VDA | Verband der Automobilindustrie

ECG The Association of European Vehicle Logistics

VDA and ECG Recommendation

Emissions calculation and reporting guideline for automotive supply chains

December 2023

About VDA

The German Association of the Automotive Industry (VDA) consolidates about 650 manufacturers and suppliers under one roof. The members develop and produce cars and trucks, software, trailers, superstructures, buses, parts and accessories as well as new mobility offers. We represent the interests of the automotive industry and stand for modern, future-oriented multimodal mobility on the way to climate neutrality. The VDA represents the interests of its members in politics, the media, and social groups. We work for electric mobility, climate-neutral drives, the implementation of climate targets, securing raw materials, digitization and networking as well as German engineering. We are committed to a competitive business and innovation location. Our industry ensures prosperity in Germany: More than 780,000 people are directly employed in the German automotive industry. The VDA is the organizer of the largest international mobility platform IAA MOBILITY and of IAA TRANSPORTATION, the world's most important platform for the future of the commercial vehicle industry.

About ECG

ECG – the Association of European Vehicle Logistics is the established European platform for the outbound automotive logistics sector bringing together logistics service providers and suppliers to the sector. ECG aims to facilitate non commercial collaboration between member companies and assist them in sharing best practices in many operational areas, especially the harmonisation of operational standards.

Content

List of abbreviations

ADD	Actual driven distance
BEV	Battery electric vehicle
CEU	Cargo equivalent units
CNG	Compressed natural gas
CO2e	CO_2 equivalent
Con-Ro	Container/ Ro-Ro Cargo Ship
DEFRA	Department for Environment, Food & Rural Affairs
DAF	Distance adjustment factor
DIUM	Distancier international uniforme marchandises
DUNS	Data Universal Numbering System
ECF	Energy consumption factor
ECG	Association of European Vehicle Logistics
EIID	Emission Intensity ID
EMS	European Modular System
EV	Electric Vehicle
FTL	Full truck load
FV	Finished vehicle
FVL	Finished vehicle logistics
GCD	Great circle distance
GHG	Greenhouse gas
GLEC	Global logistics emission council
GVW	Gross vehicle weight
HVO	Hydrotreated Vegetable Oil
ICE	Internal combustion engine
ICT	Information and communications technology
IEA	International Energy Agency
JIS	Just-in-sequence
JIT	Just-in-time
LDL	Lower deck load
LNG	Liquefied natural gas
LPG	Propane
LSP	Logistics service provider
LTL	Less than truck load
MoT	Mode of transport
OEM	Original equipment manufacturer
PCC	Pure car carrier
PCTC	Pure car truck carrier
PHEV	Plug-in hybrid electric vehicle
PTS	Points
Ro-pax Ship	Roll-on/ Roll-off passenger ship
RoRo	Roll-on/ Roll-off
RNE	RailNetEurope
RWU	Railway undertaking
SFD	Shortest feasible distance
TCE	Transport chain elements
TEU	Twenty-foot equivalent unit
TMS	Transport management system
TOC	Transport operating categories
TKM	Tonne-Km
TTW	Tank-to-Wheel
UIC	Union international des chemins de fer
VDA	Verband der Automobilindustrie
WTW	Well-to-Wheel

1. Introduction

The urgency for more sustainable and environmentally conscious automotive logistics practices has led to an initiative backed by leading players in the European automotive industry. This collaborative project engages stakeholders from all facets of the industry – Original Equipment Manufacturers (OEMs), suppliers, and Logistics Service Providers (LSPs).

Together, under the umbrella of the Verband der Automobilindustrie (VDA) and the Association of European Vehicle Logistics (ECG), this consortium has developed a guideline, framing the application of ISO 14083, to standardize transport greenhouse gas (GHG) emissions reporting within the automotive supply chain. The current focus of the guideline is GHG emissions measured as CO_2 equivalents (CO_2e), while all data exchange procedures are also capable of including additional air pollution emissions.

This widespread participation by industry leaders represents a collective commitment to mitigating the environmental impact of logistics processes in the automotive industry.

The guideline's principal aim is to provide a clear framework for the application of ISO 14083 in the automotive industry by tailoring industry-specific requirements. The objective is to harmonize the interface between OEMs, suppliers, and LSPs, delineating defined responsibilities and standard reporting procedures.

The guideline lays down minimum requirements for data accuracy and transparency and aspires to continuously elevate the ambition level within the industry.

To facilitate this transition, the guideline introduces a standard scheme for reporting the emission intensity of different transport operating categories (TOC) and consignment GHG emissions to customers. A transparent and comprehensive approach promotes comparability and comprehension across all involved parties.

The guideline specifically provides a detailed calculation guide for initially focused transport modes, namely road and rail transportation. This precise approach ensures the reliability of emissions data, thereby enhancing the credibility of reported information and confidence in the industry's sustainability measures.

As a guideline, it serves as a recommendation rather than a mandatory standard. However, companies are highly encouraged to adopt it as a means to standardize their interactions and procedures concerning GHG emissions reporting. Since this is the first version of the guideline, companies that implement their GHG reporting based on this guideline are asked to provide feedback to the VDA and ECG regarding their initial application experiences and identified needs for further development.

The guideline is designed to integrate seamlessly into the existing normative standardization schemes. It focuses on the movement of freight necessary to support the automotive industry, specifically from the perspective of suppliers and automotive manufacturers. Examples primarily target finished vehicles, production materials and service parts, but the same principles apply throughout the complete supply chain.

In conclusion, the guideline offers an industry-approved roadmap for tackling GHG emissions, fostering a shared sense of responsibility, and promoting best practices throughout the automotive supply chain. By using this guide as a starting point, companies of the automotive industry can make significant strides towards a more accurate and standardized transport emission calculation and reporting.

2. Automotive industry specifics

This section delves into special aspects of transport and logistics operations within the automotive industry, which aren't exhaustively detailed in the existing standards such as ISO 14083, GLEC Framework or Greenhouse Gas Protocol. The foundational methodology stays unchanged: it necessitates identifying all the transport chain's individual components, encompassing potential unladen journeys, and subsequently collating the required data for calculating emissions.

These unique aspects, however, influence how transport operation classifications are established for application in automotive logistics. As a result, a more nuanced and tailored set of transport categories is generated.

2.1. Strategic automotive characteristics

The automotive industry employs a hybrid procurement strategy for logistics services, combining end-to-end door-to-door transports and granular-level procurement. Transport chains include multiple legs and modes of transportation, optimizing logistics and coordination throughout. Clear logical links between Transport Chain Elements (TCEs) are therefore needed.

The Automotive Industry generally already has a high maturity level in standardized digital ordering, labeling, packaging, and delivery communication. The objective of transport GHG emission reporting is therefore to use these frameworks as much as possible and understand GHG emission reports and one additional data exchange communication during a transport.

Despite the automotive industry's stringent auditing standards for emission reporting, it's notable that there is no official auditing mode for submitted transport GHG emissions in the automotive logistics sector. This lack of certification requires industry customers and their auditors to validate the emission data from LSPs independently.

To address this, the industry uses a hybrid approach, where emission data must include a standardized data source indicator and an ISO verification indicator. This enables parties to effectively evaluate and validate information. Furthermore, LSPs are tasked with ensuring ISO-compliant validation of their data and calculation methods.

The Automotive Industry has a high general market influence and ambition level for net zero impact operations. Therefore, a clear development path of emission reporting will be defined in this guideline, reflecting both the current level of capabilities in the LSP market as well as the future industry ambitions.

A standardized emission reporting is understood as a partnership approach between OEMs / suppliers and LSPs to achieve mutual benefits in the efficiency and accuracy of the reporting process. This includes OEMs / suppliers to be responsible for appropriate input data quality e.g., in terms of consignment mass, vehicle master data etc.

2.2. Nature of the cargo transported

The Automotive Industry does rely on dedicated automotive networks (especially in finished vehicle logistics (FVL) and parts of the material logistics process) but is also a customer industry of general cargo networks such as container sea freight or road transportation groupage networks.

2.2.1. Finished Vehicles

Transporting finished vehicles in the automotive industry is a distinct logistical task, given its specific needs. It involves handling a range of vehicles with varying dimensions and mass, requiring diverse transport methods, from specialized car carriers to railway wagons. Automotive logistics also accommodates a substantial volume of used cars, adding complexity in terms of vehicle condition, value, and care during transport. As a result, transporting both new and used vehicles forms a complex yet essential part of automotive logistics.

Therefore, the guideline gives specific recommendations for finished vehicle transports regarding the allocation of transport GHG emissions to each vehicle as well as tailored default values.

2.2.2. General Cargo

In the automobile industry, general cargo typically refers to vehicle parts, components, or materials used in the manufacturing process. These items can vary significantly in size, mass, and shape, and they differ from bulk cargo. They can range from small items like nuts and bolts to larger assemblies such as engines, battery modules, pressed parts and car shells.

Despite the wide diversity of these items, their packaging, and the requirements for their transportation, the guideline offers a comprehensive framework. This framework addresses transportation types and associated calculation parameters for determining transport GHG emissions. The goal is to make the reporting of general cargo emissions in the automobile industry as standardized and comparable as possible.

2.2.3. Other materials

Beyond the aforementioned transports, the automotive industry also relies on several other specialized transport types. These may encompass raw and bulk materials as well as specific general cargo items like battery cells and modules.

The guideline does not intend to encompass all potentially transported items within the automotive supply chain. It's presumed that the GHG emission calculations for transported goods, where the automotive industry isn't the primary user, are handled by relevant initiatives from other industries (e.g., tailored GHG transport emission calculation recommendations from the chemical industry).

Specialized assets vital to the automotive industry are addressed within the guideline based on their predominant mode of transport. For rail and road transports, there will be custom recommendations specifically for battery consignments. Additionally, steel transports will be covered for rail transportation.

2.3. Transport mode specifics of the automotive industry

2.3.1. Modal split Automotive

The modal split refers to the distribution of freight transport across different modes of transport like road, rail, and inland waterways. The European automotive industry has based on Eurostat data an average modal split for intra-European inland-transports in terms of transport activity of 88 % by road, 11 % by rail, and a mere 1 % by inland waterways.

These figures reflect the specific requirements of the automotive industry. Based on this as-is situation it has been decided to initially focus on the dominating transport modes of road and rail.

2.3.2. Transport Operating Models

The transport setup in the automotive industry incorporates several unique features to ensure efficient and timely delivery of components, parts, and vehicles. Beside regular point-to-point/FTL transport, automotive transport operating modes include Just-in-Sequence (JIS) and Just-in-Time (JIT) transport, dedicated Milkrun transport in several formats (e.g., collection rounds in supplier regions or finished vehicle distribution to the dealer network). Tailored transport vehicles (especially in Finished Vehicle Logistics), dedicated loading equipment and intermodal transport setups also in needed reflected in an industry tailored GHG emission calculation approach.

2.3.3. Specialized Transport vehicles

The automotive industry employs specialized transport vehicles to meet its unique logistical needs. Car Carriers or Vehicle Transporters transport completed cars, featuring multiple levels and securing mechanisms to prevent damage during transit.

For larger vehicles like trucks or buses, Flatbed Trucks with open, level beds are used, while Vehicle Transport Trains transport finished vehicles in bulk over long distances.

Specialized Containers with advanced features like temperature control or shock resistance are employed for sensitive components like engines or batteries.

Differentiating those types of transport equipment will be a key aspect of tailored automotive specific TOCs.

2.4. Automotive-specific processes

2.4.1. Freight payer

In automotive logistics, the ‘freight payer’ is the customer primarily responsible for paying the line-haul freight charges for transportation provided by the logistic provider or the company running the owned/operated vehicles. It is essential to note that the shipper is not always the freight payer of a transport. This variability in arrangements significantly impacts emissions calculations and data transparency, necessitating information exchange among all involved parties. Thus, the concept of the ‘freight payer’ underscores the need for effective coordination within automotive logistics for accurate emissions calculations.

2.4.2. End customer

In automotive logistics, the ‘end-customer’ represents the final point in the chain where the product or component is either incorporated into the next assembly (which may not necessarily be a vehicle) or arrives at a retailer transferring ownership to a private or commercial user. For an automotive supplier, this point is crucial for calculating emissions and transparency in data sharing. For an Automotive OEM, the end-customer may be a retailer who transfers the vehicle’s ownership to a private or commercial user, i.e., those who will ultimately drive the vehicle. Alternatively, it could be an independent vehicle conversion company who significantly converts the vehicle before resale. These varied scenarios require effective coordination and communication for accurate emissions calculations.

2.4.3. Value-added services

In the automotive industry, value-added services like pre-assembly in the supply chain are common. Parts may pass through an intermediary for enhancements before reaching the manufacturer. This process, which can include component assembly, quality checks, or customization, streamlines manufacturing and simplifies supply chain management. The influence of these third parties within the end-to-end supply chain needs special consideration when defining the reporting scope of GHG transport emissions.

3. Objectives and ambitions of the automotive industry

The companies that have contributed to this guideline understand that the foundation must be inclusive, accommodating all industry players irrespective of their current level of maturity in processes and systems relevant to transport emissions calculation and reporting.

The customer side acknowledges the target scenario of ISO 14083, where emissions should be calculated based on primary data wherever possible and reported by the party responsible for transport operations. Appropriate data science approaches can be used for extrapolation of missing data and data validation.

Therefore, the guideline describes an agreed roadmap that serves as a guide for all industry players regarding the ambition level and the increase of the minimum requirements to meet these ambitions over time.

Standardized emission reporting for the automotive industry is perceived as a partnership approach between OEMs / suppliers and LSPs to achieve mutual benefits in the efficiency and accuracy of the reporting process. Thus, the roadmap deals with not only the reporting responsibilities of the LSPs but also the required input from the customer side to meet these requirements. This specifically includes the provision of accurate mass information and order reference data (including the mass and dimension master data of vehicles in FVL) provided by the industry side in their order data.

The roadmap consists of three phases:

1. **Startup phase** (until the end of 2024): Establishes the basic responsibility setup related to ISO, regarding the emission calculation responsibility on the LSP side and the emission reporting to the customers.
2. **Improvement phase** (2025–2026): Aims at the step-by-step improvement of the emission calculation methodology and accuracy.
3. **Maturity phase** (From 2027 onwards): Targets the state of primary data-based emission calculation and reporting.

Each roadmap phase defines the minimum requirements regarding the emission calculation approach, the frequency of updating or transferring data, and additional special considerations on the TOC and TCE levels. If the application of this guideline is agreed between a LSP and a customer the minimum reporting standard a LSP must meet is defined by the respective roadmap phase. Below is a detailed outline of the three phases:

Startup phase (until end of 2024)

Minimum Standard for TOC calculation and reporting	Minimum Standard for TCE calculation and reporting	Other aspects of data exchange
Applying at least the automotive specific default values where available and GLEC default values for all other transport modes Providing at least yearly updates for the emission intensity of each TOC	Applying the recommended distance modelling approach (SFD including overall route information for RoRo shipping, SFD / GCD for all other transport modes) Using actual mass information (or actual number of loading units if applicable) on the individual consignment level Applying the adjusted mass calculation for finished vehicle road and RoRo transports Reporting the GHG emission calculation results for each consignment in synchronization with the agreed payment schedule	Relevant transports according to Chapter 4 – Application scope and system boundaries of the guideline where the reporting company is not the freight payer need to be reported based on modelled information (no cross-industry data exchange)

Table 1: Roadmap for the minimum Standard for TOC and TCE calculation and reporting: Startup phase

Improvement phase (2025–2026)

Minimum Standard for TOC calculation an	Minimum Standard for TCE calculation and reporting	Other aspects of data exchange
At least applying a detailed modelled emission calculation approach fully specifying all recommended TOC parameters / characteristics Providing quarterly updates for the emission intensity of each TOC	Applying the recommended distance modelling approach (SFD including overall route information for RoRo shipping, SFD / GCD for all other transport modes) Using actual mass information (or actual number of loading units if applicable) on the individual consignment level Applying the adjusted mass calculation for finished vehicle road and RoRo transports Reporting the GHG emission calculation results for each consignment in synchronization with the agreed payment schedule	Relevant transports according to Chapter 4 of the guideline where the reporting company is not the freight payer need to be reported based on modelled information (no cross-industry data exchange)

Table 2: Roadmap for the minimum Standard for TOC and TCE calculation and reporting: Improvement phase

Maturity phase (from 2027 onwards)

Minimum Standard for TOC calculation and reporting	Minimum Standard for TCE calculation and reporting	Other aspects of data exchange
A primary data-based emission intensity calculation should be applied under consideration of the recommended rules and methods of the guideline Providing quarterly updates for the emission intensity of each TOC	Applying the recommended distance modelling approach (SFD including overall route information for RoRo shipping, SFD / GCD for all other transport modes) Using actual mass information (or actual number of loading units if applicable) on the individual consignment level Applying the adjusted mass calculation for finished vehicle road and RoRo transports Reporting the GHG emission calculation results for each consignment in synchronization with the agreed payment schedule	A data exchange interface between the freight paying company and other reporting companies is used (freight payer takes responsibility in sharing emission information with the customer / supplier)

Table 3: Roadmap for the minimum Standard for TOC and TCE calculation and regulation: Maturity phase

This roadmap reflects the collective ambition of the industry players to improve the accuracy of emission calculations, standardize the reporting process, and enhance the overall efficiency of the system. It underscores the shared responsibility of all stakeholders in achieving a greener and more sustainable automotive industry.

4. Application scope and system boundaries

This Chapter delves into the intricate realm of GHG emission reporting in the automotive industry, specifically focusing on its application scope and system boundaries. Given the industry's complex structure – ranging from a multi-tiered supply chain to diverse end customers and varied distribution channels – it is crucial to accurately define these aspects.

First, a process map that delineates the intricate structure of the automotive industry is introduced. This map provides a comprehensive overview of the journey of materials through the supply chain, as well as the array of end customers and distribution paths. This wide-ranging view serves as the foundation for a concrete definition of the application scope and system boundaries.

Common scenarios within the automotive industry are then drawn building on this foundation. These illustrations shed light on who holds the responsibility for reporting Scope 3 emissions within the diverse constellations comprising the industry's process landscape. These case studies encompass different phases of the supply chain – pre-inbound, inbound, pre-outbound, and outbound – as well as intracompany business.

The ultimate goal is to foster a profound understanding of the unique challenges and requirements concerning GHG emission reporting in the automotive industry. With this Chapter, we aim to provide clear and practical guidelines for the application scope and definition of system boundaries within this context.

4.1. Process Landscape

The process landscape of the automotive industry is vast and interconnected. It begins with the procurement of raw materials from various sources and extends to the production of vehicles and their delivery to end customers.

