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Exploring the Visibility of Emission Data in Transport Chains

Challenges within emissions traceability for companies and their stakeholders

Master's thesis in Quality and Operations Management

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Cover:
Visualisation of data sharing in transport chains created in DALL-E showing a world map with different locations being connected by different transport modes and linkages.

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Challenges and opportunities within emissions traceability for companies and their stakeholders

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SUMMARY
In response to the increasing urgency of climate change and the introduction of regulatory frameworks such as the EU's Corporate Sustainability Reporting Directive (CSRD), companies are under mounting pressure to quantify and report greenhouse gas (GHG) emissions throughout their value chains. The transport sector, which accounts for a significant share of global emissions, presents particular challenges due to its fragmented structure, complex stakeholder networks, and widespread reliance on subcontracted services. Despite recent standardisation efforts, including ISO 14083 and the GLEC Framework, companies continue to face difficulties in accessing high-quality emission data, ensuring methodological consistency, and facilitating reliable data exchange.
This study explores the barriers and enablers related to the collection and sharing of transport emissions data between transport service providers and transport buyers. A qualitative case study was conducted, based on 19 semi-structured interviews with companies operating across various sectors and supply chain roles. The collected data was analysed through a thematic analysis, which allowed for the identification of recurring patterns and underlying challenges across stakeholder groups. To structure the findings and enhance clarity, a framework was developed that organises the key themes and illustrates how they interact within the broader context of transport emissions reporting.
The results of the study show that the main barriers to effective emissions reporting lie not in the absence of regulatory ambition, but in the limited practical capacity to meet increasing data demands. A key gap exists between top-down policy requirements and the day-to-day realities of data collection and exchange, especially within subcontracted and SME-dominated logistics chains. The findings highlight the urgent need for interoperable digital systems, harmonised templates, and support mechanisms that enable more efficient, accurate, and scalable reporting. Furthermore, the study underscores the importance of sector-wide collaboration and shared responsibility among transport buyers, providers, and policymakers.

Keywords: Emission Data, Transport Emission Calculation, Transport Emission Reporting, Logistic Emission Calculation, ISO 14083, CSRD.

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Ida Wågesson & Johanna Hjortsberg, Gothenburg, June 2025

List of Acronyms

Below is the list of acronyms that have been used throughout this thesis listed in alphabetical order:

CSRD	Corporate Sustainability Reporting Directive
EFRAG	European Financial Reporting Advisory Group
ERP	Enterprise Resource planning
ESRS	European Sustainability Reporting Standards
FMS	Fleet Management System
GHG	Greenhouse gas
GLEC	Global Logistics Emissions Council
ISO	International Organization for Standardization
OEM	Original Equipment Manufacturer
SME	Small and medium-sized enterprises
TMS	Transport Management System
TTW	Tank-to-Wheel
WTT	Well-to-Tank
WTW	Well-to-Wheel

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1
Introduction

Transport plays a vital role in modern society, enabling the movement of goods in business operations and facilitating mobility through land, air and sea. The seamless integration of different modes of transport has become routine, often overlooking the scale and environmental impact of these operations (World Economic Forum, 2022b; Stockholm Environment Institute, 2023).

With increasing urgency to address climate change, frameworks and regulatory initiatives have emerged to improve transparency in emissions accounting and support more informed decision making by companies and consumers. Notable among these efforts are the International Organization for Standardization (2023) standard and proposed EU regulations EUR-Lex (2020), which establish guidelines for reporting greenhouse gas (GHG) emissions across complex transport chains. These initiatives aim to increase accountability, encourage innovation, drive behavioural change, and ensure emissions reductions aligned with international goals. However, the fragmented and global nature of transport chains, characterised by numerous small actors, poses significant challenges to comprehensive emissions accounting (EUR-Lex, 2020).

1.1 Background

The transport sector is essential for the global economy, but it remains a major contributor to GHG emissions. In 2020, transport accounted for approximately 26% of the GHG emissions in the EU, with road transport alone responsible for around 20%. (European Commission, 2022).

To address climate change, the European green deal (European Commission, 2019) and the European climate law (European Commission, 2021b) have set the goal of achieving climate neutrality by 2050, aligning with the Paris Agreement (United Nations, 2024). Within this framework, the EU aims to reduce transport-related emissions by 90% by 2050 (European Commission, 2019). However, projections suggest that global transport demand could double by 2050, potentially more than double the emissions in the absence of mitigation efforts (Smart Freight Centre, 2024).

The growing pressure for more sustainable transport options, combined with regulatory emission reporting requirements and voluntary climate commitments, has

increased the focus on quantifying GHG emissions in the sector (CLECAT, 2024). This has been reinforced by the EU Corporate Sustainability Reporting Directive (CSRD), which since January 2023 requires larger companies to report their emissions, including emissions across their value chains (CLECAT, 2024).

Over time, various stakeholders have developed calculation methods and frameworks for GHG emissions in transport. However, the absence of a universally adopted methodology and globally harmonised reporting requirements has led to a fragmented landscape. As a result, actors often apply different models, yielding inconsistent and incomparable data that reduce transparency, traceability, and accuracy. Consequently, researchers and industry organisations have advocated for a common framework (EUR-Lex, 2020; Smart Freight Centre, 2021; CLECAT, 2022).

Several initiatives have responded to these challenges. In 2012, the European Committee for Standardisation introduced EN 16258, the first transport-specific standard for calculating and reporting energy consumption and GHG emissions (EUR-Lex, 2020). In 2016, the Global Logistics Emissions Council (GLEC), led by the Smart Freight Centre, developed a framework to further standardise the accounting of transport emissions (Smart Freight Centre, 2024). This framework was instrumental in the creation of ISO 14083, an international standard released in March 2023, which offers a comprehensive methodology for quantifying and reporting emissions between transport modes and logistics hubs (International Organization for Standardization, 2023). Other initiatives, such as the French Transport Code, the GHG Protocol, and SmartWay, have also established reporting standards, the French Code specifying additional national requirements (EUR-Lex, 2020).

A central challenge in emissions reporting is the availability, quality, and exchange of accurate data across complex supply chains. The logistics industry comprises many small and medium sized enterprises (SMEs) that often lack the resources to implement robust emission measurement systems (European Parliament, 2023). A survey of 800 European road transport SMEs found that 43% did not measure emissions at all, 32% did so only for internal operations, and just 25% extended the measurement to customer levels (Finger and Serafimova, 2021). Outsourcing is common in the industry, further complicating data access and reporting. Effective data exchange between stakeholders is therefore essential, but not without barriers. Businesses may be reluctant to share emissions data due to concerns about competition, ownership, and confidentiality (European Parliament, 2023). As emissions calculations depend on inputs such as fuel consumption, vehicle type, and route efficiency, companies relying on subcontractors often lack direct access to primary data. Consequently, many use activity-based approaches with default or estimated values instead of energy-based calculations grounded in operational data, introducing uncertainties and inaccuracies (CLECAT, 2024; European Parliament, 2023). In the absence of reliable primary data, companies often rely on default or modelled datasets. Although default data reflect industry averages, they may not represent actual operations and can significantly distort results (Auvinen et al., 2014).

Moreover, as EUR-Lex (2020) notes, emission factors used in these calculations vary widely between databases, with differences in national scope, specification, and underlying models, resulting in divergent results even when the same method is applied. Finger and Serafimova (2021) emphasise that without high quality data, it is impossible to evaluate decarbonisation options, track emission reduction progress, or set science-based targets. The lack of standardised data formats further hinders interoperability and emission tracking between systems and stakeholders (EUR-Lex, 2020).

Although standards such as ISO 14083 and the GLEC framework provide structured methodologies, their implementation varies between industries and countries, limiting their global effectiveness (CLECAT, 2024). To fully realise the potential of harmonised reporting standards, it is critical to ensure both the collection and creation of accurate emissions data. As surveys indicate that most companies do not measure their GHG emissions themselves but rely on data from transport providers, carriers must expand their measurement capabilities.

1.2 Purpose

The purpose of this study is to explore the challenges and barriers related to collecting and sharing transport emission data among transport service providers and transport service buyers in the transport chain. By identifying obstacles in data availability and exploring enablers for improved information sharing, this study seeks to contribute to improving the transparency, comparability, and reliability of emissions data.

1.3 Research Questions

Q1. What are the primary challenges and barriers faced by transport service providers and transport service buyers in collecting transport emission data?

Q2. How do the existing practices and technologies for sharing transport emission data among stakeholders in the transport chain impact the efficiency and accuracy of data exchange?

1.4 Structure of the Report

This report is structured into six main chapters, each designed to build an understanding of the challenges and opportunities related to the visibility of environmental data in transport chains.

Chapter 2 provides the theoretical foundation for the study. It introduces the key frameworks relevant for transport emissions reporting, such as CSRD, EN 16258, GLEC, and ISO 14083. The chapter also explores the main drivers behind emissions

reporting, the associated challenges, and the importance of accurate data. Chapter 3 outlines the methodology used in the study. It explains how the empirical material was collected through interviews and secondary data, the selection process of the participating companies, and the role of Centiro in this study. Chapter 4 presents the empirical findings of the interviews. The results are structured around barriers and challenges, drivers and enables improving for emissions reporting. The perspectives of both transport buyers and transport service providers are included to capture different points of view throughout the value chain.

Chapter 5 provides an analysis of the findings by comparing it with the theory presented in Chapter 2. Initially, a framework is presented that was developed to provide an understanding of the results. This is followed by the research questions that have guided the study. These are thoughtfully addressed to be able to answer the purpose of the study. Chapter 6 presents the main conclusions of the study by identifying the main challenges and barriers in collecting and sharing transport emission data among transport service providers and transport service buyers in the transport chain. The report concludes with references and appendices that contain the questionnaires used.

2

Theory

This chapter presents the theoretical framework developed to support the study. It is based on a review of the existing literature on emissions reporting methodologies and the challenges associated with calculating emissions in transport systems. The review also includes research on the sharing of emissions data across supply chains and between stakeholders. Additional efforts were made to identify the literature that addresses the availability and use of different data types by transport buying companies. However, most of the existing literature approaches this topic from a general perspective, with limited qualitative studies or empirical findings specific to transport buyers.

The chapter begins by outlining the need for emissions reporting, highlighting key frameworks and regulations that influence reporting practices. Then it examines the main drivers and challenges associated with transport emissions reporting. Finally, the chapter discusses the importance of accurate data, describing the different data types used in emissions calculations and the most influential factors affecting data quality and reliability.

2.1 Standardising Emissions Reporting

Sustainability reporting is gaining prominence, particularly following the introduction of the CSRD in 2023. Given the breadth of reporting requirements that span most aspects of business operations, several voluntary frameworks have been developed to support emissions reporting. These initiatives aim to harmonise the calculation and reporting of GHG emissions from transport services, though they vary in scope and complexity. Before 2012, there was no unified standard for reporting transport emissions, resulting in inconsistencies and output that was difficult to compare between organisations (CLECAT, 2024). As illustrated in Table 2.1, a wide range of methods has since emerged, varying in terms of transport modes and segments covered. Initial efforts included the GHG Protocol (2001) and ISO 14064-1 (2006), which provided corporate-level reporting guidelines, but lacked specific methods for transport chains (International Organization for Standardization, 2006; World Resources Institute and World Business Council for Sustainable Development, 2004). Other frameworks, such as ISO 14067 (focussing on product carbon footprints) and national guidelines such as DEFRA (Department for Environment, Food and Rural Affairs) (UK) or EU Emissions Trading System (EU ETS) for aviation, introduced sector-specific approaches (International Organization for Stan-

dardization, 2018; Ehrler and Seidel, 2014). Calculation tools such as EcoTransIT and SEMBA, and various emission factor databases also emerged. However, without common regulation, these tools produced divergent results (Ehrler and Seidel, 2014).

Table 2.1: Primary methods for GHG emissions calculations in the transport sector

Standard/methodology	**Modes**	**Segments**
GHG protocol	All modes	Passengers & freight
EN 16258	All modes	Passengers & freight
ISO 14083	All modes	Passengers & freight
PEF	All modes	Passengers & freight
French transport code (Article L. 1431-3)	All modes	Passengers & freight
Parcel Delivery Environmental Footprint	All modes	Parcel
GLEC	All modes	Freight
SmartWay	All modes	Freight
Topsector	All modes	Freight
Clean Cargo Working Group	Maritime	Freight
EU MRV	Maritime	Freight
IMO DCS	Maritime	Freight
CORSIA	Aviation	Passengers & freight
ICAO/IATA RP1678	Aviation	Freight
IATA	Aviation	Passengers
EU ETS aviation	Aviation	Passengers & freight

Source: (Schroten et al., 2024)

Although CSRD is not included in Table 2.1, this is because CSRD is not a methodology for calculating emissions. Rather, it is a directive that mandates sustainability reporting and refers companies to the ESRS (European Sustainability Reporting Standards) for guidance on what must be reported. The ESRS outlines the required disclosures but does not specify how to calculate emissions. Therefore, the frameworks introduced in more detail in the following sections, EN 16258, GLEC, ISO 14083, and CountEmissionsEU, are specifically chosen because they focus on how to calculate transport-related GHG emissions. These methodologies represent the main approaches referenced in policy and practice today, and they form the basis for the practical calculation work conducted by companies. They are also the methods most frequently mentioned in interviews and secondary sources in this study.

2.1.1 CSRD

The CSRD, introduced in January 2023, is part of the EU's Green Deal and aims to improve consistency, comparability, and accessibility of sustainability information (European Commission, 2021a). Given the significant transition required for businesses, it is being gradually rolled out based on company size, starting in 2024 with companies previously covered by the Non-Financial Reporting Directive (NFRD) (European Commission, 2025). Over time, additional companies will be included in the scope of the directive (European Council, 2024). By allowing access to comparable non-financial information from investment entities between the EU, the directive is expected to facilitate investor assessments of sustainability risks and the broader implications of their investments (European Commission, 2021a).

The European Commission (2023b) believes that an EU directive is essential to establish uniform regulations throughout the EU, thus mitigating the risk of inconsistent reporting requirements between member states. Such discrepancies could lead to increased costs for companies operating across borders (European Commission, 2023b). At the global level, an initiative of this nature is also expected to positively influence the development of policies on sustainability reporting (European Commission, 2021a).

To enable companies to meet the requirements of the CSRD in practice, the European Financial Reporting Advisory Group (EFRAG) has developed the reporting standards known as the European Sustainability Reporting Standards (ESRS) (European Commission, 2025). The ESRS also takes into account existing voluntary sustainability reporting frameworks, to prevent double reporting by companies (European Commission, 2023a). The CSRD follows the principle of double materiality, which means that companies must report both their impact on the environment, such as emissions and pollution, and how environmental factors, such as climate change, affect them (European Commission, 2023b). Emissions are classified into three scopes to provide a comprehensive view of a company's climate impact (ESRS E1 Climate Change, 2022).

Scope 1: Direct emissions from a company's own operations, for example, emissions from facilities and vehicles. (ESRS E1 Climate Change, 2022).

Scope 2: Indirect emissions from energy consumption, particularly purchase of electricity, district heating, or cooling from external providers. Although these emissions are not generated directly by the company, they are a consequence of its activities. (ESRS E1 Climate Change, 2022).

Scope 3: Indirect emissions that occur outside of the company's direct operations but within its value chain. These can originate from suppliers, transportation, product use, and waste management (ESRS E1 Climate Change, 2022). Scope 3 can be divided into upstream (indirect emissions related to purchased goods and services) and downstream (indirect emissions related to sold goods and services) (WBCSD and WRI, 2011).

For a complete climate impact assessment, total GHG emissions must include all three scopes (ESRS E1 Climate Change, 2022).

In February 2025 the European Commission adopted a simplification package, called the Omnibus package, which entails several changes to the CSRD. The package exempts about 80% of companies that were previously covered by the CSRD and introduces some changes in how reporting should be conducted. Reporting requirements for companies currently covered by the CSRD will be postponed by two years. These changes aim to make sustainability reporting more efficient and less burdensome, while still holding the largest companies with the greatest environmental and climate impact accountable. (Commission, 2025).

2.1.2 EN 16258

Published in 2012 by the European Committee for Standardisation, EN 16258 was the first European standard for quantifying GHG emissions in transport services (CLECAT, 2024). It applies to all modes of transport and uses the Well-to-Wheel (WTW) approach, which incorporates both upstream (Well-to-Tank, WTT) and operational (Tank-to-Wheel, TTW) emissions. The development of EN 16258 was driven by the need for a standardised method to compare transport emissions. While EN 16258 provided a foundational methodology, differences in interpretation led to inconsistent results across companies, prompting the need for further harmonisation (Ehrler and Seidel, 2014).

2.1.3 GLEC

Developed by the Global Logistics Emissions Council (GLEC) and launched in 2016, the GLEC Framework provides a globally harmonised approach to calculating emissions in multimodal freight chains (Smart Freight Centre, 2024; Fancello et al., 2023). The framework is updated continuously to align with developments in the climate and logistics sectors. Widely used by carriers, freight forwarders, and logistics providers, it enables transparent comparisons across transport options (Fancello et al., 2023; Smart Freight Centre, 2024). The framework aligns with several other standards, including the GHG Protocol, the UN's Global Green Freight Action Plan, and CDP Reporting. It has also significantly influenced the development of ISO 14083 (Smart Freight Centre, 2024).

2.1.4 ISO 14083:2023

ISO 14083:2023, published in 2023, replaced EN 16258 as a standard for quantifying and reporting GHG emissions from transport chains (International Organization for Standardization, 2023). It includes more detailed guidelines to account for both direct and indirect emissions throughout the entire transport chain (International Organization for Standardization, 2023; CLECAT, 2024). Developed by ISO in collaboration with Smart Freight Centre and the German Institute for Certification, it builds on the GLEC Framework (Smart Freight Centre, 2023). The purpose of ISO

14083 is to create an international standard that can be used by both small and large companies within global transport chain operations. It includes all transport modes and extends coverage to operational emissions from logistics hubs (International Organization for Standardization, 2023).

The standard outlines four data types for emissions calculations:

- **Option A:** Primary data
- **Option B:** Model-Based Calculation
- **Option C:** Default values from a database
- **Option D:** Values from contracted operator using Option A or B.

Primary data is preferred, with clear guidance to prioritise modelled data over default values when primary data is unavailable. The selected method must accurately reflect actual emissions, not just minimise reported figures (International Organization for Standardization, 2023). Further explanations on the different data types can be found in Section 2.4.1.

2.1.5 CountEmissionsEU

CountEmissionsEU is a proposed EU initiative to introduce a mandatory standard methodology for emissions reporting in transport, aiming to improve data comparability and reliability across Europe. The proposal, tabled in July 2023, is currently under legislative review. If adopted, companies reporting emissions from transport chains would be required to follow ISO 14083, though reporting itself would remain voluntary. The proposal also includes certification of external calculation tools to ensure compliance with the methodology. As in ISO 14083, primary data is prioritised, with a clear data hierarchy for consistent application of the methodology (European Parliament, 2023).

2.2 Drivers for Transport Emission Reporting

Since most frameworks for transport emissions reporting have historically been voluntary, it is important to understand the underlying drivers that motivate organisations to engage in such efforts. Understanding these drivers also provides insight into some of the challenges associated with implementing emissions reporting in practice.

Table 2.2: Drivers for Transport Emission Reporting from Literature

Drivers	**Description**
Internal	• KPI for internal sustainability performance • Adapting to regulations and prepare for future standards • Operational efficiency improvements and cost savings
External	• Commercial pressure • Competitive advantage • Emissions tracking is often a low organisational priority
Anticipating Regulatory Developments	• Preparing for legal requirements • Regulatory readiness

Dobers et al. (2019) categorises the drivers into three different categories. The first relates to internal performance and strategic alignment. Tracking emissions is necessary to monitor sustainability goals and internal improvements. Calculating emissions and related key performance indicators (KPIs) enables organisations to evaluate their progress, support strategic decision-making, and report transparently to external stakeholders such as customers and shareholders (Dobers et al., 2019). Additionally, Finger and Serafimova (2021) emphasise the growing business case for carbon accounting. Emissions tracking is increasingly viewed as a means to improve operational efficiency, reduce costs, and lower emissions. The ability to demonstrate environmental progress can also provide competitive advantages, particularly when customers are willing to pay a premium for more sustainable transport solutions.

The second driver is external commercial pressure. As noted by Dobers et al. (2019), organisations are often required to report emissions to fulfil customer or contractual demands. This is further supported by Kühne Logistics University (2024a), whose survey shows that customer pressure is the second most important motivation for SMEs to invest in decarbonisation. While emissions reporting is not explicitly mentioned, it can reasonably be assumed as a prerequisite for demonstrating progress, as measurement is essential for validation.

