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School of Transportation Sciences

Master of Transportation Sciences

Master's thesis

The role of collaboration between buyers and providers of road freight services to reduce emissions

Stefanie Sohm

Thesis presented in fulfillment of the requirements for the degree of Master of Transportation Sciences

SUPERVISOR :
Prof. dr. ir. Ansar-Ul-Haque YASAR

CO-SUPERVISOR :
Prof. dr. Muhammad ADNAN

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2024

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"In the past, we had to buy transportation from A to B. It was easy. Now we have not only to speak about the price; we have to speak about the solution. For all these kinds of solutions, we have to collaborate."

(quote from an interview with a shipper)

SUMMARY

Progress in reducing greenhouse gas emissions (GHG) from freight transport has been insufficient to meet climate targets. The increasing attention given to value chain emissions could well create new needs and room for collaboration between value chain partners to reduce emissions, also for buyers and providers of road freight services.

This research aimed to identify the needs and areas for collaboration in reducing road freight emissions between three groups of actors: shippers, logistics service providers in their role as intermediaries and buyers of transport services from external carriers, and carriers. 28 European companies with a demonstrated commitment to reducing road freight emissions were interviewed regarding the mitigation measures they are using and planning to use, the areas and action of collaboration that are relevant for the implementation of these, and the enablers and barriers of collaboration. The research produced the following key findings:

On average, the three groups see the highest potential in reducing road freight emissions in the next three to five years with the use of biofuels (mainly HVO), Book and Claim, and electric trucks. Important potential to achieve emissions reductions also remains with truck and rail and with fleet management. Other technology and efficiency measures score lower regarding their remaining and future potential.

In line with their high ratings of measures' potential, shippers take most often action on truck and rail, electric trucks, and biofuels; Book and Claim is used but still in its early stages. Despite the remaining potential, fleet management is not a priority area in shippers' actions with their providers.

Intermediaries take action with their carriers most often on fleet management and eco-driving in the field of efficiency measures; carriers equally take action in both areas on their own. Among the technology measures, Intermediaries most often take action with their carriers on electric trucks and biofuels. Even though at a lower level, intermediaries approach both, clients and carriers to get them on board, particularly for action on electric trucks and biofuels. According to Intermediaries, their carriers do not approach them to develop capacities in the implementation of mitigation measures.

Shippers tend to implement new measures with an existing provider and often outside standardized procurement processes. Overall, the implementation of measures more often takes place following their request than following a provider's proposal. As shippers and intermediaries report, failing requests have had little consequences so far; however, intermediaries and carriers expect increasingly stringent sourcing approaches and see their ability to provide lower-emissions services as a competitive advantage of increasing relevance.

Although comparing intermediaries with and without a fleet was not an explicit objective of this research—the primary focus was on intermediaries without a fleet—the sample composition yielded additional insights: Intermediaries that own a fleet tend to prioritize emissions reduction measures within their fleet before working with their carriers. Conversely, intermediaries without a fleet face challenges in identifying carriers experienced in implementing specific emissions reduction measures.

Overall, shippers' perceived need for collaboration with their providers to implement measures for emissions reduction is greater than intermediaries' perceived need for collaboration with their

shippers. The greatest need for more collaboration is unanimously seen by shippers and intermediaries for electric trucks; biofuels and Book and Claim follow. While collaboration on truck and rail seem to be long-practiced, opinions on the need for more collaboration on fleet management are mixed and roles and responsibilities of the different actors remained rather unclear; this seems to conflict with the high ratings of fleet management's remaining potential.

The possibility to report emissions savings on the shipper's side was found to be a key driver for action to reduce emissions. However, differing methodologies of emissions accounting and the use of average values compromise fair and comparable reporting. Action to overcome these challenges is still in its early stages, partly, because solving some of these issues requires a broader collaborative effort; partly, because reluctance to share primary data on fuel consumption and activity persists in the freight sector.

The challenges with the implementation of electric trucks concern financial and operational requirements, and lack of expertise. Collaborative action to overcome these include: shippers pay a price premium and provide longer contracts; partners use an open book approach to transparently allocate costs; shippers take part in charging infrastructure; some intermediaries plan to facilitate financing of their smaller carriers' electric trucks; all actors engage in the planning of operations; shippers accept changes in operations and embrace the early stages of implementation as a 'learning journey'.

Biofuels inherit some of the challenges of emissions accounting. Uncertainty regarding the correct accounting grows from carrier to intermediary to shipper, and is exacerbated by lack of transparency. Collaborative action on information sharing and documentation is needed between actors but also at the broader level. Since common frameworks and public registries for Book and Claim in road freight are still missing, operators step in with individual solutions; the co-existence of various approaches requires a high level of communication, particularly with shippers; for intermediaries to build Book and Claim with their carriers' fleet, additional efforts in ensuring compliance are required.

Apart from the role of financial aspects, four enablers and barriers of collaboration were identified: First, having a vision for the reduction of emissions and communicating it helps companies to engage their value chain partners. Second, a lack of alignment between vision and internal processes, mainly in procurement, can become a barrier to collaboration, mainly at shippers' level. Third, collaboration on emissions reduction measures is most likely to take place in well-established and trusted relationships; opportunistic and short-term sourcing approaches have their limitations when it comes to emissions reductions. Fourth, greater transparency and sharing of information on operations is both, a prerequisite and result of collaborations that enable emissions reductions along the value chain.

Overall, the findings indicate that commitments to reducing value chain emissions drives and requires collaboration to implement measures. The quality of the collaborative action needed, i.e., its area, action, and intensity, depends primarily on the mitigation measure and its particular challenges, as well as on the level of experience the value chain partners have in implementing it.

Lastly, it must be noted that the engagement described in this research stands for a very small part of the overall road freight market; for the majority of road freight actors, reducing emissions is far from being an integral part of the action.

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ABBREVIATIONS

BAU	Business As Usual
B2B	Business To Business
B2C	Business To Consumer
CAPEX	Capital Expenditure
CDP	Carbon Disclosure Project
CEP	Courier, Express, and Parcel business
CSRD	Corporate Sustainability Reporting Directive
ECTA	European Clean Trucking Alliance
FTL	Full Truck Load
GHG	Greenhouse Gas
GLEC	Global Logistics Emissions Council
HDV	Heavy-Duty Vehicle
HVO	Hydrotreated Vegetable Oils
LTL	Less Than Truck Load
LSP	Logistic Service Provider
MDV	Medium-Duty Vehicle
MHDV	Medium- and Heavy-Duty Vehicle
OEM	Original Equipment Manufacturer
OPEX	Operating Expenditure
RQ	Research Question
SBTi	Science Based Targets initiative
SFBA	Smart Freight Buyers Alliance
St Dev	Standard Deviation
TCO	Total Cost of Ownership

1 INTRODUCTION

1.1 Problem statement

Progress in reducing greenhouse gas emissions (GHG) from freight transport is insufficient to meet climate targets. Over the last decade, the transport sector has experienced the fastest growth in GHG emissions among all sectors and remains almost fully dependent on fossil fuels. Global transport emissions stand at ca. 8 Gt of CO_2; freight accounts for ca. 3.4 Gt of CO_2 (42%) with road freight being responsible for ca. 75% (SLOCAT, 2023). While transport emissions in developed regions have rather been plateauing—the EU-27 road transport emissions peaked at 0.8 Gt of CO_2 in 2007 yet still count 0.75 Gt of CO_2 in 2022 (Eurostat, 2024); the United States went from 1.6 Gt of CO_2 in 2005 to 1.47 Gt in 2022 (EPA, 2022)—emissions in developing regions are rising: the projected global economic growth together with current levels of ambition to reduce emissions would translate into a doubling of freight activity and an increase in overall freight emissions to 4.7 Gt of CO_2 (ITF, 2023). In a scenario that keeps global warming within 1.5°C limits by 2050, the CO_2 budget available for the entire transport sector is estimated at less than 2 Gt of CO_2 (Axsen et al., 2020).

1.2 Relevance of this research

Consensus has grown that private businesses have a critical role to play in driving the transition towards a low-carbon economy, and that their action beyond legal requirements will be instrumental to achieving the climate targets (Krabbe et al., 2015; Li et al., 2020; Hollinger, 2021). An increasing number of companies is committing to reduce emissions from their own activity and across their value chain (SBTi, 2023). Several voluntary initiatives exist under which companies commit to reduce and disclose their emissions; for example, the Carbon Disclosure Project (CDP, n.d.) and the Science Based Targets initiative (SBTi, n.d.).

With growing interest from stakeholders (Dhanda et al., 2022; Correll & Betts, 2023), companies' emissions and climate actions are getting under increased scrutiny (Black et al., 2021; Hansen et al., 2022; McGivern et al., 2022; Reavis et al., 2022); independent not-for-profit organizations like the Net Zero Tracker (Net Zero Tracker, n.d.) bring corporate targets and progress into the public domain. Beyond voluntary emissions reporting, the Corporate Sustainability Reporting Directive CSRD (Directive (EU) 2022/2464, 2022) will make it mandatory for companies of a certain size in the EU to disclose their emissions, including relevant value chain emissions, starting in 2025. The State of California, through its Climate Corporate Data Accountability Act (Senate Bill 253, 2023) sets similar requirements for companies of a certain size to disclose their value chain emissions.

Value chain emissions reporting frameworks like the GHG Protocol (WRI & WBCSD, 2004, 2011)—the most widely used framework for corporate emissions accounting (see Kasperzak et al., 2023)—allocate a company's emissions to different scopes: scope 1 are the direct emissions from its activity; scope 2 comprises the emissions from its energy use; scope 3 accounts for emissions from activities along the value chain. The approach is different from inventory frameworks designed to report the overall emissions from a national economy or a specific industry sector, as it shows the interdependencies between actors and their emissions: In the case of freight transport emissions, a carrier's scope 1 emissions caused by the operation of his fleet are at the same time the scope 3 emissions of the buyer of the freight service. If the carrier reduces his scope 1 emissions, the buyer will also see a decrease in

her scope 3 emissions. In that sense, value chain emissions reporting shifts the perspective to specific actors along the value chain and their roles in contributing to these emissions. It purposefully reports these same emissions to different scopes for different actors; at the same time, it avoids that the same emissions are counted twice in the different scopes of one actor.

The number of companies, however, that comprehensively report scope 3 emissions remained low in the past (Blanco et al., 2016; Depoers et al., 2016; Patchell, 2018; Supply Shift, 2021). This is mainly a result of the effort required to collect information from suppliers and on other drivers of emissions up and down the value chain on the one side, and the lack of external pressure to provide these information on the other side (Hook, 2021; Schaltegger & Csutora, 2012).

With the increased scrutiny and forthcoming legal requirements, the situation seems to slowly evolve: a recent survey by IBM in the Tech Industry showed that, from a sample of 3,250 businesses, 38% measure their scope 3 emissions (Unglesbee, 2023). Data published by the Science Based Targets Initiative (SBTi, 2023) suggests that 1,715 of the large companies (per definition of the SBTi, companies count as large if they fulfil at least two of these three criteria: over 250 employees, over USD 50 million turnover, over USD 25 million of assets) have validated scope 3 emissions targets.

The Logistics & Freight Transport Industry Report for Belgium 2024-Q1 (Fitch Solutions, 2023) predicts that „*Increased focus on supply chain emissions, especially scope 1 and 3 emissions from transportation and logistics, will increase pressure [on companies]*."

Together, corporate climate commitments, increasing emissions transparency, and pressure from external stakeholders could well create areas of shared interest and new room for collaboration between value chain partners to reduce emissions, also for buyers and providers of freight services.

2 LITERATURE REVIEW

The area of work that addresses emissions reductions from freight and logistics has mainly evolved under titles like *Green Freight* or *Green Logistics* (e.g., Demir et al., 2014) and *Sustainable Logistics* (e.g., Ren et al., 2020). One of the most recent and comprehensive overviews of options to reduce emissions from road freight is provided by McKinnon (2022). These options include: reducing the demand for logistics' activity through more localised sourcing and production strategies; shifting freight to modes that emit less carbon per unit transported, e.g., from air to sea, from road to rail; improving the utilisation of logistics assets through consolidation of loads, optimised routing, and avoidance of empty kilometres; improving the energy efficiency of logistics through engine and fuel design as well as through operations of vehicles, such as eco-driving; converting logistics to low-carbon energy, i.e., adopting low-carbon fuels and low- to zero-emissions vehicle technologies.

