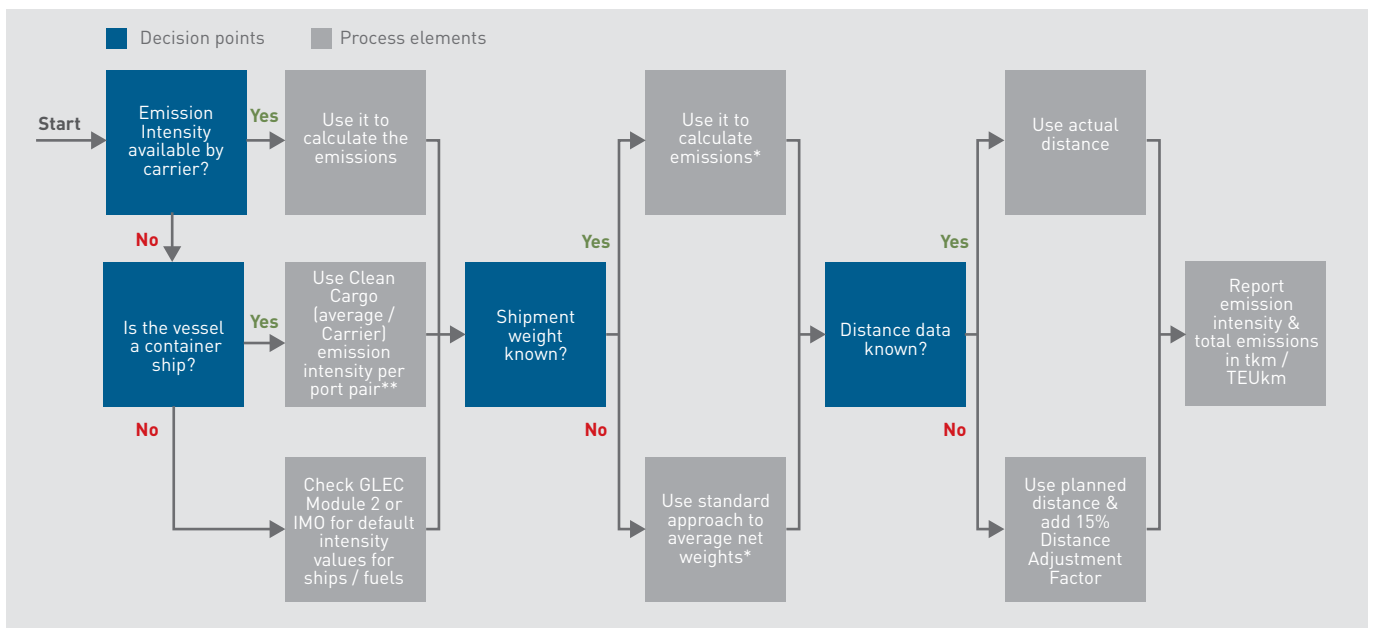
EN17837: Parcel Delivery Environmental Footprint (forthcoming) will provide further details on the allocation mechanisms for the mail and parcel sector.

4.2.2 Sea

The following adjustments take place for sea and maritime transport:

- For container vessels, the Clean Cargo methodology provides a set of industry average emission intensity factors for maritime container transport per trade lane that are updated annually. Through Smart Freight Centre membership, carrier-specific trade lane factors are accessible.¹¹ When calculating activity for a shipment/consignment, if specific mass or weight value is lacking, the equation can be adapted to reflect the common unit in shipping, TEU. Conversion factors from TEU and FEU to tons are available.
- For other vessel types, default factors for the variable of emission intensity are provided in Module 2 of the GLEC Framework.

Figure 7: Sea freight flowchart for calculation



Prerequisite is to have a specific time period defined

*conversion from TEU to tonnes is possible

** ensure the applicable distance adjustment factor are applied if actual transport distances are used

Table 7: Recommended sea freight TOC characteristics

Vessel type	Freight condition	Service type
<ul style="list-style-type: none"> • Bulk • Chemical tanker • Container ship • Roll-on-Roll-off • Liquified gas tanker • Oil tanker • Other liquid tanker • Breakbulk 	<ul style="list-style-type: none"> • Ambient • Temperature controlled • Mixed-ambient and temperature-controlled freight 	<ul style="list-style-type: none"> • Scheduled (trade lane) • Chartered

¹¹ At the time of writing, there is ongoing development establishing carrier-specific container transport emission intensity factors per port-pair combination. Please see www.smartfreightcentre.org or the latest information.

4.2.3 Inland waterways

The scope of the emissions when calculating for this mode should include empty backhauls and vessel repositioning. The GLEC Framework methodology is aligned with the principles of the International Maritime Organization (IMO) guidelines and the US EPA SmartWay Barge Carrier Tool. To ensure comparability, where the methodologies consider tank-to-wheel scope, an adaptation to reflect well-to-wheel should be made.

When collecting data for the calculation of the respective emissions from inland waterway transport, a lot of similarities are identified with the sea freight. In terms of the weight being transported, the actual weight is preferred; where it is unknown, the conversion from amount of TEU or FEU to weight is advised. For the

distance, the total should be calculated using actual waterway network distance based on the start and end point of the journey. Where nautical miles are used, conversion to km is advised.