The third driver involves anticipating regulatory developments. According to Dobers et al. (2019), many companies adopt emissions reporting to prepare for future legal requirements, positioning themselves as proactive and adaptable. Engaging in GHG reporting prior to it becoming mandatory demonstrates not only regulatory readi-

ness but also a commitment to environmental responsibility. As noted by (World Economic Forum, 2022a), this proactive approach is increasingly seen as necessary for all companies aiming to remain competitive and compliant in a rapidly evolving regulatory landscape.

2.3 Challenges in Transport Emission Reporting

Emissions calculations are influenced by several factors, including the quality, data completeness, calculation tools, system boundaries, modelling assumptions, and emission factors. This section synthesises key challenges from the literature regarding sustainability reporting within transport emissions.

2.3.1 Organisational and Methodological Barriers

Table 2.3 presents challenges identified in the literature, categorised here as organisational and methodological barriers. The remainder of this section provides a more detailed description of these challenges and their implications.

Table 2.3: Organisational and Methodological Barriers from Literature

Challenge	**Description**
Fragmented reporting standards	• Different actors use varied methods to collect and report emissions • Inconsistent terminologies and practices complicate comparison • Lack of harmonised metrics • Feasibility for companies competing with granularity from regulations
Regulatory ambiguity	• Weak enforcement limits compliance incentives • Need for alignment with existing regulations to avoid extra administration • Potentially complicates international operations and data collection

- ***Fragmented reporting standard***

To effectively monitor, benchmark, and improve environmental performance, a clear understanding of current and historical levels is needed (European Parliament, 2023; Finger and Serafimova, 2021). However, the absence of a universally accepted methodology for emission data collection, calculation and reporting poses a significant challenge (EUR-Lex, 2020). In the current landscape, companies must choose

among a wide range of frameworks (see Section 2.1), tools, and emission factors databases (see Section 2.4), each differing in scope, allocation logic, methodology, default values, objectives, and perspectives (European Parliament, 2023). Consequently, methodological inconsistencies, large variances, and fragmented reporting practices emerge, undermining the accuracy, comparability, relevance, and reliability of emission data and reporting (Dobers et al., 2019; Finger and Serafimova, 2021; European Parliament, 2023).

A key issue is the lack of a holistic framework that encompasses all transport modes, regions, and operational contexts. This gap results in significant discrepancies not only between companies but also across various transport modes (Dobers et al., 2019; Finger and Serafimova, 2021). In addition, emissions scopes and organisational boundaries are often defined differently. For instance, emissions may be inconsistently classified as direct (Scope 1) or indirect (Scope 3), and many reports exclude emissions from upstream activities or administrative operations (Finger and Serafimova, 2021). A review of 121 corporate sustainability reports found that only a small fraction included emissions from energy supply or administrative processes, resulting in substantial underestimations of overall carbon footprints (Dehdari et al., 2023).

Frameworks also differ in granularity, with some applying TTW and others WTW perspectives. Additional complexity arises in shared transport operations, where emission allocation across multiple users is often unclear and non-standardised. Emissions reporting also varies across hierarchical levels, ranging from product-level calculations to corporate-level aggregates, making it difficult to integrate or compare data across different levels of the supply chain Finger and Serafimova (2021). These inconsistencies are illustrated by Stevens (2018) who described how Heineken voluntary explored the possibility of broadening their emission report to include air pollutants, illustrating the evolving and often ambiguous nature of emissions scoping. Because reporting entities often determine their own reporting boundaries without providing clear justifications, the comparability of reported emissions data across companies is compromised (Stevens, 2018).

This fragmentation reflects a broader tension between methodological rigour and operational feasibility. While academia often promotes granular data collection, companies must consider constraints of time, budget, and personnel. As noted by Stevens (2018), some companies question whether increased accuracy justifies the cost. This highlights a broader divergence where academic approaches prioritise rigour, while companies value simplicity, practicality and comparability. To improve consistency, Dobers et al. (2019) recommend adopting an ISO standard. However, stakeholder feedback in Finger and Serafimova (2021) highlight industry support for the GLEC Framework, which is favoured for its flexibility, adaptability, and ongoing updates.

- ***Regulatory ambiguity***

To promote wider adoption of harmonised frameworks, some stakeholders advocate

for mandatory emissions reporting. The European Commission's CountEmissionsEU initiative aims to standardise reporting methodologies across the transport sector. Yet, it also recognises that in the absence of mandatory obligations, many companies continue to rely on diverse and inconsistent methodologies (European Parliament, 2023). Kühne Logistics University (2024a) emphasises the pivotal role of national governments and the EU in decarbonising European road freight. Their findings suggest that stakeholders view regulatory intervention as essential for establishing unified methodologies and clearer guidance. Furthermore, the effectiveness of any new framework depends on its widespread adoption among cargo operators, without broad industry uptake, its impact remains limited (Finger and Serafimova, 2021). Similarly, Stevens (2018) highlight that the effectiveness of voluntary frameworks like GLEC depends heavily on collective adoption across the industry. However, their study also underscores a key challenge: while academia tends to focus on the lack of standardisation, companies more often cite data access as the primary barrier.

Notably, research suggests that developing a rigid, all-inclusive framework is not sufficient on its own. Alignment with existing regulations, such as those within the EU, is crucial to avoid creating additional administrative burdens or duplicating reporting obligations (Finger and Serafimova, 2021). For example, European Parliament (2023) note that the proposed CountEmissionsEU regulation could complicate reporting for international operators working across different jurisdictions. Variations in national reporting rules further compound this challenge, reducing data comparability and increasing compliance costs for multinational firms (Finger and Serafimova, 2021).

2.3.2 Data Quality and Availability

Table 2.4 presents challenges identified in the literature, categorised here as challenges with data quality and availability. The remainder of this section provides a more detailed description of these challenges and their implications.

Table 2.4: Data Quality and Availability from Litareture

Challenge	**Description**
Limited data access	• Emissions data from subcontractors is often unavailable • Different degree of data depending on mode and structure of transport chain

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Challenge	Description
Inconsistent practices	• Varying databases used for emission factors • Different calculation methods and model assumptions • Data quality varies and causes reduced trust
Technological limitations	• IT systems between actors are not interoperable • Many systems lack real-time tracking capability • Aggregating and integrating data from multiple sources is complex

- ***Limited data access***

Improving the collection and accessibility of operational data and current emissions levels is essential for accurate emissions reporting and for advancing the transport sector toward more environmentally sustainable practices and more informed decisions regarding transport mode selection (Finger and Serafimova, 2021). While much of the existing literature emphasises harmonising of reporting frameworks, challenges related to data collection are also addressed. Stevens (2018) report that, according to one interviewed expert, the lack of comparability in emission results stems less from methodological differences and more from data related issues. In line with this, the GHG Protocol recommends prioritising robust data collection systems, noting that the availability of high-quality data is often the primary obstacle in developing GHG inventories (World Resources Institute and World Business Council for Sustainable Development, 2004). Dobers et al. (2019) identify data collection, data sharing between different stakeholders in the supply chain, and data quality as the main barrier to emission calculation, with primary data often being non-existent. Even when clear allocation methods are applied, such as those aligned with EN16258, implementation remains difficult due to missing or inaccessible data (Ehrler et al., 2016). Finger and Serafimova (2021) argue that more disaggregated and activity-based primary data is needed to enable eco-labelling of products, support consumer transport choices, offer adequate recycling of products, and track progress on emission reduction targets.

One structural issue is the limited control organisations have over the full extent of transport chains. Multimodal and subcontracted arrangements introduce administrative complexity and hinder data collection and transparency, as the ability to collect emissions data from transport providers depend on the extent of control exerted over the transport. This leads firms to rely on internal data to maintain traceability (Stevens, 2018). Moreover, data availability varies by transport mode. Road transport, for instance, has seen increased adoption of granular tracking meth-

ods, while inland waterway and rail sectors often lag behind (Finger and Serafimova, 2021).

Another dimension is trust. Data uncertainties can arise from inconsistencies in fuel consumption records (Finger and Serafimova, 2021), vehicle specifications (Kioutsioukis et al., 2004), or trip distances (EUR-Lex, 2020), all of which are sensitive to the data collection methods used and to real-world operating conditions (European Parliament, 2023). European Parliament (2023) report that transport buyers have limited confidence in the data provided by carriers. As a result, users may not demand emissions data, which in turn reduces carriers' motivation to invest in accurate calculations.

- ***Inconsistent practices***

The absence of a standardised framework has led to a fragmented practices across the sector. A wide range of tools, databases, and modelling methods are employed, often based on varying assumptions and data inputs. Due to significant data gaps, the use of default or modelled values is common. Consequently, there is substantial variation in data quality, input data types, as well as data collection efforts across firms (European Parliament, 2023; Ehrler et al., 2016).

Default values are based on general assumptions, such as average vehicle efficiency or driver behaviour, that may not reflect actual operations (Kioutsioukis et al., 2004). Methodological differences also persist in terms of granularity, system boundaries, and geographical scope, resulting in incompatible outputs. As Finger and Serafimova (2021) observe, the sector suffers from an *"over-reliance on industry-default values of carbon intensity and a failure to regularly recalibrate emission factors in line with technology advancements and improvements in business practice"*. To address these shortcomings, several authors have advocate for default values to be scientifically validated and independently verified (European Parliament, 2023; Ehrler et al., 2016). According to Ehrler et al. (2016), a centralised and widely accepted databank, ideally established at the EU level, could significantly enhance the reliability and consistency of emissions data.

Similarly, emission factors, used to estimate emissions per unit of fuel or activity, further contribute to inconsistencies, varying widely in their source, transparency, and relevance (International Organization for Standardization, 2023; Plassmann et al., 2010; Finger and Serafimova, 2021). Selecting appropriate factors is challenging, as assumptions are often undocumented or poorly explained (Stevens, 2018). To improve consistency across transport modes and contexts, Finger and Serafimova (2021) emphasise the need for regular updates and greater transparency.

The selective use to apply default values, particularly when these yield lower reported emissions, undermines trust and credibility. Although this may be beneficial for the reporting entity, it undermines the overall reliability of emissions reporting. European Parliament (2023) and Stevens (2018) note that a harmonised verification system would strengthen data reliability, but may simultaneously reduce the will-

ingness to share data due to added costs and administrative burden.

Even when using the same tools and datasets, subjective judgment in areas like boundaries setting and data allocation methods introduce subjectivity to the process (Kioutsioukis et al., 2004). Dobers et al. (2019) describe this challenge as a trade-off between granularity and feasibility, while aggregated default values are easier to apply, they may not reflect actual operations, conversely, detailed data demand more resources and specialised knowledge. These issues are especially evident in decentralised organisational and complex supply chains, where multiple actors may apply inconsistent assumptions. This diminishes transparency and traceability, complicating verification and stakeholder trust (Stevens, 2018).

These issues result in considerable uncertainty in reported emissions, sometimes yielding counter-intuitive outcomes, such as more precise data leading to higher reported emissions. Inconsistent practices weaken comparability, as organisations operating under similar conditions may report vastly different figures. This undermines benchmarking and the credibility of environmental claims (Stevens, 2018; Ehrler et al., 2016).

- ***Technological limitations***

Reliable transport emissions calculation depends on coordinated data sharing across the supply chain, but integration remains limited. As no single actor has all the necessary information, collaboration is essential to generate reliable estimates on shipment level (Dobers et al., 2019).

A major barrier lies in the lack of interoperability between systems. Despite the widespread use of digital tools such as telematics, fuel receipts, and third-party platforms, data is often stored in incompatible formats (Freitas and Gervásio, 2024; Plassmann et al., 2010). Within organisations, disconnected operational and administrative systems further fragment data flow, while between companies, digital ecosystems lack standardisation (Kühne Logistics University, 2024b).

Finger and Serafimova (2021) highlight that data exchange is frequently constrained at both the intra- and inter-organisational levels. They emphasise the need for stronger collaboration mechanisms, citing promising examples, such as partnerships between vehicle manufacturers and operators to access real-time data. Workshop participants echoed this view, suggesting regulatory measures to require original equipment manufacturers (OEMs) to share relevant vehicle data. A harmonised framework for secure and standardised data exchange was identified as a key enabler. However, implementing comprehensive data systems is resource intensive. Data retrieval, validation, and integration require multiple iterations and quality checks. These efforts require significant investments in time, personnel, and technology, making it challenging for companies, particularly SMEs, to adopt robust tracking solutions (Dobers et al., 2019).

2.3.3 Data Sharing and Collection

Table 2.5 presents challenges identified in the literature, categorised here as challenges with data sharing and collection. The remainder of this section provides a more detailed description of these challenges and their implications.

Table 2.5: Data Sharing and Collection Challenges from Literature

Challenge	Description
Lack of trust and collaboration	• Emissions data is seen as commercially sensitive and confidential • Fear of negative exposure discourages transparency • Low collaboration across supply chain actors
Limited data collection capabilities	• Many small carriers lack capacity to collect and report emissions data • Emissions accounting is seen as complex and costly • Limited demand and few financial incentives discourage investments

- ***Lack of trust and collaboration***

A major barrier to the availability of emissions data is the lack of trust among supply chain actors, particularly in the sharing of operational and emissions-related data. Although primary data, such as fuel or energy consumption, is considered the most accurate input for emissions calculation, access to this information often requires insight into operational processes that transport service providers are reluctant to share (European Parliament, 2023). This reluctance is mentioned to stem from concerns over data confidentiality. Ehrler et al. (2016) and European Parliament (2023) emphasise that sharing activity-based data can conflict with company confidentiality policies, as it can reveal sensitive information on fuel usage, cost structures, and operational performance. Kühne Logistics University (2024b) and Ehrler et al. (2016) also report that emission data is widely viewed as commercially sensitive, preventing providers from sharing it with regulators, industry groups, or reporting platforms.

Importantly, this challenge is not exclusive to smaller companies. Although large companies typically struggle with issues of data completeness and system integration, SMEs face more fundamental challenges, such as limited capabilities and increased concerns about competitive exposure. Due to their smaller size and weaker market positions, SMEs perceive a greater risk of sharing detailed operational data

(European Parliament, 2023).

Despite these concerns, several authors argue that confidentiality should not outweigh the need for transparency. Dobers et al. (2019) advocate prioritising emissions data exchange, noting that withholding such information undermines sector-wide efforts to improve data quality and comparability. Without trust and collaboration, companies often fall back on default values, perpetuating low data availability, quality and limited emissions insight (Finger and Serafimova, 2021; European Parliament, 2023).

- ***Limited data collection capabilities***

A core barrier to emissions data collection and reporting lies in the structure of the land-based transport sector, which is dominated by a large number of SMEs. This fragmentation creates a competitive environment with low margins, limiting the resources available for investments in emissions tracking systems (Finger and Serafimova, 2021).

Several studies highlight the capacity gap between smaller operators. Finger and Serafimova (2021) report that 43% of 800 SMEs surveyed lacked any emission measurement capabilities, while only 25% could measure emissions at the customer level. The remainder reported only company-level measurements. Kühne Logistics University (2024a) similarly found a strong correlation between fleet size and data capability: 60% of carriers with fewer than 10 vehicles were unable to measure emissions, compared to only 20% among those with fleets consisting of more than 100 vehicles. These figures underscore the difficulty of mandating detailed emissions reporting in the sector (Finger and Serafimova, 2021). However, involving these actors in the development of future reporting regulations is crucial to achieving EU climate targets, given their numerical dominance and their pivotal role in transport chains (Kühne Logistics University, 2024a).

The perception that emissions accounting is complex and costly further discourages adoption, particularly among SMEs. Data calculation often requires combining information from multiple systems, databases, and calculation models. Smaller companies typically lack the personnel, expertise, or digital infrastructure needed to manage these tasks (European Parliament, 2023). Financial incentives also play a role in shaping company priorities. EUR-Lex (2020) note that in the absence of market-based rewards, such as tax incentives or sustainability-linked financing, many companies deprioritise emission tracking, especially when not legally required. Without a clear return on investment, emissions reporting is often seen as a cost rather than a value-adding activity. In addition, complex structures further increase resource demands. Larger transport service providers may rely on multiple subcontractors, each with their own data practices, formats, and assumptions. Internal organisational structures and the complexity of global operations further complicate data sharing between departments and subsidiaries, with regional disparities in data maturity (Stevens, 2018). In contrast, a small carrier that works with multiple carriers may face conflicting data demands, resulting in a variety of method and for-

mat requirements from their multitude of customers (European Parliament, 2023).

Another barrier to data collection and data sharing is the limited demand for emission data from customers. Finger and Serafimova (2021) report that many transport service providers do not collect or share emission data simply because it is not requested. In one study by Kühne Logistics University (2024a), 76% of the carriers stated that fewer than 10% of their customers requested GHG-related data. Since customer demand is a key driver of emissions reporting (see Section 2.2), this limited interest contributes to a low engagement among providers. Although integrating emissions criteria into procurement processes could help incentivise data sharing, environmental performance still ranks below cost in most purchasing decisions (Finger and Serafimova, 2021). Without clear market signals or commercial advantages related to emissions transparency, providers deprioritise such efforts (Kühne Logistics University, 2024a).

2.4 The Need for Accurate Data

This section outlines why accurate data are essential for reliable emissions reporting in the transport sector. It begins by explaining the different data categories defined in ISO 14083, primary, modelled, and default data, and highlights the importance of using primary data whenever possible. The section then describes how GHG emission factors are used in calculations, including the challenges posed by variation between countries and methodologies. Finally, it presents key operational parameters that significantly influence emission estimates, such as load factor, vehicle type, and transport distance, and discusses how assumptions about these can lead to major deviations in reported emissions.

2.4.1 Data Categories

Emission calculations in the transport sector rely on two primary data categories, primary and secondary data (International Organization for Standardization, 2023). Secondary data includes both modelled and default data and do not meet the criteria required for primary data. International Organization for Standardization (2023) emphasises that primary data is the preferred input, as it is derived from direct measurements and is therefore expected to give more accurate results. This data should be possible to obtain from the transport operator or carrier.

International Organization for Standardization (2023) defines the different data types as;

- **Primary data**: *"quantified value of a process [...] or an activity obtained from a direct measurement or a calculation based on direct measurements"*,
- **Modelled data**: *"data established by use of a model that takes into account primary data [...] and/or greenhouse gas (GHG) emission-relevant parameters*

of a transport operation [...] or hub operation [...]",

- **Default data**: *"secondary data [...] value drawn from a published source",*
- ***Secondary data**: "data which do not fulfil the requirements for primary data [...]".* (International Organization for Standardization, 2023).

Secondary data include modelled or default data and therefore do not meet the requirements for primary data (CLECAT, 2024). Modelled data are processed, structured, or created based on a model. Meaning it is a representation of reality based on assumptions, calculations, or simulations (SAP SE, 2024). For transparency and verifiability, models and data sources should be thoroughly documented (CLECAT, 2024). Default data are typically used when neither primary nor modelled data is available. It is a predefined estimate or standard value and is retrieved from existing databases, industry standards, or standard/preset values. Although default data simplifies the reporting process, especially for activities with low importance of emission, they vary in quality. Some default values are broad approximations, while others are based on robust empirical data. The closer these values are to actual operational conditions, the more reliable they become for emission estimation (CLECAT, 2024).

Although primary data are generally considered the most precise, their accuracy still depends on how they are collected, processed, and verified. Likewise, default emission intensities, despite being standardised, may fail to reflect real-world scenarios. For this reason, transparency regarding data sourcing, modelling assumptions, and verification processes is essential. Clearly revealing how emissions are calculated not only improves trust in the results but also improves the comparability and credibility of sustainability disclosures (International Organization for Standardization, 2023).

2.4.2 GHG Emission Factors

GHG emission factors are coefficients used to convert energy consumption and refrigerant leakage into quantifiable GHG emissions (International Organization for Standardization, 2023; CLECAT, 2024; Smart Freight Centre, 2024). These factors form the basis of emissions calculations, enabling organisations to translate operational data into measurable climate impacts. Emission factors for energy carriers incorporate both upstream and operational emissions, covering the entire energy lifecycle, whereas refrigerant factors typically capture emissions only from the operational phase. To ensure accurate results, each transport activity must be linked to a specific emission factor that corresponds to the relevant energy carrier or refrigerant.