4.1.1. Raw Material Acquisition and Initial Processing

The initial phase of the process landscape includes the acquisition of raw materials and their initial processing. Suppliers at this level provide a variety of materials, from steel and aluminium for the vehicle's frame to plastics and textiles for the interior.

4.1.2. Component Manufacturing

Once raw materials have been processed, they are used in the production of components. This includes everything from engine parts and body panels to electronic systems and interior fittings. These components are produced by a range of suppliers, often known as Tier 1, Tier 2, and Tier 3 etc. suppliers, depending on their place in the supply chain.

4.1.3. Vehicle Assembly and Manufacturing

Vehicle manufacturing in the automotive industry is not a simple, linear process. The automakers operate through intricate internal processes that involve various stages of assembly and manufacturing, often occurring at different sites. These multi-tiered procedures within the manufacturers resemble the layered structure of the supply chain, adding another level of complexity to the process landscape.

4.1.4. Distribution and Sales

Once vehicles have been manufactured, they are transported to dealerships or directly to customers. This phase includes not only local deliveries but also international shipping, requiring a complex logistics network.

4.1.5. Service Parts and Accessories

In addition to the manufacture of complete vehicles, components and accessories are also part of the automotive supply chain – providing items to customers and service centres for the maintenance and repair of vehicles

4.1.6. End Customer

Finally, the vehicles reach their end customers. These could be individual consumers, businesses, leasing companies, rental car agencies, or government organizations. Each of these customer types represents different distribution channels and requires GHG reporting.

Understanding this process landscape is crucial for determining who is responsible for calculating and reporting emissions in various scenarios within the automotive industry's process landscape.

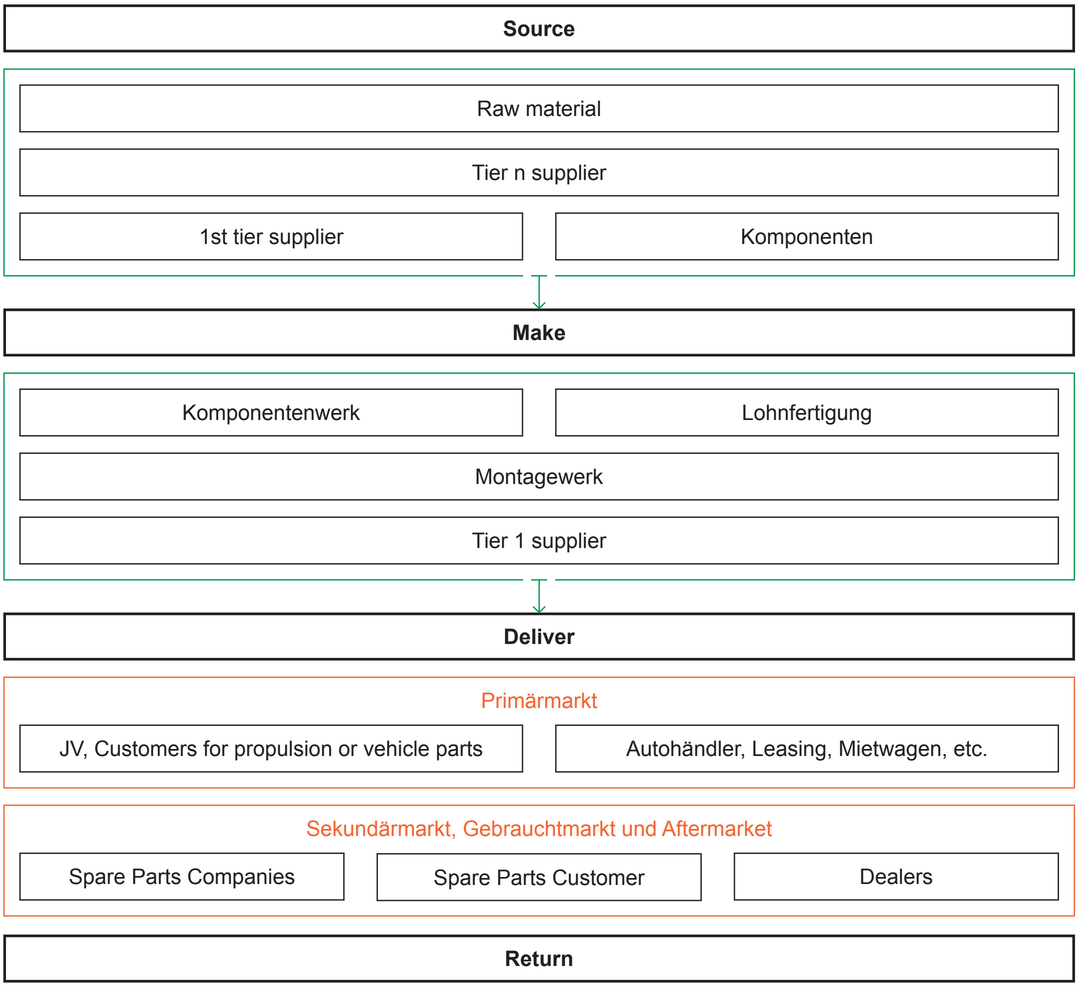

Figure 1: Process landscape of the automotive industry

4.1.7. Freight payment

Unraveling the task of assigning responsibility for reporting and controlling greenhouse gas emissions linked to transportation and distribution proves challenging within the convoluted structure of the automotive industry. The key to deciphering this responsibility often lies in who pays for the freight. Essentially, the responsibility for identifying/calculating emissions from transportation and distribution lies with the company responsible for freight payment. This is because the freight-paying company usually has contractual control over the choice of transportation and can access the emissions data from the freight transport operator.

4.2. Reporting Scopes of automotive transport

In the context of the automotive industry's supply chain from the perspective of an OEM, there is a distinction between 1st tier and N-tier (all suppliers below 1st tier) suppliers when it comes to categorizing Scope 3 emissions. Emissions related to movements between N-tier and 1st tier suppliers typically fall into category 1 (Purchased Goods and Services) of Scope 3 emissions, as the transportation and distribution are an integral part of the provided goods and services.

Freight transportation related emissions can be classified as Scope 1, Scope 2, or Scope 3 (Categories 4 and 9) within the Greenhouse Gas Protocol. All emissions starting from tier 1 to the end customer of a reporting company must be included. The Scope that the freight movements should be recorded against relates purely to the ownership or who the freight payer is for the transport being used. Scope 1 and Scope 2 relate to emissions from owned and operated vehicles, including electrically powered ones charged with imported/purchased electricity. Scope 3, however, covers transportation not reported in Scope 1 or 2, i.e., non-owned/operated transport.

As all entities within the supply chain are obligated to report their upstream transport from their tier 1 suppliers, as well as the downstream transportation to their end customers, it's imperative to establish a robust communication method for sharing the emissions data. The company responsible for the transportation (either as owner-operator or person paying for the service) should also be responsible for communicating the level of CO_2e (CO_2 equivalent) applicable from the share of the freight movement to the other interested parties.

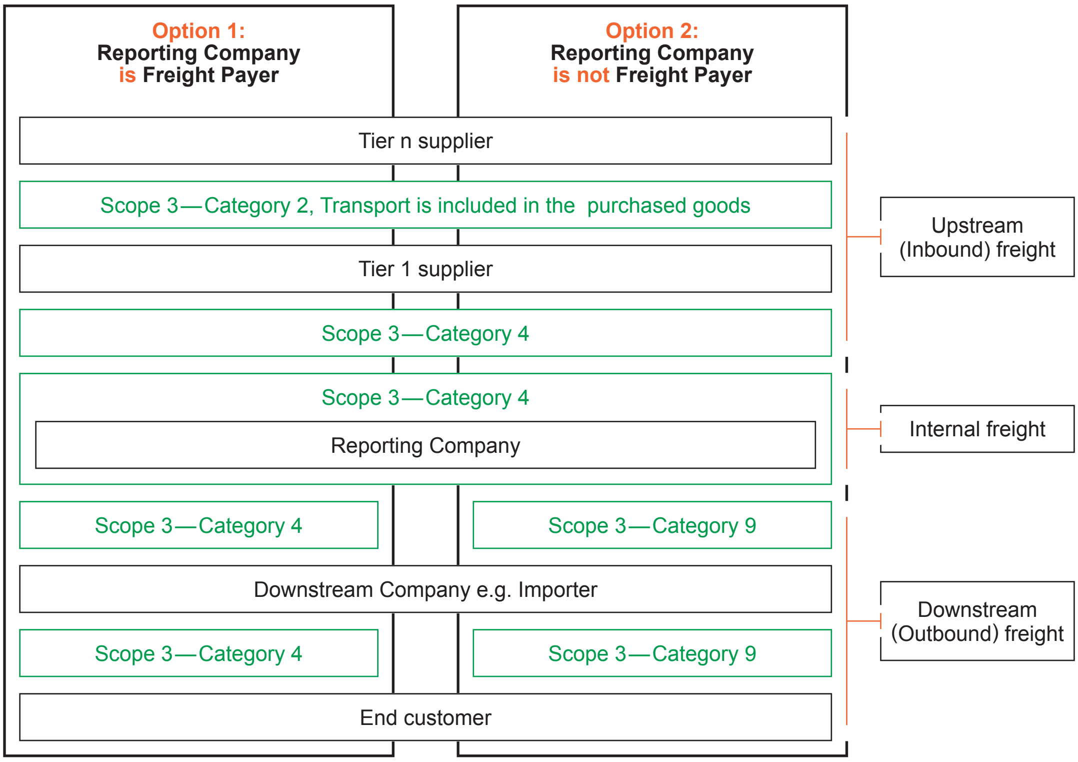

Figure 2: Non owned/operated transport emission categories from the perspective of the "Reporting Company"

To ensure comprehensive and accurate tracking and management of GHG emissions, the following checklist is designed to cover all relevant supply chain processes for an OEM or supplier.

These sections include Inbound, Intracompany, Outbound, Aftermarket, Retail transports, and the flow of empty packaging materials. The objective of this checklist is to confirm that all emissions, including those generated during the transportation and handling of empty packaging materials, are effectively measured, monitored, and managed in accordance with applicable regulations and industry best practices.

Each section refers to a dedicated example in the annex of the guideline for further details and explanations.

Supply Chain step	**Description**	**Reference**
Inbound	Inbound transports coming from suppliers to production or component plants as well as deliveries to consolidation and distribution centres are covered for all freight payment situations.	Annex 8.1.1
Intracompany	All transports between the various business units. This includes the transportation of raw materials, components, semi-finished goods, finished goods between different production sites, warehouses	Annex 8.1.3

Supply Chain step	Description	Reference
Outbound	Consignments of finished vehicles or products (from suppliers) are covered from the production plant down the retail chain as far as possible (ideally until the end customer), also if the legal entity structure changes.	Annex 8.1.4
Aftermarket	OEMs and suppliers must consider all transportation related to the distribution of spare parts, accessories, and other products sold after the original sale of the primary product. This includes transport to various distribution centres, retailers, or directly to the customer.	Annex 8.1.5
Material flows of empty packs	All transportation associated with the return of empty production packaging materials back to the supplier. This includes transport from the place of origin to the production sites, intracompany transports, and return transports once the materials have been used.	Annex 8.1.5
Returns	All transport related to the return of goods. This encompasses not only customer returns but also intracompany returns of unsold or defective products, and reverse logistics necessary for their management. It may include the transport of these goods back to distribution centres, warehouses, or manufacturing sites, and potentially onwards to recycling or disposal facilities.	Annex 8.1.5

Table 4: Automotive Industry transport scenarios

5. Roles and responsibilities in automotive transport emissions calculation and reporting

The logistics and transportation sector is at the heart of global commerce, fueling economic development and facilitating a connected world. However, this crucial industry is also responsible for a substantial portion of worldwide GHG emissions, demanding significant attention towards environmental sustainability. In this context, the role of Transport Operators emerges as pivotal.

5.1. Logistics Service Providers

Logistics Service Providers carry a profound responsibility for adopting sustainable practices, reducing the carbon footprint of their operations, and contributing to a sustainable logistics and transportation industry. From selecting the appropriate modes of transportation to optimizing routes for fuel efficiency, their actions have a direct impact on the GHG emissions associated with each transport. Thus, LSPs are not just service providers; they are the torchbearers of sustainability in the industry.

5.1.1. Creating the Right Environment for Responsibility

For LSPs to effectively shoulder this responsibility, they require supportive conditions and active cooperation from their customers. Customers need to recognize their role in fostering a green supply chain and work collaboratively with their LSP. This collaboration can manifest in various forms, such as providing accurate and timely data, being flexible with transport modes and schedules, and acknowledging the efforts made towards environmental sustainability.

5.1.2. Meeting Customers' Reporting Obligations

Despite the onus being on the LSP to reduce emissions, customers have their own reporting obligations as well as strategic ambitions and objectives in GHG emission reduction. Customers therefore need detailed data to fulfil their responsibilities, demonstrate their commitment to environmental sustainability, and provide auditable proof of their efforts. It's thus imperative that customers receive comprehensive and accurate reports from their LSP. These reports should provide granular insights into the GHG emissions associated with their transports, empowering them to not only meet their reporting obligations but also devise effective strategies for further emission reductions.

This foundation of an effective GHG emission reporting structure lies in clearly defined roles and shared responsibilities. All key stakeholders – the ECG, VDA, OEM, Suppliers, and LSP must contribute to achieving accurate and comprehensive emission calculations and reporting.

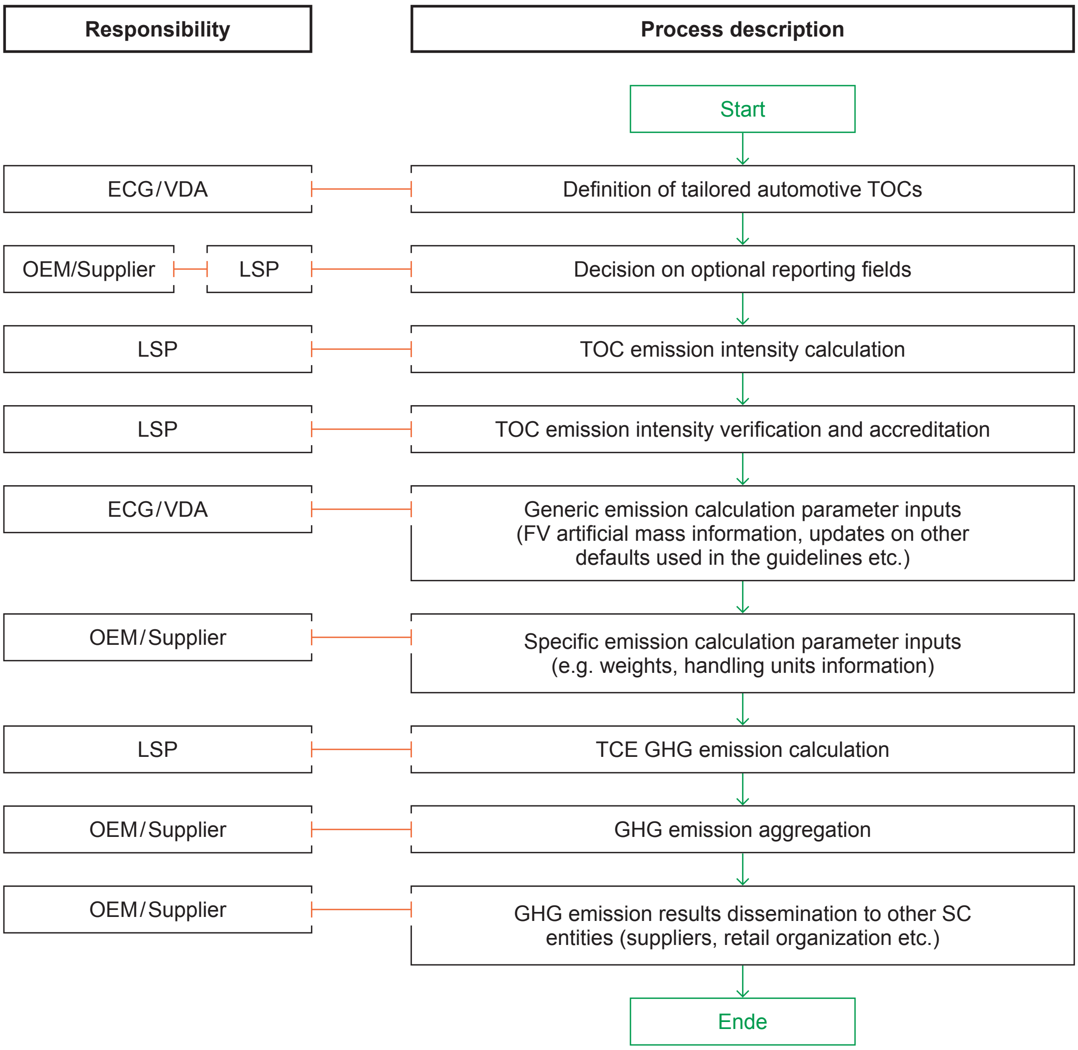

Figure 3: Roles and Responsibility in automotive transport emission calculation and reporting

This model of shared responsibility not only streamlines the emission calculation and reporting process but also fosters a culture of transparency, accountability, and collaboration among all stakeholders.

The following Chapters delve into the specifics of the reports, namely the TOCs Report, TOC Emission Intensities Report, and TCE Report. These reports underscore the concerted efforts of all parties and form the foundation of a robust and credible sustainability reporting structure in the automotive transport industry.

6. General guideline for transport emissions reporting

6.1. TOC Master Data Report

The process of creating an accurate emissions report begins by attributing all transports, regardless of the client, to a corresponding TOC. A TOC is a categorization framework that helps organize transport operations based on their shared attributes, serving as the basis for all subsequent analysis.

The TOC Master Data Report is a comprehensive dataset for each TOC. It includes an identification code, the name, and further specific parameters such as the Mode of Transport (MoT), Asset type, Propulsion type, and more, depending on the mode of transport. These parameters are critical in accurately grouping each transport operation under the appropriate TOC and serve as key variables in the ensuing emissions calculations.

6.1.1. TOC Identification Code

Each TOC is represented by a specific seven-digit serial number. Each position of this number corresponds to a particular parameter in the context of the chosen mode of transport, and the number at that position provides information about the specific manifestation of that parameter.

As an example for the rail mode of transport, let's consider the serial number '1135101'. The significance of each number in this serial number is as follows (Annex 8.4.1):

Number	Parameter	Value
1	Asset	Finished Vehicle
1	Transport concept	Single Wagon
3	Train configuration	< 700 m length
5	Wagon type	Flat Wagon
1	Operating mode	Shuttle full-full
01	Propulsion type + Source of electric energy	Electric powered – energy mix

Table 5: TOC identification example

It's essential to note that in the serial number "0" stands for "empty." This means that the specific parameter has no significance for the particular mode of transport.