To calculate the emissions, apart from activity data, the emission intensity is needed. The recommendation is to use carrier-specific emission intensity information. If this is not available, the GLEC Framework recommends specific emission intensity values based on average values of empty distance and load factor. These factors are based on the use of marine fuel oil. If a different fuel or energy is used, then the GLEC default emission intensity factors are not applicable.

Table 8. Recommended inland waterways TOC characteristics

Vessel type	Freight condition	Service information
<ul style="list-style-type: none"> • Bulk • Container • Pallets • Mass-limited cargo • Volume-limited cargo 	<ul style="list-style-type: none"> • Ambient • Temperature controlled • Mixed-ambient and temperature-controlled 	<ul style="list-style-type: none"> • Origin-destination information • Waterway classification • Routing/intermediate stops • For convoys, number of barges

4.2.4 Air

When calculating the emissions from air freight, the GLEC Framework takes into consideration the emissions from the full flight cycle for freight and passenger aircraft, for example, taxiing, take-off, cruising, landing, as well as any other movement related to freight loading and unloading. Any other emissions occurring at airports should be covered by factors related to the logistics sites. The GLEC Framework provides guidance on this, which should be chosen if not more specific data is provided from the airport operators. In addition, as it is stated for the rest of the modalities, the result of emissions from an air freight flight has to be expressed in WTW CO₂e emissions to be GLEC conformant.

When selecting data for the final calculation, there are some crucial parameters to be considered and carefully collected. First of all, the distance (with intermediate stops if taken) is very important in the activity calculation of the transport. What is recommended is to use the great-circle distance between the airports. In addition, the exact mass of the freight is also needed as this will

lead to a more accurate result. Emissions shall be split between passengers and freight, using the provisions outlined in the ISO 14083 standard, which reflects provisions of IATA Recommended Practice 1726. Related to weight, the load factor is also applicable in air freight for both dedicated freighters and passenger aircrafts. The load factors should be provided by air freight operators.

Obtaining accurate flight numbers to identify the exact journey can significantly help improve the accuracy of emissions calculations as this confirms the distance, intermediate stops, and aircraft type. Air freight operators who own the fleet (proprietary fleets) have the benefit of having access to high-quality fuel consumption data and fuel type. It is recommended that these data are shared with the parties who have a legitimate interest in supporting the calculation of emissions. Fuel data can be multiplied by a WTW fuel emission factor. Dual fuel use is at the moment negligible (1-2% network average), so it is considered acceptable if it is ignored from the calculations.

Table 9: Recommended air freight TOC characteristics

Aircraft type	Service information
<ul style="list-style-type: none"> • Freighter/passenger • Model • Engine type 	<ul style="list-style-type: none"> • Origin-destination information • Routing/intermediate stops

4.2.5 Rail

Globally, rail transport is gaining popularity and has been gradually growing the past five years. Rail transport can significantly reduce emissions, in particular when powered by renewable energy. Mostly the energy is either electric or conventional fuels such as diesel. Thus, different equipment types require specific emission intensity factors. The GLEC Framework uses the UIC (International Union of Railways) methodology for areas outside the United States, where the methodology by EPA SmartWay Rail Carrier Tool is preferred. These methodologies and tools are deemed appropriate for the modeling of emissions from rail freight.

When calculating rail GHG emissions, specific principles should be considered. First and foremost, the most important step is to define the engine type (or locomotive) and thus, the primary source of energy for the freight train. For electric trains, one can investigate the source

of electricity to specify if it was renewable or not. Then, the appropriate emission value for that source can be applied. The next step is to find the consignment weight. If no data are available, then the weight can be approximated using other available proxies, such as volume or number of pallets.

To complete the calculation of activity, the distance also needs to be known. In rail transportation, the distance should reflect actual rail network distances from the beginning and end point taking into account empty distance and loading factor. Overall, modeling rail transportation is a difficult task due to the lack of data and granular default values. Accredited tool providers for rail can support this process.

Note: Emissions from rail terminals are classified as emissions from logistics sites.

Table 10: Recommended rail freight TOC characteristics

Engine/locomotive	Cargo type	Cargo density	Journey type	Activities
<ul style="list-style-type: none"> • Train size • Engine class • UIC class • % of feedstock 	<ul style="list-style-type: none"> • Bulk (dry/liquid) • Containers • Pallets • Mass/volume limited cargo 	<ul style="list-style-type: none"> • Light • Medium • Heavy 	<ul style="list-style-type: none"> • Domestic • International 	<ul style="list-style-type: none"> • Direct or hub network • Topography • Temperature state

4.2.6 Logistics sites (hubs)

Logistics sites, nodes, hubs, and terminals are all important steps within a transport chain. The emissions are relatively small, but important to incorporate within the total GHG calculation to ensure a representative picture of the total GHG emissions from the operations.

The emission intensity of a logistics site is expressed in GHG emissions per ton processed or, if considered more appropriate, TEU or item.

Emission intensity factors are limitedly available and are yet to be determined in greater detail for many types. If emission intensity factors are not available from the carrier or terminal operator, default values can be obtained from the REff Tool,¹² the GLEC Framework or other suitable locations. Additional guidance is also available by Fraunhofer IML Guide for Greenhouse Gas Emissions for Logistics Sites.