The variability in emission factors can be attributed to several contextual variables, such as the energy source's origin, production method, and the characteristics of the local consumption environment. National emission factors are often tailored to local conditions, including average temperatures, the regional electricity grid mix, typical vehicle technologies, and fuel types, to improve comparability within national

borders. However, this localisation may hinder global reporting efforts. For multinational logistics operators, differences in national methodologies and calculation assumptions create significant challenges for producing consistent and comparable emissions data. Discrepancies also persist due to the varied approaches taken by different stakeholders when establishing emission factors. Some emission factors conform to ISO 14083 by accounting for WTT emissions, while others capture only TTW emissions. This distinction affects the comprehensiveness of the emissions inventory. Given these variations, several authors underscore the need for transparent, reliable, and standardised emission factors (International Organization for Standardization, 2023; CLECAT, 2024; Kioutsioukis et al., 2004; EUR-Lex, 2020).

2.4.3 Impact of Input Parameters on Emissions

Greenhouse gas (GHG) emissions from transport are typically calculated using a well-to-wheel (WTW) approach, as defined by International Organization for Standardization (2023) and Smart Freight Centre (2024). This methodology encompasses both direct and indirect emissions and is divided into two components: well-to-tank (WTT), which includes emissions from energy production and distribution up to the fuelling point, and tank-to-wheel (TTW), which includes emissions from the actual operation of the vehicle or vessel. See figure 2.1.

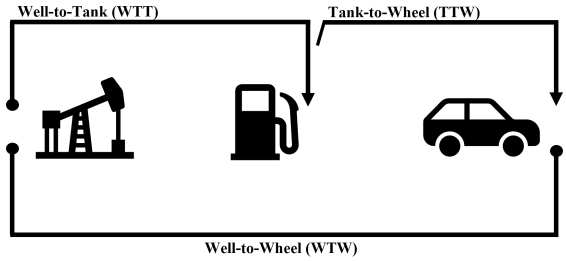

Figure 2.1: Visualisation of the WTT + TTW = WTW calculation

As emissions are calculated based on the energy consumed throughout the entire transport chain, several operational and contextual parameters become critical for accurate results. Both ISO 14083 and the GLEC Framework recommend including emissions from all legs of the transport chain, including return or empty trips, and calculating them using a tonne-kilometre unit, which requires data on cargo mass and distance transported.

International Organization for Standardization (2023) and EcoTransIT World (2024) identify the most influential factors that affect GHG emission, as shown in Table 2.6:

Table 2.6: List of key parameters for determining GHG emissions

Category	Parameter	Details
Vehicle/Vessel	Type	Ship type, freight/passenger aircraft
	Size and weight	Payload capacity, motor concept, energy, transmission
Operational	Capacity utilisation	Load factor, empty trips
	Cargo specification	Mass-limited, volume-limited, general cargo, pallets, container
Driving Conditions	Conditions	Number of stops, speed, acceleration, air/water resistance
Traffic Route	Route	Road category, rail/waterway class, curves, gradient, flight distance
Freight Details	Weight	Total weight of freight
Distance	Transport distance	

While these parameters are essential for accurate emission calculations, they are often difficult to obtain. As discussed in the section on data types (see Section 2.4.1), many companies lack access to detailed primary data and instead rely on secondary sources. This introduces uncertainty because assumptions must be made about key variables, which might have a substantial impact on emission outcomes. An impacting parameter is the load factor, the ratio of cargo transported to available transport capacity. Calculating the load factor is complex and varies between stakeholders. It may be defined based on pallets, volume, weight, volumetric weight or shipping weight, each producing different results (Wang et al., 2022). These variations can have significant consequences. For example, calculating the load factor is vastly complicated and the methods differ between different stakeholders. (Wang et al., 2022). These differences give large effects. For example, reducing the assumed load factor from 100% to 20% can result in an increase in emissions of more than 260% per transported unit (Smart Freight Centre, 2024).

Therefore, although the calculation methodology is standardised, the quality of the input data plays a decisive role. Inaccurate assumptions can lead to an overestimation or underestimation of emissions, reducing the credibility and comparability of sustainability reports. Thus, it is crucial for companies to ensure that secondary data are as representative of actual transport conditions as possible and to document all assumptions transparently.

3
Methods

This study aim to explore the challenges and barriers associated with the collection and sharing of transport emission data among transport service providers and buyers within the transport chain. To address this, a multiple case study design was employed. The study relied on primary and secondary data. Primary data were collected through semi-structured interviews, while secondary data, drawn from sustainability reports, company information, and academic literature, served to contextualise and complement empirical findings.

3.1 Empirical research

The research was carried out in collaboration with Centiro, a company operating in the logistics sector. The authors initially approached Centiro with a proposed research topic, which was refined through a series of exploratory interviews and workshops. The final topic was mutually agreed on, aligning with Centiro's operational expertise and offering a valuable context for accessing professional knowledge relevant to the study. More details about the company are provided in section 3.3.

A qualitative, inductive approach guided the concept development, with the study primarily built on empirical data. 19 semi-structured interviews were conducted with selected companies to investigate the current practices and challenges connected to collection and exchange of emissions data. These challenges were analysed from the perspectives of different stakeholder roles in the value chain, taking into account differences based on stakeholder position and organisational characteristics.

3.1.1 Secondary Data

The study began with a review of secondary data related to existing and emerging regulations and frameworks that govern the reporting of transport emissions. This provided an overview of the regulatory landscape and the expectations placed on companies. The review focused on official sources such as the European Commission, European Parliament, and EFRAG (European Financial Reporting Advisory Group), as well as industry organisations such as the Smart Freight Centre and international standardisation bodies such as ISO and SIS (Swedish Standards Institute). These sources were deemed reliable given their relevance and wide application in the sector.

Google was primarily used to locate regulatory content, as such materials are more commonly published on institutional websites than in academic journals. Scopus and Google Scholar were used to identify academic studies that address the implications of these regulations and methodologies for the calculation of emission.

The most used search terms:

- ISO 14083
- ISO 14064
- CSRD
- Emission Data
- Transport Emission Calculation
- Transport Emission Reporting
- Logistic Emission Calculation
- Emission Calculation Methodology

Additional search terms were used to ensure the inclusion of relevant literature supporting the research objectives. Since the CSRD directive was introduced in 2021 and finalised in 2022, sources published from 2021 onward were prioritised to capture contemporary insights and early implementation experiences. As recently published sources as possible were preferred, as they are likely to include more insights and empirical experiences from the market, rather than merely forecasts or potential challenges. Regarding the calculation of transport emissions, the publication date was deemed to not impact the reliability. Although more current research were important, to understand how current regulations and frameworks recommend the calculation of emissions, the underlying principles and definitions used often build on previous research within the field. Therefore, older sources were also considered valuable, given the continuity in underlying theoretical frameworks, and provided that they were of sufficient quality.

Prior to each interview, sustainability reports and general company information were reviewed to tailor questions to each participant's organisational context. This preparatory step enabled more targeted and relevant discussions, strengthening the overall quality of the interviews.

3.1.2 Interviews

To address the purpose of this study, semi-structured interviews were conducted with stakeholders in the transport chain. This method offered both structure and flexibility, enabling consistency across interviews while allowing interviewees to elaborate and introduce new perspectives. Each interview lasted approximately 45–60 minutes, which provided enough time to explore the subject in depth, while maintaining a clear structure aligned with our research questions.

The interviewees received an advance copy of the interview guide, a background summary, and the study's objectives. This preparation allowed participants to nominate

the most suitable respondent within their organisation. Typically, a representative participated per company, though their roles varied, ranging from sustainability and procurement to data analysis. In some cases, the roles were even more diverse, depending on how the responsibilities were distributed within the organisation. These variations influenced the responses to some questions, as the participants had different levels of insight into specific areas. When participants were unable to answer certain questions due to role limitations, this was taken into account in the analysis and interpretation of the results. In some interviews, multiple representatives with different roles participated. The diversity of roles enriched the discussion and provided more comprehensive answers. In addition, obtaining varying perspectives increased the likelihood that all questions could be answered more thoroughly, since participants were able to complement each other's knowledge and provide more in-depth information.

Semi-structured interviews are widely used in qualitative research because they are based on open-ended pre-defined questions, enabling the researcher to guide the conversation while still allowing the respondents to elaborate on their thoughts and introduce new perspectives (DiCicco-Bloom and Crabtree, 2006). This format is particularly useful in this type of study, where practices and challenges may vary across actors, and where the goal is to explore both shared and divergent experiences. The use of a semi-structured interview guide ensured that all interviews addressed the key research themes systematically, while allowing space for further follow-up questions (DiCicco-Bloom and Crabtree, 2006). The interview guides used for transport buyers and transport service providers are included in Appendix 1 and Appendix 2.

Additionally, semi-structured interviews offer a practical advantage in that they can be conducted in a single session, making them well-suited for professionals with limited availability (DiCicco-Bloom and Crabtree, 2006). This was particularly important in our study, as several participants held time-constrained roles and were unable to commit to more extensive participation. The majority of interviews were conducted remotely, with only two held in person. This choice improved efficiency given the wide geographical distribution of participants, spanning across Sweden and Denmark, and the time limitations of the project. No noticeable difference in quality or depth was observed between remote and in-person interviews, and therefore no separation of the results based on interview format was made.

Alternative formats of interviews were considered, but ultimately excluded. Unstructured interviews, for example, are better suited for long-term research, resembling informal conversations, lacking the consistency needed to address specific research questions in a focused way, making it harder to compare responses between participants (Corbin and Morse, 2003; Gray, 2009). Non-directive or informal conversational interviews, which involve spontaneously generated questions, were also ruled out, as they risk drifting too far from the core themes and reducing the comparability between interviews (Gray, 2009).

In contrast, the semi-structured format provided a strong balance between depth and comparability, facilitating the collection of rich empirical data while maintaining coherence between interviews (DiCicco-Bloom and Crabtree, 2006). This method proved effective for identifying the range of experiences and perceptions related to emission data collection and sharing in transport chains.

3.2 Company Selection and Study Implications

This section presents the selection of the companies included in the study and outlines the rationale for their inclusion. A brief description of the operations of each company is provided to give context to their role within the transport and logistics sector. Each section also discusses how the selection of the specific companies may have influenced the study and its results.

In this study, we have chosen to anonymise all interviewed companies, even though all but one, gave their consent to be named in the report. This decision was made to ensure equal treatment between all participants and create a safe space that encourages openness and honesty in descriptions. By treating all interviews confidentially, we minimise the risk that sensitive or critical information could be linked to a specific organisation. The companies are therefore referred to using code names (e.g., GlobalFreight, LocalHaulier and BioIndustry) to preserve anonymity while retaining relevant contextual information.

3.2.1 Transport Buyers

In selecting interview participants from the category of transport buyers, the main objective was to include large companies subject to the CSRD. These companies were expected to have experience with the collection, management and reporting of transport-related emissions data, making them particularly relevant for the study's focus on practical challenges and barriers. To ensure broader representation, the sample also included companies not currently covered by CSRD requirements, such as TechDistributor, which does not meet the size thresholds, and Forrester, a member-owned company not legally obliged to report under the directive. These organisations were included to explore how smaller or differently structured companies handle emission data, particularly when indirectly pressured by customers or market expectations. It was assumed that such companies may still face growing demands for emissions data, especially from clients with their own reporting obligations. Their inclusion offered valuable insights into challenges experienced under different conditions, such as reduced bargaining power with suppliers or fewer internal resources for sustainability reporting.

The selection of companies also deliberately aimed to include a range of industries. The final sample included product manufacturers, trading firms, and service-oriented companies. This diversity was intended to avoid sector bias and better reflect the variation in industry norms, customer demands, and regulatory pressures that influence how companies approach sustainability. By engaging organisations across

multiple sectors, the study sought to identify both common patterns and industry-specific challenges, thereby enhancing the generalisability of the findings.

Participants were identified through multiple channels. For transport buyers, a majority of contacts were made through Chalmers' career fair, where the authors actively sought out representatives in relevant roles. Additional interviewees were found through network contacts. Some contact information was also provided by Centiro, helping to establish a connection with a key stakeholder. This combination of outreach methods was essential in securing a diverse set of interviewees under the time constraints of the study.

While this approach enabled access to a broad range of perspectives, it also had limitations. The heterogeneity of the companies, in terms of size, industry, ownership, and regulatory exposure, can limit the comparability of results. Furthermore, companies with more advanced sustainability initiatives may be overrepresented, as they were more likely to respond to outreach and have staff capable of addressing emissions-related questions in detail. Nonetheless, this variety is believed to have provided a more comprehensive view of market conditions and to have helped identify both shared and context-specific challenges. The resulting insights offer a balanced understanding of the reporting landscape for transport emissions across different types of organisations.

A thematic analysis was conducted to structure the results by identifying recurring patterns and themes in the collected data. This method was chosen as it allows for a systematic approach to analyse qualitative material and provide deeper insight into complex issues (Naeem et al., 2023).

Table 3.1: Interviewed Transport Buyers

Company	**Role of Interviewee**	**Transport Modes**	**Size**	**Geographical Range**
MedTech	Customer Relationship Manager	• Air • Maritime • Rail • Road	Large	Global
TechDistributor	Logistics Specialist, Sustainability Coordinator	• Air • Maritime • Road	Medium	Global
AeroManufacturer	Environmental Sustainability Lead	• Air • Maritime • Rail • Road	Large	Global

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Company	Role of Interviewee	Transport Modes	Size	Geographical range
TruckOEM	Supply Chain Sustainability Controller	• Air • Maritime • Rail • Road	Large	Global
Recycler	Logistics Developer	• Maritime • Rail • Road	Medium	Nordics
Forrester	Quality and Compliance Manager	• Maritime • Rail • Road	Medium	Nordics
AutoOEM	Sustainability Leader, Purchasing Analyst	• Air • Maritime • Rail • Road	Large	Global
WholesaleDistributor	Transport Manager	• Air • Maritime • Rail • Road	Medium	Nordics

3.2.2 Transport Service Providers

In selecting transport service providers for this study, we initially prioritised larger companies, based on the assumption that these organisations would possess more established processes for emissions data management and allocate greater resources to sustainability reporting. However, early interviews with transport buyers revealed the crucial role played by smaller hauliers, often operating fewer than ten vehicles, within many transport chains. These smaller actors are frequently subcontracted by larger transport providers, freight forwarders, third-party logistics providers (3PLs), and end customers. Their central role adds complexity to both data flows and the overall structure of the value chain. Figure 3.1 presents our conceptualisation of the hierarchy typically found in land-based transport supply chains. The figure illustrates the layered subcontracting relationships, with smaller carriers positioned at the base, operating under larger logistics providers and intermediaries. Blue arrows indicate one-way contractual relationships, while red arrows represent two-fold relationships, where an actor may both contract others and be contracted themselves. To reflect this structure and gain a more comprehensive understanding of the sector, we sought to include the perspectives of smaller transport companies. Engaging with smaller hauliers proved challenging, as these companies often lacked the time or capacity to participate in interviews. In several instances, our outreach efforts received no response. To address this, we interviewed representatives from trans-

port cooperatives and industry associations such as LocalHaulier2, LocalHaulier3, LocalHaulier1, and IndustryOrg. These organisations, which support their member hauliers in operational matters but do not operate fleets themselves, offered valuable insights into the conditions and data-related challenges faced by smaller carriers, insights that would otherwise have been difficult to obtain.

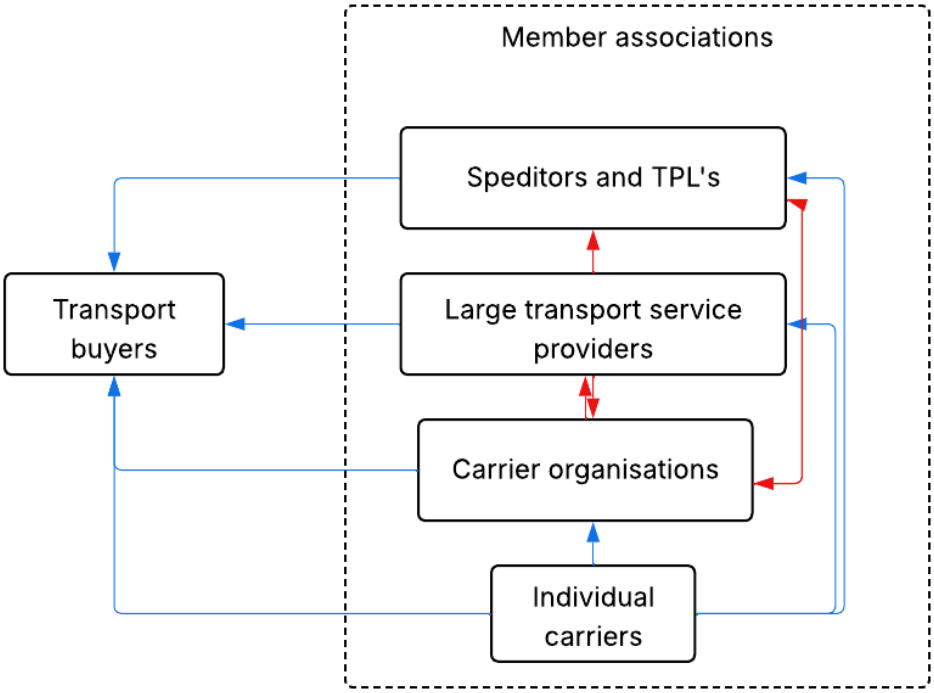

Figure 3.1: Conceptualisation of transport structure and relations

Participants were identified through a combination of outreach strategies. The majority of transport providers were contacted via LinkedIn, where we targeted individuals in relevant roles. Additional contacts were established through Centiro, the supporting company in this study, and one interview was arranged through direct email. This varied approach was instrumental in securing a diverse set of participants within the time constraints of the research.

Consistent with the study's purpose, no specific transport mode was prioritised. Instead, the sample included companies operating across multiple modes to reflect the diversity of the sector. For example, GlobalShipping and PublicTransporter contributed insights related to ocean and public transport, respectively. Several companies, including ParcelCarrier and GlobalFreight1, operated multimodal networks that combined road, rail, ocean, and air freight. While this provided a more comprehensive understanding of emissions data challenges across transport modes, it is important to note that none of the companies interviewed directly operated rail or air transport services. Rather, these services were procured from third parties. As such, the findings related to rail and air modes are based on the perspective of

transport buyers, rather than operators, which may limit the depth of insight into the specific challenges of these segments.

The included providers also represented a range of operational contexts. A few focused on parcel delivery and last-mile logistics, while others were involved in large-scale freight transport for construction or industrial sectors. This diversity enabled the study to explore how emissions data management practices vary depending on the type of cargo, transport distance, and customer demands. While the breadth of operations covered contributes to a more holistic understanding, it also limits the granularity of insights within specific transport segments, such as last-mile delivery.

In summary, the selection of transport service providers facilitated a broad and representative understanding of the challenges associated with emissions data collection and reporting. Although the inclusion of larger companies and industry organisations strengthened the study's empirical base, the limited coverage of rail and air operators and the broad scope of transport operations constitute limitations that should be considered when interpreting the findings.

Table 3.2: Interviewed Transport Service Providers

Company	**Role of Interviewee**	**Transport Modes**	**Size**	**Geographical Range**
ParcelCarrier	Sustainability Manager	• Air • Maritime • Rail • Road	Medium	Europe
GlobalFreight1	Sustainability Specialist	• Air • Maritime • Rail • Road	Large	Global
GlobalFreight2	Sustainability Director	• Air • Maritime • Rail • Road	Large	Global
LocalHaulier1	Vice CEO & Head of Distribution and Crane	• Road	Small	Sweden
LocalHaulier2	Sustainability Manager, Head of Business Development for Thermo and Distribution	• Road	Small	Sweden
GlobalShipping	Senior GHG Emissions Specialist	• Air • Maritime • Rail • Road	Large	Global

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Company	Role of Interviewee	Transport Modes	Size	Geographical range
LocalHaulier3	CEO	• Road	Small	Sweden
Nordic3PL	Sustainability Manager	• Air • Maritime • Rail • Road	Medium	Nordics
IndustryOrg	Technology Specialist, Sustainability Manager, Industry Representative	• Road	N/A	Sweden
Speditor	Business Developer	• Air • Maritime • Rail • Road	Medium	Global
PublicTransporter	Sustainability Manager	• Road • Maritime	Medium	Sweden

3.3 Centiro

Centiro is a Swedish technology company headquartered in Borås, founded in 1998. The company specialises in developing cloud-based solutions that support the management of goods flows in e-commerce, logistics, and industrial operations. Through its software platforms, Centiro helps businesses connect and optimise their delivery and service networks. These solutions enable more efficient transport operations, improved customer experiences, and real-time handling of complex logistics flows.