Detailed definitions for the individual numbers and positions of the serial number related to different modes of transport – Road, Rail, and RoRo – can be found in the respective sub-Chapters of this guideline.

To ensure the correct identification of the associated mode of transport, this will be guaranteed by a separate column in the 'TOC Master Data Report'. Through this system, companies can categorize their transport activities accurately and ensure consistent GHG reporting.

6.1.2. TOC Master Data Report Parameters

The TOC Master Data Report is delivered initially and only updated when there's a change in any of the relevant parameters. This approach ensures that any changes in the operation characteristics are accurately captured and reflected in the emissions data, promoting accurate and up-to-date reporting. This foundational step is critical to understanding the complex relationship between different transport types and their corresponding greenhouse gas emissions, enabling us to create more targeted strategies for emissions reduction.

Parameter	Definition	Requirement
TOC_ID	See 8.2.1	mandatory
TOC_Name	See 8.2.1	optional
TOC_Business_Entity_ID	See 8.2.1	mandatory
TOC_Type	'Automotive TOC', 'Other TOCs' See 8.2.1	mandatory
TOC_MoT	'rail', 'road', 'sea', 'air', inland waterway', 'hub' See 8.2.1	mandatory
TOC_MoT = 'sea' & TOC_Asset = 'FV'		
TOC_ShipType	'Vehicle Carrier (PCC+PCTC) ', 'ConRo', RoRo', 'RoPax' See 7.4.2.1	mandatory
TOC_TransportConcept	'Deep Sea', Short Sea' See 7.4.2.2	mandatory
TOC_MoT = 'rail'		
TOC_Asset	'FV', 'General Cargo', 'EV batteries', 'Steel' See 7.3.2.1	mandatory
TOC_TransportConcept	'Single wagon', 'Wagon group', 'Block train' See 7.3.2.2	mandatory
TOC_TrainConfiguration	'<500 m', '<600 m', '<700 m', '>=700 m' See 7.3.2.3	mandatory
TOC_WagonType	Finished Vehicle: 'Double deck', 'Flat Wagon' Components: 'Regular', 'Multimodal wagon', 'Steel transporting wagon' See 7.3.2.4	mandatory

Parameter	Definition	Requirement
TOC_OperatingMode	'Shuttle full-full', 'Shuttle full-empty', 'Triangle', 'Network' See 7.3.2.5	mandatory
TOC_PropulsionType	'Electric-powered', 'Diesel-powered' See 7.3.2.6	mandatory
TOC_SourceofElectricEnergy	'Energy mix', '100 % renewable' See 7.3.2.6	mandatory
TOC_MoT ='road'		
TOC_Asset	'FV', 'general cargo', 'EV batteries' See 7.2.2.1	mandatory
TOC_JourneyType	General Cargo: 'FTL'. 'LTL' Finished Vehicle Transports: 'FV Point-to-Point', 'FV Multi-stop' See 7.2.2.2	mandatory
TOC_DistanceClass	'Long haul', 'Short haul' See 7.2.2.3	mandatory
TOC_VehicleType	'>3.5-7.5 t', '>7.5-12 t', '>12-20 t', '>20-26 t', '>26-40 t', '>40 t Truck' See 7.2.2.4	mandatory
TOC_PropulsionType	'ICE ', 'BEV', 'PHEV', 'LNG', 'Hydrogen fuel cells', 'Dual fuel' See 7.2.2.5	mandatory
TOC_FuelType	'Diesel', 'Gasoline', 'Electricity', 'CNG', 'LNG', 'Hydrogen', 'LPG', 'Biodiesel', 'HVO', 'Ethanol', 'Hybrid Fuels' See 7.2.2.5	mandatory
For all mode of transports or asset types not covered by this guideline		
TOC characteristics individually defined by the transport operator according to ISO 14083 or other industry specific recommendations		

Table 6: TOC Master Data Report Parameters

6.2. TOC Transactional Data Report

The second crucial report in the system is the TOC Transactional Data report. This report contains information regarding the specific emission intensity for each TOC. The emission intensities are calculated by dividing the total emissions of a TOC by its transport activity. Thus, this report provides a detailed snapshot of the environmental footprint of each TOC, quantifying the amount of GHG emissions produced per unit of transport service in a defined time period.

The report has a direct link to the TOC Master Data Report. The Emission Intensity ID (EIID) and the Business Entity ID number ensure this connection. The EIID serves as a unique identifier of a particular emission intensity data set. This unique ID allows each TOC to be distinctly associated with its emission intensity. Thus, the EIID provides a direct link between the TOC Master Data Report (which houses all the necessary characteristics of a TOC) and the TOC Transactional Data (which contains the emission intensity of the TOC). The TOC_ID in both reports ensures that the emission intensity data can be directly tied back to the specific TOC it pertains to, enabling accurate tracking and reporting of the emissions associated with each TOC.

In addition to the EIID, the business entity ID further enhances the connectivity between the TOC Master Data Report and the TOC Transactional Data. The Business_Entity_ID can be defined as the unique nine-digit DUNS (Data Universal Numbering System) identifier or the business ID according to ISO 15459.

This report not only indicates the emission intensities for different types of transport but also provides critical inputs to the third and final report, which applies these emission intensities to specific consignments.

Parameter	Description	Requirement
TOC_EIID	See 8.2.2	mandatory
TOC_Business_Entity_ID	See 8.2.2	mandatory
TOC_validityfromdate	See 8.2.2	mandatory
TOC_validitytodate	See 8.2.2	mandatory
TOC_ID	See 8.2.2	mandatory
TOC_DataSource	‘primary’, ‘secondary’ See 8.2.2	mandatory
TOC_SampleSize	See 8.2.2	mandatory (if DataSource = primary)
TOC_SampleSpecificity	‘customer specific’, ‘not customer specific’ See 8.2.2	optional (if DataSource = primary or modelled)

Parameter	Description	Requirement
TOC_Verification	‘true’, ‘false’ See 8.2.2	mandatory
TOC_Accreditation	‘true’, ‘false’ See 8.2.2	mandatory
TOC_WTWemissionfactor	See 8.2.2	mandatory
TOC_WTWemissionintensity	See 8.2.2	mandatory
TOC_WTWemissionintensity2	See 8.2.2	optional

Table 7: TOC Transactional Data Parameters

6.3. TCE GHG Emission Report

The final piece of our comprehensive emission tracking system is the GHG emission (TCE) Report. The TCE report applies the TOC specific emission intensity, as calculated and provided in the TOC Emission Intensities Report, to individual transports or consignments. Thus, the TCE report forms the endpoint of our approach, linking the data from the previous two reports to actual transportation activities.

Once the TOC specific emission intensity is assigned to a consignment, it is then multiplied by the transport activity of that consignment to calculate the total emissions generated by that particular consignment. This critical calculation translates the previously abstract TOC specific emission intensity into a tangible figure of greenhouse gas emissions for each consignment, facilitating a more transparent and comprehensive understanding of the environmental impact associated with a company’s shipping activities.

The TCE GHG Emission Report includes several crucial parameters. These include identifiers like the consignment ID, consignment reference number, and transport order number, which provide information about the consignment. The TOC Emission Intensity ID (TOC_EIID) links the consignment back to the TOC and its associated emission intensity. Key data points such as the arrival date of transport, the place of arrival, the source of distance and mass data, and the distance and mass used for the calculation provide context and input for the calculation. The report then presents the calculated emissions in terms of both Well-To-Wheel (WTW) and Tank-To-Wheel (TTW) GHG emissions.

To summarize, the TCE GHG Emission Report effectively applies the data compiled and calculated in the TOC Master Data Report and the TOC Emission Intensities Report to real consignments. It allows us to quantify the emissions generated by each consignment in a standardized and comparable way. This report, therefore, forms the core of our emission tracking and reporting process, providing companies with the vital data they need to track, reduce, and offset their consignment-related emissions.

Parameter	Description	Requirement
Primary identifiers according to the defined reporting level of the consignment		
TCE_ConsignmentID	See 8.2.3	mandatory
TCE_ConsignmentIDReference	See 8.2.3	optional
Additional identifiers for reference		
TCE_TransportOrder	See 8.2.3	optional
TCE_TransportID	See 8.2.3	optional
TCE_TransportIDLSP	See 8.2.3	optional
TCE_TransportChainReference	See 8.2.	optional
TCE_TOCEIID	See 8.2.3	mandatory
TVE_Business_Entity_ID	See 8.2.3	mandatory
TCE_ArrivalDate	See 8.2.3	mandatory
TCE_ShippingLocation	See 8.2.3	mandatory
TCE_PlaceofArrival	See 8.2.3	mandatory
TCE_DataSourceDistance	'default', 'secondary' See 8.2.3	mandatory
TCE_DataSourceMass	'default', 'secondary', 'primary' See 8.2.3	mandatory
TCE_Accreditation	See 8.2.3	mandatory
TCE_Distance	See 8.2.3	mandatory
TCE_AdjustedMass	See 8.2.3	mandatory
TCE_OriginalMass	See 8.2.3	mandatory
TCE_WTWCO_2e	See 8.2.3	mandatory
TCE_TTWCO_2e	See 8.2.3	mandatory

Table 8: TCE GHG Emission Parameters

6.4. Application Examples

6.4.1. Logistics Service provider reporting example

A LSP runs two different transport chains for a customer (K).

In national Groupage transport, he transports goods from K as an area forwarder from the northwest of Germany to the south of the country to Munich. The main part of transport chain is conducted by train with electric propulsion. The pre- and post-carriage is operated by truck.

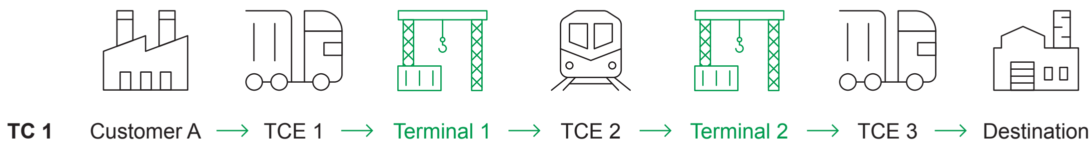

Figure 4: First transport chain for customer (K)

In the second transport chain, air freight consignments are transported from Germany to a warehouse in the USA in Houston, Texas. In this chain pre- and post-carriage are also carried out by truck.

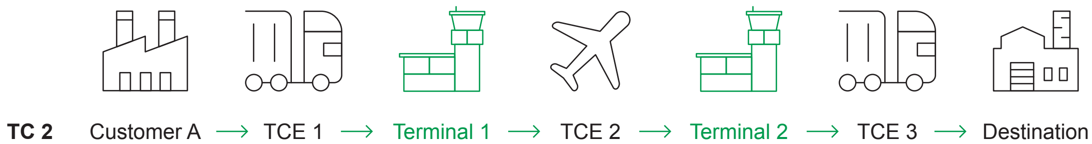

Figure 5: Second transport chain for customer (K)

Customer K expects information on what TOCs are operated and a quarterly update of the respective emission intensity information for each TOC. The individual elements of the transport chain are shown and given in “g CO_2e per tonne-kilometre (tkm)”. The reporting also correctly monitors the proportion of primary and secondary data used according to the automotive guideline. Apart from that Customer K requests information of compliance with ISO 14083. The TOC information the LSP provides to customer K include:

TOC_EIID	TOC_DUNS	TOC_start_date	TOC_end_date	TOC_ID	TOC_DataSource	Data_Sample_Source	TOC_Verification	TOC_Emission_Intensity
000-TC1	315954487	20230801	20230831	TC1_TCE1	primary	70%	TRUE	82,3 gCO_2e/tkm
000-TC1	315954487	20230801	20230831	TC1_TCE2	secondary		TRUE	15,2 gCO_2e/tkm
000-TC1	315954487	20230801	20230831	TC1_TCE3	primary	20%	TRUE	72,7 gCO_2e/tkm
000-TC2	315954487	20230801	20230831	TC2_TCE1	primary	40%	TRUE	67,3 gCO_2e/tkm
000-TC2	315954487	20230801	20230831	TC2_TCE2	secondary		TRUE	808,2 gCO_2e/tkm
000-TC2	315954487	20230801	20230831	TC2_TCE3	secondary		TRUE	128,1 gCO_2e/tkm

Figure 6: TOC information

6.4.2. Example of customer usage of reporting information

This example outlines the practical application of GHG reporting information received from LSPs and the actions most customers will undertake in using this data across various application dimensions.

Upon receiving TCE data, the first step for a company is to integrate this information into a central data cube. This repository ensures consistency, accessibility, and the possibility for advanced analytics across the entire organization.

OEMs and suppliers are typically required to disclose environmental impact in their annual sustainability reports. The GHG emissions per consignment from LSPs feed directly into these reports, providing quantifiable and verifiable metrics on logistics emissions. The data will be aggregated to reflect total emissions associated with logistics and compared against previous periods to track performance and set future targets.

Beside annual sustainability reporting, OEMs and suppliers typically measure the environmental impact associated with individual products throughout their life cycles. The granular GHG emission data per consignment support those life cycle analyses as the accurate allocation to specific products is simplified.

Additionally, OEMs and suppliers have their own internal KPI systems for sustainability performance within logistics operations. Holding granular GHG emission information per consignment allows for different information aggregations and analyses. This includes the calculation of transport GHG emissions per plant, region, logistics process type, mode of transport and LSP, enabling OEMs and suppliers in identifying inefficiencies, setting reduction goals, and benchmarking against industry standards.

LSP-provided emission intensities per TOC also serve as an input for logistics planners. By standardizing values related to emissions, planners can integrate sustainability considerations into routing, mode selection, and carrier choice.

7. Guidelines for transport emission calculation per mode of transport

7.1. Emissions Assignment in FVL transport

This Chapter outlines how to assign GHG emissions to consignments in FVL. In general, mass is used as the basis of assigning emissions to general cargo and mass, or Cargo Equivalent Units (CEU), is used to assign emissions to car transports.

For most general cargo, mass is the key unit for assigning emissions. E.g., emissions for a transport would be calculated using the direct distance, emissions factor and mass of the package.

7.1.1. Defining a conversion system for assigning emissions for FVL

In the context of assigning emissions to cargo, the ISO14083 standard typically utilizes mass as the default unit, a practice that presents unique challenges and complexities, especially when dealing with car transporter capacity. Since mass is not a sufficient measure for car transporter capacity, conversion systems have been developed as a standard metric for car transport. The system acknowledges that capacity usage varies across modes: surface area matters for ships, space and mass for trucks, and dimensions more than mass for trains.

Different conversion models are needed for each transportation mode. For road and RoRo FVL transportation, these are particularly crucial due to dimensional limitations and capacity considerations, especially with varied cargo like conventional cars, light trucks, and modern electric cars. In the case of rail transport, detailed modelling of volumetric load restrictions is more difficult and less common.

For RoRo transportation, the main concern is floor space usage, and existing RoPax models that factor in volume and mass have been deemed suitable. This alternative to mass is referenced in ISO 14083 as passenger equivalent unit (PEU) and was renamed to CEU for the RoRo method standard. The CEU is intended to satisfy the need for a complementary value that does not rely exclusively on mass but also takes into account length, width and height which reflects the space that cargo occupies on a Ro-Ro vessel.

7.1.2. Conversion calculation model for road FVL Transport

The CEU-Road value is based on mass, height, length, and width. Units are mm for measurements and kg for mass.

For each dimension, a base value is defined:

base_mass = 1400
base_height = 1500
base_length = 4000
base_width = 1900

For each dimension, if the value exceeds the base value, the excess is calculated:

If mass < base_mass Then extra_mass = 0 Else extra_mass = mass – base_mass
If height < base_height Then extra_height = 0 Else extra_height = height – base_height
If length < base_length Then extra_length = 0 Else extra_length = length – base_length

For width it is assumed that any extra width of a car does not influence the load factor of a FVL transport as long as the width does not exceed the allowed maximum of a car transporter. Therefore, no additional manipulation of the base value is needed for the width.

A base value of 10 CEU-Road is assigned to every car as a starting point, regardless of size. Therefore, the minimum CEU-Road a car model is evaluated with is 10 CEU-Road:

res = 10' Base CEU-Road

Additional CEU-Road are then added based on how much a car exceeds the base value in the measures as follows:

res = res + extra_mass/250 + (extra_length/500) * (extra_height/300)

E. g., this means that mass adds an extra CEU-Road for every 250 kg over the base mass and that excess length is multiplied by excess height, each divided by different factors before being multiplied.

The result is lastly rounded to whole figures, for practical reasons. The idea is that to standardise for example a VW Golf as a 10 CEU-Road car and a Tesla as a 13 CEU-Road car, rounded.

Pts = Round (res, 0)

7.1.3. Conversion from CEU-Road to adjusted tonnes for road FVL Transport

This initial assumption is that a standard transporter can load a maximum of 18 tonnes, and a maximum of 100 CEU-Road.

Under this assumption, adjusted tonnes can then be calculated as 0,18*pts and must always be used for the conversion from CEU-Road to adjusted tonnes. E. g., for a 10 CEU-Road car that means 10 * 0,18 = 1.8 tonnes.

This means that light cars will be adjusted upwards, while heavy, normal size cars will be close to their real mass.

An Audi A1 for instance, in reality only weighs 1.269 kg. The mass of 10 Audi A1s is 12,69 tonnes, but since 10 Audi A1s is a full load of a standard Car Transporter, the adjusted mass should be 18 tonnes to illustrate that the truck is full.

A Tesla S weighs 2.162 kg, so a full load of 8 Teslas weighs 17,296 tonnes. The Tesla S is 13 CEU-Road, so the adjusted mass is 0,18*13 = 2,34 tonnes.

A Ford Transit ELWB is a 35 CEU-Road vehicle, so it's adjusted mass is 35 × 0,18 = 6,3 tonnes.

7.1.4. Conversion calculation model for RoRo FVL Transports

The CEU-RoRo value is based on mass, height, length, and width of the vehicle. Units are mm for measurements and kg for mass.

The calculation formula is as follows:

Pts = 0,00041 x mass (kg) + 0,019756 x volume (m3)

The volume is defined as the vehicle width * vehicle height * vehicle length, measured at the widest, highest, and longest points of the vehicle (volumetric principle).

The formula consists of the two variables, mass and volume, and the fixed coefficients.

The CEU-RoRo value in RoRo FVL Transports is used by allocating total emissions according to share of CEU-RoRo-based transport activity, divided by the transport activity based on the actual mass.

7.2. Road Transport

7.2.1. Introduction

This Chapter provides a structured overview of the recommended way of GHG emission calculation for road transport operations within the automotive industry. Beginning with a detailed exploration of Road TOC, the Chapter delves into the specifics of assets, journey types, distance classes, and vehicle-related classifications. The discourse then transitions to data collection methodologies, emphasizing system boundaries and the distinction between primary and secondary methods. Conclusively, the guide offers insight into the precise calculations for emissions and their intensities. The calculations in this example are based on FVL and therefore the conversion methodology. For other general cargo like components and materials the calculations are based on the mass of the packages.