The strategic and operational approaches to managing the reduction of emissions along the supply chain have become part of the broader, partially overlapping areas of *Green Supply Chain Management* (e.g., Srivastava, 2007), *Sustainable Supply Chain Management* (e.g., Gold et al., 2010), and more recently, with a clear focus on carbon emissions, *Low Carbon Supply Chain Management* (Das & Jharkharia, 2018). Much of the work in these disciplines predominantly looks at the interfaces between buyers and suppliers in the area of goods for manufacturing and retailing (e.g., Uemura Reche et al., 2020; Huang et al., 2016); less attention is given to the roles of buyer and providers of freight services (Sallnäs, 2016).

Also, and even though supply chain management, by definition, "*includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers*" (CSCMP, 2013), much of the researched and proposed approaches are rather managerial than collaborative, such as the development of methods and criteria to select suppliers that show certain characteristics and manage them with performance indicators. Work that looks at the collaborations between buyers and providers in the field of *Green Logistics* tends to take a unilateral perspective, either the buyer's (e.g., Chen & Wang, 2016) or the provider's perspective (Bask et al., 2018; Cheng et al., 2019); less attention is given to the actors' interaction and collaboration from the perspectives of both (Sallnäs & Huge-Brodin, 2018; Creazza et al., 2023).

Several studies with a focus on the interaction, relationship, and coordination between shippers and freight transport providers to reduce emissions have been conducted in Sweden. For example, Dahlgren and Ammenberg (2022) found that shippers have difficulties influencing certain providers of transport services to offer services that could achieve more radical reductions in emissions, such as electrification or the use of biofuels. The providers' hesitance to adopt low-carbon freight solutions was often related to short-term contracts and uncertainty about future market potential for the required investments.

Also in the Swedish context and based on four case studies, Sallnäs (2016) suggests that the coordination mechanisms used between shippers and providers to implement environmental measures are primarily defined by their dependence on each other in general, their dependence on each other with regard to specific environmental practices, and their respective environmental ambition. Sallnäs and Huge-Brodin (2018) examined why environmental ambition can flourish and fade in relationships of shippers and logistic service providers; they found that a service provider's ambition

is constrained by his relationship with the shipper, and that ultimately the latter's pro-activeness is decisive.

While it seems intuitive that the final decision depends on the buyer of the service—at least as she needs to approve increases in cost, lead times, and changes in operations that reach into her processes—Santén suggested already in 2013 that providers should adopt "*a more proactive attitude regarding offering environmentally preferable services and providing increased information about effects of changes and possibilities to follow up environmental goals of freight services*" (Santén 2013, p.i) to help shippers understand their options and the impacts of their behaviour on the transport operations performed by their operators.

The lack of information and insights on the shippers' side has also been unveiled in a 2020 case study on Swedish and German companies' purchasing and contracting behaviour of green freight services—among them measures of energy efficiency and adoption of biofuels (Jazairy, 2020; Jazairy & von Haartman, 2021). The authors identified how shippers' too specific, conflicting, or unfeasible green demands clashed with providers' reality and sometimes their existing efforts, like asset-sharing for greater efficiency to reduce cost and with it, energy consumption and carbon emissions. This misalignment could be traced back to shipper's lack of understanding of the logistics provider's operational models in place, as well as to a lack of coordination between departments within the shipper's organization.

To overcome conflicts between shippers' request for lower-emissions road freight services and providers' efficiency approaches (and other obstacles, like unavailability of certain fuels in certain regions), market-based mechanisms, also referred to as *Book and Claim* or *Carbon Insets* (Greene & Brost, 2020) can be used. These approaches decouple the physical flow of goods and fuels from the emissions reductions (a more detailed explanation of the functioning of the Book and Claim mechanism can be found in the annex.). Book and Claim made its way relatively recently from the energy sector first into aviation and shipping (e.g., Davydenko et al., 2022; Pechstein et al., 2020). Its use in the road freight sector is still scarce and poses new challenges in knowledge and methodology to shippers and providers (Smart Freight Centre, 2023). While it is primarily being used with biofuels, operators are moving to trials with the use of Book and Claim also for electric vehicles (e.g., Kuehne + Nagel, 2024).

In their large-scale survey with Swedish shippers and logistic service providers, Jazairy et al. (2021) analyse the importance of two types of collaboration mechanisms: close relation-specific collaborations, where investments in client-dedicated assets are made by the provider and backed by long-term contracts with the buyer on the one hand, and sharing of knowledge, defined as learning exchange, personnel exchange, and IT integration, for the adoption of different green logistics practices on the other hand. While their findings show that both types of collaboration mechanisms are important to both groups, relation-specific mechanisms have a stronger effect than knowledge sharing, and that the two mechanisms vary in importance for different green practices.

With a particular focus on small and medium freight transport operators, a large-scale study in Great Britain (Allen et al., 2023) provides valuable insights on the barriers these companies face towards the adoption of green logistics practices; these include gaps in awareness and knowledge, lack of human and financial resources, short-term contracts, competing priorities such as focus on profit optimization in the short run. Among the barriers in the relationships with their buyers figure a lack of trusted intermediaries and a split incentive problem. In their recommendations, the authors suggest that

buyers should lengthen contracts and provide financial support for upfront investments as pull-mechanisms, as well as set minimum requirements as push-mechanisms.

In its *Procurement Playbook,* the Smart Freight Centre (2024a) suggests that procuring low- to zero-emissions logistics services requires a transformational approach rather than a transactional approach: while the latter uses a well-defined, routine procurement process with standardized specifications and bidding procedures, a transformational approach takes place outside normal procurement, "*often leading to profound and far-reaching changes in existing operational processes*."

Even before selecting measures to reduce emissions and procuring them, the ability to measure emissions across the value chain has widely been recognized as a key step to set targets, inform action, and track progress (Hansen et al., 2022; Hettler & Graf-Vlachy, 2023; McKinnon, 2022) and the resulting emissions transparency and assigned responsibility is found to incentivize companies to coordinate with supply chain partners to reduce emissions (Gopalakrishnan, 2022). Collaboration between buyers and suppliers was found to be a key success factor for identifying, evaluating, and reducing emissions (e.g., Asif et al., 2022).

The above cited work makes important contributions to understanding the set of options available to reducing emissions from road freight and the general factors at play in a buyer-provider relationship that influence the success of their implementation. However, few of the studies take the perspective of both sides, buyers and providers. Few are specific to the needs and areas for collaboration for a given emissions reduction measure, and those that are take a rather generic perspective regarding the type of collaboration these require. Also, the identified literature mainly distinguishes between shippers as the buyers of the service, and logistics operators as the providers; no distinction between logistic operators who own a fleet, and are hence in direct control of their assets, and those who procure services from external carriers, with another buyer-provider relationship in which different forms of collaborations may become relevant. Lastly, with the very recent emergence of scope 3 emissions reduction targets on the side of buyers of freight services, research has had little opportunity to examine the impact of this increased ambition on the choices of (more radical) measures and the (eventually) growing relevance of collaborations to implement these.

3 OBJECTIVES

The primary objective of this research is to identify the need and areas for greater collaboration between buyers and providers of road freight services to reduce carbon emissions from their transport activities. By examining these actors' actions and perspectives, the research aims to provide insights on the forms of collaboration they are using for specific measures, the forms of collaborations they might still be missing, as well as the collaborations' enablers and barriers. Particular interest is given to the role of logistic service providers (LSPs) who act as an intermediary buyer of the service, and where a second buyer-provider relationship with the carrier becomes relevant in addition to the one between the intermediary and the shipper.

On a secondary level, and as part of the research methodology, the research collects information on buyers' and providers' views on the potential of different road freight mitigation measures, as well as on their action in implementing these measures.

The research draws on the premise that buyers and providers of freight services with a demonstrated ambition to reduce value chain emissions from freight transportation have greater experience in implementing measures to reduce emissions than industry-average actors, and, eventually, take more collaborative action with their value chain partners to achieve their targets. The research therefore focuses on a sample which can be considered as front runners who can provide a forward-looking picture and learnings from their experiences; it is not representative for the overall road freight sector.

4 RESEARCH QUESTIONS AND SCOPE

4.1 Research Questions

The research starts with the hypothesis that collaboration between buyers and providers beyond a traditional road freight procurement approach can help, or is even needed, to achieve (further) road freight emissions reductions. To answer the main research question (RQ) "What is the role of collaboration between freight buyers and providers in reducing emissions ?", the following sub-questions will be addressed:

No	Question
RQ1	How do buyers and providers rate the potential of different measures to (further) reduce road freight emissions ?
RQ2	What measures are buyers and providers taking with their value chain partners to reduce road freight emissions, and who drives the action ?
RQ3a	Which mitigation measures require more collaboration than traditional buyer – provider relationships ?
RQ3b	What areas and forms of collaborations are relevant for selected mitigation measures ?
RQ3c	What are the enablers and barriers of these collaborations ?

4.2 Scope

4.2.1 Actors

The research addresses buyers and providers of road freight. Road freight buyers comprise both, Shippers and logistic service providers who mainly or exclusively source road freight services for their clients from external carriers. In this research, these are referred to as Intermediaries. Logistics service providers and carriers who mainly or exclusively provide road freight services with their own fleet are referred to as Carriers (see Figure 1).

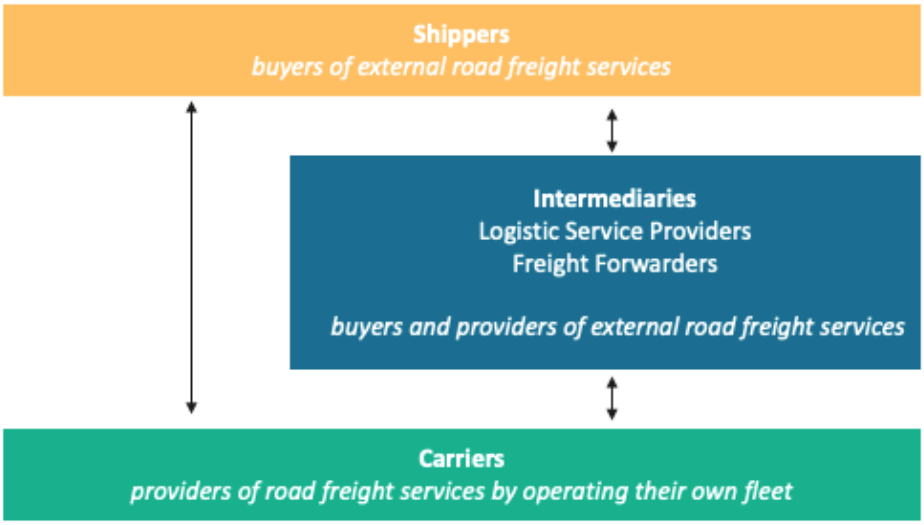


Figure 1: Actors considered in this research

The research focuses on actions and collaborations that lie in the collective sphere of influence between these actors. Collaborations outside these actors' relationships, e.g., with their peers on the horizontal level, with actors further down or further up in the value chain, and collaborations with governments and authorities are not included. Similarly, barriers that lie outside of these actors' direct sphere of influence, i.e., availability of technology, public infrastructure, regulation and policies are not part of this research.

4.2.2 Value chain emissions

The research looks at carbon emissions from road freight transportation. Other emissions from the logistics sector, e.g., from vehicle production, infrastructure, warehousing, packaging, data processing, etc. are not considered.

It applies the most widely used categorization of value chain emissions as laid out by the GHG Protocol (for details, see WRI & WBCSD, 2011). With this value chain emissions perspective, the actions in focus of this research address a shipper's scope 3 emissions from purchased road freight transportation. These are the same emissions that an intermediary, from his perspective, reports equally in his scope 3 emissions. The Carrier who uses his own or leased vehicle fleet to provide the service to the intermediary, and ultimately, to the shipper, reports his emissions under scope 1.

4.2.3 Emissions reduction measures

Based on the comprehensive overview of emissions reduction measures for the freight sector provided by McKinnon (2022), the following selected measures to reduce road freight emissions are considered in this research:

- Operating vehicles and fleets more efficiently:
  - (1) eco-driving, e.g., backed by driver-training and the use of fuel consumption monitoring
  - (2) shifting driving to off-peak times
  - (3) improved fleet management through increased loads, reduced empty running, optimized routing

- Modifying existing vehicles for greater energy efficiency:
  - (4) vehicle equipment to improve aerodynamics and reduce rolling resistance

- Adopting fuels and vehicles, which, by design, have lower and zero tailpipe emissions :
  - (5) biofuels, particularly HVO (Hydrotreated Vegetable Oils)
  - (6) mega-trucks (noting the reduction takes place on a 'per unit transported' basis)
  - (7) gas vehicles
  - (8) electric vans
  - (9) electric medium- and heavy-duty vehicles (MHDV)s
  - (10) hydrogen MHDVs

- Shifting road freight
  - (11) to combined truck and rail services
  - (12) to cargo bikes

To account for the latest evolutions in the use of market-based mechanisms, which are not a measure a such but can facilitate the uptake of low- and zero carbon solutions also in the road freight sector, this research also considers the

- Book and Claim mechanism.