Table 11: Recommended logistics site HOC characteristics

Processes	Freight type	Condition (temperature)
<ul style="list-style-type: none"> • Freight transshipment only • Combined passenger and freight transfer • Freight transshipment and storage 	<ul style="list-style-type: none"> • Average/mixed • Containerized/swap bodies • Palletized • Piece goods/breakbulk • Dry bulk • Liquid bulk • Vehicle transport • Other 	<ul style="list-style-type: none"> • Ambient • Temperature controlled

¹² REff Tool, developed by IML Fraunhofer: <https://reff.iml.fraunhofer.de/>

5. Assurance and verification



5. Assurance and verification

To resolve the emissions accounting challenges that businesses face today, high-quality (granular, comparable consistent) and reliable data must be able to be shared across value chains. Assurance and verification ensure reliability of data, creating the necessary trust among all stakeholders to drive decarbonization at scale.

Assurance and verification undertaken by independent verifiers can help establish whether emissions have been accounted for in compliance with the GLEC Framework and other relevant standards and accompanying methods.

This section provides guidance on the assurance and verification of emissions taking place in the context of this Guidance.

5.1 Objectives and scope

5.1.1 Objectives

The overarching objective of this section is to define the requirements around assurance and verification of emissions in alignment with the accounting methodology laid out in this Guidance.

By clearly defining requirements, this Guidance seeks to:

- Establish a common basis and language around assurance for all stakeholders in the ecosystem
- Increase the uptake of emissions assurance practices across the logistics industry with a multilevel approach
- Provide clarity on best-practice assurance and verification requirements to support the preparation process for stakeholders wishing to be aligned with best practices
- Streamline the assurance process by providing guidance on what evidence companies need to prepare for an assurance engagement

5.1.2 Scope and limitations

This Guidance defines three separate assurance ambition levels of requirements that companies shall refer to when seeking to comply with the requirements

of this Guidance. The three levels aim to represent different degrees of ambition and granularity associated with the assurance process to increase emissions data reliability and trust in the overall ecosystem. Because assurance statements are shared across the value chain, companies wishing to distinguish themselves through greater data credibility will be incentivized to go beyond the minimum ambition level of assurance.

From a practical standpoint, verified emissions data obtained from another logistics supply chain stakeholder and used for calculations of a company's own emissions reduces the transactional cost of a company's own audit. This is because exchanged emissions do not need to be (re)verified as long as no changes are made to the underlying calculation models and data used by the company that shared the data in the first place.

Finally, this Guidance recognizes that verification of emissions disclosures involves many challenges, including:

- The limited control of companies over emission sources
- Assurers' limited ability to obtain sufficient evidence on all necessary items
- The evolving scientific consensus on questions directly affecting emissions disclosures, such as emission intensity factors
- The required subject-matter expertise, which not all companies and assurers may currently have at scale

This Guidance seeks to help mitigate these challenges by providing clarity and a reference point. Nonetheless, companies and assurers should continue to collaborate to assure their emissions to the best of their knowledge and to continue to improve emissions disclosure assurance practices throughout the logistics sector.

It should also be noted that this chapter by itself is not intended to be used as an assurance standard. This Guidance defines the requirements and proposed outcomes of the assurance process (i.e., the "what" of assurance) but does not prescribe the assurance process itself (i.e., the "how" of the assurance process). Assurance providers should therefore refer to additional assurance standards when verifying logistics emissions and the methodology presented in this Guidance.

Finally, this chapter exclusively provides guidance around assurance and verification. Companies seeking accreditation should refer to [Smart Freight Centre's Accreditation program](#). While assurance and accreditation are related, accreditation seeks to determine whether a company's calculation methodology aligns with the GLEC Framework, while an assurance process seeks to determine whether a specific emissions disclosure is accurately calculated and stated.

5.2 Assurance ambition levels

5.2.1 Structure

This Guidance is structured as a framework consisting of three ambition levels, each one encompassing requirements across eight assurance dimensions, as shown in Figure 8, and building on the Pathfinder Framework.

Figure 8: Ambition levels and dimensions of the assurance requirements



5.2.2 Overview

The following table presents an overview of this Guidance’s assurance requirements for the three levels by dimension:

Table 12: Assurance levels overview

Dimensions	3 Bronze	2 Silver	1 Gold
Coverage Extent of the data to be assured	Own operations	Own operations + contracted operations	Own + contracted + sub-contracted operations
Conformance Basis for the assurance	Any recognized standard	GLEC Framework	GLEC Framework
Boundary Depth of data to be assured	Well-to-wheel	Well-to-wheel	Well-to-wheel
Level Degree of confidence	Limited assurance	Limited assurance	Reasonable assurance
Provider Entity providing the assurance	Independent Third Party	Independent Third Party	Independent Third Party
Process cycle Temporal validity of the assurance	Biannual	Annual	Annual
Application to SMEs SME requirements	Phased-in approach for SMEs All requirements above identically apply to SMEs but with a two-year time lag to allow for capacity building until 2025		
Evidence Guidance for	Evidence Pack Guidance Companies should use guidance around evidence consolidation (see Appendix) to facilitate and streamline the assurance process		

To interpret and decide the level of assurance to be undertaken, the above requirements shall be seen as a checklist where all conditions must be satisfied (“and” relationship) to meet any given level. For example,

an assurance cannot be ranked as “Gold” if all other conditions are met, but the assurance level is “Limited.” The following sections provide further details on each dimension and requirement.