7.2.2. Road TOC Definitions

In the landscape of automotive industry logistics, establishing a clear and standardized framework is pivotal. One of the primary tools in achieving this clarity is through the delineation of TOCs. This Chapter serves as an essential guide to the various TOCs we've crafted specifically for the automotive logistics sector. Each TOC is tailored to encapsulate the diverse operations, transport modes, and nuances inherent in the industry.

As described in Chapter 6, each TOC is assigned a 7-digit number. For road transport, the positions are associated with the TOC parameters and their potential values. An overview table can be found under in the annex 8.3.1.

7.2.2.1. Asset Type

For the definition of TOC, the asset type stands as a paramount criterion for segmentation. This prominence is accentuated, especially in the automotive industry, where the mass-to-volume ratio of transported goods can vary significantly. To ensure precision and clarity in defining TOCs, it's imperative that we adopt consistent and clearly delineated categories.

Considering the multifaceted nature of assets in the industry and the need to maintain manageability, we recommend segmenting into three principal asset types:

- Finished Vehicles
- Electric Vehicle Batteries
- General Cargo

7.2.2.2. Journey Type

The "Journey Type" is crucial in describing a transport's operating mode. It's directly related to transport efficiency, impacting factors like cargo utilization and the portion of empty trips. Because of its influence on emission intensity, it's recommended to consider the Journey Type when defining TOC. In the standardized definition of appropriate Journey Types, a distinction must be made between General Cargo/Electric Vehicle Battery transports and Finished Vehicle transports.

For **General Cargo/Electric Vehicle Battery Transports,** there are two recommended distinctions:

- **A FTL** (Full Truck Load) transport in road transportation refers to dedicated consignments where the cargo is transported directly to the destination without sharing the space with other cargo owners. In the automotive industry this is often related to high volume transports where the truck transports parts with a stable delivery frequency.
- **A LTL** (Less than Truck load) transport involves consolidating multiple consignments from different sources into a single truckload for cost-effective and efficient delivery to various destinations.

For **Finished Vehicle Transports,** the distinctions are:

- **Point-to-point** transport entails the exclusive use of a truck that is fully loaded with vehicles from a single source or for a specific destination. The truck is dedicated solely to the consignment of finished vehicles, ensuring that the entire truck capacity is utilized for the transportation of the designated quantity of vehicles.
- **Multi-stop** is a method of shipping where multiple cargo from different sources or destinations are consolidated onto a single truck for transportation. In logistics, multi-stop transport is commonly used when there is a need to transport a smaller quantities than full truck loads. Multi-stop transport allows for the efficient use of truck space by combining multiple smaller consignments into a single load.

7.2.2.3. Distance Class

Distance Classes represent a crucial characteristic in defining TOC in road transportation. The distance a transport covers is not merely about how far a vehicle travels; it's closely related to various operational factors influencing transport efficiency, such as the mix of stop-and-go driving and average driving speeds. Given the significance of these correlations to the emission intensity, it's imperative to employ a clear classification. In this context, we will introduce a simplified distance class classification for integration into the TOC definition.

In transport logistics, **long haul transport** is used to describe the transportation of cargo where the average shortest feasible distance for each leg is 50 km or more. This typically involves intercity, interstate, or even international routes. It covers the movement of finished vehicles or material components from sources such as manufacturing plants, distribution centres, ports, or rail yards to distant destinations. Given the significant distances involved, specialized logistics and transportation modes are often required for efficiency.

Conversely, **short haul transport** pertains to the transportation of goods where the average shortest feasible distance per leg is less than 50 km, generally occurring within a local or regional scope. This category deals with the movement of finished vehicles from manufacturing plants, distribution centres, ports, or rail yards to closer destinations like dealerships, car rental agencies, or other specified sites. It can also involve pick-up trips from material suppliers within a confined region to a consolidation centre or cross-dock.

A leg is understood as a segment of a journey with a consistent payload. Any (partial) loading or unloading initiates a new leg within that journey. ISO 14083 uses TCEs to describe legs. TCE is a section of a transport chain within which the freight is carried by a single vehicle.

To determine the average shortest feasible distance per leg within a transport, one divides the shortest possible distance of the entire journey by the number of legs. For instance, a trip spanning a shortest feasible distance of 120 km, divided into 3 legs, would result in an average distance of 40 km per leg. Consequently, this journey would be classified as short haul transport.

7.2.2.4. Vehicle Type

Vehicle Types serve as a familiar and essential differentiation criterion, one that is highly recommended when defining TOC. Rooted in the generic classification of commercial vehicles (known as EU Vehicle Groups), the automotive industry finds a need to further streamline the number of distinguishable vehicle classes. This need arises due to the relatively limited and standardized profile prevalent in both General Cargo / Electric Vehicle Battery Transports and Finished Vehicle Transports.

For **General Cargo / Electric Vehicle Battery Transports,** the following vehicle types are differentiated:

- **Vans:** Within logistics, a van denotes a commercial vehicle chiefly intended for the carriage of smaller quantities of goods. Such vans are frequently employed in diverse automotive logistics operations, such as emergency transport of missing production materials or the last-mile distribution tasks in after-sales logistics.
- **7,5-tonne trucks:** This type of truck refers to a commercial vehicle boasting a maximum gross vehicle weight (GVW) of 7,5 tonnes. Predominantly, it serves light to medium-duty transport and delivery tasks, especially in urban and suburban environs.
- **12-tonne truck:** Referring to a logistics vehicle with a GVW of 12 tonnes, this truck finds its application in assorted transportation and delivery operations, mainly for medium-duty tasks. Typical use cases encompass Local and Regional Distribution, Last-Mile Delivery, and Light to Medium-Duty Haulage.
- **Megatrailers:** Standing apart from standard trailers, Megatrailers flaunt a taller internal height of 3 meters. This unique feature facilitates the stacking of box pallets up to three times, thereby amplifying its capacity. Given their vast loading volume and the 3 m interior height, which can be optimally used due to standardized load carriers, Megatrailers find a niche in the automotive sector. Distinct from its standard counterpart, the Eurotrailer proffers a loading space longer by 1,38 meters, accommodating two additional Euro pallets.
- **Drawbar Trucks:** Comprising a truck cab and an affixed trailer via a drawbar, these vehicles stand out in efficient, flexible transportation, especially in dense urban settings. Marrying agility with stability, they're a go-to for local or regional distribution. Notably, these trucks, stretching up to 25,25 meters, surpass the conventional truck length (max. 18,75 m) but adhere to the stipulated mass norms (either 40 t or 44 t in combined transport).

For **Finished Vehicle Transports,** differentiation is done for the following vehicle types:

In the realm of finished vehicle logistics, each vehicle category bifurcates further into two nuanced sub-types: open and covered.

- **Car Carriers:** Within the confines of finished vehicle logistics, a car carrier is a transport vehicle, tailor-made for the proficient, secure transport of a plethora of finished vehicles, ranging from compact cars to SUVs and trucks.
- **EMS Car Carrier:** Distinguished from the standard car carrier, this elongated version is adept at accommodating and ferrying a more substantial volume of vehicles across extended distances. Its design caters to heightened vehicle volumes, thus fostering operational efficiency.

- **Motor Vehicles:** Within automotive logistics, this vehicle, also dubbed as a tow or breakdown truck, is pivotal for transporting fewer quantities. Typical scenarios include the repositioning of pre-owned vehicles or the dispatch of finished vehicles to urban retail outlets with constrained storage.

For an in-depth understanding of the default gross and net mass parameters associated with each vehicle type, please refer to the annex 8.3.2.

7.2.2.5. Propulsion and fuel types

The propulsion and fuel type of a truck are critical determinants of its emission factor and subsequent emission intensity in transport operations. Within the automotive domain, specific procurement agreements often exist between customers and transport operators concerning the usage of certain truck types. Consequently, it's prudent to embed the differentiation of propulsion and fuel types into the TOC definition. Instead of relying on an average mix of the transport operator's fleet, direct specification of propulsion ensures more accurate emission intensity calculations.

In a standardized automotive TOC definition, using the following propulsion types is recommended:

- **Internal Combustion Engine (ICE) Propulsion:** with Diesel predominantly found in heavy-duty trucks and Gasoline commonly associated with lighter trucks.
- **Battery Electric Vehicles (BEV):** Employ batteries for energy storage.
- **Plug-in Hybrid Electric Vehicles (PHEV):** A fusion of battery power and an internal combustion engine.
- **Hydrogen Fuel Cells:** Uses hydrogen to produce electricity, driving the truck's propulsion.
- **Dual Fuel:** Involves the simultaneous use of diesel and another fuel variant, such as natural gas or propane.

Additionally, the following general fuel types should be differentiated:

- **Diesel:** The mainstay fuel for the majority of heavy-duty trucks.
- **Gasoline:** Opted for in several lighter truck variants.
- **Electricity:** The power source for electric and plug-in hybrid trucks.
- **Compressed Natural Gas (CNG):** Customary for medium to heavy-duty trucks.
- **Liquefied Natural Gas (LNG):** An alternative in long-distance trucking scenarios.
- **Hydrogen:** The fuel for hydrogen fuel cell-equipped trucks.
- **Propane (LPG):** Some trucks are designed to function on propane.
- **Biodiesel:** Blendable, with or usable as a direct replacement for, conventional diesel.
- **HVO (Hydrotreated Vegetable Oil):** Derived from sustainably sourced renewable materials. Compatible in pure form or blended with fossil diesel.
- **Ethanol:** While uncommon, it occasionally serves as a gasoline blend.
- **Hybrid Fuels:** A mix of multiple fuels in hybrid systems.

Annex 8.3.1 provides the detailed overview regarding which propulsion types and fuel type combinations are predominant in the automotive industry and should therefore be used in the TOC definition.

7.2.3. Data Collection

7.2.3.1. System boundaries

System boundaries in transport GHG emission reporting for the automotive industry define the scope of data collection, specifying the processes and activities that are included or excluded in the assessment. They are critical in ensuring a consistent and transparent evaluation of emissions, aligning with specific guidelines and standards. The following sections detail the included and excluded processes within these boundaries.

Processes included:

The following processes are considered in the calculation of CO_2e emissions related to transportation in the automotive industry:

- **Vehicle Operational Processes:** This encompasses all activities directly related to the operation of the vehicle.
- **Vehicle Energy Provision Processes:** This refers to the provision of energy required to power the vehicle, including all associated emissions.
- **Loaded and Empty Trips Made by Vehicle:** All trips, whether loaded or empty, related to a transport order
- **Combustion and/or Leakage of Energy Carriers at Vehicle:** This includes emissions resulting from the combustion or leakage of energy carriers used in the vehicle.
- **Leakage of Refrigerants Used by Vehicles:** This pertains to emissions resulting from leakage of refrigerants used in vehicles.

Processes excluded:

The following processes are excluded from the calculation:

- **Production and Supply Processes of Refrigerants:** This includes all processes associated with the manufacturing and supply of refrigerants.
- **Processes at the Administrative (Overhead) Level of the Organizations Involved in the Transport Services:** All higher-level administrative processes of the transport service providers are excluded.
- **Processes for the Construction (e.g., Embedded GHG Emissions Associated with Vehicle Production), Maintenance, and Scrapping of Vehicles or Transhipment and (De) Boarding Equipment:** This excludes emissions related to the manufacturing, maintenance, and scrapping of vehicles and related equipment.
- **Processes of Construction, Service, Maintenance, and Dismantling of Transport Infrastructures Used by Vehicles:** This excludes emissions related to roads, inland waterways, rail infrastructure, or transhipment and (de) boarding infrastructure.
- **Examples of additional Trips Besides a Transport Order:**
    - Internal Transport Activities
    - Drive to Gas Station: Specially started trips towards a gas station outside of a transport order are not taken into account. Additional mileage due to refuelling operations during a transport order is already compensated with the distance adjustment factor (DAF).
    - Drive to Maintenance: Specially started trips towards a repair shop outside of a transport order are not taken into account. Additional mileage due to maintenance activities during a transport order is already compensated with the DAF.
    - Journeys of External Companies or Independent Drivers to the Starting Point
- **Use of Information and Communications Technology (ICT) Equipment and Data Servers Related to Transport and/or Hub Operations**
- Black Carbon Emissions

7.2.3.2. Primary Data collection for a consumption-based calculation

This method employs specific measurement devices and instruments to directly measure emissions at their sources. By installing emission monitoring systems on vehicles or other emission sources, accurate and immediate measurements are obtained. The foundation for emission calculations is built on this measured data, which we classify as 'primary data. ' Primary data, by definition, is data that originates directly from the source in this context, data procured via an information or telematics systems. The distinguishing factor between primary data and modelled data lies in the origin of the information. For primary data, the original source is decisive. Furthermore, a crucial connection exists between emission data and order management, ensuring a cohesive and comprehensive assessment of emissions based on real-time activities and operations.

Primary Data Parameter:

In order to be able to calculate emissions from road transport on the basis of primary data, information is basically required on three topics: Information on the mileage performed (loaded and empty), information on the mass transported, and information on the actual fuel consumption.

Energy Consumption:

Currently there are 3 main technological approaches available for energy consumption measurement in road transportation. First, telematic systems in trucks capture energy consumption data essential for consumption-based emission calculations. The fuel consumption is typically calculated via the injection quantity determined by the engine control unit. Flow metres are an alternative way to measure fuel consumption in a direct way (fuel consumption is determined directly with the flow meter). An alternative to energy consumption measurements are emission measuring devices, which means that the resulting emissions are measured directly and not calculated based on fuel consumption data.

This recorded data serves as a foundational input, enabling accurate assessments of emissions relative to the energy consumed. While direct energy consumption or emission measurements are ideal, implementing this strategy is not always feasible for all LSPs. An alternate method to gather primary data is a consumption-based calculation using average vehicle fuel consumption data. Instead of collecting consumption data on a trip-by-trip basis, it is proposed to aggregate the data over specific intervals. This method can be a temporary solution, but the defined level of ambition remains: to achieve trip-specific consumption data. If a truck's journeys consistently fall within the same TOC, collecting and analysing aggregated data at the vehicle level always is a valid approach.

Mass and information for adjusted mass calculation of finished vehicles:

A primary data-based mass approach information is defined as consignment gross mass information originating directly from the customers transport order message. In FVL the same logic applies for the additional information needed for the adjusted mass calculation of a specific vehicle (car model and / or dimensions of the vehicle). Mass calculations by the transport operator based on historical data and other own calculation approaches do not meet the standard of a primary data-based mass information.

Distance:

Distance information always needs to be calculated as shortest feasible distance (SFD). Actual driven distances (ADD) should not be used to calculate GHG emission intensities, because only the LSP knows the ADD. Therefore, the customer is not able to validate or plan the TOC CO_2e with the ADD and must use the SFD to do so. A shortest feasible distance meeting the standards of being primary data based must be calculated based on the real geocoordinates of the source and destination of the transport. The extrapolation of this geographical information or a calculation based on aggregated geographical regions (e.g., postal code areas) do not meet the primary data standard. A well-established route calculation service with good accuracy of the underlying route network data (including specific heavy trucking restrictions) should be used for this calculation. The preferred data source of these distance calculation results is the internal transport management system of the transport operator to ensure a high level of process robustness and auditability of the calculation. Distance calculations in manual processes (e.g., excel based calculations) should be avoided.

7.2.3.3. Secondary Data collection for a transport activity-based calculation

Within GHG transport emissions reporting in the automotive sector, primary data might be hard to come by. When faced with such gaps, the transport-based calculation, fortified by secondary data sources, offers a dependable recourse. This methodology emphasizes transportation specifics over direct consumption metrics. By assessing intrinsic transportation factors such as distance, vehicle type, and load mass, the transport-based calculation constructs a credible emissions estimate. It's crucial to note that companies using this guideline, who find it challenging to source specific data for the mentioned parameters, have the option to rely on default values. However, these default values, being of the highest level of aggregation, might lead to less precise emission calculations. Nevertheless, this method serves as a valid strategy, especially for stakeholders operating within data constraints, ensuring that the automotive industry can maintain both accuracy and transparency in its emissions reporting even when primary data is elusive.

In order to be able to calculate emissions from road transport based on secondary data, information is required on the following parameters:

- **Distance travelled:** The span covered during the transportation of automotive components or finished vehicles, usually measured in kilometres or miles. To model the distance, the point of origin and the point of destination are necessary, as well as the route for ADD and SFD.
- **Vehicle Type:** Pertains to the specific classification of the truck, factoring in its design, size, and intended use. Different trucks (e.g., heavy-duty vs. light-duty) have varied emission profiles based on their efficiency and build.
- **Mass:** Represents the gross mass of the automotive parts or finished vehicles being transported. The gross mass of automotive parts includes mass of container, packaging and pallet. The mass directly influences the fuel efficiency of the truck and consequently, its emissions.
- **Empty Trip Factor:** Indicates the proportion of a truck's journey where it travels without carrying automotive parts or vehicles. During such trips, the truck's emission dynamics differ due to the absence of cargo mass.
- **Utilization Rate:** Describes the degree to which a truck's cargo space is occupied by automotive parts or vehicles. It provides insights into the efficiency of space utilization and its potential impact on emissions.
- **Emission Factor:** A value denoting the amount of CO_2e emissions produced by trucks per unit of activity, specific to the automotive transport context. This factor helps in converting distance travelled, mass carried, and other activity metrics into tangible CO_2e emission values.

In case of unavailability of secondary data for modelling, it is valid to resort to default values. In 8.3.3 and 8.3.4, you will find a comprehensive table that includes default values. Additionally, we have provided a ranking that dictates the order in which these default values should be referred to.

Fuel/Energy Economy: It's advised to utilize the recommended emission factor data sources specific to each country. If such specific data sources are not available, one can turn to the default values provided by GLEC. However, in using GLEC's default values, it's crucial to adapt the Empty Trip Factor and Loading Factor to best suit the specific use case.

Distance Travelled: No specific preference is indicated here. The main distinction to make is between data sourced from public repositories and those obtained from internal records or analytics.

Mass Carried: When considering the mass being transported, the primary data source should be the mass of parts or vehicles as provided by the customer. If mass information is missing in FVL, LSPs are recommended to refer to the vehicle mass and dimension catalogue provided by ECG.

Any other sources of mass data should be considered secondary and used only when the primary source isn't available.

7.2.4. TOC emission intensity calculation

The emission intensity of every applicable TOC should be calculated based on primary data wherever possible. This approach promises the highest data quality and is most likely to allow conclusions to be drawn about the emissions that actually occur. For those transports where a calculation based on primary data is not possible, the emission value can be modelled, or default values can be used.