Acknowledging that Book and Claim is not a measure in itself but can serve as a facilitator for the scaling-up of biofuels, and at a very nascent stage, electric truck deployment, the set of measures will further on referred to as '12+1 measures'. More details on the functioning of the Book and Claim mechanism can be found in the annex (see chapter 12.1) and in Smart Freight Centre (2023).

In the absence of an established way of clustering these measures, a matrix overview was developed (see Figure 2). The matrix groups the measures in measures of operational efficiency (Efficiency) and in measures that imply a change of vehicle or fuel technology (Technology). On a second level, it distinguishes whether a measure requires a change in operations, a change by design, or a mode shift. For simplicity, Book and Claim was put in the group with of Technology Measures which it can facilitate.

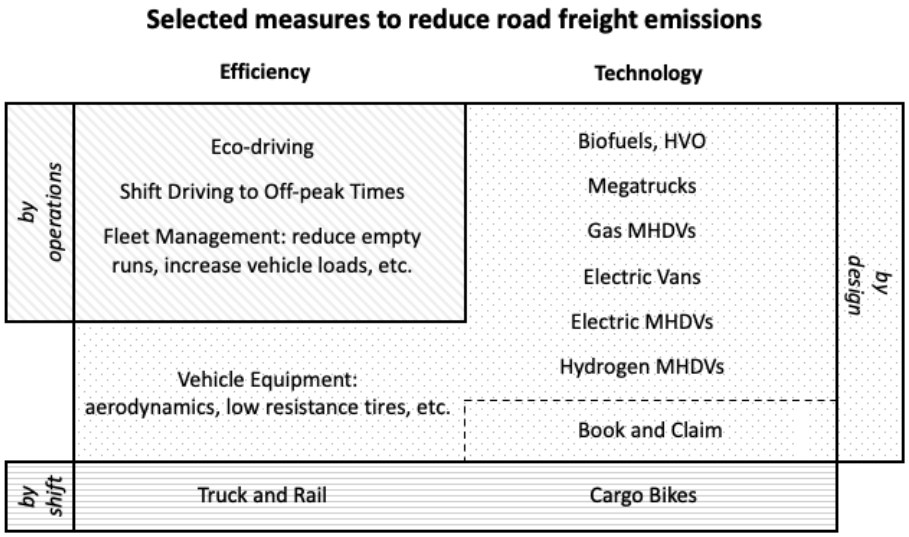


Figure 2: Matrix of measures to reduce road freight emissions

4.2.4 Areas of collaborations

Collaborations serve, by definition of the Cambridge Dictionary "[…] *to create or achieve something together*". The research yields to cover a broad area of potential collaborations between freight service buyers and providers; based on the literature review and on the researcher's own assumptions, it sets out with the following possible areas:

- intellectual: actors share knowledge and expertise
- informational: actors exchange data on relevant activities
- procedural: actors change processes, establish supportive and eliminate constraining ones
- contractual: actors modify contractual arrangements
- in-kind: actors contribute with non-monetary resources, e.g., materials, facilities, personnel, power
- financial: actors collaborate on costs, investments, and access to finance

5 METHODOLOGY

5.1 Research technique and materials

The research used interviews as the principal research technique; it combines a quantitative approach, operationalised with a structured survey in the first part of the interview, and a qualitative approach in the form of a semi-structured interview in the second part of the interview. The questionnaire can be found in the annex (see chapter 12.2).

Using a mixed approach can serve different objectives (see e.g., Bryman, 2006; Creswell, 2003); the intention here is to enable the collection of data in a structured and comparable way where categories can be defined by the researcher upfront on the one hand, and where searching for explanations and patterns that are less defined or unknown at the beginning of the research on the other hand.

The survey-based first part of the interview covered:

a) contextual information on actors' road freight activity, buyer-provider contracting habits, and emissions targets, with results presented in chapter 6.1;
b) rating of the potential of the 12+1 measures to reduce emissions, presented in chapter 6.2;
c) measures implemented with value chain partners and drivers behind the action, presented in chapter 6.3;
d) identification of measures that require more collaboration than business as usual (BAU), presented in chapter 6.4.

The questionnaire used single-choice and multiple-choice questions as well as rating exercises with Likert scales from 0 (= low) to 4 (= high); open text questions were reduced to a minimum and used where unavoidable, e.g., to collect information on emissions targets. To account for the different roles of each group of actors—Shippers, Intermediaries, Carriers—the questionnaire was prepared in three dedicated versions, each with slight adjustments. The questionnaire was set up to by responsive so that follow-up questions built on the interviewees' preceding answers; it was developed with the online tool Zoho Survey.

To allow the interviewee to quickly capture the set of 12+1 measures, the online questionnaire included the matrix visual with modified column titles intended to simplify technical language: the Efficiency Measures were entitled 'Classics', as these have been known and available for a long time; the Technology Measures were entitled with 'Trending' as all of them, eventually except for Gas MHDVs, are recent or nascent (see Figure 3 on page 14).

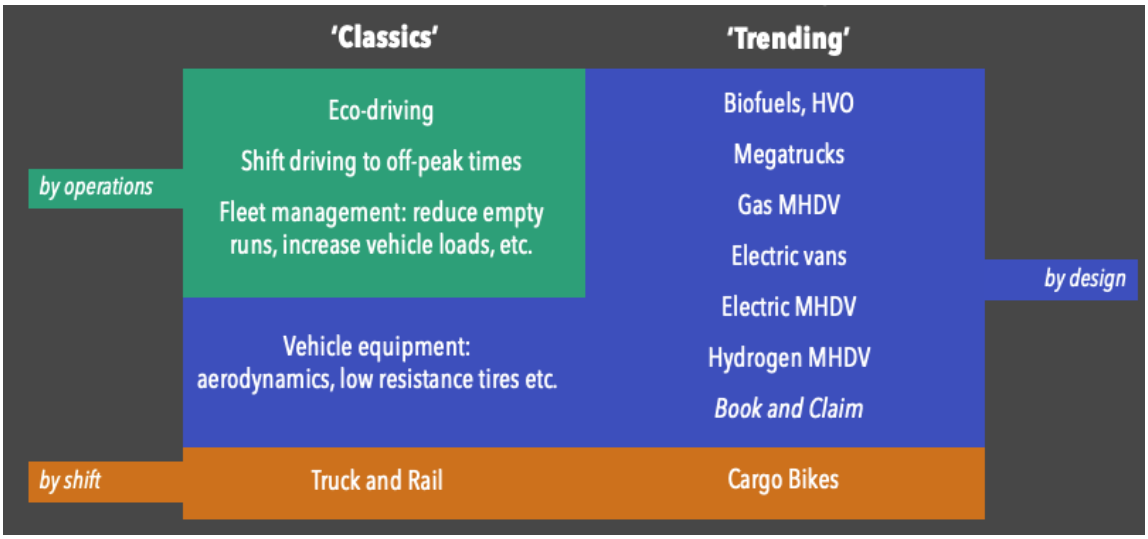


Figure 3: Interview material: matrix of measures

This first survey-based part of the interview also served to narrow down the broad set of 12+1 emissions reduction measures to the ones that were most relevant to the interviewee and for this research; these were then discussed in more detail the second, semi-structured part of the interview. Filter questions were used for this purpose: In the case of the Efficiency Measures ('Classics'), measures were only taken further if interviewees stated that they had experience in implementing them with value chain partners. In case of the Technology Measures ('Trending'), only those were taken forward if interviewees rated their potential to reduce emissions in the next three to five years at 2 or higher on a Likert scale from 0 = no potential to 4 = very high potential. In a second filtering step, only measures of both categories were taken forward if the interviewee stated that the measure required more collaboration with their provider or buyer than business as usual in traditional road freight buyer-provider relationships.

The questionnaires were tested with two industry representatives and improved based on the experience; after the first two interviews per sub-group, small adjustments were made to improve the natural flow of the questions and the pre-defined answer options.

The semi-structured second part of the interview was designed to give interviewees the flexibility to speak more freely about their experience and perspectives and focussed on

a) areas and actions of collaboration with their buyers and/or providers, with results presented in chapter 6.5;
b) enablers and barriers of collaborations, with results presented in chapter 6.6.

In the semi-structured part of the interview, only the two to three most relevant measures that were identified with the filtering questions as described previously were discussed. If more than two measures remained from the filtering questions, interviewees were given the choice to select which ones they wanted to discuss in more detail.

To start the conversation, the interviewees were shown a visual overview of areas of collaborations on which they could reflect in a dialogue with the researcher (see Figure 4 on page 15). The visual overview was developed based on literature, the researcher's assumptions, and refined after the first interviews.

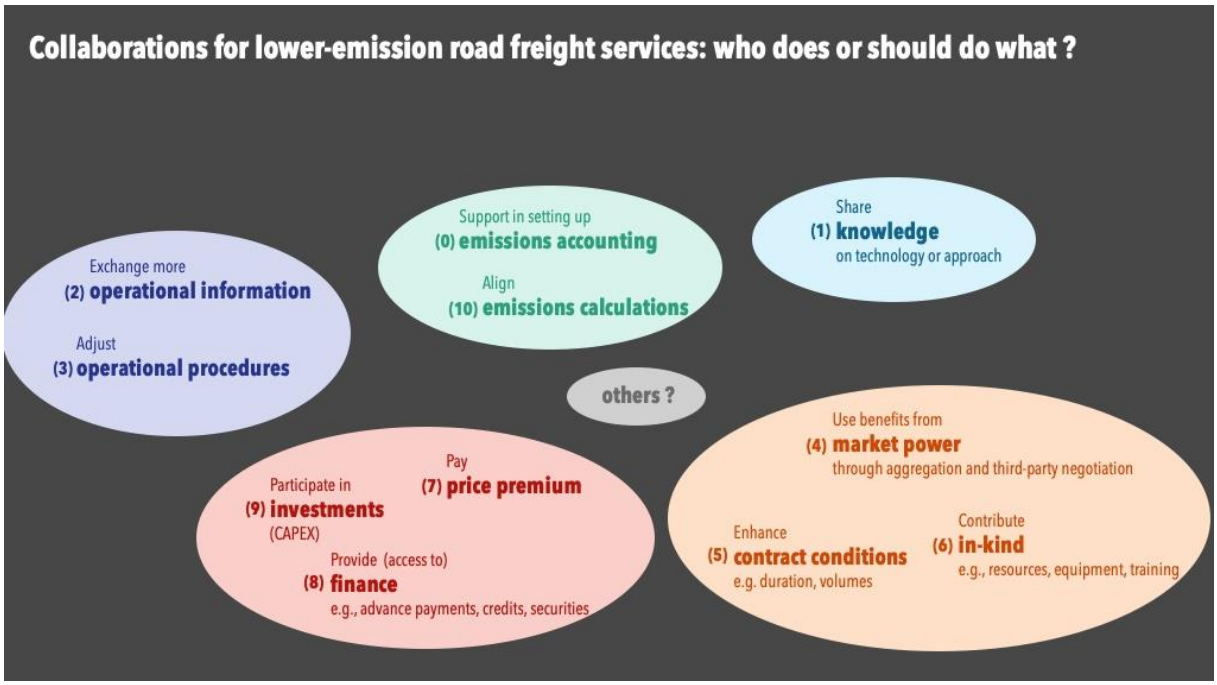


Figure 4: Interview material: areas and actions for collaboration

The pre-defined areas cover, starting at the upper right corner in blue (1) sharing of knowledge regarding technologies or approaches to reduce emissions; the green cluster with (0) and (10) addresses activities in the area of emissions accounting; (2) and (3) in purple aim at collaboration in the exchange of information regarding operations between the actors and the adjustment of certain operational procedures, like changes to routes, lead times, loading and delivery windows; the peach cluster in the lower right corner comprises different non-informative and non-monetary ways to collaborate, e.g., (4) the use of market power with which one (larger) partner may be able to improve conditions also for the weaker partner, (5) the willingness to enhance contract conditions so they become more attractive for the partner who needs to make investments, and (6) in-kind contributions, where other than financial resources are made available; ultimately, the red cluster comprises financial collaboration like (7) paying a price premium for certain lower-emissions services, (8) providing access to finance, and (9) directly participating in investments relating to lower-emissions services.