In this study, Centiro has been both a collaboration partner and a knowledge resource. At the initial stage of the project, representatives from Centiro participated in exploratory discussions with the authors to define the overall research direction and formulate the study's focus. Leveraging their industry expertise and familiarity with emerging challenges in the logistics sector, Centiro played an active role in refining the study's purpose and shaping the final research questions. Centiro also contributed to the theoretical groundwork by helping to identify relevant regulatory frameworks and current developments in transport emissions reporting. In addition, the company provided valuable support in the data collection process by facilitating contact with potential interview participants. This enabled the inclusion of diverse perspectives from both transport buyers and transport service providers. Throughout the course of the study, preliminary findings and analytical reflections were continuously shared with Centiro. Their feedback not only strengthened the practical relevance of the study but also ensured that the research remained grounded in the operational realities of the industry.

4
Result

This chapter presents a structured synthesis of the empirical findings derived from interviews with both transport service buyers and transport service providers. The results are illustrated with selected quotations from the interview transcripts to support interpretation and authenticity. To address the study's objective of identifying challenges in collecting, and sharing transport emission data, a thematic analysis was conducted. As summarised in Table 4.1, the chapter is organised into four main sections. It begins by outlining key barriers and challenges, followed by an overview of current sustainability reporting practices and transport chain structures to provide the necessary context. The subsequent sections explore the identified drivers that incentivise emissions reporting and conclude with a presentation of enablers that could facilitate improved data transparency and reporting accuracy.

Three overarching categories of challenges were identified: organisational and methodological barriers, issues related to data quality and availability, and difficulties surrounding data sharing and collection. In parallel, both internal and external drivers for emissions reporting were recognised, ranging from regulatory compliance to commercial incentives. Finally, the study identified several enablers, including digitalisation, standardisation, and collaboration mechanisms, that have the potential to support enhanced emission visibility.

In this framework, barriers and challenges refer to factors that obstruct the flow and visibility of emission data across supply chains. Drivers represent motivating forces that motivate organisations to engage in emissions reporting and data exchange. Enablers, while not prerequisites for reporting, are elements that facilitate better alignment with standards such as ISO 14083. Their absence does not necessarily prevent emissions reporting, but often leads to reliance on less accurate forms of data, such as secondary sources rather than primary sources.

This structure aims to clarify the nature of existing obstacles, the motivations to address them, and the mechanisms through which more transparent and standardised reporting practices could be achieved.

Table 4.1: Overview of Themes and Associated Challenges

Theme	Challenges
Barriers and Challenges	• 4.1.1 Organisational and Methodological Barriers • 4.1.2 Data Quality and Availability • 4.1.3 Data Sharing and Collection
Drivers	• 4.2.1 External drivers • 4.2.2 Internal drivers
Enablers	• 4.3.1 Technological Solutions and Standardisations • 4.3.2 Collaborative practices

4.1 Barriers and Challenges

This section presents the principal barriers and challenges identified through the interviews, structured around three thematic areas: organisational and methodological barriers, data quality and availability, and data sharing and collection. Each theme is further divided into specific challenges, which are elaborated through narrative analysis and supported by illustrative quotations from respondents.

4.1.1 Organisational and Methodological Barriers

Table 4.2 summarises the organisational and methodological barriers reported by interview participants. These challenges reflect limitations in internal coordination, strategic prioritisation, and understanding of emissions calculation methodologies across both transport buyers and service providers.

Table 4.2: Organisational and Methodological Barriers

Challenge	Description
Fragmented organisational structures and communication	• Decentralised procurement complicates emission tracking • Lack of internal coordination between sustainability and operations teams

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Challenge	Description
Low strategic prioritisation of transport emissions	• Cost is prioritised over sustainability • Limited resources for emissions data management internally
Lack of understanding of methodologies	• Confusion regarding required data types and input parameters • Uncertainty about allocation methods • Inconsistent calculation approaches across companies • Limited internal knowledge of emissions modelling

- ***Fragmented organisational structures and communication***

As shown in Tables 3.1 and 3.2, the interviewees held a diverse set of roles, including sustainability managers, logistics specialists, procurement professionals, and quality coordinators. A key observation made by the researchers was the noticeable disconnect between those responsible for emissions reporting and those tasked with operational data collection. While sustainability teams frequently perceived data availability as adequate, individuals working closer to day-to-day operations described the process as challenging, often citing difficulties in accessing accurate, complete, and consistent data. This disconnect was also identified and described by LocalHaulier2: *"We should also note that often those of us in logistics talk to logistics people. (...) You can see that CSRD, it is something that the quality departments are doing. The people I talk to do not know what it means."*.

Several organisations noted that complex, decentralised structures, particularly in global operations, hindered emissions data visibility and coherence. At AeroManufacturer, fragmented procurement processes and organisational complexity presented a substantial challenge: *"Since we are such a big company with so many different locations with such complex business structures, even for us to just know who do we work with where and what constellations (...). To organise all of that and to have a structured approach to collecting and calculating data is still a major challenge."*.

Similarly, MedTech described the difficulty of aligning data systems across global and local teams: *"There has been demands for much, much more detailed data and in such an extremely large organisation like MedTech, some data may not be shared as much. So, the global functions may be sitting on certain data that may be complete, but then we in Sweden may not get all the data or do not even know that it exists. Currently, we are synchronising data usage so that everyone uses the same data."*.

In summary, organisational fragmentation, both vertically between strategic and operational levels and horizontally across departments and geographic locations, emerged as a key internal barrier to reliable emissions reporting. Addressing these structural and communication gaps is a prerequisite for enabling consistent and verifiable emission data management.

- ***Low strategic prioritisation of transport emissions***

The interviews revealed substantial variation in how companies organise and prioritise their sustainability work, particularly regarding emissions reporting. Not all participating companies report according to regulatory frameworks, often due to exemptions related to size or ownership structure. Nevertheless, some companies chose to voluntarily align with such standards as a demonstration of environmental responsibility. For example, Forrester will begin to report in accordance with the CSRD, despite not being formally obliged to do so. An observation in the interviews was the relationship between regulatory exposure and the maturity of sustainability practices. Companies subject to mandatory reporting obligations typically demonstrated a more developed understanding of emission scopes, data categorisation, and pursued a higher degree of granularity in their data collection. Additionally, the duration of a company's engagement in sustainability reporting appeared to influence the institutionalisation of routines. Organisations with a longer history in this domain generally had more formalised processes and internal structures, whereas those newer to emissions reporting described difficulties in establishing consistent data flows.

In most companies, the main strategic focus was on reducing emissions rather than improving access to emissions data. This was especially true for transport buyers, whose emissions are mostly caused by other parts of their operations, not by transport. In contrast, transport service providers emphasised that limited customer interest constrained their ability to prioritise and invest in both emissions reduction, and data collection, despite interest in more sustainable solutions. A central theme emerging from the interviews was the prevailing cost pressure in the logistics sector, particularly in transactions between transport buyers and service providers. Many respondents noted that sustainability considerations were frequently deprioritised in favour of cost-efficiency and delivery performance. This was clearly articulated by LocalHaulier2: *"But it is about saving money, shipping costs, delivery quality, delivery precision. That is what customers want."* and *"Many in an organisation see logistics as a necessary evil. It does not generate money, it only costs money."*.

Despite this, some transport service providers expressed a proactive approach, aiming to position themselves competitively through environmental branding. As LocalHaulier1 noted: *"We want to have a strong environmental profile with our vehicles all the time. Because we believe that it will get us more jobs."*. However, for smaller hauliers operating under tight financial margins, such efforts were often infeasible without clear commercial benefits or customer demands. This was underscored by IndustryOrg: *"There must be a logic to what problems to solve. (...) I think it has to*

become part of the business more than anything else. Then I think that competence will come with it.".

Similarly, Speditor explained that transportation is often perceived as a background function that is expected to operate seamlessly, which contributes to the low prioritization of emission data among their customers: *"For customers transport is probably a question of price and lead time. It easily becomes a function that should just work, and you may not put much thought into how to do it or who to do it with. (...) The customers might not spend as much time on the environmental aspects."*.

A lack of strategic integration was also noted on the buyer side, particularly in translating emissions data into actionable business intelligence. AeroManufacturer articulated this challenge: *"Another challenge is how to use the information [the transport data] – to formulate a strategy around it, and embed it in the business strategy, to get the support from top management. Because we are talking absolute emission reductions while the company wants to grow. So how do you do that? To use the emissions data and translate it to something that business people understand and take decisions on, which usually is financial data."*.

These findings suggest that low strategic prioritisation of transport emissions, both in terms of data collection and internal integration, significantly limits the availability and quality of emissions data. For service providers, the absence of customer-driven incentives reduces the return on investment in sustainable practices. For buyers, the lack of internal prioritisation hinders the potential for data to inform improvement initiatives and support long-term emission reduction strategies.

A recurring barrier identified across both transport buyers and service providers was the lack of clarity surrounding emission calculation methodologies. While most interviewees expressed confidence in their chosen approaches, often viewing their results as valid within their operational context, closer examination revealed divergent interpretations of core methodological concepts. Specifically, inconsistencies were observed in how companies applied allocation principles, selected emission factors, and interpreted the granularity required for accurate reporting.

Several interviewees reported confusion over which emission factors to apply and how to allocate emissions between clients or transport legs. This variation in practice was often shaped by differing customer expectations and sector-specific requirements. As IndustryOrg described: *"Some actors are okay with classifying a diesel as diesel, but may have very strict requirements on the frequency of delivery. Another might think it is really important to know exactly what emission factor there is for the particular fuel we have been driving on. But it is not that particular when it was done. Finding that balance is really important, and to not focus on only one parameter. That is a big uncertainty now."*.

Misalignments were also apparent between transport service providers and their customers, leading to discrepancies in expectations and reported figures. Several

stakeholders described having to educate customers or providers on emission reporting fundamentals. As ParcelCarrier noted: *"We have also seen that many customers do not know what to ask for, if they ask at all, and think they know what they are asking. (...) We have spent quite a lot of time educating our customers as well."*. This pattern was particularly visible among larger organisations such as AutoOEM, TruckOEM, GlobalFreight2, and Forrester, which often reported high confidence in their methodologies yet differed markedly in their interpretations of what constitutes reliable input data.

A notable example of methodological divergence was the varied emphasis placed on fuel consumption. While some companies viewed fuel volume as central to accurate calculations, others saw it as irrelevant unless paired with specific cargo allocation data. ParcelCarrier illustrated this point: *"Some customers say 'we need to know how many litres you've filled up'. And we respond with 'Okay, what are you going to do with that?' It is not that interesting to know how many litres we've filled up if you don't know what percentage of your cargo went into that car."*.

Within individual organisations, differences were sometimes found across departments, with sustainability and operational teams using distinct tools or assumptions, leading to inconsistent emissions figures. Moreover, the reliance on third-party calculators, transport provider estimates, or generic tools often occurred without a clear understanding of the underlying data types or assumptions. TechDistributor illustrated this issue: *"I will not say I know for sure [the amount of primary data]. I have assumed it is primary data. That is how I have interpreted it. From what I have been given."*. This highlights a common assumption among transport buyers, that provided data is of high quality, despite frequent reliance on default or modelled values from providers.

Finally, the technical complexity of standards such as ISO 14083 was a source of uncertainty for several participants. LocalHaulier1 reflected on this challenge: *"We are back to the same problem. I do not know how I am going to be able to read this. For example, when you have shared transports. (...) It is not solvable [the current calculation methods and required data types]."*.

In summary, the interviews revealed that while commitment to sustainability was strong, a limited understanding of emissions methodologies constrained the reliability, comparability, and transparency of emissions data.

4.1.2 Data Quality and Availability

Table 4.3 shows the themes identified during the conducted interviews, with respect to challenges that is connected to data quality and availability.

Table 4.3: Data Quality and Availability Challenges

Challenge	Description
Limited access to primary data	• Low control over subcontracted transport operations • Over-reliance on estimates and assumptions • Difficulty tracking fuel origins and emission factors
Incomplete and inconsistent data reporting	• Data quality varies across providers • Customer demand different formats and structures • The interviewed companies use a mix of data types for calculating greenhouse gas emissions, including primary data, model-based calculations, default values, and in some cases data from contracted operators • Companies uses different methods for retrieving emission factors, either from national recommendations, industry standards, from suppliers or calculate them their selves. • Data type and level of granularity vary based on capabilities and contractual arrangements
Difficult to validate data	• Low consistency in validation of fuel data • Different transparency depending on industry • Low follow-up frequency • Time consuming

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Challenge	Description
Decentralised structure of transportation (low level of vehicle control)	• Relationship with transport providers influences data availability • Transport chain complexity influence data availability • Limiting the communication possibilities • Reducing the understanding of operations • Manual collection, affecting smaller hauliers not having the same resources to calculate and collect data
Credibility and transparency issues in green claims	• Unclear use of renewable fuels in mass balance systems • Uncertainty in renewable electricity source tracking • Customers questioning green fuel claims

- ***Limited access to primary data***

A key barrier to high-quality emission reporting identified in the interviews was the limited access to primary data. Many companies, particularly those outsourcing transport operations, reported low visibility and control over the operational parameters needed for accurate emissions calculation. In the absence of direct data, such as fuel consumption, odometer readings, or shipment-level tracking, many relied on modelled outputs, default values, or high-level estimates.

From the customer perspective, TruckOEM illustrated this challenge by explaining their strategic reliance on modelled data due to the inaccessibility of fuel consumption figures: *"We use modelled data we retrieve information from our own systems and what we know internally. For example, the load factor and time of when the order was placed and arrived. We cannot check the fuel consumption at all, because we do not have access to that data."*. Collecting data manually from their extensive network of carriers was deemed infeasible: *"I think it would be too much manual labour with someone needing to go through all these reports and check that they're correct. We have an incredible number of carriers in our network."*.

Interestingly, TruckOEM noted that less digitised departments, which rely more on carrier reports than modelling tools, sometimes obtained more primary data: *"They [a department at the company] haven't gotten that far yet with having a digital system - so they get a lot of reports from their suppliers. Which is good in a way, because you can basically say that they get more primary data."* However, they also noted that primary data had historically been deprioritised in the industry: *"The problem is that primary data has not been obvious in the industry. But it is starting*

to become more common now.".

This gap in primary data access was echoed by other transport buyers. Recycler, for instance, expressed a goal of relying entirely on primary data but acknowledged a practical threshold: *"Almost all the data we get is primary data, because we ask the transporters specifically. However, we do not receive data from 100% of the suppliers, instead we have decided to settle for at least 80%."*.

TechDistributor, which uses large freight forwarders, assumed that received emissions data was primary despite lacking transparency in the calculations: *"We got the calculated CO_2 emissions directly, based on how much we had driven. That is how it works - the reports you can request from the big freight forwarders are the emissions reports which usually contains your carbon dioxide equivalents."* and: *"I will not say I know for sure [the amount of primary data]. I have assumed it is primary data."*. Similarly, other companies, such as Forrester and MedTech, appeared to assume reported figures as primary data, without fully understanding the underlying data collection methodologies of their transport providers. WholesaleDistributor described this challenge not only in terms of access, but also in managing the complexity of highly detailed data: *"We basically have no primary data. However, a lot is modelled. (...) As long as there is no primary data, we try to make the models at as detailed a level as we can. (...) What we may have difficulty understanding today is when we do not have primary data."*.

Contrary to the expectations of many buyers, several transport service providers confirmed that they primarily rely on modelled or default values. GlobalFreight2 stated: *"We collect data from our transporters once a year. (...) We do not collect primary data from the vehicles. (...) Engineers often want more granular data, but it is not always as easy as it seems, with for example, changing routes and infrastructure."*.

Challenges were especially pronounced among intermediaries such as Speditor and Nordic3PL, which do not own fleets and therefore lack direct access to operational data. Speditor described their use of modelled data through tools such as EcoTransIT: *"(...) so far it feels difficult to get more accurate data from shipping companies or hauliers on a specific transport performed for you."*. They also emphasised that the availability of high-quality data was contingent on the suppliers' own capabilities and transparency: *"We cannot become better than our suppliers. So we believe this was the best solution to still present a value that is based on very good foundations. (...) In general, I think the industry is not very far along, neither on data or on how to report. Since we do not get that data from the shipping companies or hauliers, there is nothing we can use either, unfortunately."*.

Notably, the company did not actively request primary data from its providers, potentially contributing to the broader lack of incentive within the industry to prioritise detailed data collection. Some companies expressed a preference for consolidating transport contracts with fewer providers or internalising transport operations to in-

crease data visibility. Speditor explained: *"I think it is difficult to get data for all modes of transport. The advantage for sea is that there are fewer shipping companies, so it might be easier there than by for example by truck, where it is difficult because we cooperate with about 60 different haulage companies. (...) If we had owned the transport, it would probably have been much easier to collect. But since we act as an intermediary and always want to find the best solution for the customer, collaborating with many different transporters, it becomes difficult to systematically get emissions data another way than our current practices."*. Nordic3PL, although also an intermediary, reported better access to fuel and emissions data, though it lacked insight into actual distances travelled due to the changing routing of subcontracted carriers: *"We collect everything related to the transports. (...) We do not get the actual driven distances, we can get a theoretical distance but if we hand a parcel over to for example GlobalFreight2, they might have another parcel to pickup and then we do not know exactly which dips and hubs they use to complete the transport. (...) I would say that we receive data from all transport service providers upon request."*.

In contrast, companies with vertically integrated logistics and ownership of transport assets, such as GlobalShipping, reported much higher access to primary data, particularly within their own operations: *"Activity data, what I would call primary data, is 100% of our scope 1 and the majority of our scope 2. Basically, every direct or energy-related emissions are based on activity data. For the scope 3 related to transport, we have around 25% of activity data, and the rest is modelled. And a small portion is based on spend."*. They explained that the level of access varies by mode: *"For shipping, we have a very good data suite (...). For landside transportation, the type of data is very different."*. GlobalShipping further emphasised that the highly fragmented trucking sector, and its price-driven procurement dynamics, hinder systematic access to primary data: *"They have telemetric system and everything. But we contract globally from thousands of trucking providers. We cannot set up an API for each one of them to get their information. It would be insanely difficult and time consuming. (...) The procurement of transportation services is extremely cost dependent, maybe causing you to go with a supplier that provides worse quality service and provides you less data just because they cost less."*. Moreover, they highlighted the benefits of owning the transport assets: *"So, when you are not operating the assets, it is quite challenging to get primary information. And if you do not get primary information, you can not report as accurately as you could."*.

Although many companies reported using primary data, the findings suggest a widespread misunderstanding regarding the definition and origin of such data. Several transport buyers assumed that data received from providers was automatically primary, despite the lack of transparency about how it had been calculated or whether default assumptions were used. As TruckOEM pointed out: *"Even if you categorise reports from the carriers primary data - it is not certain that it actually is 100% primary data. Then you have to know how they have actually calculated that figure."*. This lack of insight into the data's characteristics, combined with inconsistent practices and terminology, significantly affects the credibility and comparability of reported emissions. Ultimately, it constrains efforts to build transparent and ac-

curate emission inventories across the transport sector, as stated by ParcelCarrier: *"We are working quite intensively to get even better data. (...) The biggest challenges are garbage in - garbage out."*. However, some stakeholders voiced scepticism about focussing too narrowly on precision in reporting. As Forrester remarked: *"The data is not the most important thing, the most important thing is that progress is made in this area [sustainability]."*.

- ***Incomplete and inconsistent data reporting***

A recurring challenge identified in the interviews was the incomplete and inconsistent reporting of emission data across the supply chain. This issue was closely linked to the digital maturity, internal capacity, and reporting practices of transport service providers. For instance, Nordic3PL described significant variation in data types, data quality and structure of incoming data from subcontractors, creating a heavy administrative burden and necessitating manual calculations to get comparable results: *"We have our own calculation factors. Because one thing we see when we look at such a large number of incoming reports from transport service providers is that everyone does things quite differently and calculates transport emissions in slightly different ways. For example, some always assume fully loaded trucks, both in terms of volume and weight, even though we know that is not the case."*. Respondents observed that larger service providers often imposed rigid reporting formats, making data harmonisation difficult for intermediaries and transport buyers. Smaller hauliers, in contrast, were perceived as more cooperative and adaptable to customer needs. As Nordic3PL stated: *"We want the data in a comprehensible way that makes it possible to further work with the data, but that is not the real world scenario. Instead, the big global players do not care what you think and they say, 'this is our data, this is our report, take it or leave it'. So it is usually easier to reach out to smaller haulage companies, to get data that we can more easily access and read in automatically."*. However, the company also noted that smaller firms often lacked the internal competence to handle emissions data requests: *"I think that smaller haulage companies do not have an organisation to handle these issues, and the number of data requests. They might add this task to someone who works with sending out invoices, perhaps not having the competence to actually solve the task or understand what kind of data they are supposed to provide."*.