5.2.3 Coverage

The coverage of the assurance defines the extent of emissions to be included in the assurance process. While the emissions exchanged under this Guidance are expected to result in end-to-end emissions, the boundary of the assurance can be broader, narrower, or equal to the emissions shared. For the purpose of assurance, this Guidance categorizes the coverage into three separate levels: own, contracted, and sub-contracted operations. Sub-contracting refers to the multitiered process of contracting another party when the stakeholder (i.e., Carrier A) that was initially chosen by the shipper is unable to conduct a shipment within their own capacity. Thus, subcontracting is the act of assigning a carrier (i.e., Carrier B) outside the initial one (Carrier A).

Bronze

Companies shall assure their own operations' emissions.

Silver

Companies shall assure their own operations and contracted operations.

Gold

Companies shall assure their own operations and contracted and subcontracted operations.

Please note that the verification process will both assure the calculations made and the underlying data. Therefore, while the primary activity data of subcontracted and contracted operations may be more difficult to collect and sometimes unavailable, companies are still expected to estimate these emissions using default or modeled data.

5.2.4 Conformance

The conformance of the assurance defines the reference standard or guidance to be used for the assurance process.

Bronze

Companies shall use any recognized emissions accounting standard as the basis for the logistics emissions assurance.

Silver

Companies shall use the GLEC Framework as the basis for assurance. Companies may be required to undertake additional assurance steps to ensure conformance with other existing standards or regulations, for example, to meet regulatory requirements. This Guidance therefore

strongly encourages conformance with the GLEC Framework as well as additional recognized standards, such as the upcoming ISO 14083.

Gold

Companies shall follow the same requirements as in the silver level.

5.2.5 Boundary

The boundary of the assurance defines the depth of the data to be assured. In line with the GLEC Framework, companies will need to include within their assurance process all WTW logistics emissions. This requirement applies to all three ambition levels.

5.2.6 Level of assurance

The level of assurance defines the degree of confidence in the assurance statement. While this Guidance defines the level of assurance for the three ambition levels, companies should work closely with assurers to determine which assurance level is appropriate and feasible in any given situation. Box 1 provides further context on assurance levels.¹³

Bronze

Companies are required to seek limited assurance.

Silver

Companies shall follow the same requirements as in the bronze level

Gold

Companies shall seek reasonable assurance to fulfill the requirements of this Guidance.

¹³ Retrieved from ISAE 3000 and related standards such as ISAE 3410.

Box 1. Assurance levels

Why?

To ensure all stakeholders understand the degree to which emissions disclosures have been verified. The goal is to enable:

- Companies to plan the assurance process and depth of verification they desire
- Assurers to prepare the verification according to standardized practices
- External stakeholders, such as downstream companies, to understand the reliability of the reported data

What?

There are two assurance levels commonly used in emissions disclosure assurance:

- Limited: The conclusion of a limited level of assurance is framed in a negative sense, indicating that the assurer did not find any evidence that the

emissions disclosures contain any material misstatement based on the applicable criteria.

- Reasonable: The conclusion of a reasonable level of assurance is framed in a positive sense, indicating that, according to the assurer, the emissions disclosures have been prepared according to the applicable criteria in all material aspects.

Table 13 provides an additional overview of the different characteristics of the two levels.

How?

Companies should define which level of assurance they are going to seek before an assurance engagement, in line with the requirements set by this Guidance. The assurance provider may suggest adjustments if they believe the desired level will not be feasible (provided that the minimum requirements of this Guidance are met).

Table 13: Assurance levels comparison

Ambition levels	Level	
Aspects	Limited assurance	Reasonable assurance
Opinion statements	Negative <i>“Nothing has come to our attention that the assurance statement does not conform with the Pathfinder Framework and contains material misstatements”</i>	Positive <i>“In our opinion the disclosure conforms with all Pathfinder requirements and is fairly stated in all material aspects”</i>
Application	Commonly used for non-financial disclosure	Commonly used in financial disclosures
Process	Limited in scope - different or fewer checks than reasonable assurance	More expansive in scope, e.g., potentially including site visits

5.2.7 Provider

The provider of the assurance is the entity that verifies the emissions data. When the reporting company also performs the assurance, this is known as first-party assurance. When a party other than the reporting company performs the assurance, this is known as third-party assurance.¹⁴

Companies shall choose an independent third party to conduct the verification process. While first-party quality controls and plausibility checks are encouraged, they do not suffice to fulfill the assurance requirements of this Guidance.

Companies may choose any qualified assurance provider, given that the provider meets the required expertise to conduct an assurance engagement. Proof of such expertise may include previous assurance engagements around logistics emissions, industry-specific knowledge, and technical capabilities in carbon accounting. Section 5.5.3 provides additional details on criteria to consider when selecting an assurance provider.

5.2.8 Process cycle

The process cycle defines the validity period of the assurance statement (e.g., one year or more).