While the two parts of the interviews used different tools, the presence of the researcher—other than in distributed surveys—created a space for conversation already in the survey-based first part of the interview. Interviewees sometimes provided comments beyond the questions and anticipated elements that were planned to be covered in the second semi-structure part. Thus, the two parts of the data collection have no strict split and particularly the semi-structure part blended into the survey-based part already (see Figure 5). This was considered when analysing the semi-structured interview part, where relevant additional comments made during the survey-based interview were included.

Figure 5: Flow of the survey-based and the semi-structured interview parts

5.2 Participants

5.2.1 Research population

The research population are buyers and providers of road freight services with a demonstrated ambition to reduce road freight emissions. It comprises:

- Shippers who act as buyers of road freight services,
- Intermediaries, i.e., logistic service providers or freight forwarders, who exclusively or mainly source services from road freight carriers and who act as both, buyers and providers, and
- Carriers, who act as providers to intermediaries or shippers.

It is irrelevant to this research and unknown to the researcher if companies in the sample entertain business relationships among them.

The research focussed on Europe; members of the research population are all active in road freight in Europe, and either headquartered in Europe or, in the case of non-European companies, represented with a European subsidiary.

Throughout the report, upper case letters are used to refer to the specific Shippers, Intermediaries, and Carriers that were interviewed for this research. Lower case letters are used where the text refers to these actors as a generic group and beyond the specific actors in this research.

5.2.2 Sampling and recruitment

Convenience sampling was used to build a sample of 28 companies from the defined research population.

To identify members of the population with the characteristic 'demonstrated ambition to reduce emissions from road freight', companies' participation in a dedicated initiative or their commitment to an emissions target (scope 3 for Shippers and Intermediaries, scope 1 for Carriers) were used as proxies. Two initiatives were considered: the Smart Freight Centre's (SFC) *Sustainable Freight Buyers' Alliance* (SFBA) and the *European Clean Trucking Alliance* (ECTA). To identify companies with a relevant emissions target, the *Science Based Targets initiative's* (SBTi) monitoring database (SBTi, 2023) was screened. For Shippers, companies in the service industry (e.g., finance, consulting services, software, education, etc.) that have limited transportation activities were excluded.

Ca. 70 European members of the *Sustainable Freight Buyers' Alliance* active in road freight were contacted with the support of the Smart Freight Centre. In the case of the *European Clean Trucking Alliance,* the 15 members listed on the website were contacted by the researcher via email and invited to an interview. From the SBTi database, 89 European shippers and 39 European intermediaries and carriers active in road freight and with a relevant SBTi Target were contacted via email.

The outreach processes started in early March 2024; those who did not respond received one reminder email two weeks after the initial email.

The final sample comprises 12 Shippers, 12 Intermediaries, and four Carriers. Twenty of the sample members are a member of the SFBA, 18 have a relevant Science Based Targets, and one is a member of the ECTA (see Figure 6 on page 17).

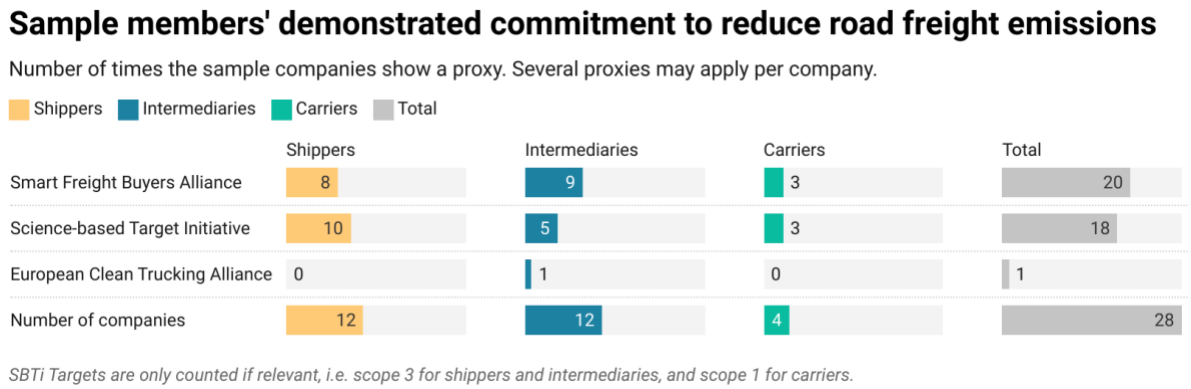


Figure 6: Sample members' demonstrated commitment to reduce road freight emissions

As shown in Figure 7, the sample comprises 24 companies headquartered in Europe and four companies that are a European subsidiary of a non-European company. It represents 12 European countries with no Eastern European country and a relative strong concentration of members located in Germany

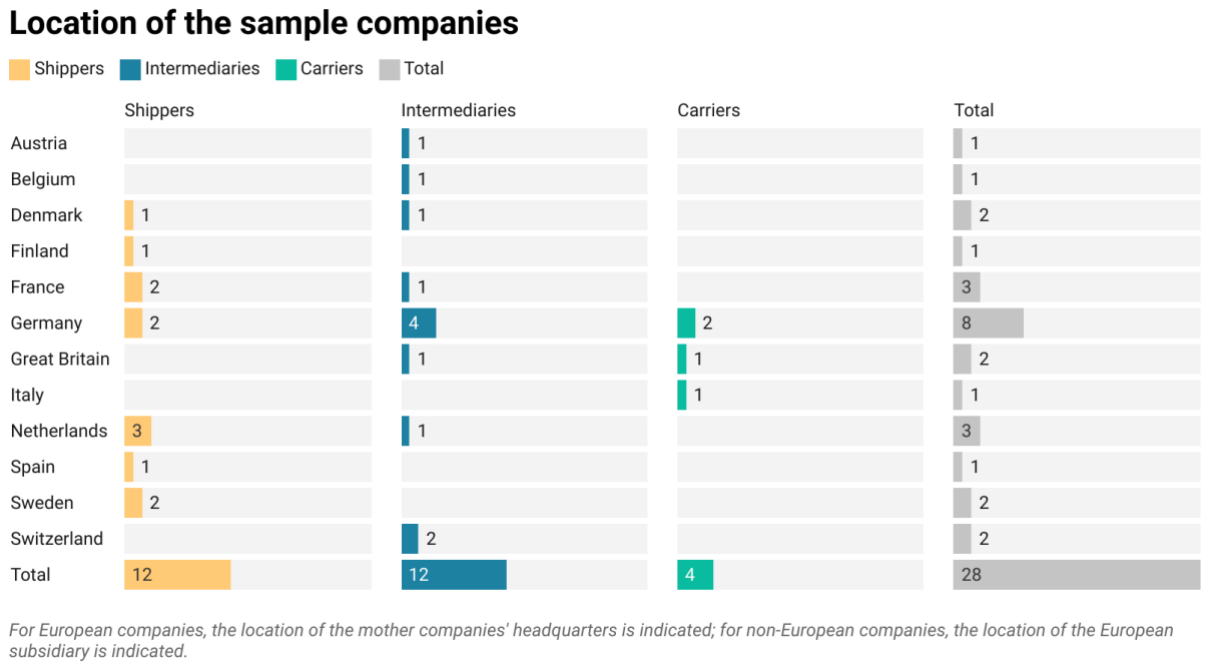


Figure 7: Geographical locations of companies in the sample

5.3 Data collection and analysis

5.3.1 Data collection

The interviews were conducted between end of March and middle of May 2024. They were held online with a duration of 60 minutes; four interviewees (one Shipper, one Intermediary, two Carriers) requested to shorten the duration of the interview to 30 minutes.

Ahead of the interviews, the interviewees received information about the purpose and the process of the interview. The information sent included the matrix visual of measures (Figure 3 on page 14), the

visual with areas for collaboration (Figure 4 on page 15), the list of contextual questions (see annex chapter 12.2).

In the first part of the interview, the researcher screen-shared the questionnaire, went through it with the interviewee, and filled in the responses; in the second part, the collaboration visual was shared to initiate the in-depth discussion on pre-selected measures.

The majority of the interviews were held in English, interviews with German-speakers were held in German; the interviews were audio-recorded for analysis.

5.3.2 Analysis of the survey-based interview part

For the survey-based part of the interview and to answer RQ1, RQ2, and RQ3a, the data collected with the questionnaire was analysed quantitatively; contextualizing comments from the interviewees were considered to frame some of the quantitative results from the questionnaire.

Weighted mean and weighted ranking for RQ1

For RQ1, a weighted mean was calculated to reflect the differences in number of ratings received and the resulting strength of the result. For illustration: measure A is rated by 12 out of 12 interviewees with a mean of 3.0. Measure B is rated by only five out to 12 interviewees equally with a mean of 3.0; the remaining seven interviewees state that they cannot tell, that the measure is not applicable in their case, or they simply do not provide a rating. Not weighing the mean would give five interviewees the same weight of voice as 12 interviewees. To account for the different participation rates, a weighted mean was calculated with the following formula:

$$\mu_{\,weighted} = \frac{\mu * n + \left((N - n) * \left(\frac{n}{N} * \mu\right)\right)}{N}$$

where:

μ = arithmetic mean of collected ratings
n = number of ratings collected
N = number of interviewees (equal to maximum possible ratings)

This approach of calculating the weighted mean uses the mean rating multiplied by the number of those who rated ($\mu * n$) and includes those who did not rate ($(N - n) * \left(\frac{n}{N} * \mu\right)$). It assumes the same mean as for those who rated and adjusts the influence on the weighted mean of those who did not rate proportionally to their number and the overall participation rate. This leads to the effect that the higher the participation rate, the more weight is given to the few who did not rate and for whose theoretical rating the same mean is assumed as the one of those who did rate. The assumption is that a mean that results from a high participation rate reflects a stronger consensus which is less likely to change if additional ratings are added.

In the following, the effect is illustrated using the examples A (all interviewees participate in the rating) and B (only five out of 12 interviewees participate in the rating) and adding an example C where the rating by 10 out of 12 interviewees results equally in an arithmetic mean of 3.0 :

$$\mu_{\,weighted}\,[A] = \frac{3.0 * 12 + \left((12 - 12) * \left(\frac{12}{12} * 3.0\right)\right)}{12} = 3.0$$

$$\mu_{\,weighted}\,[B] = \frac{3.0 * 5 + \left((12 - 5) * \left(\frac{5}{12} * 3.0\right)\right)}{12} = 1.979 \approx 2.0$$

$$\mu_{\,weighted}\,[C] = \frac{3.0 * 10 + \left((12 - 10) * \left(\frac{10}{12} * 3.0\right)\right)}{12} = 2.92 \approx 2.9$$

The weighted mean was used to establish a weighted ranking; it was applied for the entire sample, combining ratings from the three sub-groups as well as for each sub-group individually.

To best interpret the meaning of results of RQ1, it is recommended readers take note of the weighted mean and the other descriptive indicators provided in chapter 6.2 (mean, median, minimum value, maximum value, standard deviation).

5.3.3 Analysis of the semi-structured interview part

Thematic analysis was applied to the semi-structured part of the interviews to identify themes and patterns in relation to the research question, and to thematically structure the content (see Clarke & Braun, 2013). In line with Clarke and Braun's proposed stages of thematic analysis, the recorded interviews were first transcribed and read through. In a first round of coding (using the coding software Atlas), text pieces were labelled using pre-defined categories, such as the set of mitigation measures and the areas of collaboration. Additionally, inductive coding, i.e., using codes that emerged from the text, was used to capture topics that were brought up directly, e.g., *relationship*, *communication* or which could be generated from statements, e.g., "*we do not know their actual fuel consumption; they do not share the information with us*" was tagged with *no collaboration*, *transparency*, and *primary data*. Codes were continuously reviewed to maintain a balanced set of codes of a manageable size, and which is not too granular on the one side, nor too general on the other side. The main themes were then identified based on the frequency with which they were brought, and based on their relevance to answer the research questions. To avoid redundancies between the survey-based part and the semi-structured interview part, tags were only applied where the answer was not to a question from the survey. For example, "*I would rate the potential of Electric MHDVs at 3*" as an answer to the rating question would not be tagged for analysis of the semi-structured interview part. However, if the interviewee provided more information to a question from the questionnaire and which was of relevance to the content to be covered later in the semi-structured interview, it was tagged for analysis. For example, "*I would rate Electric MHDVs at 3; but I think it requires a change to the way how we set up the contracts with our providers*." would be tagged *Electric MHDV*, *Contracts*, *Collaboration*.