If the transports with available primary data within a TOC are representative for all transports within the same TOC, the emission value collected on the basis of primary data can be allocated for the entire TOC. Transports are representative if they are a realistic representation of the general transport operations profile, such as the technical equipment used, the geographical conditions, customer service level requirements and logistics operating model.

In the following, both calculation approaches are explained by way of example.

7.2.4.1. Primary data-based TOC emission intensity calculation

In the following, the emission intensity for one finished vehicle transportation TOC is determined as an example (the example is also a reference for material logistics transports).

Summary of primary data-based emission intensity calculation for one TOC

Parameter	Value	Unit	Source
Total calculated transport distance (SFC)	950	km	TMS
Calculated empty trip factor (SFC)	28,4	%	TMS
Adjusted mass	2	Adjusted tonnes per vehicle	calculated acc. to customer transport orders (Chapter 7.1.3)

Parameter	Value	Unit	Source
Number of cars	38	#	
Total energy consumption (Diesel, B5)	285	l	Telematics system linked to TMS
TTW-GHG emissions factor (Diesel, B5)	2.497	gCO_2e/l	GLEC Framework v3.0 2023
WTW-GHG emissions factor (Diesel, B5)	3.315	gCO_2e/l	GLEC Framework v3.0 2023
TTW-GHG Emission intensity	44,34	gCO_2e/adjusted tonne km	calculated acc. ISO 14083
WTW-GHG Emission intensity	58,86	gCO_2e/adjusted tonne km	calculated acc. ISO 14083

Table 9: Primary data-based emission intensity example calculation

First, the total emissions incurred within the scope (usually a specific TOC over one quarter) is calculated. To do this, the actual energy consumption of the vehicles (including empty and loaded runs) is multiplied by the emission factor of the corresponding energy carrier.

When selecting an appropriate emission factor, the minimum requirement is to refer to one of the sources recommended in this guideline. If available, a propulsion type specific emission factor should always be preferred. This value could be obtained from a certificate on the purchased fuel or from the certified electricity label of the respective energy supplier.

$$Total\ emissions\ [gCO2e] = Energy\ consumption\ [unit]\ \cdot\ Emission\ factor \left[\frac{gCO2e}{unit}\right]$$

In the second step, the transport activity is calculated. For this purpose, the mileage under load is multiplied by the transported mass. Preferable is the calculation on a trip by trip level, but also at an aggregated level is possible and sometimes necessary. The following provides an explanation and a simple example of how to calculate the transport activity on a trip by trip level (1) and on an aggregated level (2).

1. In this calculation method, the sum of products between transported mass (adjusted mass for finished vehicle transports respectively) and mileage under load of all legs is formed for each transport order. The sum of all transport orders thus forms the transport activity of the TOC.

Transport order 1

Leg 1: Point A to Point B; 100 km SFD; 15 adjusted tonnes
Leg 2: Point B to Point C; 50 km SFD; 7 adjusted tonnes
Leg 3: Point C to Point A; 70 km SFD; empty

Transport order 2

Leg 1: Point A to Point B; 200 km SFD; 20 adjusted tonnes
Leg 2: Point B to Point A; 200 km SFD; empty

Transport order 3

Leg 1: Point A to Point B; 300 km SFD; 18 adjusted tonnes
Leg 2: Point B to Point A; 300 km SFD; 16 adjusted tonnes

The total transport activity is hence:

$$Transport\ Activity = (100 * 15 + 50 * 7) + (200 * 20) + (300 * 18 + 300 * 16) = 16.050\ adjusted\ tonne\ kilometers$$

2. Another option is to use calculated average values based on all transports within the TOC. In the example of a finished vehicle transport, the average load factor (information from the TMS) is multiplied by the average adjusted mass of a vehicle (calculated within the TMS in a preparatory step), to determine the transported mass. This is then multiplied by the total mileage and the load mileage percentage.

$$Transport\ performance\ [tkm] = Total\ mileage\ [km] \cdot (1 - Empty\ run\ factor\ [\%]) \cdot average\ transported\ adjusted\ mass\ [t]$$

In the last step, the total GHG emissions of the TOC are divided by the transport activity in order to determine the final emission intensity factor.

7.2.4.2. Modelled data-based TOC emission intensity Calculation

If the calculation of the emission value of a TOC is not possible on the basis of primary data due to an insufficient data basis, the value must be modelled using default values.

This reduces the required parameters to the essentials. In the following, two examples are used for explanation.

Summary of modelled emission intensity calculation for one TOC with default values

Parameter	Value	Unit	Source
Load Factor	60	%	GLEC Framework V3.0 2023
Empty Factor	17	%	GLEC Framework V3.0 2023
Energy consumption factor (Diesel)	0,023	kg/tkm	GLEC Framework V3.0 2023
Lower Heating Value (Diesel)	42,8	MJ/kg	ISO 14083
TTW-GHG emissions factor (Diesel)	74,1	gCO_2e/MJ	ISO 14083

Parameter	Value	Unit	Source
WTW-GHG emissions factor (Diesel)	87,3	gCO_2e/MJ	ISO 14083
TTW-GHG Emission intensity Diesel EU	66,60	gCO_2e/tkm	calculated acc. ISO 14083
WTW-GHG Emission intensity Diesel EU	78,47	gCO_2e/tkm	calculated acc. ISO 14083

Table 10: Modelled emission intensity example calculation with default values

The first case describes the application of a default emission factor from the GLEC Framework for transport with a truck with a GVW of 40 t. This case should only be applied if no more detailed information about the transport is available, such as the Load Factor or the Empty Factor.

The GLEC framework offers a certain number of default values. Shown here is the use of an articulated truck up to 40 t GVW, assuming a loading factor of 60 % and an empty run share of 17 % with the corresponding specific fuel consumption [kg/tkm]. For the full list of recommended default values and their sources refer to Annex 8.3.3. In order to convert this value into an appropriate emission intensity, we need the Lower Heating Value of diesel [gCO_2e/MJ] and the emission factor of the fuel [gCO_2e/MJ].

$$Emission\ intensity\left[\frac{gCO_2e}{tkm}\right] = Energy\ consumption\ factor\left[\frac{kg}{tkm}\right] * Lower\ heating\ value\left[\frac{MJ}{kg}\right] * Emission\ factor\ [\frac{gCO_2e}{MJ}]$$

In result, this emission intensity represents the simplest way of sourcing a TOC value.

Summary of modelled emission intensity calculation for one TOC with detailed modelling parameters

Parameter	Value	Unit	Source
Emtpy mass truck	14,00	t	assumption
Max. total mass of the truck	40,00	t	assumption
Empty Factor	50 %	Percentage	TMS
Average mass	2,00	t	TMS
ECF_full	33,84	l/100 km	DEFRA, 2021: Articulated Truck (>33 t) 100 % loaded
ECF_empty	20,51	l/100 km	DEFRA, 2021: Articulated Truck (>33 t) 0 % loaded

Parameter	Value	Unit	Source
Payload Capacity	26,00	t	Calculation
Capacity utilizsation	8 %	Percentage	Calculation
ECF actual load	21,54	l / 100 km	Calculation acc. EcoTransIT World – Methodology Report 2023 page 59
WTW-GHG emissions (Diesel, B5)	3.315	gCO_2e / l	GLEC Framework V3.0 2022
WTW-GHG Emission factor loaded	714,10	gCO_2e / km	Calculation
WTW-GHG Emission factor empty	679,91	gCO_2e / km	Calculation
WTW-GHG Emission intensity	696,98	gCO_2e / tkm	Calculation

Table 11: Modelled emission intensity example calculation with detailed modelling parameters

As seen in the previous example, the use of default values can only partially reflect reality due to the limited data complexity. Therefore, wherever possible, additional information should be taken into account during modelling. The following example describes the calculation of a TOC for transports in the general cargo logistics with very low utilization of the GVW, making common default values not applicable and a more detailed modelling approach necessary.

In this example, we assume that the truck used (40 t GVW) has an empty mass of 14 t. As the next step, we need information about the total mileage within the TOC driven, as well as the average percentage of empty trips. This can preferably be extracted from a TMS, but for recurring transports, a fixed tour plan, for example, is an option as well. The same applies to the average mass transported during the loaded segments of the transport.

As we assume that we do not have any information about the actual energy consumption, we need to model the energy consumption factor (ECF) for the actual load. In order to do so, we need an assumption for the energy consumption during empty trips and at 100 % capacity utilization. Various data sources or studies can be used to determine the corresponding consumption values. In the example, a fuel consumption value for an Articulated Truck from DEFRA (Department for Environment, Food & Rural Affairs) was used.

After calculation the Payload Capacity (GVW minus the average transported mass) and the Capacity Utilization (average transported mass divided by the Payload Capacity) we are able to use the following formula in order to calculate the ECF under actual load.

$$ECF_{actual\ load}\left[\frac{l}{100km}\right] = ECF_{empty}\left[\frac{l}{100km}\right] + \left(ECF_{full}\left[\frac{l}{100km}\right] - ECF_{empty}\left[\frac{l}{100km}\right]\right) * Capacity\ utilisation\ [\%]$$

By multiplying the ECFactual load and the ECFempty with the corresponding emission factor [gCO_2e/l] we calculate the emission intensity [gCO_2e/km] both for the loaded and for the empty runs. The final emission intensity for the TOC is then calculated using following formula:

$$Emission\ intensity\ \left[\frac{gCO_2e}{tkm}\right] = \left(\frac{(1 - Empty\ Factor\ [\%]) * ECF_{actual\ load}\left[\frac{l}{100km}\right] + Empty\ factor\ [\%] * ECF_{empty}\left[\frac{l}{100km}\right]}{(1 - Empty\ Factor\ [\%]) * Average\ weight\ [t]}\right.$$

$$* \ WTW\ GHG\ Emission\ factor\ [\frac{gCO_2e}{l}]$$

7.2.5. Consignment GHG emission calculation

Your first step is to identify all consignments within the desired reporting timeframe. Emphasize the significance of a digital system, if possible, which can adeptly track emission metrics for every consignment. Such systems ensure accuracy, speed, and efficiency, eliminating manual errors and saving time.

Upon gathering all the necessary data, the next pivotal task is the categorization of consignments. Each consignment should be associated with its correct TOC. Familiarizing oneself with the array of TOC classifications is essential.

For a more hands-on approach: closely examine each consignment. Factors such as the mode of transportation, fuel type, and chosen route play crucial roles. For instance, was the consignment transported via car carrier or a van? Was diesel or green electricity used as fuel? The answers to these questions will guide you towards the correct TOC.

For clarity and future reference, always document the TOC determinations for each consignment. Such documentation is not merely an administrative formality. It stands as a testament to transparency and can significantly aid in future reporting or referencing.

To show the concept further, let's explore a fictitious calculation. Let's assume five transport groups, each showcasing varied properties, as outlined below:

	Asset Type	Journey Type	Distance Class	Vehicle Type	Propulsion and fuel types
1	Finished vehicle	Point-to-Point	Short haul	Car Carrier	ICE – Diesel, B0
2	Finished vehicle	Point-to-Point	Long haul	Car Carrier	ICE – HVO
3	Finished vehicle	Multi-stop	Short haul	Car Carrier	ICE – Diesel, B100 (100 % Bio-Diesel-share)
4	General Cargo	FTL	Long haul	Drawbar Truck	Hydrogen – green
5	General Cargo	LTL	Short haul	Van	BEV – green

Table 12: TOC examples

Based on these transport properties, it is now possible to obtain the corresponding TOC number for each transport with the help of table in 8.3.1. Based on the own TOC emission calculation, the WTW emission intensity of the specific TOC is to be used.

	TOC	TOC Emission intensity [gCO_2e/tkm]
1	1316001	90
2	1326006	20
3	1416005	100
4	3125018	60
5	3211014	0

Table 13: TOC Emission intensity examples

In the next step, the total transport activity of the respective TOC is determined by multiplying the load kilometres by the transported mass for all transport operations. This transport activity of the TOC is multiplied by the associated emission intensity to finally obtain the emission quantity to be reported.

	Transport activity [tkm]	TOC Emission intensity [gCO_2e/tkm]	Total emission [tCO_2e]
1	1.500.000	90	135,00
2	20.000	20	1,60
3	14.500.000	100	290,00
4	7.500.000	60	450,00
5	6.000.000	0	—

Table 14: Total emissions per TOC example calculation

In order to calculate the emissions of a consignment or vehicle transported, two examples of consignments are presented. The first example is a consignment operating in TOC number 1, the second example is a consignment operating in TOC number 3.

Example 1

The first consignment is a dedicated point-to-point transport for a single customer (VW as an example), transporting seven vehicles in total with a mass of 10,9 t over 40 km, which is illustrated by the figure below.

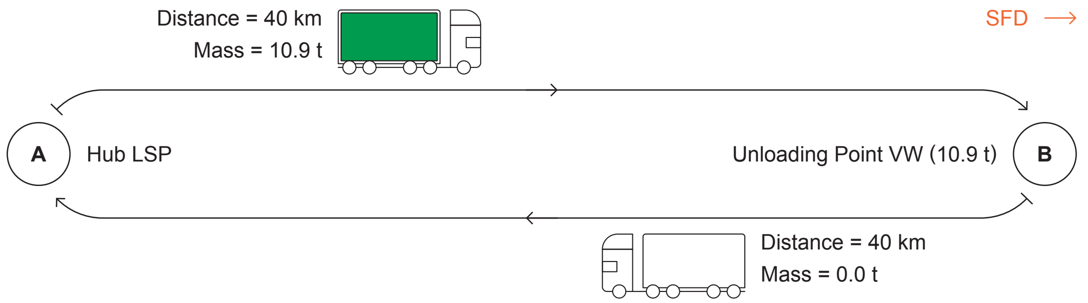

Figure 7: Point-to-point transport for a single customer

The first step is to calculate the total emissions resulting from the transport chain element, using the corresponding TOC emission intensity:

$$Total\ emissions_{Example1}[gCO2e] = 40[km] * 13{,}68[t] * 90[\frac{gCO_2e}{tkm}]$$

By that, it is assumed that the consignment led to total emissions of ~49 $kgCO_2e$. In the following step every vehicle transported must be listed, including the mass and the CEU-Road of the car model, based on Chapter 7.1.3.

Customer	Model	Mass [kg]	CEU-Road/Car	Adjusted mass [kg]	Vehicles loaded
VW	Golf	1.304	10	1.800	3
VW	Passat TDI	1.703	11	1.980	2
VW	Passat GTE	1.780	12	2.160	2

Table 15: Vehicle specific parameters

Based on this, the total emissions are allocated to the individual vehicle models. This assignment is calculated by dividing the product of the points and the amount of vehicles transported per model by the sum of products of both variables across all models. For example:

$$Assignment_{Golf} = \frac{10 * 3}{10 * 3 + 11 * 2 + 12 * 2} = 39\ \%$$

The emissions generated per vehicle model is then calculated by multiplying the assignment by the total emissions generated during transport. The final result is shown in the table below.

Customer	Model	Assignment [%]	Emissions [$kgCO_2e$]	Emissions per vehicle [$kgCO_2e$/car]
VW	Golf	39 %	19,21	6,40
VW	Passat TDI	29 %	14,28	7,14

Customer	Model	Assignment [%]	Emissions [$kgCO_2e$]	Emissions per vehicle [$kgCO_2e$/car]
VW	Passat GTE	32 %	15,76	7,88
			49,25	

Table 16: Emissions per vehicle

Example 2

The second example shows a multi-stop transport for three different customers (VW, Ford and Audi), which is illustrated by the figure below.

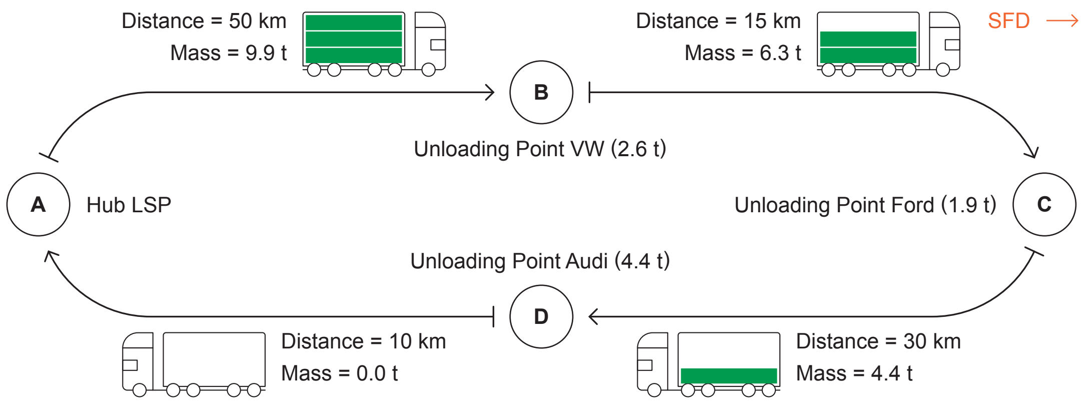

Figure 8: Multi-stop transport for three different customers

Again, the first step is to calculate the total emissions occurred by the transport, using the corresponding TOC emission intensity:

$$Total\ emissions_{Example2}\ [gCO2e] = (50[km] * 14{,}58[t] + 15[km] * 10{,}98[t] + 30[km] * 4{,}68[t]) * 100[\frac{gCO2e}{tkm}]$$

By that, it is assumed that the transport led to total emissions of ~ 103 $kgCO_2e$. In the following step every vehicle transported is listed, including the mass and the CEU-Road of the car model, based on Chapter 7.1.3.

Customer	Model	Mass [kg]	CEU-Road/Car	Adjusted mass [kg]	Vehicles loaded
VW	Golf	1.304	10	1.800	2
Ford	Transit EWLB	1.908	35	6.300	1
Audi	A8	2.220	13	2.340	2

Table 17: Vehicle specific parameters

Based on this, we allocate the total emissions generated to the individual vehicles. This assignment is calculated by dividing the product of the points and the amount of vehicles transported by the sum of products of both variables across all models. The emissions generated per vehicle model is then calculated by multiplying the assignment by the total emissions generated during transport. The final result is shown in the table below.

Customer	Model	Assignment [%]	Emissions [kgCO_2e]	Emissions per vehicle [kgCO_2e/car]
VW	Golf	25 %	25,85	12,925
Ford	Transit EWLB	43 %	44,47	44,47
Audi	A8	32 %	33,09	16,545
			103,41	

Table 18: Emissions per vehicle

The final step is to convert the calculated emissions per vehicle into the reporting form according to Chapter 6.3.

With this comprehensive approach to emission reporting, automotive industry players can ensure that they are not only compliant with regulations but also contributing to a transparent and sustainable future.