Bronze

Companies are required to renew the assurance at least biannually.

Silver

The assurance statement shall be valid for a maximum of one year. The requirement for an annual renewal of assurance on the corporate level aims to be aligned with regulatory requirements such as the EU's Corporate Sustainability Disclosure Directive (CSRD) and the US Securities and Exchange Commission's (SEC) proposed rules on nonfinancial disclosures.

Gold

Companies shall follow the same requirements as in the silver level.

5.3 Requirements for SMEs

While this Guidance encourages any company to assure its emissions data according to one of the three levels laid out in Section 5.3, small and medium-sized

enterprises (SMEs)¹⁵ may face additional challenges in meeting assurance requirements due to initial resource and capability constraints.

To give SMEs time to build the necessary capabilities to fulfill assurance requirements, each requirement as defined in Section 5.2.2 shall become applicable for SMEs two years after the requirement will first come into force for larger corporates, in 2025.

While the assurance levels will not be considered requirements until then, it is strongly encouraged that SMEs begin to prepare to meet the assurance requirements sooner than they are required to by this Guidance.

5.4 Evidence

5.4.1 Context and purpose

The provision of standardized and relevant evidence to substantiate emissions claims and support the assurance process is the cornerstone of any verification and assurance process.

This section is therefore meant to guide companies' efforts to gather and organize the evidence that might be required in an assurance engagement. This Guidance does not replace any guidance that assurers themselves may provide during an engagement and is not a blueprint for an assurance engagement. Rather, it is meant to help companies prepare for an assurance engagement ahead of time, speeding up and streamlining the assurance process.

5.4.2 Structure and dimensions

The Guidance on evidence is structured along three dimensions central to verifying emissions disclosures:

- 1 Data:** Evidence around the required data elements, sources, and quality of data used in the calculations
- 2 Methodology:** Evidence around the calculation steps, results, and assumptions
- 3 Governance:** Evidence around the underlying processes used during the calculations, including how data was stored, how quality was ensured, and how risks were mitigated

¹⁵ In the context of this Guidance, SMEs are defined in accordance with the latest EU recommendation 2006/361 criteria and thresholds, where SMEs are defined as companies that employ fewer than 250 persons and have an annual turnover not exceeding €50 million, and/or an annual balance sheet total not exceeding €43 million.

Each dimension contains five concrete elements that constitute the evidence pack for that dimension. As the maturity of companies' emissions accounting reporting varies, the evidence pack distinguishes between minimum and optional elements that may bring further clarity to the assurance process.

5.4.3 Evidence pack

The provision of standardized and relevant evidence to substantiate emissions claims and support the assurance process is the cornerstone of any verification and assurance process.

5.5 Process and reporting

5.5.1 Choosing an ambition level

Before beginning the assurance process, companies should define the desired assurance ambition level. While the more ambitious assurance levels are encouraged, companies may choose any assurance ambition level as long as they communicate transparently which level was chosen. The considerations in choosing an ambition level are highly context dependent, but key factors may include:

- The reporting company's emissions disclosure maturity (i.e., the degree to which emissions accounting practices and processes have been established in the company)
- The use case of the emissions data to be assured, such as reporting or impact assessment
- The assurance needs of data users receiving the emissions data
- Resource and time constraints, for example when the data is meant to be shared with others

Companies are also encouraged to discuss their desired assurance ambition level with potential assurance providers to better understand the feasibility of the ambition level and any steps to be undertaken to reach the desired level.

5.5.2 Timing

Assurance engagements in the context of this Guidance shall begin after the result to be assured, such as a transport-chain element, has been calculated and

before the result is reported or exchanged with other stakeholders. Given that the verification process may take time, depending on the complexity of the underlying emissions disclosure, it is the company's responsibility to start the assurance process early enough to avoid delays in data exchange.

It may be the case that reporting companies need to share emissions data before it has been assured, for example, to meet contractual obligations or because the timing of the disclosure is predetermined. Companies may share data that has not been assured as long as they transparently communicate with data users to what extent the data has undergone assurance.

5.5.3 Requirements for choosing assurance providers

While this Guidance does not include specific requirements around choosing an assurance provider, the following criteria may be used to select assurance providers:

- Expertise and experience:
 - Proven experience conducting assurance engagements and applying assurance standards
 - Capabilities around life cycle assessment and carbon accounting, as shown by experience, educational qualifications, and tools used
- Industry and sectoral knowledge:
 - Understanding of the logistics industry
 - Understanding of business operations within the sector to which the product or corporation belong
- Credibility:
 - Proof of no conflicts of interest between assurance provider and reporting company
 - Proof of successful conduction of verification processes
- Capacity:
 - Enough staff capacity to conduct the assurance engagement.

5.5.4 Reporting

In line with the Greenhouse Gas Protocol Product Standard, companies shall include the assurance statement in the emissions disclosure. An assurance statement, at the minimum, shall include:

- The assurer's assertion
- The level of assurance
- The assurance provider's name and the executing individuals
- A summary of the assurance process and work performed
- The relevant expertise of the assurer
- Any potential conflicts of interest
- The assurance standard applied, if any
- A list of criteria that were evaluated to reach the assertion.