5.3.4 Limitations of the analysis for Carriers

The low turnout in recruiting Carriers (four) for the research, in combination with two of them asking for a shortened interview of 30 minutes, has implications for the data analysis that can be provided as well as for the robustness of the results. For several research question, data is insufficient, and Carriers are therefore excluded.

6 RESULTS

6.1 Contextual information about the companies in the sample

6.1.1 Characteristics of the Shippers

Interviewees

All interviewees are affiliated with a central department of their company and hold a strategic position that combines sustainability and supply chain management and logistics; all of them work with the operational business units and procurement department, some with a decision-making power, some in a consulting position.

Activities

The sample of 12 Shippers comprises eight business to business (B2B) companies and four business to consumers (B2C) companies; three of the B2C companies supply retail stores. The sample covers a broad range of sectors, including chemicals, steel, wood products and paper, electrical equipment and apparatus, healthcare equipment, pharmaceuticals, fashion, furniture, household appliances, household ware, and other goods of daily consumption. For four of the Shippers, goods that require special handling like heavy goods, pharmaceuticals, and sensitive devices make up 60 to 100% of their shipments.

Road freight spend

Shippers in the sample differ considerably in the road freight volume they procure in Europe; spendings range from EUR 10 million to over 200 million, with four of them ranking at the upper end.

Types of vehicles used

For 11 Shippers heavy-duty vehicles (HDV) play a significant role in their purchased road freight services. Medium-duty vehicles (MDV) are less frequently used and play no role in the case of five Shippers. Vans play no role for half of the Shippers and a minor role for the remainder of the sub-group. Cargo Bikes play no role, with one minor exception (see Figure 8)

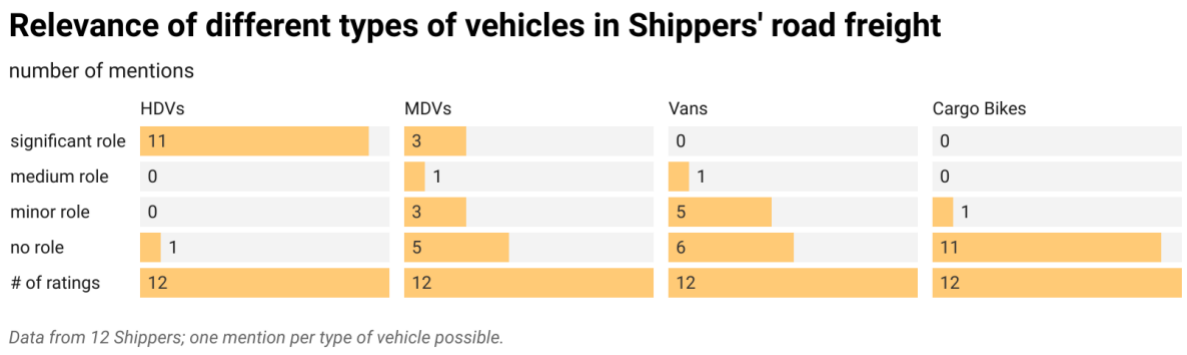
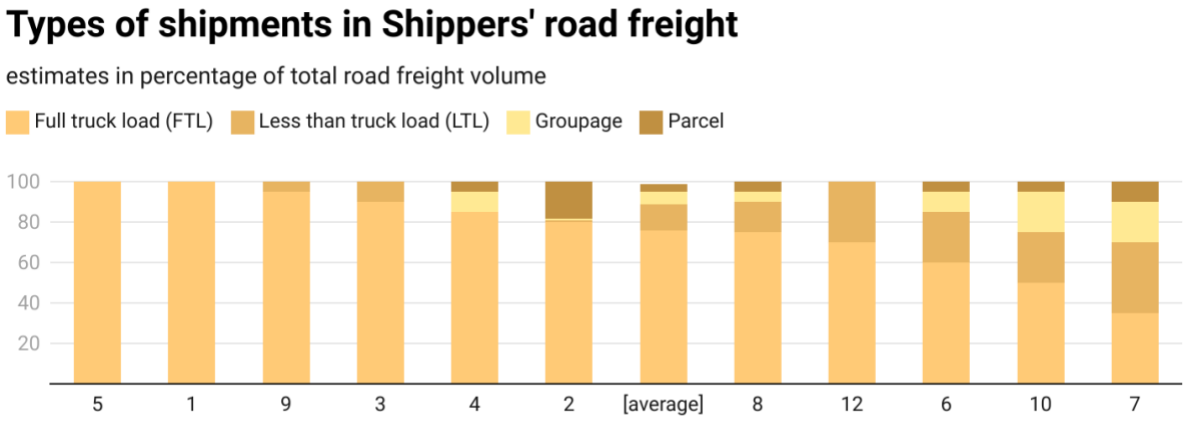


Figure 8: Relevance of different types of vehicles in Shippers' road freight

Types of road freight services procured

Overall, full truck load (FTL) is the most often used type of road freight service, accounting for an estimate 70 to 100% of shipments for eight of the 12 Shippers. Less than truckload (LTL) accounts for 25 to 35% of shipped volumes for four Shippers. Groupage (shipments from different shippers and with a weight of typically under 2.5 tonnes that are consolidated and deconsolidated at central locations) and parcel services have low relevance for six Shippers, and no relevance for five Shippers.

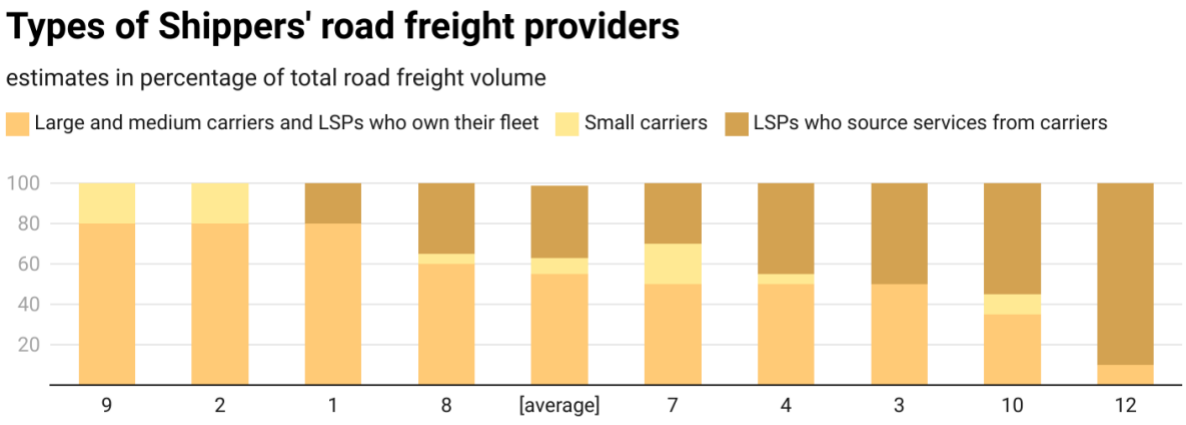


Data from 11 Shippers; values are rough estimates by interviewees and can only be indicative.

Figure 9: Types of Shippers' shipments

Types of Shippers' road freight providers

Shippers in the sample state to work more often with large and medium road freight service providers who own their fleets than they do with asset-light intermediaries or small carriers. Three shippers have 80% of their road freight handled by large and medium carriers or Logistic Service Providers (LSPs) with their own fleet; another four achieve 50 to 60%. Four Shippers have 45 to 90% of their road freight handled by LSPs who source services from carriers. Shippers considerably less often work directly with small carriers; if they do, it is mainly for services in a limited local perimeter.



Data from 10 Shippers; values are rough estimates by interviewees and can only be indicative.

Figure 10: Types of Shippers' road freight providers

Shippers' contracting behaviour

Nine of the 12 Shippers source 90 to 100% of their road freight volumes from providers with whom they have a contract (seven) or an open-ended framework agreement (two) with specifications and rates agreed for the short term. Shippers in this sample barely use the spot market.

Contracts with a length of up to 1 year are slightly more often used than contracts with a length of 2 to 3 years. In longer contracts, rates can be adjusted to reflect changes in fuel prices; as part of framework agreements, rates are fixed only for the short term. Respondents also indicated that it would be rather frequent that contracts are renewed with the same provider several times or that they keep working with the same providers in the context of their framework agreements for many years, in some cases leading to long-term relationships of many years, even decades. However, some Shippers argue for shorter contracts to maintain flexibility; this preference is equally reported for some of their providers who prefer shorter contracts so they can adjust rates to market evolutions.

Half of the Shippers in this sample stated that they have a rather concentrated sourcing approach, i.e. more than 75 % of their purchased road freight services are carried out by a few key providers. Two Shippers highlighted that it has been a strategic choice to reduce the number of providers to build closer business relationships and achieve a higher service level. From the other half, three Shippers stated that their sourcing approach would be somewhat concentrated, i.e., 50% is carried out by a few key providers; the remaining three Shippers state to have a diversified pool of providers.

A cross-analysis of Shippers' contracting and sourcing behaviour (see Figure 11) suggests that the choice to have fewer providers is likely to go hand in hand with the choice to give longer contracts: those who state to have a highly concentrated pool of providers typically use contracts of 2 to 3 years. None of those who very frequently use 2 to 3 years contracts stated they had a diversified pool of providers. All three who stated to have a very diversified pool of providers use very frequently 1-year contracts or framework agreements.

Shippers' sourcing approaches and length of contracts with providers

Combinations of number of mentions; multiple mentions per Shipper possible.

	upto 1 year very frequent	upto 1 year somewhat frequent	2 to 3 years very frequenet	2 to 3 years somewhat frequent
Highly concentrated	2	0	4	0
Somewhat concentrated	2	1	1	2
Diversified	3	0	0	1

Data from 12 Shippers. Read: 2 Shippers who use a highly concentrated sourcing approach give their providers very frequently contracts of upto 1 year.

Figure 11: Cross-tabulation of Shippers' sourcing approach and length of contracts with providers

Shippers' ambition to reduce emissions

All Shippers in this sample have targets to reduce their scope 3 emissions with different levels of ambition, ranging from -24% in 2030 to zero-carbon in 2030; covering different time horizons; and showing different levels of granularity: from general scope 3 targets to road freight-specific scope 3 targets (see Figure 12). Two Shippers did not share their target, stating it was currently under revision.

When asked for their satisfaction with the progress they have made towards their targets, three Shippers stated they were very satisfied with their progress which was in line with their expectations.

The majority of eight Shippers stated they were rather satisfied, but that they had made less progress than expected.

One Shippers—the one with the most ambitious target (zero carbon in 2030)—stated they were not satisfied, and that progress fell short of their expectations.

General scope 3 targets:

- -30% 2021-2030
- -28% 2020-2030, - 90% 2020-2050
- -30% 2019-2030, climate neutral 2050

***Freight-specific scope 3 targets*:**

- -24% 2020-2030
- -30% 2020-2030
- -30% 2019-2030, climate neutral 2045
- -42% 2020-2030
- -70% 2017-2030
- zero carbon 2030

Road freight-specific scope 3 target:

- -42,400 tons of CO_2 2021-2025

Figure 12: Shippers' relevant scope 3 targets

6.1.2 Characteristics of the Intermediaries

Interviewees

All interviewees are affiliated with a central department in their company and have a strategic role in sustainability; all of them work with the operational business units, the sales and the procurement departments.

Activities

Ten of the 12 Intermediaries operate in supply chain logistics; two are in the Courier, Express, Parcel (CEP) business. While eight of the Intermediaries also operate their own road fleet, this activity makes up the minor part of their overall road freight business and is for some rather insignificant. Several of the Intermediaries work with thousands of mainly small and very small carriers to deliver the services for their clients. It is important to recall that Intermediaries were explicitly asked to answer questions with a focus on the services they procure from external carriers, not the services they provide with their own fleet.

Two of the Intermediaries handle mainly goods that require some sort of special handling, like heavy loads, hazardous goods, cold chain logistics, pharmaceuticals or electronical equipment; for seven of them, products that require special handling make up 15 to 30% of their activities.

Road freight turnover from purchased services

Intermediaries in the sample differ considerably in the road freight turnover they generate with purchased services in Europe. Two of them are rather small with under EUR 50 million, one has a medium sized activity of close to EUR 100 million, and four of them are large with ranges from EUR 800 million to over 2,000 million. Four could not provide any figures.