7.3. Rail Transport

7.3.1. Introduction

This Chapter presents a structured guide on the recommended methodology for calculating GHG emissions related to rail transportation operations within the automotive industry. It first introduces the Rail TOC and breaks them down into parts like Asset, Transport Concept, Train Configuration, Operating Mode, and vehicle-related classifications. As we progress, attention is turned to the methodologies for data collection, focusing especially on system boundaries and distinguishing between primary and secondary methods. Ultimately, the Chapter explains the exact calculations associated with emissions and their respective intensities.

7.3.2. Rail TOC Definitions

In the world of automotive logistics, it's crucial to have a clear and consistent structure. One main way to achieve this is by defining TOCs. This Chapter is a key guide to the TOCs designed especially for rail transport in automotive logistics. Each TOC captures the different activities, transport methods, and unique aspects of the industry.

As described in Chapter 6.1, each TOC is assigned a 7-digit number. For rail transport, the positions are associated with the TOC parameters and their potential values. An overview table can be found in 8.4.1.

7.3.2.1. Asset Type

In defining TOCs, the type of asset is a key factor for grouping. This is especially true in the automotive industry, where there's a wide range in mass-to-volume ratios of the goods being moved. For clear and accurate TOCs, we need uniform and well-defined categories. For Rail transport four main asset types are differentiated:

1. **Finished Vehicles**
2. **Electric Vehicle Batteries**
3. **Steel**
4. **General Cargo**

7.3.2.2. Transport Concept

In rail logistics, the 'Transport Concept' delineates how goods and cargo are organized and transported on the rail network. It's a systematic approach to categorize the scale and specificity of rail movements. The concept is pivotal for operational efficiency and offers insight into the flexibility or continuity of freight services. There are three predominant transport concepts.

1. **Single Wagon** refers to an individual railcar that is used for the transportation of goods or cargo. It is a standalone that plays a significant role in rail logistics by providing a flexible and efficient means of transporting goods by rail.
2. In rail logistics, a **wagon group** is a set of rail cars, grouped based on criteria like cargo type or route. Similar to a convoy in automobile transport, it's a method to streamline operations and improve management efficiency, but instead of road vehicles on a highway, it refers to wagons on a rail network.
3. In rail logistics, a **block train** refers to a type of train consisting of a continuous series of wagons or containers that are dedicated to carrying a single type of cargo or belonging to a single customer. The wagons or containers are coupled together without any intermediate stops or shunting operations along the designated route.

7.3.2.3. Train configuration

Train configurations regarding length refer to the measurement of the overall length of a train from the front of the locomotive or leading unit to the end of the last car or wagon. It is an important aspect of train design and operation, as the length of a train affects various factors such as capacity, manoeuvrability, braking performance, and the ability to negotiate curves and gradients.

The length of a train configuration can vary significantly depending on the specific requirements and constraints of the railway system, including infrastructure limitations, platform lengths, and operational considerations. The recommended length categories for train configurations are as follows:

- **< 500 m length**
- **< 600 m length**
- **< 700 m length**
- **>= 700 m length**

7.3.2.4. Wagon type

In rail logistics for the automotive industry, the "Wagon Type" categorizes railcars based on what they transport and their specific requirements. This choice is crucial for efficient loading, protecting goods and timely delivery. The two main categories in this system are finished vehicles and components.

Finished vehicles

For the transportation of completed vehicles, rail logistics utilizes specific wagon types optimized for the job. Under the category of "Finished Vehicles, " there are primarily two specialized wagon designs: Double deck wagons and Flat wagons. These are tailored to ensure the safe and efficient transit of vehicles.

1. **Double deck** wagons in automobile rail logistics refer to specialized railcars designed to transport vehicles in a stacked configuration, maximizing the utilization of space on a train. These wagons have two levels or decks, and may be open or close.
2. **Flat wagons** in automobile rail logistics, also known as flatcars or car carriers, are specialized railcars designed to transport vehicles in a single layer of vehicles. These wagons have a flat, uninterrupted deck without any sides or walls, providing a large open space to accommodate automobiles of various sizes and configurations.

Electric Vehicle Batteries, Steel and General Cargo

When it comes to the transportation of automotive components, rail logistics employs a variety of specialized wagons, each designed to cater to specific needs. Within the “Components” category, we primarily discuss three main types of wagons: the Regular Wagon, Multimodal Wagon, and Steel Transporting Wagon. Each of these wagons is meticulously designed, keeping in mind the nature of the components they transport, ensuring safety, efficiency, and compatibility with various rail infrastructures.

1. In the Automotive Logistics industry, a “**regular wagon type**” refers to a standardized rail car used for transporting a variety of automotive components, ranging from smaller parts to larger units like engines or vehicle bodies. These wagons typically have a closed design for protection against external elements, are designed for stackability to maximize space, and incorporate securing mechanisms to prevent load movement during transit. They also adhere to standard dimensions for compatibility with various rail infrastructures. Some may have specialized loading and unloading mechanisms. The specific design varies depending on the transported components and the requirements of the automotive company.
2. A “**Multimodal Wagon**” in automotive rail transport is a versatile rail car designed for intermodal freight transport. It carries containers or units that can easily be transferred between trains, trucks, and ships without unloading the cargo. The design is standardized to accommodate different sizes of containers and allows quick loading and unloading between transport modes. The exact design can vary based on cargo type and specific requirements.
3. A “**Steel Transporting Wagon**” in automotive rail transport is a robust rail car specifically designed to carry steel in forms like coils, sheets, rods, or slabs. These wagons have high load-bearing capacities and specialized load-securing mechanisms tailored to the mass and shape of the steel products. The wagon can be either open or closed, depending on the type of steel transported and its protection needs. The exact design varies based on the specific steel product and the requirements of the automotive industry.

7.3.2.5. Operating mode

“Operating Mode” in rail logistics provides a structured framework for understanding and categorizing the various ways freight trains conduct their journeys in terms of routing, loading strategies, and frequency. This framework is pivotal for ensuring efficient and streamlined operations within the complex realm of rail transportation. By designating specific operating modes, stakeholders in the rail logistics domain can better strategize, optimize costs, and align their operations with environmental sustainability goals. The four primary operating modes are:

1. **Shuttle full-full:** The term “shuttle transport” typically implies a regular, repeated movement between two fixed points, often following a predefined schedule or route. In this context, the shuttle transport operates with the objective of maximizing efficiency by ensuring that the vehicle is fully utilized both in its outbound and return journeys.
2. **Shuttle full-empty:** In this context, the term “shuttle transport” indicates a regular, repeated movement between two fixed points on a rail network, often following a predetermined schedule or route. However, in this case, the return trip of the shuttle transport is without any payload, resulting in an empty or unladen return journey.
3. **Triangle** transport in rail logistics refers to a transport operation involving three or more distinct locations, creating a triangle-like route. The primary benefit is increased efficiency, as it allows the rail service to carry goods at all stages, thereby reducing the likelihood of making trips with empty loads. This can lead to significant cost savings and environmental benefits.
4. **Network:** In rail logistics for finished vehicles, a transportation network refers to the interconnected system of routes, rail lines, facilities, and operations that facilitate the movement of finished vehicles from manufacturing plants or distribution centres to their final destinations.

7.3.2.6. Propulsion type and source of electric energy

Propulsion Type in rail transport refers to the primary power source utilized by locomotives to move and convey goods or cargo across the railway network. This classification is essential, as it not only dictates the locomotive’s operational capabilities but also impacts environmental considerations and energy consumption. Within the context of rail logistics, two principal propulsion types are predominant.

1. An **electric-powered** locomotive in rail logistics is a type of train vehicle that relies on electricity as its primary power source to propel and transport goods or cargo along the railway network. It uses electric motors or engines to convert electrical energy into mechanical energy, driving the locomotive’s wheels or propulsion system.
2. A **diesel-powered** locomotive in rail transportation is a type of train vehicle equipped with a diesel combustion engine as its primary power source. Diesel locomotives are also known as diesel locomotives or diesel multiple units.

Source of Electric Energy as a TOC in rail transportation refers to the origins of the electrical power used to propel electric-powered locomotives. Recognizing and categorizing this source is crucial for understanding the environmental implications and sustainability of rail operations. Within this context.

1. An **energy mix** refers to the combination of different sources used to generate electric energy for an electric-powered locomotive. Instead of relying on a single source, such as fossil fuels or renewable energy, an energy mix incorporates multiple energy sources to meet the electricity demand.
2. **100 % renewable** energy refers to a state where all energy use is sourced from renewable energy resources.

7.3.3. Data Collection

7.3.3.1. System boundaries

For the purpose of streamlining and maintaining clarity in our rail transportation emissions calculations, it’s vital to be explicit about the components considered within our system boundaries. Appropriate sample size to obtain meaningful and reliable emissions data. It is important to carefully justify the chosen sample size and document the underlying assumptions and limitations.

Processes included

The following processes are considered in the calculation of CO_2e emissions related to transportation in the automotive industry:

- **Shunting:** This ensures that all activities, energy consumptions, and resultant emissions related to shunting are accounted for in our evaluations

Processes excluded

The following processes are excluded from the calculation:

- **Hubs:** This includes all handling facilities
- **Specific operational processes:** These are construction, waste management, administration tasks, maintenance and strapping

By excluding these areas, we maintain a focused approach, targeting the most direct and pertinent sources of emissions in rail transportation.

7.3.3.2. Primary Data collection for a consumption-based calculation

This method uses specialized measuring tools to directly capture emissions at their point of origin. By equipping vehicles or other emission points with monitoring systems, we can achieve precise and real-time data collection. This collected information, termed as ‘primary data’, serves as the basis for calculating emissions. Primary data is inherently sourced directly from its origin, typically through an information or telematics system. The key difference between primary and modelled data is the data’s source. For primary data, its direct origin is what matters most. Additionally, there’s a vital link between telematics data and order management, which ensures a thorough evaluation of emissions based on current activities and processes.

To compute emissions from rail transport using primary data, three key pieces of information are essential: details on the distance travelled (both loaded and empty), data on the mass of goods transported, and records of actual fuel consumption.

Mass

In the realm of CO_2e emission calculations for rail transport in the automotive industry, understanding the mass parameter is pivotal, especially when employing the consumption-based calculation method or the primary calculation. Mass, in this context, is split into two main categories:

- **Mass of the Empty Wagon (Equipment):** This represents the mass of the rail wagon when it is unloaded.
- **Mass of the Freight:** An illustrative example here is a loaded finished vehicle.

It’s important to note that the mass details of both the wagon and its load are systematically recorded in the bill of lading, ensuring data accuracy. To determine the overall mass of a train, one must consider the individual mass of each wagon and multiply it by the total number of wagons. However, if for any reason this data isn’t readily accessible from system records, default values can be employed. These default values are predicated upon the type of freight and the transport concept, with examples including finished vehicles and GaG transport. This methodological approach ensures that CO_2e emission calculations remain as precise and representative as possible.

Distance

In the process of determining distances for CO_2e emission calculations in rail transport for the automotive industry, the DIUM (Distancier international uniforme marchandises) directory by UIC (Union internationale des chemins de fer) stands as a principal source. However, not all Rail Undertakings may have access to it, necessitating the use of alternative solutions.

The customer information platform of RailNetEurope (RNE) is recommended as a publicly available alternative source with the limitation of only focussing on major European rail corridors. If additional routes not covered by RNE are needed, commercial tools that provide accurate distance calculation based on DIUM data (e.g., EcoTransIT World) are a commendable substitute.

Energy Consumption

The process for determining carbon emissions in the automotive industry based on the information you provided involves two key steps:

Step 1: Identifying the needed emission factor

First, you need to determine which emission factor should be used for calculating emissions in your specific situation. This can be done on three levels:

1. Market-based approach: The use of a company-specific emission factor that results from the actual energy mix or fuel mix is an option. This method requires certified emission factors and is best if such a factor is available for your specific operation or vehicle model, as it provides the most accurate and relevant data.
2. Using a country-specific emission factor: If no certified emission factor is available, you should resort to country-specific emission factors. These can be provided by various organizations, including the International Energy Agency (IEA) and Eurostat.
3. Using the average power mix as per GLEC Framework: If neither a certified nor a country-specific emission factor is available, you can resort to the average power mix as indicated in the Global Logistics Emission Council (GLEC) Framework.

Step 2: Application of the emission factor

Once you've determined the relevant emission factor, apply it to the specific operational data of your fleet. This could be, for example, the total distance travelled.

7.3.3.3. Secondary Data collection for a transport activity-based calculation

Navigating the challenges of data collection in today's complex organizational setups often leads businesses to seek alternatives. Secondary data stands out as a prominent solution, especially when primary data remains elusive. Predicated largely on transport-based calculations, this type of data offers companies a means to reliably estimate their energy consumption and associated emissions through modelled information.

Modelled data's strength is its adaptability. By leveraging pre-existing datasets and research, or specially designed models, it factors in key parameters like utilization rates and the share of empty runs. Such an approach ensures that even in the absence of direct measurements, companies can maintain an informed perspective on their environmental impact.

In the sections to follow, we delve deeper into the nuances of secondary data, with a special focus on transport-based calculations, emphasizing its vital role in facilitating a comprehensive emissions assessment for businesses.

Modelled or secondary calculation leverages a variety of parameters to construct a representative model of transports and their associated CO_2e emissions. Here's a brief overview of each parameter:

- **Distance:** This parameter denotes the length of the route between the starting point (origin) and the endpoint (destination). Accurate distance measurements are crucial to approximate the emissions generated over a given transport journey.
- **Train type:** The specific category or model of the train used has inherent efficiencies and characteristics that influence emissions. Different train types, such as passenger trains, freight trains, or high-speed trains, have varied emission profiles.
- **Train Mass:** This refers to the total mass of the train, including both the wagons and their cargo. The mass can influence the amount of energy required to move the train, and consequently, its emissions.
- **Utilization Rate:** This parameter indicates the degree to which a train's capacity is utilized. A fully loaded train may emit more in total, but its emissions per unit of cargo could be lower compared to a half-empty train.
- **Proportion of Empty Runs:** This denotes the percentage of trips where the train operates without cargo or passengers. Empty runs, while generating emissions, don't contribute to productive transport, thus affecting the overall emission efficiency.
- **Drive or Propulsion System:** The propulsion system, whether electric, diesel, or a hybrid, plays a pivotal role in determining emission outputs. Electric drives, for example, may have different CO_2e emissions depending on their energy source.
- **Shunting:** This refers to the movements of trains or individual wagons within rail yards or terminals. Shunting operations, though short in distance, can add to the total emissions due to frequent start-stop actions and idling.

By understanding and integrating these parameters, the transport-based calculation method offers a comprehensive approach to estimating CO_2e emissions in rail transport.

In case of unavailability of secondary data for modelling, it is entirely valid to resort to default values. In 8.4.3, you will find a comprehensive table that includes both default values and their sources.

7.3.4. TOC emission intensity calculation

The emission value of a TOC should be calculated based on primary data wherever possible. This approach promises the highest data quality and is most likely to allow conclusions to be drawn about the emissions that occur. For those transports where a calculation based on primary data is not possible, the emission value can be modelled, or default values can be used.

When the transports with existing primary data accurately represent all the transports within a TOC, the emission value derived from primary data can be applied to the entire TOC. A transport is deemed representative when it genuinely mirrors the general transport operations profile, encompassing aspects like utilized technical equipment, geographical conditions, client service requirements, and the logistics operating model. Next, we'll illustrate both calculation methods with examples.

7.3.4.1. Primary Data-based TOC emission intensity Calculation

In the following example the emission intensity for one finished vehicle transportation TOC is determined.

Summary of primary data-based emission intensity calculation for one TOC

Parameter	Value	Unit	Source
Total calculated transport distance	476	km	DIUM
Freight mass	400	t	Railway undertaker (RWU)
Energy consumption	8.000	kwh	RWU
Emission factor	400	gCO_2e/kwh	Sourced Country specific GLEC Framework V2.0 2022
GHG Emission intensity	16,8	gCO_2e/tkm	calculated acc. ISO 14083

Table 19: Primary data-based emission intensity example calculation

First, the total emissions incurred within the scope (usually a specific TOC over one quarter) is calculated. To do this, the actual energy consumption of the train (including empty and loaded runs) is multiplied by the emission factor of the corresponding energy carrier.

The minimum requirement for the emission factor of the propulsion type is an average emission factor from recommended source (see 8.4.2), if available, a specific emission factor for the propulsion type should be used. This value could be obtained from a certificate on the purchased fuel or from the certified electricity label of the respective energy supplier.

$$Total\ emission\ [gCO2e] = Energy\ consumption\ [unit]\ \cdot\ Emission\ factor\ \left[\frac{gCO2e}{unit}\right]$$

In the second step, the transport activity is calculated. For this purpose, the total calculated transport distance is multiplied by the freight mass.

$$Transport\ activity\ [tkm] = Total\ mileage\ [km] \cdot Average\ transported\ mass\ [t]$$

In the last step, the total GHG emissions of the TOC are divided by the transport activity in order to determine the final emission intensity factor.

$$GHG\ Emission\ factor\ \left[\frac{gCO2e}{tkm}\right] = \frac{Total\ emission\ [gCO2e]}{Transport\ performance\ [tkm]}$$

7.3.4.2. Modelled data-based TOC emission intensity Calculation

If the calculation of the emission value of a TOC is not possible based on primary data due to insufficient data, the value must be modelled using default values.

Summary of modelled emission intensity calculation for one TOC with detailed modelling parameters

Parameter	Value	Unit	Source
Train Empty mass	500	t	RWU
Average freight mass	400	t	RWU
max. possible freight mass	700	t	RWU
Total mass (train + freight mass)	900	t	RWU
Empty trip share	96	%	RWU
Energy consumption	0,0157	kWh/gross tkm	EcoTransIT World – Methodology Report 2023 page 73
Energy consumption actual load	0,02826	WH/net tkm	calculated
Energy consumption empty	0,0216	WH/gross tkm	EcoTransIT World – Methodology Report 2023 page 73
Energy consumption empty actual load	0,01728	WH/net tkm	calculated
Emission Factor	0,3962	gCO_2e/WH	EcoTransIT World – Methodology Report 2023 page 126, emission factor Germany converted from WTT gCO_2e/MJ
Shunting Data			
Shunting	2	hours	RWU
Energy Consumption (Shunting)	18	l/hour or kWh/hour	RWU
Energy (Shunting)	36	l or kWh	RWU
Well-to-Wheel GHG	3.240	gCO_2e/l or gCO_2e/kWh	RWU
Calculated Data			
WTW-GHG Emission factor loaded	11,97	gCO_2e/km	Calculated
WTW-GHG Emission factor empty	6,85	gCO_2e/km	Calculated

Parameter	Value	Unit	Source
GHG Intensity (Transport)	9,025	gCO_2e/tkm	Calculated
GHG (Shunting)	0,12	gCO_2e/tkm	Calculated
GHG Intensity (Total)	9,145	gCO_2e/tkm	Calculated
Average GHG Intensity (Total) per vehicle	16,461	gCO_2e/vehiclekm	Calculated

Table 20: Modelled emission intensity example calculation

1. Mass Parameters:

Start by understanding the train's empty mass and its mass when loaded with freight. The total mass of the train during its journey (either loaded or empty) plays a crucial role in determining its energy consumption.