Similar concerns were raised by WholesaleDistributor , who described inconsistencies in data formats and methodologies across different transport partners: *"The format may differ depending on which carrier it is. It probably depends more on which operator it is than which mode. (...) out of ten transporters, there could be five that report based on the exact same format."*. WholesaleDistributor reported large discrepancies in calculated emissions values and expressed doubt about stakeholders' understanding their own data: *"It can be somewhere 30-60% difference between the received reports and what [Business partner] calculates it to be. (...) Then we try to understand the reason to it - it could be differences in what emission factor was applied, or that we have not captured information about all the deliveries, or if the carriers base their calculations on a different distance. (...) I think there are many people calculating emissions who might buy a product where you plug information in*

at one end, and you get the emissions out at the other. There are fewer people who understand what the calculation model itself looks like and can critically examine it.".

On the provider side, inconsistent customer demands further complicates data consistency. Several interviewees noted the absence of an industry standard and the need to tailor outputs to different clients. LocalHaulier1 explained: *"There is no real industry standard for emission reporting, so customers are usually world champions at coming up with their own type of calculation for it. (...) You usually have to discuss with the customer, how should we measure? How should we come up with it? What is relevant?"*. IndustryOrg reported that conflicting expectations from customers and formal frameworks created uncertainty for their members: *"Both ISO and Count emissions are starting to say one thing, but the customer side says another."*. GlobalShipping echoed these observations, linking the level of detail requested to the size and internal capacity of the customer: "*The larger the corporation, the more granular they want it, simply because a larger group has more people that work on emission accounting. (...) If you have a smaller sustainability team, I guess it would be fine to just receive an aggregated figure and know that you have emitted this much by using our transportation over the year."*.

Inconsistencies also stemmed from the use of different data types and calculation methods. ParcelCarrier, for example, used primary data for their own fleet in Norway but default or supplier-reported data in other contexts. Load factor estimation and emission factor selection further complicated data consistency. As ParcelCarrier stated: *"I think that all large transport companies will say the same thing - no one has full control over everything. (...) It is not like you can take our daily report and go to another large transport provider and ask them to pull out a report and compare. (...) They might use different emission factors or they had a different load factor. There are so many sources of error when comparing."*. Fuel-specific factors, especially for renewable fuels like HVO100, were highlighted as problematic by LocalHaulier2, LocalHaulier3, and IndustryOrg. Different providers referenced varying databases, DEFRA, NTM, or proprietary tools, further reducing comparability. IndustryOrg pointed out: "*We have almost all fuels in Sweden with the right emission value, but is that what we are going to do, or should we set a modelled value for diesel or something else? And right now, things are done a little differently. (...) This inconsistency in customer demand is hindering further development(...). When demand is inconsistent and the end result is unclear, it is difficult to implement automation."*.

Discrepancies were also observed within companies. GlobalShipping noted challenges in coordinating global systems and integrating region-specific data: *"Sometimes companies in different region work in their own ways and systems. (...) It may be a system that is not technically compatible with another one, so then you cannot extract the data."*. Likewise, TruckOEM reported internal variation in tools and methods, resulting in significantly different emission estimates: *"It could be that you are comparing apples to oranges because you have such scattered bursts. For example, one department switched from manually calculating their emissions to using*

this modulated digital tool and had huge differences in their results.".

Taken together, these findings show that inconsistent data types, methodologies, and digital maturity create significant barriers to transparent, comparable, and credible emissions reporting. They also complicate the aggregation and validation of emissions data across organisations and supply chains.

- ***Difficult to validate data***

A recurring theme in the interviews was the inconsistent application of data validation, verification, and external auditing processes. Among transport service providers, validation practices varied considerably. While many expressed an ambition to ensure data quality, their approaches differed significantly. For instance, WholesaleDistributor , TruckOEM, and Recycler benchmark data from multiple providers to detect anomalies. MedTech emphasised that this was a major challenge: *"The biggest challenge is probably data availability, and if you can actually trust that the data is verified."*. Forrester highlighted a broader concern about the limited expertise among auditors, particularly in relation to mass balance certificates: *"I think it's a big problem in general, that the auditing expertise across CSRD and CSDDD doesn't exist. (...) We have a very big challenge with the mass balance certificates, that have not gotten approved third party certification."*. AutoOEM described a highly resource-intensive procurement validation process, sometimes requiring several weeks due to misunderstandings or low-quality submissions from carriers. Other companies reported limited formal validation, relying instead on trust in their suppliers. For example, TechDistributor stated: *"This is only the second year we are collecting data, so right now it is mostly about collecting data and see what is available. Data validation and quality checks might be implemented in the future. (...) We trust our large transport service providers."*.

Transport service providers, in contrast, generally perceived their data as inherently trustworthy and expressed limited awareness of why customers might require independent validation. IndustryOrg noted that audit or third-party verification of fuel data is not common but may become more prevalent, especially if required by clients for inclusion in annual sustainability reporting. However, current feedback from hauliers suggests limited adoption of such practices. For intermediaries such as Nordic3PL, the need to understand and validate incoming data led to rigorous internal scrutiny: *"I think the big challenge is that you get so many different types of data so you have to be a bit of a detective when you read through them. You can not just take one piece of data and take it for truth, you really have to go through the data in a structured way and understand what is there."*.

Fuel data in particular was identified as especially difficult to validate, with several organisations noting challenges in tracing fuel usage back to specific vehicles or shipments, especially when using subcontracted carriers. ParcelCarrier, for example, collects fuel receipts for its subcontracted operations but acknowledges the limitations of this method: *"Collecting receipts does not really say much either - they could have filled up any car. It is important to find a process that shows the truth without*

having to invest your whole life in them.". GlobalFreight2 similarly described fuel verification as a major issue: *"Just as our customers ask us, 'do you really know your data?' we ask 'But do the fuel suppliers really know that the fuel is without PFAD?'. (...) And each supplier of raw material should then have a specific certificate. (...) It is very important, but also a huge challenge."*. Furthermore, LocalHaulier3 describe difficulties verifying data on green fuel: *"We are working on compiling data from the fuel companies, (...) with the FMS data where we see that it has refuelled at a certain time. That way we can see the details of what the car has refuelled. Much, much more difficult than we thought."*. Some companies mitigated this challenge by entering framework agreements with fuel suppliers or co-owning fuelling companies, enabling more reliable data access. LocalHaulier2 reported a streamlined validation process due to such arrangements: *"I know that many companies face challenges with validating data. Then you have to send in receipts or copies of invoices and so on. And it is quite administrative. So we have a big advantage there that we have our own fuel department. (...) That makes it very easy to control."*.

Another finding is that transparency varies by industry, implicating differences in what data can be verified. For example, GlobalShipping highlighted confidentiality in the maritime sector as a limiting factor in data sharing, while PublicTransporter's public sector operations allowed for a more transparent and auditable approach using the FRIDA platform. This system includes receipt verification, audit trails, and automated anomaly detection, enabling a higher level of data control.

Overall, our findings indicate that while some transport buyers conduct internal checks and compare data across providers, this is not necessarily due to mistrust but rather a recognition of methodological inconsistencies. Verification was especially prioritised in the context of green fuels and mass balance, where buyers were sceptical about whether premium costs translated into measurable environmental benefits. On the supply side, there was a strong willingness to meet customer demands, but providers often struggled with the granularity and traceability required for credible verification, particularly due to limited insight into fuel sourcing and upstream emissions.

- ***Decentralised structure of transportation***

A key barrier to emission data visibility identified in the interviews was the decentralised nature of transport operations. In particular, long and complex supply chains, involving multiple layers of subcontracting and intermediaries, create significant organisational and operational distance between data owners and data users. This fragmentation makes it difficult for transport buyers to access high-quality emissions data and for service providers to maintain consistency and transparency across their networks.

As shown in Table 4.4, the vast majority of transport buyers rely on subcontracted transport services (✓), with limited ownership of vehicles or logistics assets (✗). Only a few, such as Recycler and Forrester, report partial ownership of transport resources. Among service providers, the landscape is more heterogeneous. Compa-

nies like ParcelCarrier, GlobalFreight1, GlobalFreight2, GlobalShipping, and PublicTransporter own transport assets, while cooperatives such as LocalHaulier1, LocalHaulier2, and LocalHaulier3 operate through member hauliers without direct asset ownership. Notably, all providers except LocalHaulier1 and LocalHaulier3 also subcontract part of their operations, meaning the their role in the value chain becomes two folded, acting as a transport buyer as well.

This layered structure complicates accountability and emissions reporting. While buyers are responsible for collecting and reporting sustainability data, providers, whether asset-owning or coordinating subcontractors, are responsible for operational delivery. The resulting data flows span multiple actors and steps, introducing variability and gaps in emissions tracking. Figure 3.1 illustrates this complexity by conceptualising the multi-tiered transport hierarchy. The findings highlight the importance of considering organisational structure when assessing responsibilities and data quality in sustainability reporting.

The study found that companies with direct ownership of vehicles, or those engaged in long-term, close collaborations with dedicated transport partners, generally had greater data availability and quality. Conversely, reliance on decentralised structures, subcontractors, or intermediaries reduced visibility and hindered access to granular data. The Wholesaler Distributor described this challenge: *"We have central agreements with transporters that solve 98% of our volume. Then for the remaining percentages, there may be more local solutions that exist around the country. (...) We do not have a grip on those [local] deliveries today."*. MedTech noted similar difficulties: *"So one of the challenges I am struggling with is that we have so many transporters."*. AutoOEM elaborated on the cascading effect of subcontracting: *"The most challenging with data collection is if they [the transport providers] do not own their own fleet. Because then they are dependent on their haulage companies. That becomes another step, and then they have to collect that data to then be able to give it to us."*. The value of close, long-term relationships was repeatedly emphasised. MedTech reported improved data reliability with long-standing partners, and AutoOEM described strong collaborations as enabling better transparency. GlobalFreight1 affirmed this: *"We have very good partnerships with our hauliers, who we often have worked with for a long time. The dialogue is good and we help each other to get the needed data."*. These relationships were seen as instrumental in bridging the gap created by decentralised supply chains.

Among service providers with hybrid asset structures, data collection practices differed based on operational proximity. GlobalFreight2, for example, maintained high visibility over its owned fleet but relied on estimations for subcontracted operations: *"Since there are different systems at different suppliers and carriers, it is not easy to capture the primary data. (...) For our own haulage company, we have primary data in a different way."*. GlobalShipping echoed this distinction, noting stronger data capabilities for owned assets and less visibility in subcontracted segments. PublicTransporter noted this challenge, saying: *"The data for subcontracted transport is more challenging for us to keep track of. The further away it is from our core*

business, the more difficult it is. That is probably a general problem.". In line with this, intermediaries such as Nordic3PL and Speditor, which do not operate their own vehicles, described limited insight into carrier operations. By contrast, cooperatives like LocalHaulier2, LocalHaulier3, and LocalHaulier1, despite not owning assets, were found to exert greater control over data flows. Their proximity to operational activities and use of transport management systems (TMS) and fleet management systems (FMS) allowed for more consistent data collection and centralised quality control. For smaller hauliers within such networks, digitalisation was often limited, and administrative resources constrained. This affected their ability to generate and share high-quality data. Forrester highlighted this issue: *"If you are two people, maybe both drive the cars. Then you may not be fully aware of emission data, compared to if you have a sustainability department with 250 people."*. MedTech similarly noted: *"A small transporter is a little more difficult to get good data from, (...) why there are slightly different conditions on data availability."*.

These observations underscore a consistent pattern across both buyers and service providers: the proximity, both operational and organisational, to transport execution is a key determinant of emissions data visibility. The further removed a company is from the vehicles performing the transport, the more difficult it becomes to obtain accurate and detailed emissions data.

Table 4.4: Transport Assets and Use of Subcontractors Among Interviewees

Company	Own Transport Assets	Transporting Member Org. / Economic Coop.	Subcontracted or External Transport
Transport Buyers			
MedTech	✗	N/A	✓
TechDistributor	✗	N/A	✓
AeroManufacturer	✗	N/A	✓
TruckOEM	✗	N/A	✓
Recycler	✓	N/A	✓
Forrester	✓	N/A	✓
AutoOEM	✗	N/A	✓
WholesaleDistributor	✗	N/A	✓
Transport Service Providers			
ParcelCarrier	✓	✗	✓
GlobalFreight1	✓	✗	✓
GlobalFreight2	✓	✗	✓
LocalHaulier1	✗	✓	✗
LocalHaulier2	✗	✓	✓
GlobalShipping	✓	✗	✓

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Company	Own Transport Assets	Member Org. / Economic Coop.	Subcontracted or External Transport
LocalHaulier3	✗	✓	✗
Nordic3PL	✗	✗	✓
IndustryOrg	N/A	N/A	N/A
Speditor	✗	✗	✓
PublicTransporter	✓	✗	✓

- ***Credibility and transparency issues in green claims***

A recurring and somewhat unexpected theme in the interviews was the concern over credibility and traceability in green fuel claims, particularly those related to renewable fuels and electricity. While most interviewees expressed a clear ambition to contribute to sustainability, the structural limitations of outsourced transport operations often meant that their contribution was reduced to using mass balance schemes, purchasing low-carbon fuel credits without being able to guarantee that their specific shipments were transported using renewable fuel. This limited operational visibility has raised concerns among buyers about whether their financial contributions actually result in tangible environmental benefits.

From the buyer perspective, many companies emphasised the need for external verification to ensure that the claimed amount and type of green fuel has been used in their transport operations. Forrester, for instance, raised concerns about the credibility of mass balance certificates and called for greater standardisation and clearer governance: *"A very big challenge for us is the mass balance certificates. We have not received any approved third-party certification (...) there is really no standard around it."*. Similarly, TruckOEM questioned the fairness of bearing verification costs, while still demanding accountability from their providers: *"We should not pay to ensure their process is okay. (...) We need to know that the service we buy, and pay extra for, is approved and works, so that we don't pay for something we don't get."*. AutoOEM acknowledged the value of mass balance principles but stressed the need for stronger linkage between green fuel usage and their own operations: *"Many transport providers rely on mass-balance principles. (...) We have a requirement that we have a connection to our supply chain. I do not think all transporters are with us there. Sometimes it is easier to invest in HVO in a completely different country than in the one we have transport operations."*.

On the provider side, companies like GlobalFreight1 and Nordic3PL highlighted the practical challenges of assigning green fuel usage to individual customers or shipments. GlobalFreight1 pointed to legal and technical barriers: *"We cannot currently share with customers how much biofuel a specific transport has, even though we can see it ourselves. (...) partly because it becomes personal data to track at the car level."*. Nordic3PL similarly reflected on the mismatch between mass balance and customer expectations: *"Many companies work with mass balance solutions just to*

get renewable fuel somewhere in the flow. But the problem with that solution, is if the customer wants fossil-free transports for them specifically, since they do not know if their goods are transported using fossil-free delivery.". LocalHaulier2 and LocalHaulier1 echoed these concerns, acknowledging the scalability advantages of mass balance while noting its ambiguity at the shipment level. LocalHaulier3 elaborated on this challenge in shared transport scenarios: *"It is difficult to verify the fuel for a truck operating 20 customers, and to change it all to a sustainable fuel, when there might only be one customer who is prepared to pay for it. We need to be able to verify that the specific customer's transport drove on fossil-free fuel."*. GlobalShipping similarly noted the complexity of tracking fuel origin across a large network of subcontractors: *"It is very challenging to know the type of fuel that a third party provider is using. (...) You need to have auditing and certification in place. And that is sometimes not possible to set up with all of your suppliers, especially when having thousands of them. Try to decarbonise someone else's asset, it's very difficult."*.

Overall, the findings reveal a critical tension between the ambition to reduce emissions and the ability to credibly demonstrate those reductions, particularly in well-to-wheel calculations. The lack of traceability in green fuel usage undermines confidence among buyers and risks dampening incentives to invest in low-carbon alternatives. As concerns around transparency grow, the need for verifiable, standardised, and customer-relevant green fuel reporting becomes increasingly urgent.

4.1.3 Data Sharing and Collection

Table 4.5 shows the themes identified during the conducted interviews, with respect to challenges that is connected to data sharing and collection.

Table 4.5: Data Sharing and Collection Challenges

Challenge	Description
Data ownership and confidentiality concerns	• Sensitive operational and fuel data withheld because of competitive advantage • GDPR sensitivity • Hauliers reluctant to share shipment-level data
Managing large datasets among stakeholders	• Administrative burden handling hundreds of suppliers • Need for continuous communication and reminders to providers to submit data

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Challenge	Description
Data Collection Methods	• Real-time fuel consumption can be retrieved from fleet management systems (FMS) • Limited access to high-quality data from multimodal and long-distance transports
Allocation in Shared Transports	• Difficult to allocate emission when goods vary in size/density in shared transports • Difficult to allocate emission in shared transports due to complex transport chains

- ***Data ownership and confidentiality concerns***

The interviews revealed a general willingness among transport service providers to be transparent with their customers regarding emission data. This openness was also reflected among transport buyers and intermediaries, including those relying on subcontracted carriers. Few participants reported encountering active resistance or confidentiality-related pushback when collecting emissions data from their transport providers.

For transport buyers and intermediaries, data collection from subcontractors was largely described as unproblematic. No respondent reported significant reluctance linked to ownership or privacy concerns. As Nordic3PL noted: *"Some companies might be sensitive about fuel levels because they think you should count backwards. (...) But I would not say it has been a big problem."*. Among service providers, operational performance data, such as fuel usage or emissions estimates, was generally not considered sensitive. However, some providers made a distinction between emissions data and more granular operational insights. For example, IndustryOrg noted that while hauliers are often open to sharing delivery-related data, full access to vehicle-level data might reveal competitive advantages: *"You can not simply open up all the vehicle data and say 'go for it'. There may be data only relevant for the carrier, for example 'we have solved our profitability because we have been extra efficient with something'."*. In maritime logistics, the sensitivity of operational data was more pronounced. GlobalShipping highlighted that fuel consumption data, particularly for chartered vessels, is considered commercially confidential: *"[fuel] is procurement-sensitive information (...) That is something that you really do not want to disclose."*.

Despite these nuances, several service providers emphasised their commitment to transparency. LocalHaulier1 stated: *"I do not see that we have anything that we could not share with the customers. (...) We strive to be as transparent with our customers as possible."*. At the same time, concerns were raised regarding data that

could be tied to individual drivers. For instance, LocalHaulier1 referred to GDPR as the limiting factor: *"It is GDPR we need to consider."*. LocalHaulier3 similarly described how union agreements limit the use of GPS data to central administrative purposes: *"We have not declined any request on data due to confidentiality concerns. (...) we have a discussion with the union about how we can and may use GPS data. There is no problem using it for what it is intended to be used for. But it can be misused."*.

Overall, the findings suggest that vertical data sharing between providers and their clients is generally not hindered by ownership or confidentiality barriers. Instead, concerns tend to arise in more lateral or competitive contexts, particularly where sharing operational or procurement-sensitive information could compromise commercial positioning. Thus, while transparency is widely embraced within customer relationships, maintaining a competitive edge may still require boundaries around certain types of performance data.

- ***Managing large datasets among stakeholders***

A recurring challenge highlighted by interviewees was the administrative burden and complexity of managing emissions data across multiple transport providers. This issue was closely linked to the enabler discussed in 4.3.1, as the lack of system integration was consistently identified as a barrier to efficient data handling and automation.

Among transport buyers, difficulties in processing and consolidating large volumes of data were frequently reported. AeroManufacturer described the inefficiencies of manual communication and data entry: *"If it always is a person writing an email to another person (...) that is going to just take forever. Then you also have to manually input data, which is a source for error. So automation wherever possible."*. Recycler explained: *"We have had to manually sit and merge this [retrieved data] into a huge excel file."*. Similarly, WholesaleDistributor underlined the importance of format and structure: *"Currently it is even more important that the right type of data is in the right column in the right format. Data management is a challenge."*. MedTech stressed the importance of integrated systems: *"I believe we need to change the existing data structure, not isolating data in different places but to actually have huge shared databases."*. TruckOEM cited administrative workload as a key reason for not collecting primary data: *"I think it would be too much manual labour to go through all these reports and check that it is correct. We have an incredible number of carriers in our network."*.