The reporting format will depend on the applicable requirements, particularly the coverage requirements.

Companies shall report the assurance statement alongside the emissions disclosure, such as in a sustainability report.

5.5.5 Special cases of existing assurance

It may be the case that a company needs to verify carbon emissions disclosure for purposes other than adherence to this Guidance, for example, to fulfill reporting or regulatory requirements. If verification has already taken place, even if not for the purposes of end-to-end GHG reporting, the resulting assurance may be used toward the assurance requirements of this Guidance, provided that the existing assurance conforms to, as a minimum, the bronze level requirements at the time the assurance was undertaken.

6. How to: Supplier-to-customer end-to-end GHG reporting



6. How to: Supplier-to-customer end-to-end GHG reporting

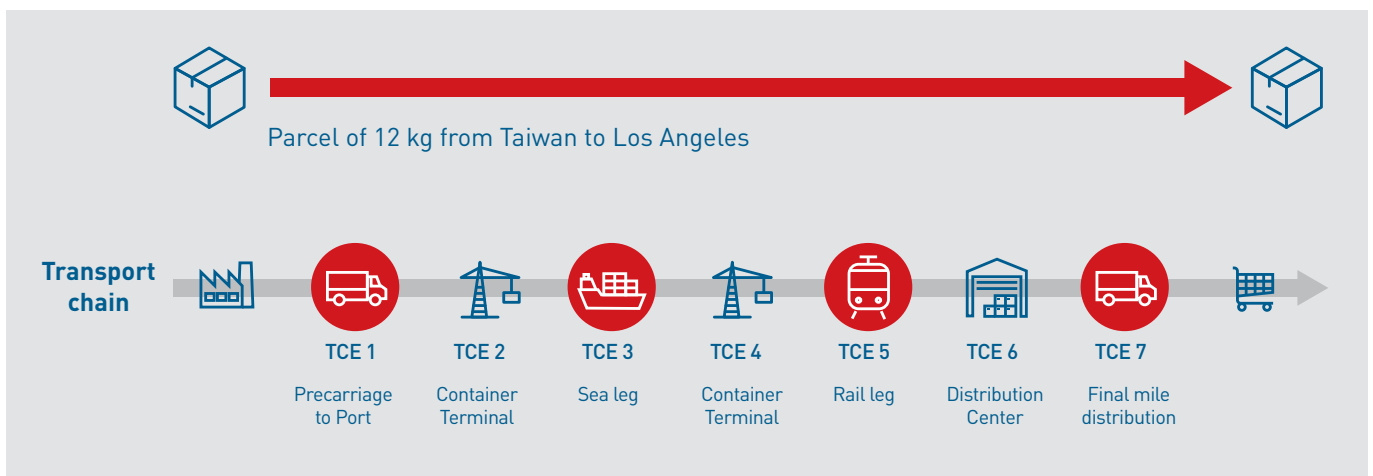
6.1 Overarching tips

When undergoing the process of calculating emissions as suggested in Section 4.1, note the following:

- A TOC or HOC consists of multiple vehicles and trips or buildings respectively over a period of time (at least one month). A TCE is a single transport leg. A transport chain consists of multiple transport chain elements.
- A difference is made in the calculation, allocation (by mass, items, or TEUs), and reporting of emissions.
- Transport activity and emission intensity shall be reported in ton-kilometers. In specific circumstances, alternative reporting metrics can be chosen. For mail and parcel sectors, this can be reporting in item-kilometers and in the container industry, reporting in TEU-kilometers.
- Mass refers to the actual mass and not the “chargeable weight”, including the producer’s own packaging, but not the packaging required by the transporter. Mass should be known or if not, approximate using standard product categories.
- Distances are calculated using planned distance for road, rail, sea, and inland waterways, and using great-circle distance for aviation between loading and unloading stations using appropriate mapping software. If actual (traveled) distances are used, the transport activity needs to be adjusted to allow for incidental detours and not to underreport emissions.
- Data quality is expressed in a number between 4 and 1 for a single consignment of a single TCE.
- Assurance is designed in 8 dimensions and has different ambition levels to meet organizational requirements.
- An accredited partner is recommended to help advance calculations, allocations, and reporting.
- Additional guidance can be found in the ISO 14083 and the GLEC Framework.

6.2 Example

Figure 9: Example of an end-to-end supply chain



Organization 'A-to-Z' has moved a 12kg parcel traveling from Toufen, Taiwan to a customer in Kansas City and wants to understand which portion of the transport has the highest emission intensity and opportunity to reduce. The organization is a Clean Cargo member and has details from its operations in Taiwan and from its last-mile delivery partner, but no other information available. This would result in the calculation below.