2. Trip Shares:

Establish the proportion of trips the train undertakes when empty versus when it's loaded. This split often varies, and understanding it helps in averaging out emissions for round trips.

3. Energy Consumption Metrics:

For each type of journey (loaded or empty), calculate the energy consumed per tonne-kilometre. The energy consumption typically differs based on the mass of the train and the nature of its journey.

4. Emission Factors:

Once you have the energy consumption data, apply the known emission factor. This factor represents the amount of CO_2e emitted per unit of energy consumed. Multiplying the energy consumed by the emission factor will provide the GHG emissions for each journey type.

5. Shunting Operations:

Besides the primary journey, rail operations often include shunting activities. These have their own energy consumption rates and durations. By understanding how much energy is used during shunting and applying the respective emission factor, you can calculate the GHG emissions specific to shunting.

6. Compiling the Data:

Now, compute the Well-to-Wheel GHG Emission factors for both loaded and empty trips. By averaging these over a round trip, you get the GHG Intensity for the transport segment. Adding the emissions from shunting operations will give you the comprehensive GHG intensity for the entire operation

7.3.5. Consignment GHG emission calculation

Your first step is to identify all consignments within the desired reporting timeframe. Emphasize the significance of a digital system, if possible, which can adeptly track emission metrics for every consignment. Such systems ensure accuracy, speed, and efficiency, eliminating manual errors and saving time.

Upon gathering all the necessary data, the next pivotal task is the categorization of consignment. Each consignment should be associated with its correct TOC. Familiarizing oneself with the array of TOC classifications is essential.

For a more hands-on approach: closely examine each consignment. Factors such as the train configuration and electrical energy used play crucial roles. For instance, was the consignment transported via shuttle or triangular rail transport? Was the standard electric energy mix or 100 % renewable energy used? The answers to these questions will guide you towards the correct TOC.

For clarity and future reference, always document the TOC determinations for each consignment. Such documentation is not merely an administrative formality. It stands as a testament to transparency and can significantly aid in future reporting or referencing.

To show the concept further, let's explore a fictitious calculation. Assume five transport groups, each showcasing varied properties, as outlined below:

	Asset Type	Transport Concept	Train Configuration	Wagon type	Operating mode	Propulsion type – source of energy
1	Finished vehicle	Single Wagon	< 500 m	Double deck	Shuttle full-full	Diesel
2	Finished vehicle	Wagon Group	< 600 m	Double deck	Shuttle full-empty	Electric – energy mix
3	Finished vehicle	Block Train	< 700 m	Flat wagon	Shuttle full-full	Electric – energy mix
4	General Cargo	Block Train	≥ 700 m	Regular	Triangle	Electric – 100 % renewable
5	General Cargo	Single Wagon	< 500 m	Multi-modal	Network	Electric – energy mix

Table 21: TOC Examples

Based on these transport properties, it is now possible to obtain the corresponding TOC number for each transport with the help of table 33 in 8.4.1. Based on the own TOC emission calculation, the emission intensity of the specific TOC is to be used.

	TOC	TOC Emission intensity [gCO_2e/tkm]
1	1111100	90
2	1221201	80
3	1332101	50
4	3343302	10
5	3114401	70

Table 22: TOC emission intensity example

In the next step, the transport activity of each individual consignment to be reported on is collected. One example could be reporting for a block train full-empty shuttle transport from Regensburg to Bremerhaven. It has been identified that this transport is categorized in the TOC 1221201 which has an emission intensity factor of 80 gCO_2e/tkm. The transport distance for this relation according to DIUM is documented as 714 km. For the customer, BMW, now the GHG emissions for each transported vehicle is reported. First, for each of these vehicles the consignment mass is needed.

Customer	Model	Mass [kg]
BMW	1er	1.600
BMW	X1	2.085
BMW	X2	1.805

Table 23: Vehicle specific parameters

Based on this, the GHG emissions for the individual consignment are calculated by multiplying the emission intensity factor with the transport distance and their mass. The final result is shown in the table below.

Customer	Model	Emissions per vehicle [kgCO_2e/car]
BMW	1er	91,4
BMW	X1	119,1
BMW	X2	103,1

Table 24: Emissions per vehicle

7.4. RoRo Transport

7.4.1. Introduction

This Chapter presents a summary of the reporting related standardization of RoRo transports, especially regarding the use of the standard TOC identifier codes. The recommended methodology for calculating GHG emissions in RoRo Transports itself is provided in the ECG

Ro-Ro GHG Emissions Accounting Guidance. All other reporting related recommendations and standards of this guideline for the TOC emission intensity and the Consignment GHG emissions also fully apply for RoRo transports.

7.4.2. TOC Definitions:

As described in Chapter 6.1 each TOC is assigned a 7-digit number. For RoRo transport, the positions are associated with the TOC parameters and their potential values. An overview table can be found in 8.5.1.

7.4.2.1. Ship type

Ship types refer to vessels specifically designed to carry wheeled cargo like cars, trucks, and trailers. Vehicles are directly driven on and off the ship, streamlining the loading and unloading process for efficient sea transport.

- **Vehicle Carrier:** Specifically, a multi-deck roll-on-roll-off cargo ship built to handle the carriage of empty cars and trucks, known as PCCs and PCTCs.
- **Ro-Pax Ship:** A vessel combining passenger and cargo capabilities, designed to accommodate more than 12 passengers and equipped with roll-on / roll-off cargo spaces.
- **Ro-Ro Cargo:** A ship engineered to cater exclusively to the transportation of roll-on / roll-off cargo units or boasting dedicated roll-on / roll-off cargo spaces.
- **Container / Ro-Ro Cargo Ship (Con-Ro):** A unique blend of a traditional container ship and a Ro-Ro cargo ship, it houses independent sections for each.

7.4.2.2. Transport Concept

The two primary concepts are short sea, emphasizing regional consignments, and deep sea, targeting intercontinental deliveries. Both facilitate efficient vehicle movement using drive-on and drive-off mechanisms.

- **Deep Sea:** Deep sea transport denotes the long-haul consignment of vehicles and components across oceans using specialized cargo ships. This method ensures global distribution and supply chain fluidity for the automotive industry, catering to demands across continents.
- **Short Sea:** Short sea transport refers to the nearby, regional consignment of vehicles and components using coastal and sea routes. This method optimizes supply chains within continents, ensuring swift distribution and reduced transit times for the automotive industry.

7.5. Other Modes of transport

In the initial release of this GHG transport emission reporting guideline tailored for automotive industry logistics, the decision has been made to focus the attention primarily on road, rail and RoRo transport.

Transport modes such container transports, barge transport, hub operations, and airfreight that are not detailed in this version are still fully covered by the provided standardized reporting scheme. For the detailed emission calculation methodology, the existing generic standards of the GLEC framework and ISO 14083 could be referenced.

8. Annex

8.1. Automotive Industry transport scenarios

In this annex, a series of transport emission scoping and reporting examples that illustrate the various scenarios within the process landscape of the automotive industry are presented. Each example is depicted through a flow chart, showcasing the flow of materials and information, the sender and recipient, the freight payer, and the associated CO_2e emissions scope. Additionally, we provide practical examples for the respective roles to facilitate a clear understanding of the responsibilities and procedures involved.

1. **Goods Flow:** The movement of automotive components/service parts or finished vehicles. This can refer to:

- Pre-Inbound flow: Activities related to the transportation of goods prior to a reporting company's tier #1 supplier.
- Inbound flow: Movement of raw materials or components/service parts from suppliers to the manufacturing or assembly plant/warehouse.
- Outbound flow: Transport of finished vehicles and service parts from the manufacturing plant to either dealerships, warehouses, or end customers.
- Intracompany flow: Transfer of goods between different facilities or departments within the same company.

2. **Shipper:** The party responsible for sending goods. In the various scenarios:

- Inbound/Pre-Inbound: Often a parts manufacturer or raw material supplier.
- Outbound: Typically, the car or component manufacturer.
- Intracompany: Any department or facility within the company sending goods to another department or facility within the same company.

3. **Receiver:** The entity receiving the goods:

- Inbound/Pre-Inbound: Usually the tier 1 manufacturing supplier, the car manufacturing or assembly plant.
- Outbound: OEM from tier 1 supplier or typically the car dealerships or end customers.
- Intracompany: Any department or facility within the company receiving goods from another department or facility within the same company.

4. **Freight Payer:** The entity that pays for the transportation of goods. In most scenarios, the freight payer could be either the shipper or receiver, depending on the terms of the sale or internal company policy.
5. **CO_2e Emissions Reporting Scope:** The outline of greenhouse gas emissions resulting from transportation activities in the automotive supply chain. This includes emissions from vehicles used in inbound, outbound, and intracompany.
6. **Information Flow:** The transmission of data related to the movement of goods, such as order updates, consignment schedules, delivery confirmations, and invoices. This flow of information is essential in all transport scenarios (inbound, outbound, intracompany, and pre-inbound) to maintain efficient operations, meet delivery schedules, and ensure synchronization of supply with demand in the automotive supply chain.

After providing the necessary context in our introductory section, we now delve into our first illustrative scenario.

8.1.1. Pre-Inbound

This flowchart represents two distinct scenarios within the pre-inbound phase of the automotive supply chain, labelled as Option A and Option B. Each scenario is characterized by different freight payers and their reporting responsibilities for transportation emissions.

In Option A, Company N, is the freight payer. In this scenario, the flow of goods starts from Company N to Company A and then finally to Company B (the Car Industry Supplier or OEM). As the freight payer, Company N is responsible for reporting transportation emissions data to Company A – these will be Scope 3 Cat 4 from company A's perspective.

From Company B's perspective, these emissions fall under Scope 3, Category 1 of the Greenhouse Gas Protocol and will be reported to them by company A as part of the goods supplied.

In contrast, Option B designates Company A as the freight payer. In this scenario, Company A assumes the responsibility for reporting transportation emissions to both Company N and Company B.

As in Option A, from Company B's viewpoint, these reported emissions are also classified as Scope 3, Category 1 according to the Greenhouse Gas Protocol.

These two options represent different configurations within the pre-inbound stage of the automotive supply chain, each with unique implications for the responsibility of CO_2e reporting. They illustrate the complexity and the importance of accurate identification of the freight payer in ensuring correct emissions reporting.

Pre-inbound

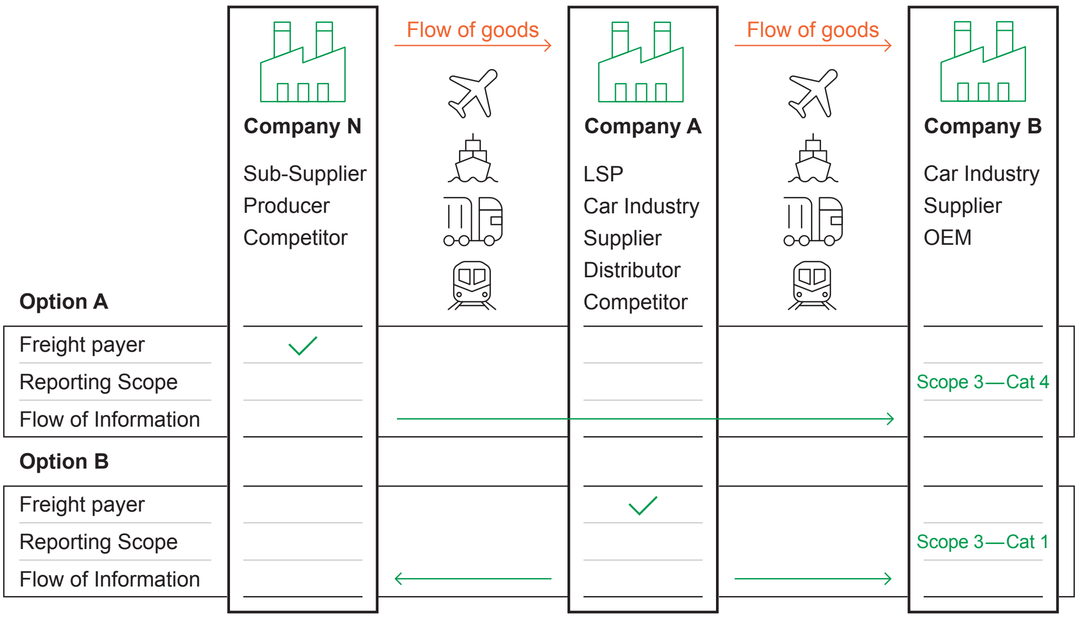

Figure 9: Pre-inbound scenario

8.1.2. Inbound

This flowchart outlines two potential scenarios within the inbound stage of the automotive supply chain, denoted as Scenario A and Scenario B. The scenarios differ based on the entity serving as the freight payer and its respective emissions reporting responsibilities.

In Scenario A, Company A, acting as a sub-supplier, producer, or competitor is the freight payer. The flow of goods extends from Company A to Company B, the Car Industry Supplier or OEM. As the freight payer, Company A bears the responsibility of reporting transportation emissions data to Company B. From Company B's perspective, these emissions are classified under Scope 3, Category 4, as per the Greenhouse Gas Protocol.

Scenario B, on the other hand, sees Company B assuming the role of the freight payer. In this setup, Company B is responsible for reporting transportation emissions to Company A. Despite the change in the freight payer, from Company B's viewpoint, these emissions remain within Scope 3, Category 4 of the Greenhouse Gas Protocol.

These scenarios serve to illustrate the varying arrangements in the inbound stage of the automotive supply chain, underscoring the critical role of identifying the freight payer in accurately assigning responsibility for CO_2e reporting.

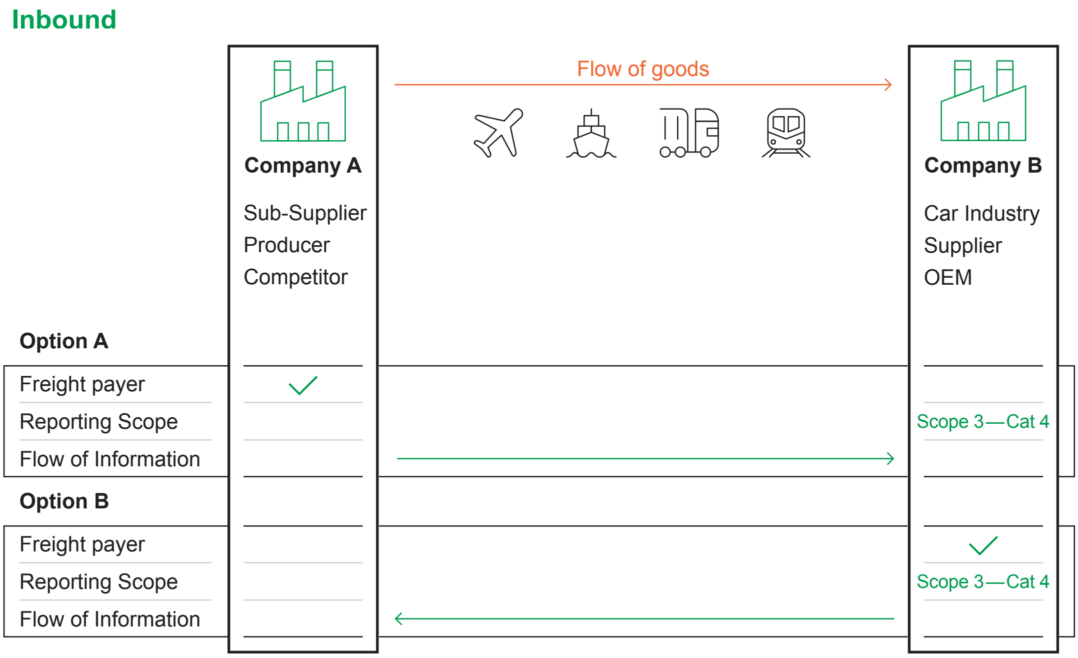

Figure 10: Inbound scenario

8.1.3. Intracompany

The Intracompany Scenario illustrates the transportation process within Company B itself, highlighting two different arrangements – Option A and Option B – each of which has distinct implications for emissions classification and reporting.

In Option A, transportation is conducted using the equipment of a third-party forwarder. As the freight payer, Company B is responsible for reporting these emissions, which are classified under Scope 3, Category 4, according to the Greenhouse Gas Protocol, reflecting emissions from transportation and distribution activities conducted by third parties.

Option B presents a different situation where transportation is carried out using Company B's own equipment. As a result, the emissions produced can fall under either Scope 1 or Scope 2 categories, depending on the sources of the energy used. Scope 1 emissions are those directly resulting from sources owned or controlled by the company, whereas Scope 2 emissions are those generated from the consumption of purchased electricity, steam, heating, and cooling.

For 3rd party transportation the company shall get emission data from the freight supplier – for company owned / operated vehicles it will be necessary to calculate your own emission levels.

These two options illustrate the importance of the nature of the transportation equipment used and its ownership in determining the appropriate emissions reporting category.

8.1.4. Outbound

The Outbound Scenario encompasses three distinctive arrangements – Scenario A, B, and C – each yielding different categories of emissions from Company B's perspective, depending on the freight payer and the transportation equipment used.

In Scenario A, Company B is the freight payer, utilizing third-party equipment for transportation. The flow of emission-related information is directed towards Company C. From an emissions reporting perspective, the emissions generated are classified as Scope 3, Category 4, as defined by the Greenhouse Gas Protocol. This category captures the emissions from transportation and distribution activities undertaken by third parties.

Scenario B involves Company B using its own equipment for transportation while also serving as the freight payer. In this setup, the emissions generated can be classified under Scope 1 or Scope 2. Scope 1 refers to direct emissions from sources that are owned or controlled by the company, such as their transportation fleet. Scope 2 encompasses emissions resulting from the consumption of purchased electricity, steam, heating, and cooling, if the vehicles used, for example, are electric and the electricity used is purchased.

Finally, in Scenario C, Company C acts as the freight payer. Here, the responsibility of reporting the emissions falls onto Company C. For Company B, these emissions are categorized under Scope 3, Category 9. This category includes emissions from the transportation and distribution of products in the downstream stages of a company's value chain when carried out by a third party.