Transport service providers expressed similar concerns regarding administrative complexity. LocalHaulier2 noted: *"Now it becomes very manual work for us to produce reports."*. ParcelCarrier pointed to the limitations of their internal systems: *"The systems are not built with a focus on doing a sustainability report. (...) Which means that we do not always have the best data."*. Nordic3PL highlighted the analogue nature of their current workflows: *"One of the main challenges is the relatively analogue work. I think automation is where we need to get to."*.

Customised reporting also emerged as a key challenge. GlobalFreight2, GlobalFreight1, and IndustryOrg described the difficulties of tailoring outputs to meet the varying expectations of their customers. As GlobalFreight1 noted: *"The biggest challenge is that we have a lot of different customers wanting different information."*. LocalHaulier1 similarly emphasised the growing burden: *"It is clear that there is more and more administration for us and the hauliers themselves."*. Several interviewees observed that this challenge is compounded by inconsistent data formats and the varying levels of digital maturity among subcontractors. GlobalFreight2 explained: *"Since there are different systems at different transporters, it is not easy to capture that data simply."* LocalHaulier2 highlighted the difficulties smaller hauliers face in adapting to these requirements: *"It is too administratively burdensome for a smaller haulage company. (...) To make the big investments in system support, and in sustainable transport, becomes very difficult."*. LocalHaulier3 echoed this concern, noting that many small carriers struggle with both the digital infrastructure and the administrative load required to support emissions reporting.

In summary, the findings highlight that emissions data management involves not only access to the right data but also the capacity to organise, standardise, and integrate large datasets effectively. Without appropriate systems and automation, both buyers and providers face significant administrative burdens, reducing the efficiency and reliability of sustainability reporting.

- ***Data Collection Methods***

The study found substantial variation in both the ambition and capacity to collect emissions data among the interviewed companies. These differences were shaped by factors such as transport mode, digital maturity, internal resources, and the degree of system integration.

Among transport service providers, telematic systems and FMS were frequently cited as key tools for capturing real-time data. IndustryOrg described the widespread adoption of such systems: *"Telematic systems and fleet management systems are very widespread. I think more or less all haulage companies use it [FMS] to some extent (...) The digital handling and implementation of these systems is continuously growing."*. This was corroborated by LocalHaulier3, LocalHaulier1, and LocalHaulier2, who all employ telematics to collect data on fuel consumption, distance travelled, and vehicle activity. LocalHaulier3, for example, uses external FMS devices in every vehicle, allowing for direct data access without driver input. These systems are often supplemented with fuel card transactions and order data to enhance accuracy. However, IndustryOrg also noted that data collection is not guaranteed: *"(...) do all transporters really collect it [vehicle data]? No, probably not. But there is a lot of data to take if you want to."*. They highlighted that ambition, business type, and segment also influence what data is collected: *"It varies a lot depending on what type of business you have. (...) Some might have hand scanners that log every little package, creating greater opportunity to match things."*. Despite technological capabilities, integrating vehicle data with shipment-level information

still often requires manual effort, particularly when systems lack interoperability.

Larger global providers, such as GlobalShipping, reported greater automation for owned assets: *"We have internal systems that communicate with each other and are able to provide data pipelines that are credible and robust, because we have this data audited."*. However, they also described the limitations when working with third-party providers: *"Third-party suppliers often report data through the supplier portal. But at times, the data is supplied as excels. (...) There is a kind of manual collection that is quite cumbersome."*. GlobalFreight2 echoed this view, stating that while they possess the technical capacity to collect primary vehicle data, scaling such efforts across subcontractors is not feasible. Instead, they rely on modelled estimates based on weight, distance, and standardised emission factors. GlobalFreight2 also questioned the perceived superiority of primary data: *"We have a new transport system that aims to capture data directly from the vehicles (...) it is not entirely simple, and even if you manage to do it, I am not entirely convinced that it will be so correct when reporting this to the customer."*.

Among transport buyers and intermediaries, manual post-transport data collection was common. Forrester described a manual approach: *"We ask the transporters for data by sending them a Google form (...) We follow up all requests to make sure we get the data."*. Recycler and others used Excel templates for data collection and described the considerable administrative burden, particularly when dealing with small carriers: *"Many small players do not really have the same resources, which is a challenge. It also becomes a challenge for us to keep track of hundreds of carriers, it is not easy for me to notice that one carrier has not reported."*. Procurement processes were also used to collect data upfront. AutoOEM described structured sourcing procedures with pre-filled templates and certification checks: *"We have an interface to our suppliers where they go in and download a bid form in Excel. Then they fill it in and upload their data and bids."*. They also highlighted that the data quality is varying, with some transport providers submitting high quality data, while a few need help in understanding what they should share.

Some companies reported not collecting data from their transporters at all. Spedi-tor, who used modelling tools to calculate emissions, stated: *"So far we have not requested data from our transporters (...) We collect distance and weight data from our business system (...) it feels difficult to get more accurate data from shipping companies or hauliers on the specific transport that you have done yourself."*. Aero-Manufacturer identified gaps in data collection and differentiated between owned and outsourced operations: *"For our own operations, we have a data collection system where we actually have pretty good visibility, but anything that is out of our hands is more difficult. (...) Sometimes the suppliers do not even have the data."*. TruckOEM similarly reported using a combination of manual and modelled methods depending on department: "*(...) this digital system, and modelled data, was the best thing available at the time. (...) Because you also have to count on going through a lot of reports every month [when collecting primary data].*". Automated emissions reports from large transport portals were mentioned by TechDistributor,

while WholesaleDistributor expressed doubt about the feasibility of more granular data collection: *"My impression is that it is difficult today. The digital solutions are not really in place."*.

Furthermore, we observed that data collection faces challenges in multimodal and long-distance transport operations, collecting detailed, high-quality data is even more difficult. AutoOEM describes data collection across global operations as challenging: *"The regional aspect is one of the key issues. In Europe the maturity level is starting to come in pretty well, but in North America, we are seeing a lot of struggle with these types of emission data requests."*. GlobalFreight2 and TechDistributor also noted geographic variation in data availability, with Sweden generally offering better access than other regions, TechDistributor noting: *"We get pretty good information from the ones that we use here in Sweden. (...) I would for example like to find the data for some forwarders who have distribution in Italy, but then I would have to search for a long time."*.

The findings highlight that data collection practices are shaped by a combination of internal ambition, digital maturity, system compatibility, and the structural complexity of logistics networks. These factors influence not only the completeness and transparency of data but also the willingness and perceived feasibility of collecting it in the first place.

- ***Allocation in Shared Transports***

A recurring challenge identified across both transport buyers and service providers concerns the allocation of emissions in shared transport scenarios, where multiple shipments from different customers are consolidated in the same vehicle. Companies report using a wide range of allocation principles, such as weight, volume, number of pallets, or distance, which leads to inconsistencies in emissions reporting and hinders comparability across the sector.

The inherent complexity of transport chains contributes to this issue. GlobalFreight2, operating large-scale logistics networks, describes the challenge of distributing emissions across line haul, pickup, and distribution flows, highlighting the need for clearer guidelines: *"You have to have rules about how you should allocate the emissions. For example, if you imagine that a truck have 100 customers (...) it is the last delivery that will carry the largest CO_2 allocation."*. While weight-based allocation is encouraged under ISO 14083, several actors, including GlobalFreight1, LocalHaulier2, LocalHaulier3, LocalHaulier1, and IndustryOrg, argue that this method does not always align with practical conditions. For example, LocalHaulier2 explains: *"If you fill a truck with chips the fill rate will be very low with regard to the maximum weight. Then you might have to switch to the freight-hauling weight (...) it becomes difficult to generalise the fill rate for all the customers."*. LocalHaulier3 similarly uses freight-hauling weight in place of actual weight, diverging from GLEC guidelines: *"GLEC, for example, advocates actual weight, but we take freight-hauling weight. We think it is more correct."*. Public transport introduces its own complexities. PublicTransporter notes that allocation efforts must consider

directional load imbalances: *"At most places in Sweden the buses go empty in one direction. (...) there is a will to compare the fill rate of public transport across regions, but you have to understand the real world conditions behind the numbers."*.

Several companies raised concerns about the practical implications of applying granular allocation models. GlobalFreight2 described how fluctuations in routing require ongoing explanations to customers: *"(...) this truck may drive another route (...) which might be longer so their emissions increases (...) to which we have to explain that 'we have lost, or added, customers'."*. LocalHaulier1 uses delivery stop counts to allocate emissions but acknowledges the lack of industry-wide standards. GlobalShipping and ParcelCarrier highlighted how the use of shared capacity, such as co-loading in passenger aircraft or cross-company shipping, further complicates internal alignment and consistency. ParcelCarrier notes: *" (...) the word load factor does not tell the whole truth, it has so many different meanings for different people. Where you are in the organisation and what you work with. (...) It differs both internally and between companies."*.

Transport buyers face similar uncertainty. TechDistributor reported limited insight into how providers allocate emissions across shipments, while AeroManufacturer described difficulties in tracing allocation across complex inter-site transfers. AutoOEM emphasised the technical intricacy of shared transport structures, which involve data on load factors, consolidation hubs, and third-party cargo. MedTech, despite using ERP-based (Enterprise Resource Planning) internal allocation for dedicated flows, still encountered challenges when distributing emissions across markets.

The findings demonstrate that while shared transport models offer logistical efficiency, they introduce significant challenges to emissions transparency. Allocation methods vary widely, and their impact on reported emissions is substantial. Moreover, correct allocation was noted to be deprioritised, viewed as an issue to be addressed once foundational data systems are in place. Nonetheless, the chosen allocation principles and load factors critically influence the accuracy and comparability of emissions data.

4.2 Drivers

This chapter presents key drivers identified in the interviews, both external and internal, that influence emission data sharing and collection. External drivers include regulatory pressure, growing customer expectations, and industry trends that promote transparency and alignment with standards. Internal drivers stem from companies' own sustainability strategies and the pursuit of operational efficiency.

4.2.1 External Drivers

Table 4.6 shows the themes identified during the conducted interviews, with respect to external drivers.

Table 4.6: List of external Drivers

Drivers	Description
Regulatory pressure	• Alignment with upcoming regulations • Customers demand detailed emissions data • Tender requirements including emissions data
Customer expectations	• Sustainability performance affects customer relationships • Data transparency used as a differentiator in procurement
Market and industry trends	• Benchmarking against industry leaders • Alignment with voluntary standards (e.g., ISO, GLEC)

- ***Regulatory pressure***

Regulatory developments, including CSRD and forthcoming initiatives such as CountEmissionsEU, emerged as key drivers for emissions reporting practices. These frameworks are shaping how companies structure their data collection processes and sustainability strategies.

Several transport service providers explicitly referenced regulatory requirements as a central influence on their emissions reporting. GlobalFreight2 and ParcelCarrier, for instance, noted that CSRD has already impacted how they organise their internal systems. ParcelCarrier explained: *"We saw an increased demand for emission reports when CSRD was introduced. (...) new EU legislations, for example product passports, will revolutionise sustainability reporting. (...) One of the reasons why we collect emissions data is for external reporting."* . Similarly, PublicTransporter stated: *"We have worked very hard to report according to CSRD."*. GlobalFreight1 and GlobalFreight2 reinforced the same point, with GlobalFreight1 saying: *"We report according to the law"* and GlobalFreight2 elaborating: *"We must report according to the requirements under EU regulations (...) [the customers] also have their own CSRD and ESG reporting. Then they have to get data from us."* .

Among industry organisations, IndustryOrg highlighted that regulatory pressure indirectly affects even smaller hauliers through customer demand: *"We see more requests from customers to our members. This demand may in turn be driven by CSRD reporting."*. LocalHaulier1 supported this view, stating: *"We are not sure if we will be obliged to report emissions according to CSRD, but still have clients who*

are covered by it. So indirectly, we will have to review how we work and how we report anyway.". IndustryOrg further pointed to the future relevance of harmonised standards such as ISO 14083 in the context of CountEmissionsEU: *"When it [CountEmissionsEU] is in place, ISO14083 will have an even more important role - that you follow and know that standard."*.

From the transport buyers' side, regulatory compliance was similarly identified as a critical motivator. Forrester emphasised its necessity for influencing supplier behaviour: *"I actually think that the legal requirements in this industry are what is required. We have some suppliers who have no incentive at all."*. AutoOEM echoed this, further noting the internal organisational activities as a consequence of legal obligations: *"It is noticeable internally at the company when there are now legal requirements. A lot of things start to happen within the company in these areas. It is very important to comply with all legal requirements, because it affects the company's brand image very much."*. Likewise, AeroManufacturer observed a growing need for emissions data, driven by increased expectations for transparency and compliance: *"We are probably going to have to start looking into emission data more going forward. Maybe because of more data needed for compliance and transparency, not just part of CSRD, but there is more regulations coming."*.

Across the interviews, regulatory frameworks were not viewed as optional ambitions but as essential requirements that shape business behaviour. While not all companies are currently obligated to report under CSRD or similar frameworks, customer-driven demands for compliant data are extending regulatory influence throughout the transport value chain.

- ***Customer expectations***

Customer demand emerged as a central driver of improved emissions data reporting. Several transport service providers, including LocalHaulier2, LocalHaulier1, and ParcelCarrier, reported a growing number of client requests for detailed, shipment-specific emissions data. These demands, particularly from large corporate or public sector clients, were identified as a key motivation for developing data collection practices. LocalHaulier1 and LocalHaulier2 observed that emissions reporting is often more advanced in market segments where customers explicitly require it: *"On some we do it more [collect emissions data], on some we do not. And on others we do it where we have customer requirements."*. ParcelCarrier further noted that the level of demand is linked to the customer's maturity in sustainability, with more sophisticated organisations requesting higher levels of granularity.

In addition, many transport buyers act as intermediaries, requesting emissions data from their suppliers to meet their own compliance and reporting needs. Speditor noted that sustainability expectations are particularly prevalent among larger organisations, and these demands tend to cascade down to subcontractors: *"I feel that larger customers often have come further in their sustainability work. (...) And also the subcontractors for large companies, as they often set demands, and the demands end up on the subcontractors as well."*. Increasingly, sustainability requirements are

incorporated into procurement processes, with emission reporting becoming a prerequisite for securing business. AutoOEM illustrated this by describing how their demands influence suppliers' internal development: *"We even have some carriers who have told us that because we ask so many questions, they have developed their own systems and they started measuring things they did not measure before."*.

Beyond reporting, customer expectations are also shaping investment decisions. LocalHaulier1 stressed that demand for green transport solutions must be matched by willingness to pay a premium: *"The change needs to be driven from the customers (...) If we do not get paid more, we cannot buy one [electrical or gas vehicles]."*. Similarly, IndustryOrg pointed out that administrative capabilities and system development are unlikely to materialise without clear commercial incentives: *"You cannot afford in this industry to build an administrative system without knowing that it is actually in demand. (...) If it is required in a procurement process, then the carriers solve it."*. However, the interviews revealed a disconnect in how responsibility for sustainability is perceived. While transport providers emphasised the need for clear incentives from buyers, some transport buyers expressed frustration at what they saw as providers shifting responsibility. As Forrester observed: *"The transport service providers just put the responsibility on the customer and do it [green investments and share emission data] for the customer's sake but do not really care themselves. (...) There is no incitement for change, we need to pay more instead. There is not much 'save the world'-attitude."*.

Overall, customer expectations are a critical force in driving emissions data visibility across the supply chain. However, the findings suggest misaligned expectations between actors, with each stakeholder group calling for greater initiative and engagement from the others. Bridging this gap may be necessary to enable meaningful progress in sustainability reporting and decarbonisation.

- ***Market and industry trends***

Many of the interviewed companies report on emission reporting being an competitive advantage, with broader industry developments also influence reporting practices. Transport service providers, like GlobalShipping and GlobalFreight1, are aligning with voluntary standards such as ISO and the GLEC framework to ensure consistency and credibility. LocalHaulier1 referred to industry benchmarking as a way to remain competitive and evaluate performance, while LocalHaulier2 reported adapting its practices to evolving industry norms: *"LocalHaulier2 is an economic association, so we do not actually meet directly with CSRD, but only indirectly. But we choose to work according to it anyway."*. These trends push companies to standardise their reporting structures and improve data quality to stay in line with peers and market expectations.

4.2.2 Internal Drivers

Table 4.7 shows the themes identified during the conducted interviews, with respect to internal drivers.

Table 4.7: List of internal Drivers

Drivers	Description
Corporate sustainability strategies	• Increased emphasis on primary data • Sustainability as competitive advantage • Cost optimisation linked to driving optimisation • Challenges related to budget and investment
Operational efficiency	• Emissions data used to optimise routing, vehicle utilisation, and fuel consumption • Efficiency improvements seen as a co-benefit of emissions tracking

- ***Corporate sustainability strategies***

For several companies, internal sustainability strategies constitute a key driver in advancing emissions data practices. When environmental goals are embedded into broader corporate agendas, such as cost optimisation, competitiveness, and brand positioning, the motivation to improve emissions data visibility increases.

Among transport buyers, firms like MedTech, TruckOEM, AeroManufacturer, and AutoOEM integrate emissions tracking into their operational and procurement strategies. MedTech, for instance, links emission reductions to logistics cost savings, while AutoOEM has adopted an internal carbon pricing model, known as abatement cost, to guide investment decisions. As AutoOEM explains: *"Abatement cost is how much do you have to invest to save a certain amount of CO_2 emissions. (...) This has been a major success factor. (...) A guideline for where we should invest the money."*. Companies also leverage emissions reporting to strengthen their market position. MedTech highlights its commitment to transparent communication and leadership in sustainability practices: *"We have a lot of external communication, showing that we are very active in becoming carbon negative. (...) really trying to set a standard in how to both report and then work with sustainability."*. Similarly, Forrester views its advanced reporting capabilities as a competitive advantage: *"We see it [emission reporting] as a competitive advantage because we are so far ahead in that work."*.

Transport service providers share similar motivations. GlobalShipping underscores the importance of reliable emissions data in demonstrating progress toward reduction targets: *"To report our emission performance accurately is very important because we have commitments and targets on reducing these emissions over time (...) if you do not have a good data foundation, it is very difficult to demonstrate improvements."*. Their strategic positioning is explicitly aligned with decarbonisation: *"We*

want to position ourselves as a partner for a solution provision of low carbon decarbonised transportation.". The importance of environmental friendly solutions, is emphasised by AutoOEM, which confirmed that sustainability performance directly influences supplier selection: *"We have changed carriers because our current carriers have not been able to supply [green solutions]"*.

These results demonstrate that when emissions data is integrated into corporate sustainability strategies, whether for internal decision-making or external positioning, it significantly increases incentives to collect, share and utilise high-quality emissions data across the value chain.

- ***Operational efficiency***

Operational performance was also identified as a secondary, yet relevant, internal driver for improving emissions data collection. Several companies reported that high-quality vehicle data contributes to operational optimisation, enabling better fuel efficiency, improved routing, and enhanced vehicle utilisation. For example, IndustryOrg noted that hauliers primarily collect fuel data for financial control rather than for sustainability reporting: *"The hauliers collect purchased volumes of fuel. However, they do not collect it in the way that we are talking about here, (...) rather for financial follow-up and knowing their costs."*. Similarly, GlobalFreight2 described how primary data is used to enhance driving behaviour and operational control: *"There are computers in the vehicles where you can collect primary data, and the transporters themselves use it to a very large extent, both so that they can ensure that their drivers drive efficiently."*.

These efficiency-related uses of data were identified as co-benefits of sustainability initiatives, or, the opposite, as enablers of sustainability data collection through investments originally justified by cost-saving objectives. In this way, operational goals and environmental tracking are mutually reinforcing, supporting broader digitalisation and data infrastructure improvements.

4.3 Enablers

To enable effective and reliable emissions data collection and sharing in the transport sector, various supporting factors, so-called enablers, are required. In the study two main categories of enables were identified: technological solutions and standardisation and collaborative practices. In this chapter these two will be presented.

4.3.1 Technological Solutions and Standardisation

Table 4.8 shows the themes identified during the conducted interviews, with respect to technological solutions and standardisations acting as enablers.