Types of vehicles used

For ten Intermediaries, heavy-duty vehicles (HDV) play a significant role in their purchased road freight services. Medium-duty vehicles (MDV) are less frequently used. Vans play no role for five of the Intermediaries and a minor role for four of them. Cargo Bikes play largely no role in this sample (see Figure 13).

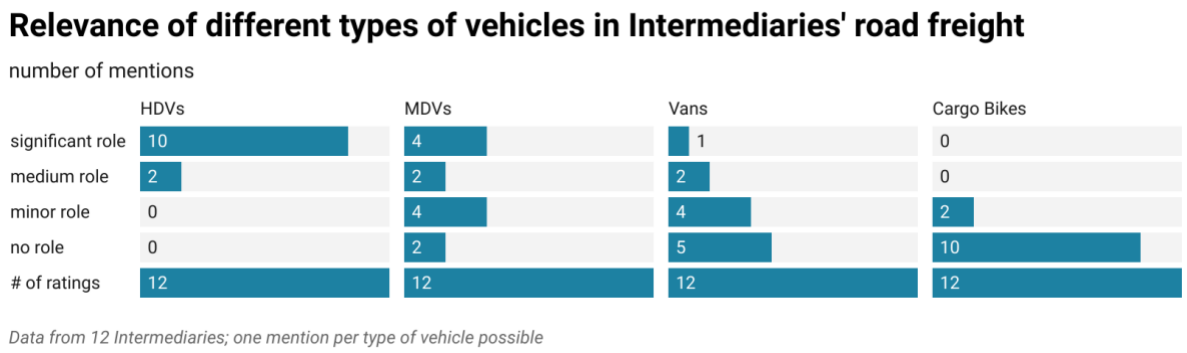


Figure 13: Relevance of different types of vehicles in Intermediaries' road freight

Types of road freight services provided

While full truck load (FTL) makes up for 70 to 100% for three Intermediaries in the sample, it accounts for 60% or less for eight of the Intermediaries. For nine Intermediaries, LTL or Groupage make up for at least 30% and up to 70% of their business activity. The CEP operators register the largest shares for parcel distribution, with 50 to 80% (see Figure 14).

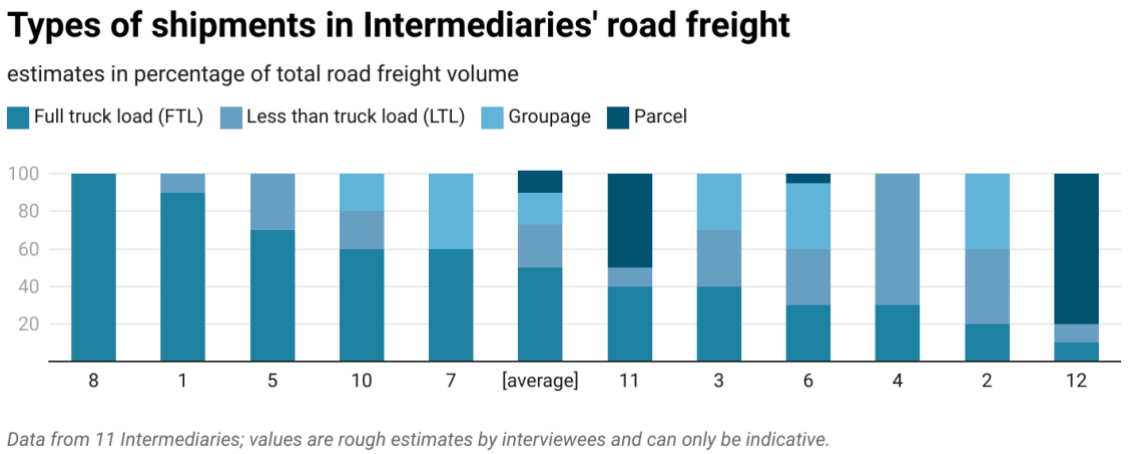


Figure 14: Types of Intermediaries' shipments

Intermediaries' contracting behaviour

Figure 15 shows the difference between the volume that is handled by Intermediaries as part of a contract with their clients in dark blue, and the volume that is handled by their carriers as part of a contract established by the Intermediary in light blue.

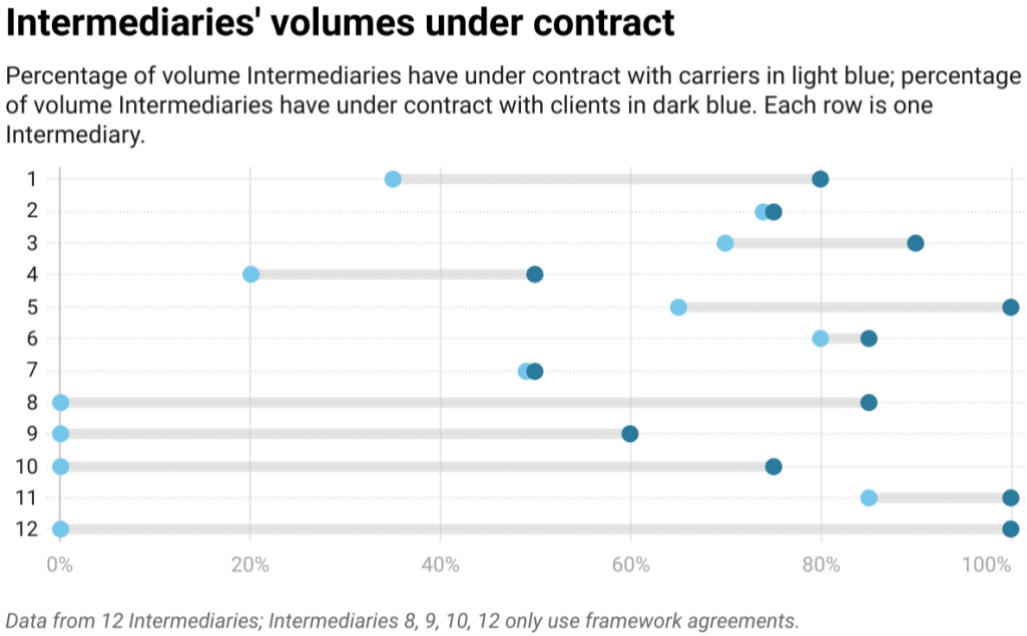


Figure 15: Intermediaries' contracts with carriers and clients

Most of the Intermediaries make less use of contracts with their carriers than they have contracts in place with their clients. may partially be explained with some of the Intermediaries absorbing a part of the contracted business with their own fleet, another part of this difference may to be explained with strategies to reduce risks and to preserve flexibility. Four intermediaries only use open framework agreements with carriers under which they pass on volumes as needed.

Figure 16 shows the contract arrangements Intermediaries have with their carriers and their clients.

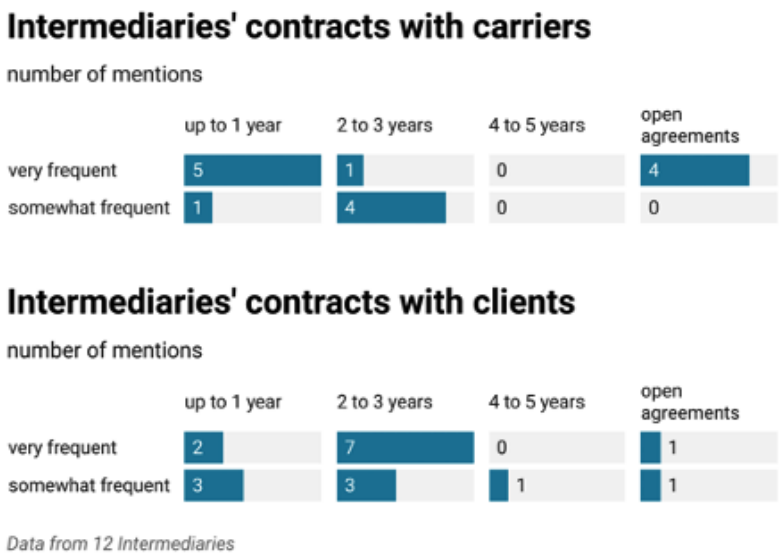


Figure 16: Intermediaries' contract length with carriers and with clients

The most frequent contract length with carriers was found to be up to 1 year; four Intermediaries stated they use framework agreements. A few Intermediaries reported that short contracting durations are also a request by carriers as it gives them the flexibility to adjust rates with market prices. With their clients, Intermediaries have most frequently contracts of 2 to 3 years.

Most Intermediaries in this sample have diversified relationships with a large number of equally important carriers and clients. As Figure 17 shows, most of the Intermediaries have a highly diversified pool of carriers from whom they source their services, as they have a highly diversified pool of clients to whom they sell their services.

Intermediaries' sourcing and selling approaches

Carries in vertical / Clients in horizontal	Highly concentrated	Somehwat concentrated	Diversified
Highly concentrated	0	0	0
Somehwat concentrated	0	2	1
Diversified	1	1	7

Data from 12 Intermediaries

Figure 17: Intermediaries' sourcing and selling approaches

Intermediaries' ambition to reduce emissions

Eight of the 12 Intermediaries have targets to reduce their scope 3 emissions from purchased freight; four are in the process of formulating a target. The ambition ranges from -25% in 2030 to net zero in 2050.

Four Intermediaries stated that they were very satisfied with their progress, which was in line with their expectations.

Four stated they were rather satisfied, but that they had made less progress than expected.

Five said they were rather not satisfied as they had made little progress and fell short of their own expectations.

***Freight-specific scope 3 targets*:**

- -75% 2030 (land transport), net zero 2050 (land and maritime)
- -33% 2030
- -25% 2021-2030, net zero 2050
- net-zero 2050
- -30% 2023-2030, -45%2040, net zero 2050
- -30% 2020-2030
- -40% 2020-2030, net zero 2040
- net zero 2050

Figure 18: Intermediaries' relevant scope 3 targets

Intermediaries with their own fleet stated to have started their action on scope 1 targets earlier and reported progress; action on scope 3 emissions is at an initial stage across the sample.

6.1.3 Characteristics of the Carriers

The sub-group of Carriers in the sample is small and, as shown in the following, highly diversified. Together, the small size of the sub-group and its high degree of diversification limit a meaningful analysis of the collected data.

Interviewees

The interviewees are all affiliated with a central department in their company and have a strategic role in sustainability. All work with the operational business units and are involved in exchanges with clients.

Activities

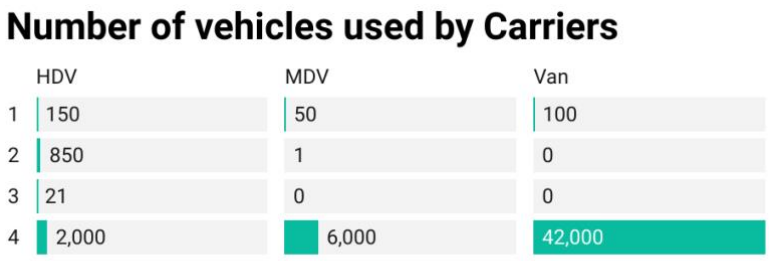
The four Carriers differ greatly in their activities: one works exclusively through Intermediaries, with half of his freight requiring special handling (hazardous goods, pharma, electronics, express); one is mainly in supply chain logistics, directly providing services to shippers; one is almost exclusively in the mail and CEP business; and one is mainly in line-haul operations, with shippers and intermediaries equally as clients.

Road freight turnover

The road freight turnover in the sample ranges from an estimate EUR 10 million (this figure was not communicated by the interviewee but is a rough estimate by the researcher, based on the fleet size) to EUR 80 million, EUR 600 million and close to EUR 10,000 million (10 billion).

Types of vehicles used, and road freight services provided

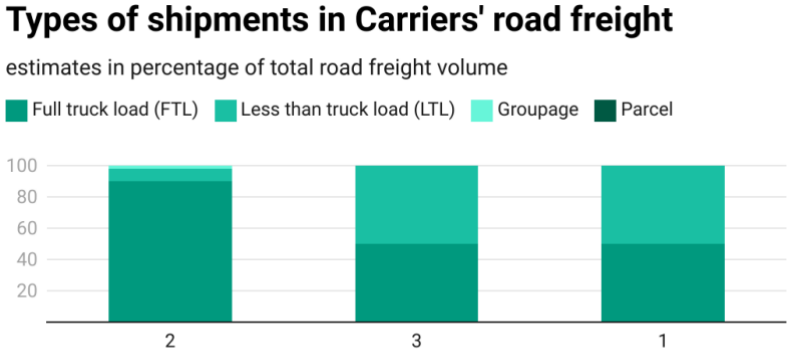
In line with Carriers' large differences in road freight turnover, the fleet sizes differ considerably, ranging from a fleet of 21 HDVs to a fleet of close to 50,000 vehicles in total (see Figure 19). The largest Carrier handles a substantial amount of mail and CEP and has a very large fleet of vans.