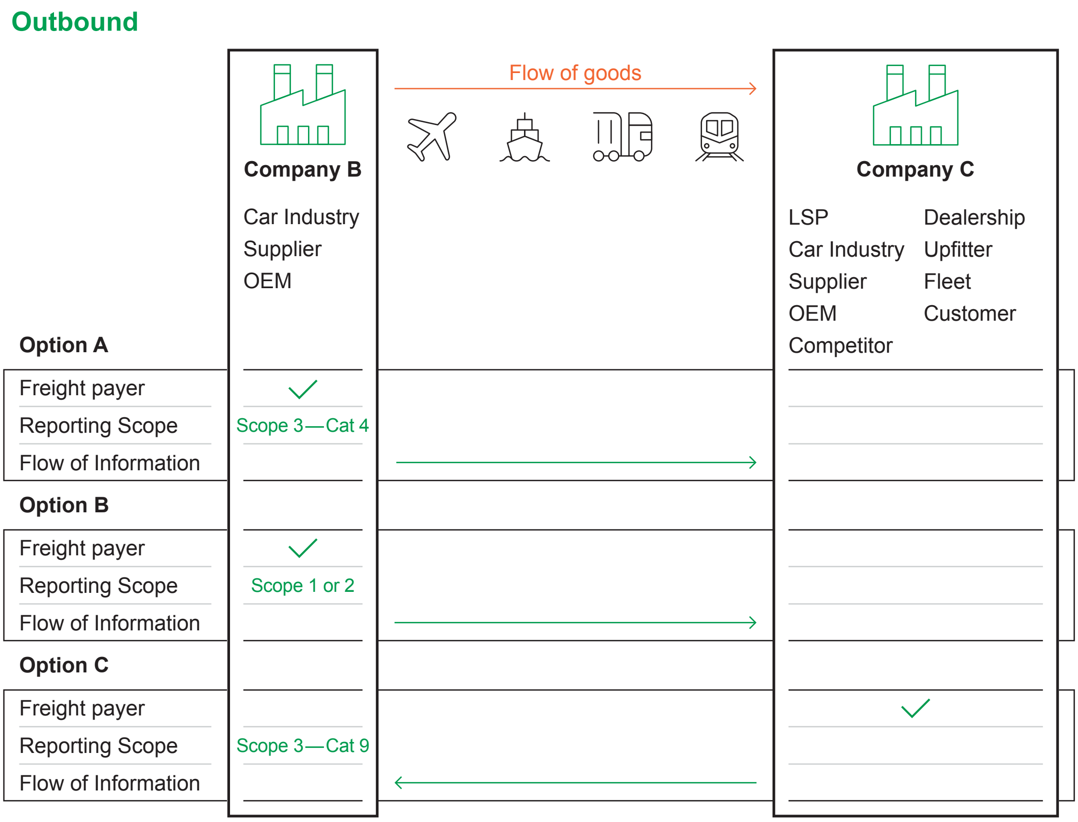

Figure 11: Outbound scenario

8.1.5. Post-Outbound

The Post-Outbound Scenario is composed of three different options—Option A, B, and C—each reflecting varying responsibility for freight payment and resulting in differing emission categories for Company B.

Option A has Company B as the freight payer. Here, the classification of emissions hinges on the nature of equipment used for transportation. If third-party equipment is used, the emissions fall into Scope 3, Category 4, capturing emissions from third-party transportation and distribution activities. On the other hand, if Company B uses its own equipment, these emissions could be classified under Scope 1 or Scope 2. Scope 1 represents direct emissions from sources owned or controlled by the company, while Scope 2 includes indirect emissions resulting from the consumption of purchased electricity, steam, heating, and cooling.

Option B has Company C as the freight payer. In this arrangement, Company C transfers emission-related information to Companies B and D. For Company B, the emissions are classified under Scope 3, Category 9. This category accounts for emissions from the transportation and distribution of products in the downstream stages of the value chain when performed by a third party.

Lastly, Option C assigns the role of freight payer to Company D. In this setup, Company D transfers information to Company C – Company C shall pass this information to Company B. Similar to Option B, from Company B's perspective, the emissions fall into Scope 3, Category 9.

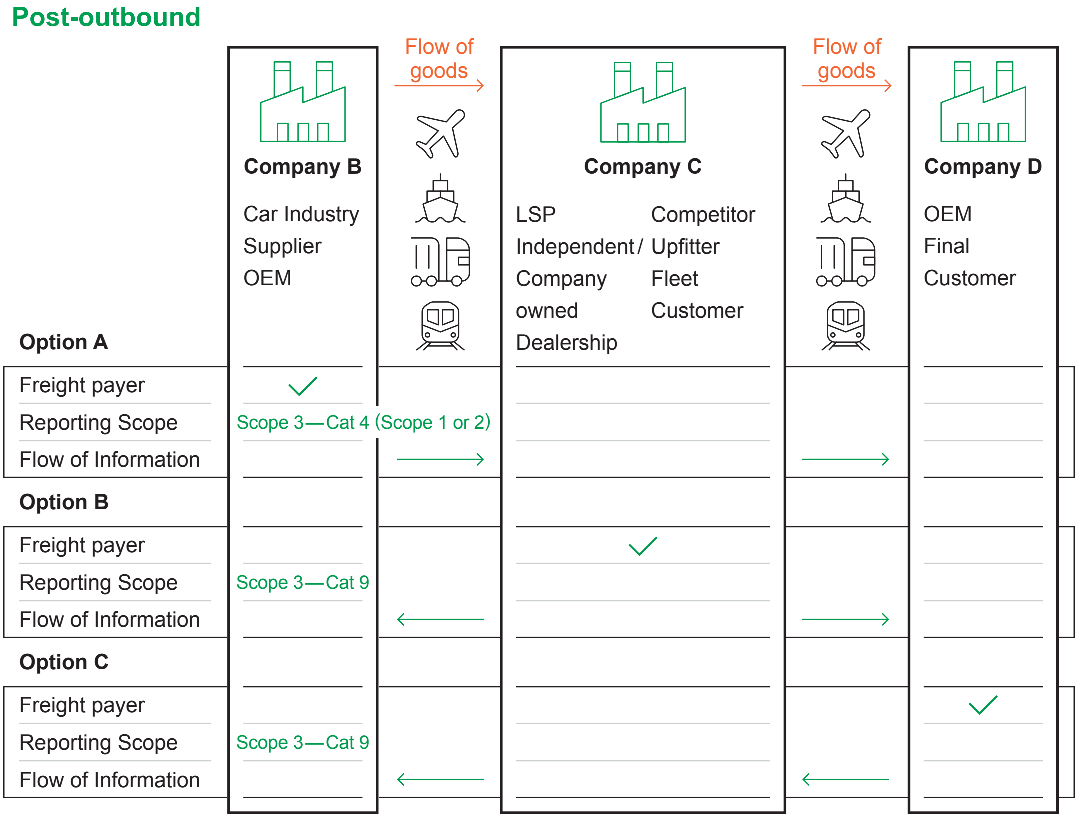

Figure 12: Post-outbound scenario

8.2. Reporting Parameter Definitions

8.2.1. Transport Operation Characteristics

Parameter	Definition	Requirement
TOC_ID	An identification code uniquely assigned to each TOC for easy recognition and differentiation purposes	mandatory
TOC_Name	A textual description or name representing the TOC, providing a clearer understanding or distinction for the category in question	optional
TOC_Business_Entity_ID	Can be the DUNS Number or the Business Entity ID according to ISO 15459 associated with the entity or organization under a specific TOC, adhering to the IFTSTA standard. Example format: NAD+CA+0123456789: : 16	mandatory
TOC_Automotive	A classification indicating the standardization of the TOC by the VDA/ECG automotive guideline, ether 'yes' or 'no'	mandatory
TOC_MoT	The primary MoT associated with the TOC. It defines the main transportation method linked to the category, including options such as rail, road, sea, air, or inland waterways	mandatory

Table 25: TOC Master Data definitions

8.2.2. TOC Emission Intensities Report

Parameter	Definition	Requirement
TOC_EIID	The unique identification code assigned to the emission intensity dataset of a specific TOC	mandatory
TOC_Business_Entity_ID	The DUNS Number or ISO Business Entity ID corresponding to the Logistics Service Provider (LSP) associated with the TOC	mandatory
TOC_validityfromdate	Specifies the starting date from which the TOC_EIID can be legitimately utilized	mandatory
TOC_validitytodate	Specifies the ending date up to which the TOC_EIID remains valid for usage	mandatory
TOC_ID	Reference identification code corresponding to the TOC	mandatory
TOC_DataSource	Indicates the nature of the data source utilized – whether it's primary or secondary.	mandatory
TOC_SampleSize	Represents the proportion of the data sample, used for primary-data based emission intensity calculation, to all transports (in tkm) of the TOC type during the reported period, expressed in percentages	mandatory (if DataSource = primary)
TOC_SampleSpecificity	Provides information regarding the specificity of the input data used for the emission intensity calculation – whether it's customer-specific or not	optional (if DataSource = primary or modelled)
TOC_Verification	Indicates if the input data has been verified by a third party compliant with ISO14083 standards	mandatory
TOC_Accreditation	Specifies if the methodology used for calculation has been accredited by a third party in adherence to ISO14083 standards.	mandatory
TOC_WTWemissionfactor	A certified emission factor, expressed in kg of CO_2 equivalent per energy consumption unit, which encompasses both the direct emissions (WTT) and the emissions from combustion (TTW)	mandatory
TOC_WTWemissionintensity	Represents the WTW emission intensity, measured in grams of CO_2 equivalent per tkm, where tonnes can be the actual mass or the adjusted mass	mandatory
TOC_WTWemissionintensity2	Measures the WTW emission intensity in an alternative unit of measure, such as TEU-km (Twenty-foot Equivalent Unit-kilometre) or parcel-km	optional

Table 26: TOC Emission Intensity Report definitions

8.2.3. Transport Chain Emissions (TCE) Report

Parameter	Definition	Requirement
Primary identifiers according to the defined reporting level of the consignment		
TCE_ ConsignmentID	Identifier for a specific consignment within a transport chain, aligned with the IFTSTA standard segment Example: CNI++ConsignmentID+9'	mandatory
TCE_Con- signment- IDReference	Reference number of a consignment within the transport chain, usually provided by the Lower Deck Load (LDL) and aligned with IFTSTA standard segment Example: RFF+AVU: 12345'	optional
Additional identifiers for reference		
TCE_ TransportOrder	Order number for a specific transport action within the transport chain, in line with IFTSTA standard segment Example: RFF+TIN: PackagingTransportOrderNumber	optional
TCE_ TransportID	Identifier for a specific transport action within the transport chain as per IFTSTA standard segment Example: RFF+AAO: 12345	optional
TCE_ TransportIDLSP	Transport action identifier given by the Logistics Service Provider (LSP) within the transport chain, aligned with IFTSTA standard segment Example: RFF+AFC: Transport number (LSP)	optional
TCE_Trans-	Reference linked to the entirety of the transport chain, in line with IFTSTA standard segment Example: RFF+AKI: Transport ID	optional
TCE_TOCEIID	Specific ID associated with the TOC emission intensity dataset being referenced in the transport chain.	mandatory
TCE_Busi- ness_Entity_ID	The DUNS Number or ISO Business Entity ID corresponding to the Logistics Service Provider (LSP) associated with the individual consignment	
TCE_ArrivalDate	Denotes when the transport action within the transport chain arrived at its destination, as per IFTSTA standard segment Example: DTM+136: 20131201: 102	mandatory

Parameter	Definition	Requirement
TCE ShippingLocation	The shipping location or source where the transport chain element starts, as defined in the IFTSTA standard segment Example: LOC+60+Place of Shipping ID: 10: Place of Arrival as Text+52.515738,13.393085	mandatory
TCE_PlaceofArrival	The location or destination where the transport chain element concludes, as defined in the IFTSTA standard segment Example: LOC+60+Place of Arrival ID: 10: Place of Arrival as Text+52.515738,13.393085	mandatory
TCE_DataSourceDistance	The type of data source used to determine the distance covered in the transport chain element. Options: 'default': Standard or preset data source. 'secondary': Data source derived from modelling	mandatory
TCE_DataSourceMass	Description: The data source used to derive the mass of the consignment in the transport chain element. Options: 'secondary': Mass determined through modeling. 'primary': Directly measured or primary data.	mandatory
TCE_Accreditation	Validates whether the methodology used for calculations within the transport chain element is accredited by a third party compliant with ISO14083	mandatory
TCE_Distance	The measurable distance between the origin and destination used for emission calculations in the transport chain element	mandatory
TCE_AdjustedMass	The mass of the consignment used for emission calculations, which might be adjusted based on certain conversion or equivalence factors	mandatory
TCE_OriginalMass	The unadjusted gross mass of the consignment without any modifications or applications of conversion and equivalent factors	mandatory
TCE_WTWCO$_2$e	WTW GHG emissions associated with the consignment, measured in kilograms of CO_2e	mandatory
TCE_TTWCO$_2$e	TTW GHG emissions associated with the consignment, also measured in kilograms of CO_2e	mandatory

Table 27: TCE Report definitions

8.3. Road Transport

8.3.1. TOC Table

Digit	Parameter	Number	Value
1	Asset	1	Finished Vehicles
		2	Electric Vehicle Battery
		3	General Cargo
2	Journey type	1	FTL
		2	LTL
		3	Point-to-Point
		4	Multi-stop
3	Distance class	1	Short-haul
		2	Long-haul
4	Vehicle type	1	Van
		2	7,5 t truck
		3	12 t truck
		4	Megatrailer
		5	Drawbar truck
		6	Car carriers
		7	EMS car carriers
		8	Motor vehicles
5	Empty	0	
6+7	Propulsion type + fuel type	01	ICE – Diesel, B0
		02	ICE – Diesel, B7 (7 % Bio-Diesel-share)
		03	ICE – Diesel, B20 (20 % Bio-Diesel-share)
		04	ICE – Diesel, B50 (50 % Bio-Diesel-share)
		05	ICE – Diesel, B100 (100 % Bio-Diesel-share)

Digit	Parameter	Number	Value
		06	ICE – HVO
		07	ICE – Ethanol
		08	ICE – LNG
		09	ICE – BIO LNG
		10	ICE – CNG
		11	ICE – BIO CNG
		12	ICE – LPG
		13	BEV – conventional (not green)
		14	BEV – green
		15	PHEV – conventional (not green)
		16	PHEV – green
		17	Hydrogen – conventional (not green)
		18	Hydrogen – green

Table 28: TOC table Road Transport

8.3.2. Truck mass categories

Mass Class	EU Vehicle Group
< 3,5 t	EU Vehicle Group 0
>3,5-7,5 t	EU Vehicle Group 0
>7,5-12 t	EU Vehicle Group 1 and 2
>12-20 t	Corresponds to EU Vehicle Group 3 and 6
>20-26 t	Corresponds to EU Vehicle Group 4 to and 7 to 17
>26-40 t	Corresponds to EU Vehicle Group 4 to and 7 to 17
>40 t Truck	Corresponds to EU Vehicle Group 4 to and 7 to 17

Table 29: Truck mass categories

8.3.3. Ranking of recommended Data sources for modelling emissions

This table presents a ranking of different sources for the modelled calculation of CO_2e emissions. The ranking is based on user experiences regarding the quality and completeness of the mentioned sources.

Data	Source	Rank
Fuel/energy economy (e.g., l/100 km)	Handbook of emission factors (DACH, France, Sweden, Norway)	1
	DEFRA (applied in the UK)	1
	EcoTransIT	2
Distance travelled	Tailored route calculation tools for truck transportation	1
	EcoTransIT for SFD	2
	Transport Management System (TMS)	2
Mass (t)	Part mass/vehicle mass from customer	1
	ECG Vehicle mass and dimension catalogue	2
	LSP – if weighing facility is available	2
Empty run %	Transport Management System (TMS)	1
	EcoTransIT	2
Utilisation %	Transport Management System (TMS)	1
	EcoTransIT	2

Table 30: Modelling data source ranking List

8.3.4. Default values

These tables display default values based on actual data analyses from the participating logistics service providers and OEMs/suppliers. This data serve as a foundation to give a more differentiated view on the average transport characteristics in the automotive industry.

Asset	Utilization rate	Empty trip
General Cargo	60 %	33 %
Electric Vehicle Batteries	75 %	38 %

Table 31: General Cargo/Battery transport default values (no further differentiation of journey types)

Finished Vehicle Transport default values per journey type	Utilization rate	Empty trip
Point-to-Point	80 %	30 %
Multi-stop		

Table 32: Finished Vehicle transport default values per journey type

8.4. Rail Transport

8.4.1. TOC Table

Digit	Parameter	Number	Value
1	Asset	1	Finished Vehicles
		2	Electric Vehicle Battery
		3	General Cargo
		4	Steel
2	Transport concept	1	Single wagon
		2	Wagon group
		3	Block train
3	Train configuration	1	<500 m length
		2	<600 m length
		3	<700 m length
		4	≥ 700 m length
4	Wagon type	1	Double deck
		2	Flat wagon
		3	Regular
		4	Multimodal
		5	Steel
5	Operating mode	1	Shuttle full-full
		2	Shuttle full-empty
		3	Triangle

Digit	Parameter	Number	Value
		4	Network
6+7	Propulsion type and source of electric energy	01	Electric-powered, energy mix
		02	Electric-powered, 100 % renewable energy
		03	Diesel-powered

Table 33: TOC table Rail Transport

8.4.2. Ranking of recommended Data sources for modelling emissions

This table presents a ranking of different sources for the modelled calculation of CO_2e emissions. The ranking is based on user experiences regarding the quality and completeness of the mentioned sources.

Data	Source	Rank
energy consumption	EcoTransIT World – Methodology report 2023	1
Distance travelled	DIUM (Distancier international uniforme marchandises) directory by UIC (Union internationale des chemins de fer)	1
	Ecotransit	2
Mass (t)	Part mass/vehicle mass from customer	1
	ECG Vehicle mass and dimension catalogue	2
Empty run %	Transport Management System (TMS)	1
Utilisation %	Transport Management System (TMS)	1

Table 34: Modelling data source ranking

8.4.3. Default values

This table displays default values based on actual data analyses from the participating logistics service providers and OEMs/suppliers. These data serve as a foundation to give a more differentiated view on the average transport characteristics in the automotive industry.

Asset	Utilization rate
General Cargo	60 %
Finished Vehicle	85 %
Batteries	75 %

Asset	Utilization rate
Steel	100 %
Operating mode	Empty trip factor
Shuttle full-full	5 %
Shuttle full-empty	100 %
Triangle	20-60 %
Network	60 %

Table 35: Default values Rail

8.5. RoRo Transport

8.5.1. TOC Table

Digit	Parameter	Number	Value
1	Empty	0	
2	Transport concept	1	Deep sea
		2	Short sea
3	Empty	0	
4	Ship type	1	Vehicle carrier
		2	Ro-pax ship
		3	Ro-Ro Cargo
		4	Container / Ro-Ro Cargo Ship (Con-Ro)
5	Empty	0	
6+7	Empty	00	

Table 36: TOC table RoRo Transport

9. Literature

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