Table 4.8: Enabling technological Solutions and Standardisations

Enablers	Description
Telematics and fleet management systems	• Real-time data improves reporting • Small hauliers lack systems for reporting • Central organisations dependent on resource-constrained partners • Need for ERP, TMS and FMS systems to integrate for accurate, automated calculations
Digital platforms and automation	• Integration of operational and emissions systems • Customisation prevents automation • High platform development costs for transport industry
Standardisation and Framework Adoption	• Integration of operational and emissions systems (e.g. ISO 14083, GLEC) • Sector-wide adoption of frameworks • Use of national platforms • Standardised data collection at tender stage • Alignment with customer requirements through standardised templates

- ***Telematics and fleet management systems***

Telematics and fleet management systems (FMS) are increasingly central to the collection of real-time, primary data for emissions reporting in the transport sector. Most modern trucks are now equipped with telematics technology, giving even small hauliers access to key operational metrics such as fuel consumption, odometer readings, driving patterns, and occasionally routing data.

Several companies in this study, particularly LocalHaulier3, LocalHaulier2, and LocalHaulier1, actively utilise these technologies to improve emission data quality. LocalHaulier3 integrates external FMS trackers with order-level data to calculate shipment-specific emissions. LocalHaulier2, in turn, combines fuel transaction data from TRB cards with FMS outputs to verify fuel type and consumption. They also report ongoing efforts to implement more advanced FMS platforms, hoping it to be an enabler for smoother data sharing: *"I have huge expectations for that it will make things a lot easier for us. That we can easily set up reports in the new system. And basically export to the customer in Excel or something similar."*. Despite

the widespread presence of telematics in vehicles, the data is not readily usable for emissions reporting without considerable manual processing. Extracting, formatting and aligning data with shipment information still requires significant human effort and auxiliary tools. As IndustryOrg observed: *"It is not a lack of data, but a lack of data structure."*.

For more granular emission reporting, especially in cases involving multiple loading and unloading points, shared transports, and varied routes, the need for system integration becomes even more pronounced. Achieving high-resolution, order-level emissions calculations is enabled by seamless data exchange between telematics systems, FMS platforms, and the transport buyer's ERP systems. In the absence of such integration, traceability and precision remain difficult to achieve.

- ***Digital platforms and automation***

Digitalisation and automation emerged as critical enablers for scaling emissions reporting. Across the interviews, companies consistently described improved system integration as a central goal for enhancing the collection, exchange, and management of emissions data.

Larger providers such as GlobalFreight2 and GlobalFreight1 have invested in internal digital platforms that connect emissions data with operational systems, aiming to reduce manual intervention and facilitate continuous reporting. These platforms allow customers to access their emissions data directly, improving transparency across the supply chain. Similarly, LocalHaulier3 identifies automation as a strategic objective: *"So the ultimate goal is to be able to integrate Fleet Management data, fuel data and our order data in such an automated way that we can print the CO_2 emissions per order on the invoice."*

Systems and automation enabling better reporting and reducing resources was highlighted by companies like Recycler and Nordic3PL, who describe how currently varying data structures across subcontractors force them to perform manual adjustments. As IndustryOrg puts it: *"You get information both from vehicles, and Fleet Management systems. (...) we see that automation is needed in reporting."*. From the hauliers' perspective, especially among smaller operators, digital platforms could significantly enhance the ability to meet customer demands and manage emissions reporting. However, economic constraints limit adoption. LocalHaulier2 notes: *"A lot would be solved if the systems would talk with each other. However, the smaller hauliers do not have the possibility to have such advanced systems. It would not be economically viable."*.

In summary, digital platforms and automation offer a clear path to improving emissions data practices across the transport sector. While the potential to streamline processes and reduce administrative burden is widely recognised, unequal access to technological infrastructure, especially among small hauliers, remains a critical barrier to implementation.

- ***Standardisation and Framework Adoption***

Standardisation was widely recognised by interviewees as a key enabler for improving the efficiency, reliability, and comparability of transport emissions reporting. Many companies expressed strong support for harmonised reporting practices, citing the need to reduce administrative effort, increase data consistency, and simplify communication across the supply chain. Despite the growing uptake of frameworks such as GLEC and ISO 14083, the interviews revealed that emissions data is still reported using a variety of tools, formats, and assumptions.

A central challenge identified was the lack of clear expectations around what data to report and in what format. This creates inefficiencies both for transport providers, who must adjust to varying customer requirements, and for buyers, who struggle to consolidate non-standardised data. Several interviewees highlighted the potential benefits of adopting common reporting baselines. TechDistributor stated: *"I would like to see a directive against the transport industry that they are forced to publish their reports according to a certain template. So that it becomes a standard, instead of having to puzzle over how it is calculated in each one."*. Similarly, IndustryOrg and LocalHaulier1 stressed that the issue lies less in data availability than in the lack of structured systems for using it: *"I really believe in an industry standard where everyone agrees on the same. So that different customers and transporters wants different data and formats. Creating a common view on how to report on it."*.

Standardisation was also viewed as a way to support smoother data exchange and improve trust in emissions figures. From a transport buyer perspective, AeroManufacturer described how regulatory alignment helps legitimise data requests: *"So it is not us asking this from you [the transport providers], it is actually the government or the EU who is asking."*. However, they also emphasised that implementation cannot be passive: *"a lot of it is also coming from ourselves, because there is not going to be a simple solution that we can just take out there and just use, buy, or implement, and then everything is done."*. LocalHaulier1 echoed this, noting the need for an operational standard tailored to vehicle data: *"You have to come up with an industry standard with data that can be collected from the vehicles, or build systems around. So that it actually works and does not become an equation x of it."*. GlobalShipping underscored the role of standards in ensuring data credibility: *"Requirement against a specific standard such as the ISO 14083 can help verify that this information is captured by the supplier and it is reported accurately to us."*. They further identified CountEmissions EU as a promising step toward harmonisation, and pointed to the forthcoming iLEAP methodology as a potential next phase. According to Smart Freight Centre Smart Freight Centre (2025), iLEAP aims to *"unlock the digital, automated exchange of high-quality logistics emission information on a global scale."*

In summary, while digitalisation and automation are essential, their effectiveness depends on agreed-upon reporting practices. Without a unified framework, the industry risks continued fragmentation, inefficiency, and limited comparability. Broad adoption of standards like ISO 14083, supported by initiatives like CountEmissions EU and iLEAP, would help shift responsibility from individual customers to system-

level structures, enabling more scalable, consistent, and credible emissions reporting.

4.3.2 Collaborative practices

Table 4.9 shows the themes identified during the conducted interviews, with respect to collaborative practices acting as enablers.

Table 4.9: Enabling collaborative practices

Enablers	Description
Collaborative Relationships Improving Data	• Long-term partnerships enhance data completeness • Feedback loops between buyers and suppliers • Joint problem-solving and shared sustainability goals
Internal Capacity and Digital Integration	• Training carriers on data reporting practices • Systematic tracking of primary fuel data through early investment in digital systems • Supplier-initiated emission tracking improvements • Sector-wide digitalisation initiatives

- ***Collaborative Relationships Improving Data***

Trust-based, long-term partnerships between stakeholders emerged as a key enabler for improving emissions data quality and completeness. Several interviewees emphasised that regular collaboration between transport buyers and service providers significantly increases the likelihood of receiving accurate, timely, and consistent emissions data. ParcelCarrier, for example, reported far better data from hauliers who work with them regularly, compared to one-off or short-term carriers, who often deliver incomplete or estimated figures. Similarly, GlobalFreight1 highlighted that all contracted hauliers provide emissions data in line with expectations, supported by long-term relationships, and internal personnel when needed.

The importance of continuous communication and capacity building was underscored by LocalHaulier2 and LocalHaulier3, who invest in training and support for smaller hauliers to raise awareness and improve their reporting practices. Feedback loops also play a critical role. TruckOEM and AutoOEM both described following up on incomplete or inconsistent fuel data and, in some cases, link emissions performance to compensation structures. Additionally, collaborative technical development was noted as a key practice. LocalHaulier2 and LocalHaulier1, for example, are developing fleet management platforms to support their own networks

in meeting reporting requirements. LocalHaulier3 is similarly working with other regional logistics companies to co-develop a new transport management system to enhance automation and data integration. These examples illustrate that strong, stable relationships, rather than purely transactional ones, are critical to enabling reliable and efficient emissions data flows.

Beyond partnerships within the transport value chain, collaboration with vehicle manufacturers was also mentioned as essential to accessing and standardising vehicle-level data. LocalHaulier1 pointed out the need to include manufacturers in standard-setting efforts: *"(...) it requires to include the vehicle manufacturers in the creation of the standard. So the correct data can be read and retrieved directly from the vehicles."*. WholesaleDistributor echoed this, stating: *"This [vehicle data] is information that a vehicle manufacturer can follow. That information should be available to others, you might think."*. AutoOEM further emphasised the potential of industry-wide collaboration, describing how cross-company partnerships can leverage broader influence and accelerate change: *"We are expanding charging infrastructure in Europe together with our competitors. (...) 'Partnership is the new leadership' as you say"*.

These findings reinforce that collaboration, both within and across organisational boundaries, is essential for improving data exchange, optimising shared resources, and advancing sustainable transport practices. Strong partnerships facilitate not only better data flows but also the broader systemic changes needed for credible and scalable emissions reporting.

- ***Internal Capacity and Digital Integration***

All interviewed companies emphasised that achieving more reliable and automated emissions reporting requires substantial investment in internal capacity and digital integration. A key enabler identified is the ability to interconnect internal systems, such as ERP, TMS, and FMS, to enable seamless data sharing without manual intervention. However, this integration places considerable demands on transport service providers, particularly smaller hauliers, many of whom fall outside formal reporting obligations. As noted by LocalHaulier3 and GlobalFreight1, these actors are often more responsive to customer expectations than to regulatory pressure. WholesaleDistributor similarly observed that the uneven progress in sustainability reporting across sectors is largely shaped by the varying demands placed on suppliers. Both LocalHaulier3 and WholesaleDistributor argue that stronger requirements from buyers can serve as an effective mechanism to raise standards across the industry.

To address these challenges, several companies are actively building internal capacity and offering support to their partners. Forrester assists subcontractors by helping them understand and comply with emissions reporting expectations, although this currently involves significant manual effort: *"We help them to get that data in such cases."*. AutoOEM, during procurement and onboarding, provides guidance and training to carriers to improve reporting readiness and data quality: *"We are fine-*

tuning our carriers and also teaching them quite a bit.". Similarly, TruckOEM and GlobalFreight1 have launched broader digitalisation programmes aimed at harmonising emissions tracking across their networks, including the development of shared platforms and more standardised processes.

Nonetheless, the fragmented nature of the road freight sector, characterised by numerous small operators with varying levels of digital maturity, continues to hinder scalable solutions. Interviewees stressed that integration is not only a technical challenge but also a financial one. As IndustryOrg pointed out, the costs associated with developing and maintaining custom digital platforms are often prohibitive for smaller hauliers. Without industry-wide infrastructure or external support, there is a risk that the burden of increasingly complex reporting requirements will fall disproportionately on those least equipped to respond, potentially slowing down the broader transition toward automated and standardised emissions data management.

5
Analysis

This chapter presents the analysis conducted to address the report's two research questions. The analysis is based on the results of the interviews and the processed literature. Throughout this process, a recurring problem was the discussion of "what is what" when it comes to data sharing and data collection. These two activities, while technically distinct, are closely interlinked and often interpreted differently depending on the stakeholder's role in the supply chain. For instance, data collection by a transport buyer may involve data sharing by a transport service provider, and similarly, intermediaries collecting emissions data from subcontractors are reliant on upstream sharing by hauliers. Therefore, the challenges and practices discussed in the two research question have striking similarities in their findings, as all these parameters are intertwined and undoubtedly linked. Consequently, we present a comprehensive analysis of key challenges, structured according to stakeholder perspectives within the transport value chain. For the second research question, we focus specifically on the mechanisms of data exchange, however, some challenges might remain shared across both questions.

5.1 Framework for Emission Data Visibility

To answer the research questions, we developed a conceptual framework that organises the findings into four categories: enablers, drivers, barriers and challenges, and effects (see Figure 5.1). This framework aims to clarify a complex topic by structuring key themes across transport buyers, providers, and shared areas. The framework draws on insights from literature, 19 interviews, and industry experts discussions at Centiro.

While effects were not explicitly explored in the interviews, they emerged through thematic coding and were included to reflect observed consequences of current practices. Notably, most of the identified challenges and barriers are shared between transport providers and buyers, yet perspectives on their causes and solutions differ. For instance, buyers frequently stress the need for more primary data, while providers point to limited incentives and investment from buyers as key obstacles to adopting the necessary tools and systems. Furthermore, several drivers and effects are interrelated, such as competitive advantage, regulatory pressure and sustainability strategy improvements. Likewise, missing enablers such as system integration (FMS, TMS, ERP) and data collection (including real-time data) often reappear as barriers.

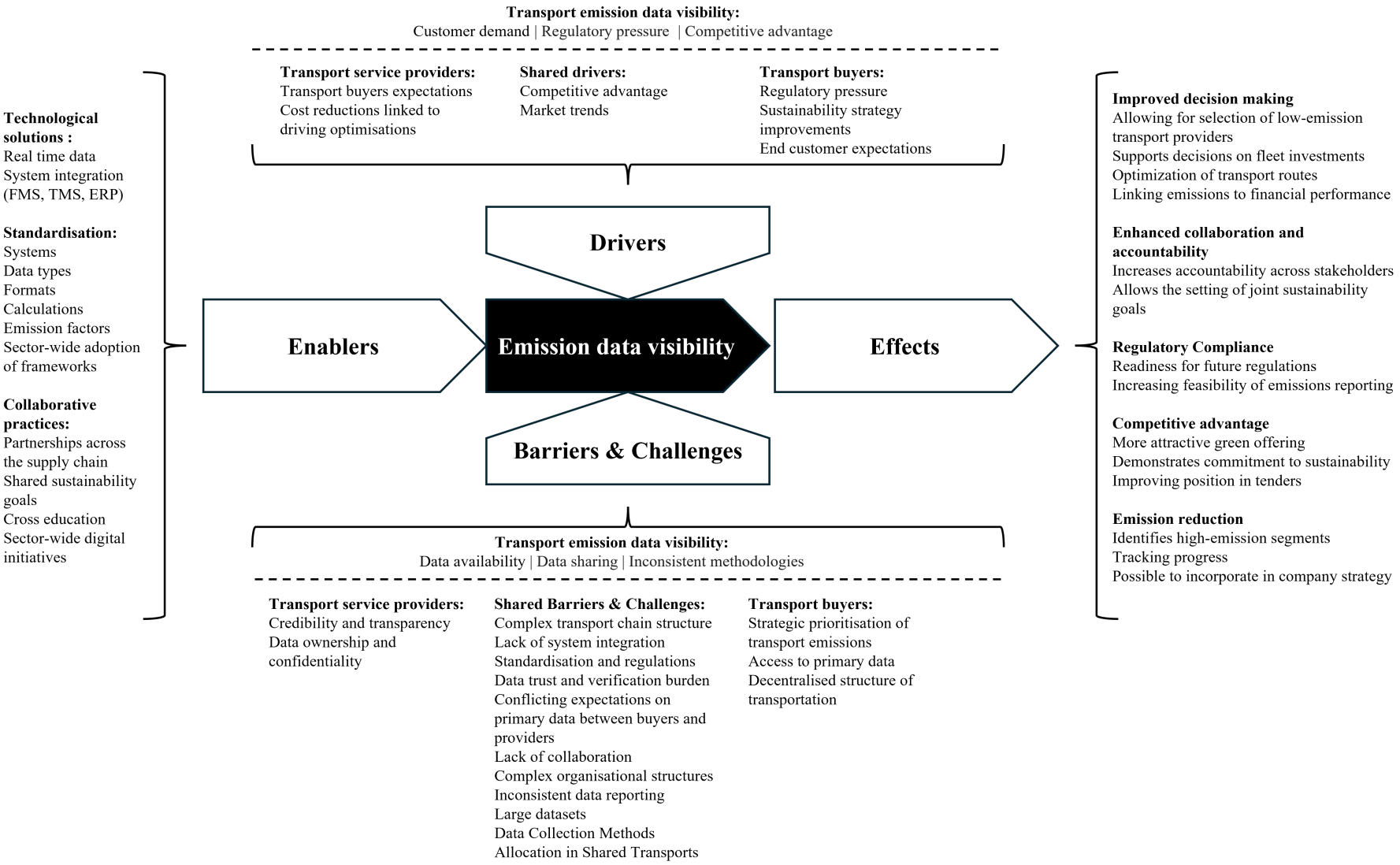

Figure 5.1: Framework for emission data visibility

5.2 Research Question 1

Answering our first research question, *"What are the primary challenges and barriers faced by transport service providers and transport service buyers in capturing and collecting transport emission data?"*, we identified a multitude of challenges and barriers in our study, as listed in Figure 5.1. Of these, we identified six as primary, presented in Table 5.1. Our study confirms many of the previously known challenges from literature, but also shows how experts and practitioners engage with these issues at a deeper and more granular level than often described in the literature. While theory provides a valuable framework, the interviews revealed concrete examples and under-reported difficulties in implementation. As discussed in the introduction of the chapter, the characteristics of collection and capturing depends on where in the value chain you are, and therefore the challenges characteristics differ accordingly. Table 5.1 is therefore divided into the three categories transport buyers, large transport providers, small carriers. As individual, small carriers have declined participating in interviewed due to resource constraints, their perceived perspective is based on our analysis of the answers retrieved from the economic associations comprising of a multitude of carriers, as well as the IndustryOrg.

Table 5.1: Primary challenges and barriers in the transport chain

Challenge	**Transport Buyers**	**Large Transport Providers**	**Small Carriers**
Complex transport chain structure	Many subcontractors increase effort needed to collect and consolidate emissions data.	Must collect data from numerous carriers and intermediaries.	Lack resources to handle complex flows and customer-specific data requests.
Lack of system integration	Difficult to manage large data volumes from different sources, requiring manual handling.	Data spread across systems (TMS, FMS, fuel, etc.), often needs manual handling.	Same needs as larger firms, but rely on manual work due to limited systems.

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Challenge	**Transport Buyers**	**Large Transport Providers**	**Small Carriers (SMEs)**
Standardisation and regulations	Unclear what data to collect, how to use it and challenging to get a uniform format.	Incomparability between actors, increased administrative burden risks out triumph real improvements and focus on too granular data	Increased administrative burden risks out triumph real improvements and focus on too granular data
Data trust and verification burden	Uncertainty about how data is calculated reduces trust.	Verification requires extra data and justification, which is costly.	Less directly affected but still requires effort to ensure traceability.
Conflicting expectations on primary data between buyers and providers	Over-reliance on modelled values from providers, treating them as primary data, reduces urgency to ensure correct primary data.	Resource-intensive process, without clear incentives from the market or regulatory push there is no motivation to invest in more advanced tracking or data systems. Customers seeing logistics as a necessary evil, prioritising low cost and not prioritising sustainability efforts.	Cannot afford to allocate resources without financial support, clear value return or regulatory push.
Lack of collaboration	Limits access and understanding for collected data from transporters.	Challenging to agree on data formats, types and calculations. Limits access to vehicle data.	Decreases the capability to collect data and implement necessary systems.

- ***Complex transport chain structure***

Previous studies, including Finger and Serafimova (2021), emphasise that challenges in emissions data collection are rooted in the structural characteristics of the logis-

tics sector, particularly its fragmentation and reliance on small hauliers with limited capacity for data reporting. While this is consistent with our findings, our study also revealed additional dimensions. Specifically, the issue is not only the presence of small actors but also the high number of transport providers involved across the chain. This volume increases the number of data points to manage, thereby amplifying the administrative burden. Manual collection, processing, and consolidation of emissions data becomes highly resource-intensive. Furthermore, the cost-driven nature of the logistics industry results in frequent changes in transport partners, which impairs the development of long-term collaborations and standardisation routines for data exchange.

- ***Lack of system integration***

The academic literature identifies limited system integration and a lack of interoperability between digital platforms as major barriers to emissions data collection and exchange (Dobers et al., 2019; FREIGHTOS, nd; Plassmann et al., 2010). These findings were strongly supported in our empirical results. Interviewees from all stakeholder groups consistently mentioned the need for better system integration and automation as a critical enabler for progress, and that the current absence of these factors presents a vital challenge. For transport buyers, one challenge lies in no system being able to manage the large volumes of emissions data received in varied formats from different suppliers. Another challenge is the absence of systems that initialise the collection of data itself, as manual handling and large resources are needed for the present. For transport providers, data is typically scattered across several system, ranging from fuel stations, FMS, and TMS platforms to manual records, which also require time-consuming manual collection and consolidation. For smaller carriers, these challenges are even more acute due to limited IT infrastructure and personnel. A unique insight from our study, not explicitly found in the literature, is the burden of customer-induced fragmentation where providers are required to adapt data reporting formats and content to each customer, significantly increasing the integration workload.