Table 14. Example calculation of an end-to-end supply chain

TCE	TOC	Data visibility	Data availability	Emission intensity	Transport activity and emissions	Data quality
1. Toufen, Taiwan – Port of Taipei	Truck, less-than-truckload, ambient	Full visibility	<p>Primary disaggregated fuel consumption for loaded and empty trips</p> <p>Data used:</p> <ul style="list-style-type: none"> • Diesel truck • Fuel consumption: 30L/100km when full, 25L/100km when empty • 100 kms loaded distance and 30 kms empty • Average load of 12t • Fuel emission factor of 3.24kgCO₂e/L. 	<p>Emissions: 30L * 3.24kgCO₂e/L = 97.2kgCO₂e for loaded distance</p> <p>Liters empty running 30 * 25/100 = 7.5L</p> <p>Emissions empty = 7.5 * 3.24 = 24.3kgCO₂e</p> <p>Total Loaded + empty emissions = 121.5kgCO₂e</p> <p>121.5kgCO₂e/(100km * 12kg) = 101gCO₂e/tkm</p>	<p>Transport activity: 12kg * 100kms = 1.2tkm</p> <p>Emissions: 1.2tkm * 101gCO₂e = 121gCO₂e</p>	1. Excellent
2. Port of Taipei	Container terminal	No visibility	<p>Container terminal operation inferred due to modal shift.</p> <p>Data used:</p> <ul style="list-style-type: none"> • Default data from GLEC Framework used • Conversion from TEU to tonnes 	<p>30.1kgCO₂e/container. 1 standard container (TEU) = 10t</p>	<p>Transport activity: 12kg</p> <p>Emissions: 12kg / 10t * 30.1kg = 36.12gCO₂e</p>	3. Sufficient
3. Port of Taipei – Port of Long Beach	Container vessel	Clean Cargo member	<p>Program data from Clean Cargo on a trade-lane or port-pair basis</p> <p>Data used:</p> <ul style="list-style-type: none"> • Carrier-specific data from Clean Cargo used (74gCO₂e/TEUkm) • Distance is 10,960km 	74gCO ₂ e/TEUkm	<p>Transport activity: 10,960TEUkm * 12kg / 10t = 13,152tkm</p> <p>Emissions: 10,960TEUkm * 74gCO₂e = 811kgCO₂e for 1 TEU</p> <p>(12kg / 10t) * 811.04 = 973.25gCO₂e for 12 kg parcel</p>	2. Good
4. Port of Long Beach	Container terminal	Container terminal	<p>Container terminal operation inferred due to modal shift</p> <p>Data used:</p> <ul style="list-style-type: none"> • Default data from GLEC Framework used • Conversion from TEU to tons 	<p>30.1kgCO₂e/container. 1 standard container (TEU) = 10t</p>	<p>Transport activity: 12kg</p> <p>Emissions: 12kg / 10t * 30.1kg = 36.12gCO₂e.</p>	3. Sufficient
5. Port of Long Beach – Kansas City	Rail, no other details	Default values via ERTAC available	<p>Only activity data is known in tkm. ERTAC data is available.</p> <p>Data used:</p> <ul style="list-style-type: none"> • Data from GLEC Framework used • Used ERTAC-specific value from the carrier: 17gCO₂e/tkm • Distance is 2,600km. 	17gCO ₂ e/tkm from ERTAC	<p>Transport activity: 12kgs * 2,600km = 31.2tkm</p> <p>Emissions: 31.2tkm * 17gCO₂e/tkm = 530gCO₂e</p>	3. Sufficient

Table 14. Example calculation of an end-to-end supply chain

TCE	TOC	Data visibility	Data availability	Emission intensity	Transport activity and emissions	Data quality
6. Kansas City	Distribution center	No visibility	Transshipment center inferred due to modal shift. Data used: • Default data from GLEC Framework used • 3.4kgCO ₂ e/t.	3.4kgCO ₂ e/t	Transport activity: 12kg Emissions: 12kg * 3.4kg/t = 40.8gCO ₂ e	3. Sufficient
7. Kansas City – Kansas City (address)	Last-mile Delivery	Limited visibility	Modeled fuel consumption for loaded trip – industry average empty trip ratio calculated Data used: • Fuel consumption when loaded = 20L/100km and 18L/100km when empty • 20 km loaded distance and empty km unknown (17% empty running factor used) • Empty Distance of 4,09kms • Average load of 3t • Fuel emission factor of 3,24kgCO ₂ e/L	Emissions: 4L * 3.24Kg-CO ₂ e/L= 12.96 kgCO ₂ e for loaded distance Liters empty running 20km / (1-17%) - 100km * 18L/100= 0.74L Emissions empty = 0.74L * 3.24 = 2.39kgCO ₂ e Total Loaded + empty emissions = 15.35kgCO ₂ e 15.35kgCO ₂ e / (20km * 3t) = 256gCO ₂ e/tkm	Transport activity: 12kg * 20kms = 0.24tkm Emissions: 0.24tkm * 256gCO ₂ e = 61.44gCO ₂ e	2. Good
Overall Taipei –Kansas City				Overall emission intensity: 1,798.73gCO ₂ e / 164.16tkm = 10,96gCO ₂ /tkm	Total transport activity: 164.16tkm Total emissions: 1,799gCO ₂ e	Weighted Average of the data quality: 2.29 Good (121gCO ₂ e * 1 Excellent + 36.1 * 3 Sufficient ... 61.44 * 2. Good) / 1,799gCO ₂ e = 2.29

7. Outlook



7. Outlook

Together we can decarbonize logistics. This requires a shared understanding and transparency of the emissions across the supply chains. This Guidance provides a step-by-step practical approach to calculate logistics emissions end-to-end – from an initial supplier to a final customer – compliant with existing methodologies.