Data from 4 Carriers

Figure 19: Carriers' vehicle fleet

The largest Carrier could not provide a break-down across the different types of shipments; for the other three, FTL ranges from 50 to 85% in terms of volume of their road freight; groupage and parcel do not play a role for them (see Figure 20).



Data from 3 Carriers; values are rough estimates by interviewees and can only be indicative.

Figure 20: Types of shipments in Carriers' road freight

Contract lengths awarded to the Carriers

The Carriers equally often state that contracts up to 1 year are very frequent as they state that a contract duration of 2 to 3 years is very frequent (see Figure 21).

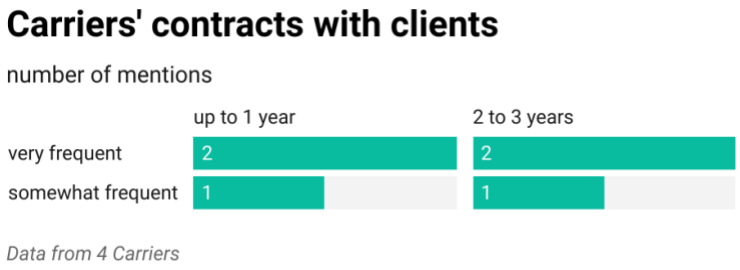


Figure 21: Carriers' contract lengths with clients

The Carriers in the sample cover all three selling approaches: working with a highly concentrated group of clients where at least 75% of the business is commissioned by a few key clients, up to a diversified selling approach, where a large pool of equally important clients is served by the Carrier.

As can be seen in the cross-tabulation in Figure 22 (and due to the sub-group's small size) it is not possible to identify a trend for a specific selling approach to occur in combination with a specific contract length.

Carriers' selling approaches and length of contracts with clients

Combinations of number of mentions; multiple mentions per Carrier possible.

	up to 1 year very frequent	up to 1 year somewhat frequent	2 to 3 years very frequenet	2 to 3 years somewhat frequent
Highly concentrated	0	1	1	0
Somewhat concentrated	1	0	0	2
Diversified	1	0	1	0

Data from 4 Carriers.

Figure 22: Cross-tabulation of Carriers' selling approaches and length of contracts

Carriers' ambition to reduce emissions

Three of the Carriers have an emissions target; two of them are publicly stated. One Carrier reported they were in the process of formulating a target.

All of them stated to be rather satisfied with the progress they made so far, even though it is somewhat less than they had expected.

***Scope 1 targets*:**

- -42% 2022-2030, net zero 2042
- -42% 2020-2030
- -50% 2020-2030, net zero 2040

Figure 23: Carriers' scope 1 targets

6.2 RQ1: How do buyers and providers rate the potential of different measures to (further) reduce road freight emissions ?

To answer the first research question, interviewees were asked to rate the remaining potential of the Efficiency Measures on a Likert scale from 0 = no remaining potential to 4 = very high remaining potential, and the potential the more recent Technology Measures for the next three to five years from 0 = no potential to 4 = very high potential.

6.2.1 Potential ratings of Efficiency Measures to reduce emissions

Figure 24 shows the ratings of all three groups combined of the Efficiency Measures in decreasing order based on the weighted rank from left to right.

Overall Ratings of the Efficiency Measures (statistical values)

ratings 0 = no more potential to 4 = very high potential

	Truck and Rail	Fleet Management	Eco-driving	Vehicle Equipment	Shift Driving to Off-Peak Times
Rank weighted	1	2	3	4	5
# of ratings	25	26	22	21	8
% of sample	89%	93%	79%	75%	29%
Mean	2.8	2.7	1.7	1.5	1.8
Mean weighted	2.7	2.6	1.6	1.4	0.9
Median	3.0	3.0	2.0	1.0	1.0
Min	1	1	0	0	1
Max	4	4	3	3	4
St Dev	1.3	1.0	1.0	1.0	1.0

Data from 12 Shippers, 12 Intermediaries, 4 Carriers

Figure 24: Overall ratings of the Efficiency Measures

Together, the three groups see the largest remaining potential to reduce emissions, by far, with the use of **Truck and Rail** and **Fleet Management**, with a weighted mean of 2.7 and 2.6 respectively (see chapter 5.3.2 for details on the calculation of the weighted mean). For both, ratings range from 1 to 4, with a median of 3.0; Truck and Rail shows a relatively high standard deviation (St Dev) of 1.3, indicating differing views among the respondents. **Eco-driving** and **Vehicle Equipment** fall behind to weighted ranks 3 and 4 with considerably lower weighted means of 1.6 and 1.4 respectively. **Shift Driving to Off-Peak Times** on rank 5 was rated by only eight interviewees, with a consequently low weighted mean of 0.9.

The analysis of the ratings per sub-group shown in Figure 25 on page 31 provides more details on the different perspectives. The decreasing order from the overall ranking from left to right is maintained.

Shippers' Ratings of the Efficiency Measures (statistical values)

ratings 0 = no more potential to 4 = very high potential

	Truck and Rail	Fleet Management	Eco-driving	Vehicle Equipment	Shift Driving to Off-Peak Times
Rank weighted	2	1	4	5	3
# of ratings	12	10	7	6	5
% of group	100%	83%	58%	50%	42%
Mean	2.8	3.0	1.7	1.2	2.2
Mean weighted	2.8	2.9	1.4	0.9	1.5
Median	3.0	3.0	2.0	1.0	2.0
Min	1	2	1	0	1
Max	4	4	3	3	4
St Dev	0.9	0.6	0.7	1.1	1.2

Data from 12 Shippers

Intermediaries' Ratings of the Efficiency Measures (statistical values)

ratings 0 = no more potential to 4 = very high potential

	Truck and Rail	Fleet Management	Eco-driving	Vehicle Equipment	Shift Driving to Off-Peak Times
Rank weighted	1	2	4	3	5
# of ratings	11	12	11	11	2
% of group	92%	100%	92%	92%	17%
Mean	2.6	2.6	1.7	1.8	1.0
Mean weighted	2.6	2.6	1.7	1.8	0.3
Median	2.0	3.0	2.0	2.0	1.0
Min	1	1	0	1	1
Max	4	3	3	3	1
St Dev	1.1	0.8	1.0	0.7	0.0

Data from 12 Intermediaries

Carriers' Ratings of the Efficiency Measures (statistical values)

ratings 0 = no more potential to 4 = very high potential

	Truck and Rail	Fleet Management	Eco-driving	Vehicle Equipment	Shift Driving to Off-Peak Times
Rank weighted	1	2	3	4	5
# of ratings	2	4	4	4	1
% of group	50%	100%	100%	100%	25%
Mean	3.0	2.0	1.5	1.3	1.0
Mean weighted	2.3	2.0	1.5	1.3	0.4
Median	3.0	1.5	1.5	1.0	1.0
Min	2	1	1	1	1
Max	4	4	2	2	1
St Dev	1.0	1.2	0.5	0.4	0.0

Data from 4 Carriers

Figure 25: Ratings of the Efficiency Measures by Shippers, Intermediaries, and Carriers

Truck and Rail remains on rank 1 for Intermediaries and Carriers, with somewhat lower scores in potential (weighted means of 2.6 and 2.3) compared to Shippers with a higher weighted mean of 2.9. Two of the three Shippers who rated the measure under average explained this with the already well exploited potential in their case; the third explained this with limitations coming from the lack of industry-specific providers that offer Truck and Rail services. Among the Intermediaries, the slightly lower ratings were explained with some of the Intermediaries' limited access to rail capacity or the requested lead times of the clients they serve. Several of the Shippers and Intermediaries stated that their rating is rather timid as they see limitations from the insufficient rail capacity in several countries and from the varying capacity across Europe which can be prohibitive to their cross-border shipments. Among the Carriers, only two provided a rating; for the other two, Truck and Rail is not applicable in their field of business.

Fleet Management scores highest with Shippers with a weighted mean of 2.9 and a fairly good convergence (St Dev of 0.6). Intermediaries rate this measure somewhat lower at 2.6 (St Dev of 0.8); Carriers differ greatly in their rating of Fleet Management, with a weighted mean of 2.0 and a large divergence across the small sub-sample (St Dev of 1.2), most likely pointing to significant differences that may lie with different fields of their business .

The ratings for **Eco-driving** and **Vehicle Equipment** fall in a range of a weighted mean of 1.7 to 1.4 and 1.8 to 0.9 respectively. The lowest weighted means for both come from Shippers; many of them stated that they do not have insights in these details of their providers operations, or that providers have worked on these measures over the last decade in their own interest to save fuel and thus cost. Some of the Intermediaries stated that they have worked with their carriers on Eco-Driving in the past, yet some of them still see some potential, resulting in a weighted mean of 1.7 with some divergence across the sub-group (St Dev of 1.0). For Vehicle Equipment, Intermediaries show more convergence (St Dev of 0.7) that there is still some potential in their carriers' vehicle fleet. In contrast, Carriers strongly agree (St Dev 0.4) that the remaining potential of this measure is rather low, with a mean and a weighted mean of 1.3. A seemingly intuitive explanation could be that the Carriers in this sample, with their commitment to reduce emissions, could well be among those operating a modern fleet already. While also Intermediaries are committed to reducing emissions, they rated their carriers' vehicles, which are in many cases small operators that may not be the most advanced when it comes to vehicle technology.

Lastly, **Shift Driving to Off-Peak Times** received the lowest number of ratings from all three groups. It was most controversial among Shippers, were the weighted mean still achieved 1.5 but with a fairly high spread of the few ratings received (St Dev of 1.2). Intermediaries and Carriers barely rated the measure stating it would not be applicable in their operations; those who rated, rated it lowest by far among the five Efficiency Measures, with a weighted mean of 0.3 and 0.4 respectively. In conclusion, most interviewees see only a theoretical potential which is limited by protection and working hours of loading personnel and drivers, local regulations, and shippers' requirements.

6.2.2 Potential ratings of Technology Measures to reduce emissions

Figure 26 shows the collective ratings of the Technology Measures in decreasing order of the weighted rank from left to right.

Overall Ratings of the Technology Measures (statistical values)

ratings 0 = no more potential to 4 = very high potential

	Biofuels, HVO	Book and Claim	Electric MHDVs	Electric Vans	Hydrogen MHDVs	Gas MHDVs	Megatrucks (60+ t)
Rank weighted	1	2	3	4	5	6	7
# of ratings	27	25	27	14	27	26	16
% of sample	96%	89%	96%	50%	96%	93%	57%
Mean	3.5	3.2	3.0	2.8	1.7	1.4	1.3
Mean weighted	3.5	3.1	3.0	2.1	1.7	1.4	1.1
Median	4.0	4.0	3.0	3.0	1.0	1.0	1.0
Min	1	1	1	1	0	0	0
Max	4	4	4	4	4	4	3
St Dev	0.8	1.4	0.9	1.6	1.3	1.2	0.9

Data from 12 Shippers, 12 Intermediaries, 4 Carriers

Figure 26: Overall ratings of the Technology Measures

Together, the three groups of interviewees see the largest potential to reduce emissions over the next three to five years, by far, with the use of **Biofuels, HVO** (weighted mean of 3.5), the **Book and Claim** mechanism (weighted mean of 3.1), and **Electric MHDVs** (weighted mean of 3.0). Biofuels, HVO and Book and Claim achieve a median of 4.0; Electric MHDVs achieve a median of 3.0. It is notable that ratings for Book and Claim diverge considerably, with a standard deviation of 1.4 across the sample.

The potential rating of **Electric Vans** (rank 4) needs to be looked at with care: Electric Vans have an overall low and, across the actors, differing degree of relevance (see chapter 6.1); this lead to only half of the sample providing a rating. Several of those who use Electric Vans are advanced in their deployment and hence rate the potential to further reduce emissions relatively low. Third, for those with a small number of vans in use, vans constitute a small portion of their emissions portfolio and have thus limited potential to reduce the overall road freight emissions. Given the different context conditions, the aggregation of ratings carry little information (also note St Dev of 1.6).

Hydrogen MHDVs and **Gas MHDVs** rank 5th and 6th with a weighted mean of 1.7 and 1.4 respectively, and a large spread of ratings from 0 to 4. Particularly for Hydrogen MDHVs, many of the low ratings are due to uncertainties if and when the technology will mature to be commercially deployable.