- ***Standardisation and regulations***

The importance of cohesive regulation and standardisation is widely acknowledged in the literature as essential for improving emission data visibility and facilitating data exchange (European Parliament, 2023; Dobers et al., 2019). The introduction of ISO 14083 is a recent development in this direction. While the literature emphasises the absence of a holistic framework as the biggest challenge, this perspective was somewhat nuanced in our interviews. The interviewees confirm that both transport buyers, providers, and industry representatives (e.g. IndustryOrg) show interest in adopting such standards. However, they often viewed standardisation more as an enabler than as the primary barrier. Participants noted that while standardised formats could improve comparability, simplify reporting, and reduce misinterpretation, they are not sufficient on their own. Many participants argued that the deeper problems, such as insufficient resources, fragmented systems, and lack of customer demand, would persist regardless. Moreover, even when standards exist, such as ISO 14083, practical implementation is hampered by vague enforcement, lack of financial

incentives and different interpretations, particularly in complex supply chain flows. Several interviewees also questioned whether additional frameworks and more granular data really would lead to real change, suggesting that regulatory compliance might divert resources from actual emission reductions, such as investing in cleaner fuels or more efficient logistics. As one interviewee from LocalHaulier3 phrased it: *"It's the dilemma of which came first – the chicken or the egg? Environmental reporting could drive awareness of the need to make a faster transition to fossil free transports rather than the opposite."*.

- ***Data trust and verification burden***

In the literature, trust is primarily discussed in relation to the comparability of published emissions reports. Our results, however, showed another angle. Among transport buyers, data quality was seldom formally verified, instead, there was a general trust that the delivered data was adequate. Nevertheless, buyers expressed concern that when paying for low-emission transport options, they needed confidence that their cargo was indeed handled in the promised manner, especially among those with publicly stated sustainability targets. The lack of formal verification routines and shared procedures among transport providers was seen as a challenge. For transport service providers, the verification burden primarily manifests as a resource issue. They must collect additional supporting data (e.g. fuel use, routing), especially from subcontractors, and may be expected to justify changes or discrepancies. Smaller carriers face similar constraints, lacking the administrative and financial capacity to verify data reliably. The literature frames data-sharing reluctance as a trust issue and as a major challenge for data collection among transport buyers. In contrary to this, our interviewees described it more as a matter of commercial negotiation where transparency had to be balanced with competitive positioning. Transport buyers generally did not perceive confidentiality as a major obstacle, and most providers expressed a willingness to be transparent. However, sensitivities were noted in some contexts, particularly marine transport and when data requests involved driver-specific information, which raises GDPR concerns.

- ***Conflicting expectations on primary data between buyers and providers***

While the literature acknowledges the need for primary data, it largely overlooks the mismatch in expectations between stakeholders. Our study found that the resource-intensive nature of data collection, combined with buyers' reliance on default or modelled values, results in limited urgency to pursue more accurate reporting. Many transport buyers did not prioritise emissions data in procurement decisions, viewing it as a secondary concern behind cost and delivery performance. For transport providers, this lack of demand translates into a challenge when trying to motivate investments in the extra effort required to collect primary data from their subcontractors. Instead, they often deliver estimated figures. For small carriers, the situation is even more constrained as they lack both the infrastructure and financial capacity to carry out primary data collection, and would need external financial incentives or support to comply. This highlights a broader discrepancy between the theoretical need for high-quality data and the market conditions required to support

its collection.

- ***Lack of collaboration***

Previous research by Finger and Serafimova (2021) advocates for increased collaboration between stakeholders to enable effective emissions data collection. Our findings confirm this as one of the primary barriers, as the result suggest that current collaboration is often lacking, especially on sustainability matters. The cost-driven culture of the logistics industry discourages investment in long-term partnerships focused on environmental data. This hinders alignment on key topics such as which data to collect, in what format, and how to calculate emissions. Without shared understanding and active cooperation, access to vehicle and route data remains limited. This fragmentation undermines both the technical and organisational capabilities needed to implement reliable and scalable data collection systems.

Our findings thus support the argument that unless emissions data reporting is directly tied to procurement, regulations, or financial incentives, meaningful improvements are unlikely.

5.3 Research Question 2

To address our second research question, "*How do the existing practices and technologies for sharing transport emission data among stakeholders in the transport chain impact the efficiency and accuracy of data exchange?*", this section first outlines key findings related to current practices and technologies used for sharing emissions data in transport chains. The observed effects of these practices are summarised in Table 5.2 and further elaborated in the subsequent sections.

Most vehicles in operation today are equipped with some form of telematics system capable of tracking vehicle and driving performance data. Consequently, the technical capacity to collect the data required for emissions calculations is, practically, already available to many transport service providers. However, for this data to be effectively utilised in emissions reporting, it must be transferred to the transport buyer and combined with shipment-specific information. Additionally, information on load utilisation, the proportion of the vehicle's capacity used by a particular shipment, is necessary to allocate emissions accurately across different customers. Achieving this level of detail requires interoperability between several digital systems, each of which captures different data types. While modern technologies can track operational parameters, the systems managing shipment and transport information are typically not designed to support sustainability reporting. As a result, data often needs to be manually extracted from disparate systems. The reporting data is frequently exchanged through a range of non-standardised formats, including Excel files, Google Forms, customer portals, and emails. To ensure both accuracy and data protection, sharing systems must be capable of extracting only the relevant parameters for emissions calculations, while also safeguarding sensitive or proprietary information - definitions of which vary across organisations.

A key insight from the study is that the structural organisation of the transport sector adds considerable complexity to emissions reporting, a dimension often underrepresented in the academic literature. Our findings confirm that the necessary data for emission calculations generally exist throughout the transport chain. However, there is a lack of systems capable of efficiently handling, organising, formatting, and sharing this data. This gap results in companies being forced to conduct substantial amounts of manual work. Due to the complexity of logistics chains, calculating emissions at the individual shipment level is often impractical, prompting many firms to rely on aggregated estimates. Although this approach is operationally feasible, it may not accurately reflect actual emissions when disaggregated. As noted in ISO14083, small changes in input parameters can drastically alter the outcomes of emissions calculations. While this study did not systematically assess companies' specific calculation models, several participants highlighted that using different methods and parameters led to significant variations in their results. For example, WholesaleDistributor, underlining the need for more standardised and automated approaches to emissions reporting. The study identifies several factors within current practices and technologies for sharing transport emission data that significantly influence the efficiency and accuracy of data exchange among stakeholders in the transport chain, see table 5.2 for a summary.

Table 5.2: Effects of Current Emissions Data Practices

State of Current Practice	**Efficiency**	**Accuracy**
Unstructured input data and unstructured customer requests	Data is submitted and requested in varying formats due to differing internal systems and routines.	Requires manual restructuring and processing; time-consuming and error-prone.
Unstructured data collection	Companies collect and prioritise data differently based on internal methods.	Leads to inconsistent and non-comparable data across the supply chain.
Impact of organisational structure	Data collection and reporting are managed by separate teams or departments.	Causes disconnect and misunderstanding of data quality in reports.

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State of Current Practice	Efficiency	Accuracy
Complex logistic structures	Shipments involve multiple stops and transport modes, with several customers sharing the same transport without clear allocation of cargo space or distance.	Manual work increases with complexity, often leading to simplified, aggregated estimates. Difficult to fairly divide emissions, leading to inaccuracies or simplifications
Technologies and systems	Systems are often not interoperable and lack integration between vehicle, cargo, and route data.	Manual matching is needed.

- ***Unstructured Input Data and Customer Requests***

The challenge of unstructured input data remains a significant barrier to efficient emissions reporting. Before any calculations can be performed, emissions data must often be manually consolidated and reformatted from various sources, making the process both time-consuming and resource-intensive. While the academic literature frequently emphasises the role of standardisation, we found that it seldom accounts for the practical complexities and administrative burden encountered in day-to-day data handling. The interviews revealed that in response to these inefficiencies, many transport buyers have started imposing stricter requirements on their service providers regarding the structure and format of emissions data. However, this shift creates challenges further down the supply chain. Transport providers, particularly those working with multiple clients, are now expected to meet increasingly diverse and granular data requests, often without sufficient administrative capacity or digital infrastructure. As noted by GlobalFreight2 and IndustryOrg, the lack of a unified format means that tailoring reports to individual customers introduces added complexity and cost. This challenge especially affects small and medium-sized hauliers, who often lack the resources to invest in advanced data systems or dedicated sustainability teams. As a result, intermediary organisations such as LocalHaulier2, LocalHaulier1, and LocalHaulier3 play a crucial role in supporting these actors by offering centralised assistance. Nevertheless, even with such support, the underlying issue persists, without harmonised data structures and automated systems, the process of collecting, formatting, and delivering emissions data remains inefficient and difficult to scale.

- ***Unstructured Data Collection***

The companies interviewed employ varied methods for emissions data collection, influenced by transport mode, ownership structure, and supply chain role. While ISO 14083 emphasises primary data as the preferred basis for reporting, its practical use remains limited. The academic literature often stresses the importance of primary

data but rarely examines the structural variation in collection practices. Stevens (2018) supports this study's findings, noting that firms tend to adopt internal, non-standardised routines. For example, IndustryOrg noted that while most hauliers have access to relevant systems, data collection remains uneven and depends heavily on internal ambition and capacity. Sector-specific practices and varying levels of subcontracting further fragment collection approaches. Additionally, the use of different emission frameworks introduces diverging expectations around what data to collect, which methods to apply, and how to structure outputs. Therefore, transport service providers might struggle to understand which types of data they are expected to collect, or have an over-reliance in old processes, leading to scattered and inconsistent approaches. In turn, transport buyers face difficulties in systematising their processes, as the data they receive varies significantly in detail and quality. His lack of harmonisation leads to inconsistent data quality and format, complicating systematisation for transport buyers and limiting comparability across emission reports.

- ***Impact of Organisational Structure***

Complex organisational structures can hinder internal communication and coordination between departments responsible for sustainability reporting and those managing data collection. As highlighted in Table 3.1 and 3.2, interviewees held diverse roles, which revealed a disconnect, sustainability managers typically perceive data as complete, while logistics and procurement personnel describe the process as fragmented and challenging. In larger organisations, such as AeroManufacturer and MedTech, the separation between central sustainability functions and local operations further complicates data access and consistency. This can result in internal data silos, where different units hold relevant datasets are neither shared nor visible across departments.

These structures contribute to fragmented internal communication, limited understanding of data quality within reporting teams, and a lack of coordination between those who generate data and those responsible for emissions reporting, ultimately impacting data sharing and accuracy within organisations.

- ***Complex Logistic Structures***

Transport chains typically involve multiple actors, including subcontractors, intermediaries, and various customers, which increases structural complexity and makes emissions data sharing more challenging. Individual shipments often include multiple stops, shared cargo, and multimodal transitions, significantly complicating emissions calculation.

Although frameworks such as the GLEC Framework and ISO 14083 provide methodological guidance, practical implementation remains difficult. As highlighted in the literature, this complexity particularly burdens small and medium-sized enterprises (SMEs) with limited technical and administrative capacity (Finger and Serafimova, 2021). Our study, however, identifies even broader practical challenges impacting the efficiency and accuracy of emissions data exchange. First, managing unstruc-

tured data from numerous subcontractors requires substantial manual effort, quickly becoming unmanageable, especially for organisations with limited resources. Second, emissions allocation in shared transports remains inconsistent. Interviewees reported using a range of allocation methods, based on weight, volume, distance, or number of delivery stops, due to the absence of common standards. These divergent practices result in inaccuracies, low comparability, and reduced credibility of reported emissions. Interestingly, transport buyers often appeared unaware of these inconsistencies and placed considerable trust in the data provided. Third, mass-balance accounting for biofuels presents additional verification challenges in shared transport flows, where the benefits of renewable fuels are difficult to attribute fairly across multiple shipments. Finally, the inherently dynamic nature of transport operations, driven by last-minute route changes, infrastructure constraints, and the need for optimisation, further restricts standardised data collection and sharing.

As a result, many organisations rely on aggregated, top-level estimates, which limits traceability and compromises the accuracy of emissions reporting.

- ***Technologies and systems***

The literature does not offer a detailed account of current practices for data exchange between vehicles and transport providers, nor between transport providers and transport buyers. However, it does describe the need for internal and external interoperability between systems, which necessitates close collaboration between stakeholders (Dobers et al., 2019; Freitas and Gervásio, 2024; Kühne Logistics University, 2024b). Finger and Serafimova (2021) further emphasise the importance to enhance the access of real-time data. Our findings support these perspectives and reveal a highly fragmented and inconsistent landscape of technologies and systems, resulting in poor system interoperability and inefficient data exchange across the supply chain. Interviewees noted that the resources required to share real time data are often not matched by corresponding financial incentives, which limits the practical use of available telematics systems and technological solutions. As a result, the feasibility of data exchange is prioritised over the granularity and accuracy of emissions data.

- ***Confidentiality Concerns***

Confidentiality and data ownership are frequently cited in the literature as key barriers to transparent emissions reporting, where European Parliament (2023) names this as one of four primary challenges. However, our findings suggest that these concerns vary between transport modes and stakeholder groups.

In the maritime sector, confidentiality was a significant issue, primarily due to the commercial sensitivity of vessel performance and fuel procurement data. GlobalShipping described fuel data as a "well-guarded secret", as it can reveal insights into operational efficiency and cost structures, which companies are reluctant to disclose. In contrast, among road transport actors, confidentiality concerns were far less prominent. Road transport providers generally expressed a high level of transparency, willing to collaborate with both customers and competitors, stating that

vehicle data was not sensitive in their business. Instead, confidentiality concerns in this segment were more closely tied to GDPR and the handling of personal or driver-specific data. For instance, LocalHaulier3 and LocalHaulier2, reported that privacy rules and union agreements limit access to detailed telematics or GPS data. Similarly, LocalHaulier1 emphasised that personal information must be handled in compliance with GDPR, even though their overall approach to emissions data sharing remains open. Although some actors noted that fuel price data could be seen as commercially sensitive, this was not a widespread issue. For example, Nordic3PL mentioned that a few providers had shown some hesitation about disclosing fuel volumes, but such concerns were rare and did not significantly hinder data exchange.

Overall, our study indicates that while confidentiality concerns do exist, particularly in relation to personal data and in certain sub-sectors, they are not among the primary barriers to emissions data exchange in the land transport sector.

6
Conclusion

This case study offer new insights into the complex landscape of emissions data visibility, focussing on data collection and sharing practices across transport supply chains. The findings led to a structured framework clarifying what is needed to improve visibility and providing a systematic understanding of key challenges, stakeholder perspectives, and how current data exchange practices affect reporting outcomes.

A central finding is the gap between regulatory ambition and practical implementation. Although forthcoming EU legislation, such as CountEmissionsEU, may incentivise improved reporting, existing frameworks often lack the enforceability and operational detail needed to ensure consistency. While the literature rightly highlights the value of standardisation, our results suggest that it is not sufficient on its own. This is especially true in fragmented logistics chains dominated by SMEs, a structural reality that is difficult to change and not a realistic focus for intervention.

The most pressing barrier identified is the lack of digital tools to support growing demands for emissions data. Current practices remain overly manual and resource-intensive, making compliance with detailed reporting requirements unfeasible for many. This reflects not unwillingness, but a desire to prioritise action over administration. Addressing this requires not only regulation, but also support mechanisms, digital tools, harmonised templates, and capacity-building, that enable actors to comply. These could expand the use of primary data, improve allocation in calculations, streamline validation, and facilitate data exchange. Legally approved methods for sharing data, which take into account business and personal concerns, would help reduce uncertainty and increase trust and the quality of the data. Furthermore, sector-wide collaboration emerges as a critical enabler. Interviews revealed differing views on whether buyers or providers should lead change. Aligning expectations and fostering dialogue can promote shared responsibility for emissions tracking and reduction. Financial support is also vital, without it, regulatory efforts may fall short. Governments must therefore engage not only as enforcers, but as enablers of the systems required for compliance.

Finally, while this study focused on overarching dynamics, future studies could benefit from exploring emissions data visibility in specific domains. As our findings suggest, data practices and operational structures vary across domains such as parcel delivery, construction logistics, and freight forwarding, which may require more tailored solutions.

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A

Appendix 1

Appendix 1 presents the interview template to be used when interviewing transport buyers.

Introduction

- What type of transport operations do you have? How are these carried out? (e.g., distance, vehicle type, third-party logistics (3PL) providers, delivery to end customers/distributors, B2B/B2C?)
- Do you include transport emissions in your sustainability reporting? (Before asking, check their sustainability/annual report to see if they disclose any emission figures.)
  - If you report emissions, do you follow a specific framework to guide the reporting process?
    - Which framework?
- Does your company have a department or function dedicated to sustainability or sustainability reporting?

Data Management:

- Do you currently collect data on greenhouse gas emissions in your transport chains?
  - What type of data do you collect? [Fuel consumption, weight/volume, load factor, vehicle capacity, fuel type, vehicle type, etc.]
- What is the purpose of collecting transport emissions data?
  - Customer demand / regulatory reporting
  - Internal use
- How frequently do you request or collect transport emissions data? (Annually, monthly, after each transport, etc.)
- Do you require the data in a specific unit of measurement?
- Do you know how much of your data is based on primary data, modeled data, or default values?
- How is the data calculated?
  - Do you use an in-house tool or an external tool to calculate emissions data?
- Do you work with shared transport loads?
  - How are emissions distributed in shared transports? (by volume/weight, etc.)
  - Do you find that the distribution of emissions in shared transports is fair?
- How do you handle missing data? (Do you use modeled/default values, etc.?)

  - Which database do you use to obtain emission factors?
- Do you conduct any quality assessments on the collected data?

Data Collection:

- How is the data collected? Through requests, invoices, automatic collection, etc.
- Do you need to pay suppliers to access emission data?
- Do you experience different challenges in collecting data depending on type of data? Type of transport provider? Company size? Geographical location? etc
- Overall, do you feel that your transport providers can supply the data you request?

Data Sharing:

- Do you get all the data that is required from the stakeholders in your value chain?

Additional Questions:

- Are there any other challenges related to sustainability reporting on transport data that we haven't discussed?
- In an ideal scenario, if you could choose how customers request transport emission data, what would that look like?

B

Appendix 2

Appendix 2 presents the interview template to be used when interviewing transport service providers.

Introduction:

- What type of transport services do you offer?
- How are these carried out? (e.g., distance, vehicle type, third-party logistics (3PL) providers, delivery to end customers/distributors, B2B/B2C?)
- Do you report your transport emissions in sustainability reporting?
- If you report emissions, do you follow a specific framework to guide the reporting process?
  - Which framework?
- Does your company have a department or function dedicated to sustainability or sustainability reporting?

Customer Demand for Sustainability Data:

- Do you experience demand from customers requesting sustainability data from you?
  - What type of data do they request?
  - Do you feel that you can provide the data they are asking for?
    - What data is easy to collect?
    - What data is more problematic? Why?
  - Do customers request the same type of data?
  - At what point do customers request the data? Progressively throughout the year (e.g., per order) or as a lump sum?
  - Do they require the data to be reported in a specific format?
    - Do customer requirements differ?
    - Do you adapt to customer needs, or do you have a standardized internal method for collecting and reporting data?

Data Management:

- Do you currently collect data on greenhouse gas emissions in your transport operations?
  - What type of data do you collect? [Fuel consumption, weight/volume, load factor, vehicle capacity, fuel type, vehicle type, etc.]
  - How is this primary data collected or calculated?
  - Do you know how much of your data is based on primary data, modeled data, or default values?

  - How do you handle missing data? (Do you use modeled/default values, etc.?)
    * Which database do you use to obtain emission factors?
- Do you conduct any quality assessments on the collected data?
- What is the purpose of collecting transport emissions data?
  - Customer demand / regulatory reporting
  - Internal use
- If multiple customers have shipments in the same transport, how are emissions distributed?

Data Sharing:

- How do you share emissions data? Through requests, invoices, automatic reporting, etc.?
- Do you experience different challenges in sharing data depending on the type of data, type of transport? Customer size? Geographical location? Etc.
- Do you charge customers for the emission data you provide?
  - If yes, is it always charged, or does it depend on the type of data requested? (e.g., if the customer requires a specific format or calculation method)

Additional Questions:

- Are there any other challenges related to sustainability reporting on transport data that we haven't discussed?
- In an ideal scenario, if you could choose how customers request transport emission data, what would that look like?

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