We need to recognize that granular visibility of logistics operations and sharing of logistics emissions data from primary sources is not yet a reality or common practice. The Guidance seeks to reflect this and ensure more transparency can be embedded within daily business practice nonetheless. It is also designed to encourage companies to improve their data granularity, quality and reliability over time as well as enable them to share data seamless across the supply chain.

To drive the process of adoption, Smart Freight Centre and WBCSD will support organizations in this journey by:

- Piloting and testing the Guidance in operational situations and across multiple use cases. The newly introduced data quality indicator and the assurance process may be refined to ensure they continue to reflect the progress and maturity of the industry while also increasing ambition for change.
- Establishing and designing the associated IT infrastructure to enable exchange of product carbon footprints from logistics operations across the supply chain consistent with this Guidance and in line with the work undertaken by PACT.
- Collaborating with supply chain partners and solution providers to deliver concrete decarbonization projects and tracking their impact using this Guidance.

We are encouraged by the collaboration shown in the development of this Guidance and are committed to meet the Paris Agreement and achieve net zero logistics, together.

Appendix: Assurance evidence pack



Appendix: Assurance evidence pack

This evidence pack contains the information that companies should consolidate ahead of undergoing emissions assurance in conformance with this Guidance.

The evidence pack is structured along three dimensions of evidence central to verifying emissions-related disclosures:

- 1 Data:** Evidence around the required data elements, sources, and quality of data used in the calculations
- 2 Methodology:** Evidence around the calculation steps, results, and assumptions
- 3 Governance:** Evidence around the underlying processes used during the calculations, including how data was stored, how quality was ensured, and how risks were mitigated

Each dimension is subdivided into five elements that constitute the evidence pack for that dimension. As the maturity of companies' emissions disclosures varies, the evidence pack distinguishes between elements that are likely to be needed at a **minimum** and elements that might be **optional** as evidence.

1. Data

Element	Description	Minimum	Optional
Data collection	In order to perform an emissions calculation, companies are expected to identify all relevant GHG sources and map the activity data available for each	Inventory of all relevant activity data: weight, distance, mode of transport, consignment	Load factor, level of vehicle details
Primary Data Sources	Understanding which of the GHG sources have been calculated via primary data collection is one of the key purposes of the End-to-End GHG reporting guidance	Comprehensive list of all primary data sources used, including biogenic emissions certificates, if any	Additional information on how and when the data was accessed
Default Data Sources	Companies downstream want to ensure that default data used for the calculation comes from credible and globally recognized sources	Comprehensive list of all default data sources used	Additional information on how and when the data was accessed
Modelled data	Should primary and default data sources not cover the entirety of the studied emissions, modelled data can be used to fill in the gaps	List of modelled data used and rationale of application	Steps taken to ensure that modelled data used is minimized in future
Data Quality	Companies will need to give evidence of the data quality assessment statement and the steps taken to calculate its data quality ratings	Results of PCF GHG sources materiality threshold assessment Overall data quality assessment statement	An individual data quality statement for each GHG source surpassing the materiality

2. Methodology

Element	Description	Minimum	Optional
Conformance	<p>Standards followed will define the framework requirements and thus the correctness of the steps taken by companies to calculate the PCF</p> <p>Companies will need to demonstrate alignment to scope boundary conditions prescribed by the Framework</p>	<p>Comprehensive checklist of standard(s) requirements followed</p> <p>List of scope boundary conditions</p>	NA
Calculation steps	It is essential for companies to be able to specify which calculation method has been followed and produce a list of calculation steps taken to convert logistics activity data into GHG emissions	Selected calculation approach and comprehensive list of calculation steps	NA
Assumptions	A list of assumptions used in calculation to ensure completeness of calculation (e.g., empty running assumptions)	Comprehensive list of assumptions made at each stage	NA
Allocation (optional)	Need to understand whether allocation has taken place to divide emissions to each item within a transport vehicle, and if so, what approach was used	Description of allocation approach followed	NA
Results	Results will allow verification parties to understand whether the calculation steps required by the standard have been completed accurately	Comprehensive list of all intermediate and final results	NA

3. Governance

Element	Description	Minimum	Optional
Data Governance	In order to ensure replicability and facilitate knowledge transfer, companies should have in place a data governance plan mapping the data processes, ownership and responsibilities, as well as documentation on the steps taken to consolidate and validate different data inputs, e.g., from different sites	Comprehensive map of all processes and responsibilities Comprehensive list of all data consolidation steps and rationale	NA
Quality Control	Internal mechanism in place to ensure quality control takes place and that responsibilities associated to it are clear	NA	Comprehensive list of controls and responsibilities
Expertise	There is a need to ensure that the team employed to undergo the calculation process has sufficient expertise in the subject in order to minimize emission misstatements	NA	Total years of expertise within team employed to undergo emissions calculation
Capacity	When asked, companies should be able to list internal and contracted team members (if any) responsible for the product footprint calculations	NA	List of all responsible individuals
Risk Management	Companies need to be able to identify potential shortcomings or pitfalls associated to the PCF calculation process in order to be able to address them	Comprehensive list of all risks and mitigation tactics	Progress against mitigation tactics employed