Megatrucks of 60+ tonnes received the lowest number of ratings and rank lowest with a weighted mean of 1.1. Interviewees from all groups stated that limitations lie with many different national regulations across Europe, which also limits their use to few countries with low applicability for cross-border shipments.

The disaggregated analysis of the Technology Measures per sub-group can provide more details on the different perspectives (see Figure 27 on page 34). The decreasing order resulting from the overall ranking from left to right is maintained.

Shippers' Ratings of the Technology Measures (statistical values)

ratings 0 = no more potential to 4 = very high potential

	Biofuels, HVO	Book and Claim	Electric MHDVs	Electric Vans	Hydrogen MHDVs	Gas MHDVs	Megatrucks (60+ t)
Rank weighted	2	1	3	4	5	6	7
# of ratings	12	11	12	5	12	12	10
% of group	100%	92%	100%	42%	100%	100%	83%
Mean	3.3	3.5	2.9	2.6	1.7	1.4	1.1
Mean weighted	3.3	3.5	2.9	1.7	1.7	1.4	1.1
Median	3.5	4.0	3.0	2.0	1.0	1.5	1.0
Min	2	1	1	1	0	0	0
Max	4	4	4	4	4	4	2
St Dev	0.7	0.9	1.0	1.2	1.3	1.3	0.7

Data from 12 Shippers

Intermediaries' Ratings of the Technology Measures (statistical values)

ratings 0 = no more potential to 4 = very high potential

	Biofuels, HVO	Book and Claim	Electric MHDVs	Electric Vans	Hydrogen MHDVs	Gas MHDVs	Megatrucks (60+ t)
Rank weighted	1	3	2	4	5	6	7
# of ratings	12	11	12	7	12	11	5
% of group	100%	92%	100%	58%	100%	92%	42%
Mean	3.6	2.9	3.2	2.7	2.1	1.6	1.8
Mean weighted	3.6	2.9	3.2	2.2	2.1	1.6	1.2
Median	4.0	3.0	3.0	3.0	2.0	2.0	1.0
Min	1	1	2	1	0	0	1
Max	4	4	4	4	4	3	3
St Dev	0.9	1.1	0.7	1.0	1.2	1.1	1.0

Data from 12 Intermediaries

Carriers' Ratings of the Technology Measures (statistical values)

ratings 0 = no more potential to 4 = very high potential

	Biofuels, HVO	Book and Claim	Electric MHDVs	Electric Vans	Hydrogen MHDVs	Gas MHDVs	Megatrucks (60+ t)
Rank weighted	1	4	2	3	5	5	7
# of ratings	3	3	3	2	3	3	1
% of group	75%	75%	75%	50%	75%	75%	25%
Mean	3.7	2.7	3.0	3.5	0.7	0.7	1.0
Mean weighted	3.4	2.5	2.8	2.6	0.6	0.6	0.4
Median	4.0	3.0	3.0	3.5	1.0	1.0	1.0
Min	3	1	2	3	0	0	1
Max	4	4	4	4	1	1	1
St Dev	0.5	1.2	0.8	0.5	0.5	0.5	0.0

Data from 4 Carriers

Figure 27: Ratings of the Technology Measures by Shippers, Intermediaries, and Carriers

The high potential of **Biofuels, HVO** got largely confirmed across the three groups with ratings ranging from a weighted mean of 3.6 for Intermediaries to 3.3 for Shippers. Even though the expectations toward Biofuels, HVO are fairly high, interviewees from all groups pointed towards the varying availability in countries, which still poses limitations and gives rise to the use of the Book and Claim mechanism. Particularly some Shippers raised concerns linked to certain types of Biofuels that use food crops as a feedstock or that cause indirect land use changes. For some interviewees of all groups, and mainly for Shippers, Biofuels constitute only a transitionary and relatively easier solution as long as truck electrification still comes at high cost and with limitations from the lack of charging infrastructure.

The **Book and Claim** mechanism scored highest with Shippers, who gave it a weighted mean of 3.5, whereas Intermediaries rated it at 2.9 and Carriers at 2.5. Within the sub-groups, the divergence on Book and Claim is somewhat lower than the divergence in the preceding collective analysis: the standard deviation across all groups was at 1.4 (see Figure 27 on page 34); in the disaggregate analysis, it ranges from 0.9 for Shippers to 1.2 for Carriers. Intermediaries and Shippers who rated the measures highest explained that it allows them to close gaps in their road freight network where Biofuels are not available. Those who rated the measure lowest had different arguments: some Intermediaries and Shippers see complexities with setting up a reliable methodology; some Shippers see it as a lost opportunity to take real action within the own value chain. A recurring subject mainly with Shippers was the ineligibility to count the use of Book and Claim towards SBTi Targets as these apply the GHG Protocol's standards that exclude the all kinds of off-set and mass balancing measures.

Electric MHDVs scored similarly high across all groups; Intermediaries rated them highest with weighted mean of 3.2 and a fairly low spread (St Dev of 0.7). The ratings were often accompanied with comments on still existing barriers, primarily the high investment cost of electric HDVs and the lack of public charging infrastructure. Particularly those who operate long-distance and trans-border lanes are less optimistic about Electric HDVs' potential in the near term.

Among the three groups, Intermediaries have the highest expectations towards **Hydrogen MHDVs**, and rate them with a weighted mean value of 2.1, even though with a high divergence (St Dev of 1.3). This contrasts sharply with Carriers in this sample, who gave a weighted mean of 0.6 and largely converged on this low rating, with a standard deviation of 0.6. Shippers rated the technology at a weighted mean of 1.7, with the highest standard deviation (1.2) of all measures, and thus the least agreement within in the sub-group. While particularly for some Intermediaries, the hydrogen technology seems attractive due to the expected higher range and simplicity of refuelling, doubts about technology readiness and the availability of green hydrogen in the next years persist.

Similarly, as for Hydrogen MHDVs, **Gas MHDVs** score highest with Intermediaries (weighted mean of 1.6 and a high standard deviation of 1.1) but lowest with Carriers (0.6 and a low standard deviation of 0.5). In absolute numbers, the most 0-potential ratings come from those Shippers who consider gas, whether fossil or of biogenic origin, not a permanent climate solution.

Megatrucks of 60+ tonnes received the lowest number and the lowest rating from all groups; in this sample, particularly Shippers and a few Intermediaries stated they had them in operations in countries were admitted.

6.2.3 Summary overview of ratings of Efficiency and Technology Measures

Figure 28 shows an overview of the weighted mean values per measure and sub-group of the sample.

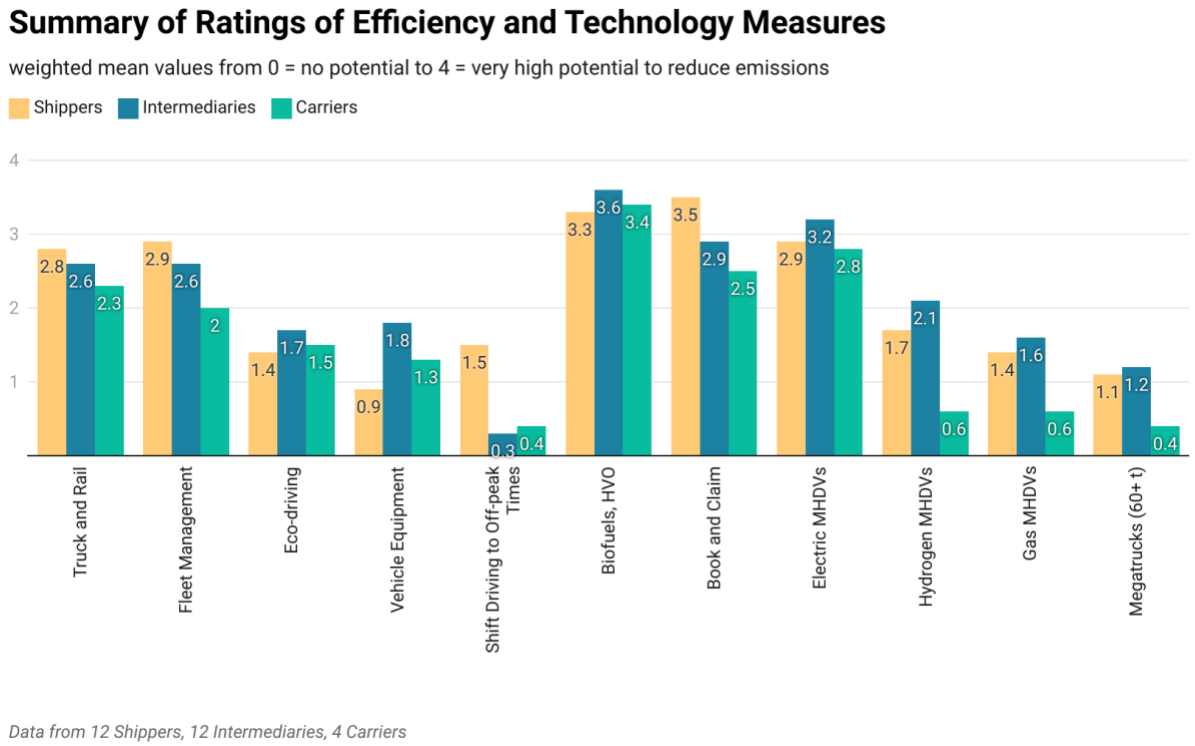


Figure 28: Summary overview of ratings of Efficiency and Technology Measures

Overall, Shippers and Intermediaries see a higher remaining potential for both, the Efficiency and the Technology Measures than do Carriers: the sum of weighted means per group is 10.6 for Shippers, 10.2 for Intermediaries, and only 7.9 for Carriers. For the Technology Measures, the sum of the weighted means is 16.8 for Intermediaries; Shippers follow with 13.9 and Carriers with 10.4.

Among the Efficiency Measures, all three groups rate the remaining potential of Truck and Rail and Fleet Management highest, even if at varying degrees. For the Technology Measures, Biofuels, HVO scores highest and with consistent ratings across groups; Book and Claim scores highest with Shippers but varies across the three groups, with the lowest ratings coming from Carriers; Electric MHDVs are third with consistently high ratings.

6.3 RQ2: What measures are buyers and providers taking with their value chain partners, and who drives the action ?

Interviewees were asked what measures they already implemented and in what context the implementation took place. The analysis mainly uses quantitative data collected with the questionnaire and was complemented with contextualizing comments provided by interviewees.

With only four Carriers in the sample, and two of them having asked for a shortened interview of 30 minutes, the data collected from Carriers on this research question is insufficient for a meaningful analysis and is therefore excluded. Building on the previous results from the rating of measures, the analyses for Shippers and Intermediaries excludes measures of low relevance to the sample: Shift Driving to Off-Peak Times is excluded from the analysis of Efficiency Measures; in the set of Technology Measures, Megatrucks and Cargo Bikes are excluded; Electric Vans are excluded from the Shippers' section as these play a minor role for five Shippers and no role for six Shippers (see chapter 6.1.1) yet included in the Intermediaries' section as they play a somewhat larger role for them (see chapter 6.1.2).

6.3.1 Shippers' action to reduce emissions from road freight

In this section, the findings on Shippers' ways to request lower-emissions services as well as on the measures they have implemented, on the actor who drove the action, their ways to procure the measures and their provider choices, and the eventual consequences of a failing request are presented.

Ways to requests lower-emissions services

When asked how Shippers request lower-emissions services, nine out of 12 Shippers stated that they do both: they request specific actions and they ask their providers for proposals. Four also stated that they would request lower-emissions services from their providers and leave it largely to them how to achieve this. This rather rare approach seems to be combined with setting provider performance indicators for emissions or requiring providers to set their own emissions targets, e.g., with SBTi.

Several Shippers, particularly those with a more concentrated sourcing approach and long-term relationships with their providers, stated that their providers also approached them pro-actively as these knew, after many years of a closer relationship, that the Shipper would likely be interested in implementing additional emissions reduction measures. Some Shippers mentioned that they consider providers with their own fleet better placed to work on emissions reduction measures with them.

Tendering as a procurement approach for specific measures is well-established for Truck and Rail services; also, for Biofuels, HVO, half of the Shippers state they include these in their tenders. Electric MHDVs are barely part of tenders—only two Shippers stated they used a tender to procure the measure—and implementation currently rather takes place as a joint initiative outside the structured procurement process. For Book and Claim, none of the Shippers stated that they have included the measure in their tendering. The measure is typically brought up for discussion with their providers outside the tendering process; one of the Shippers stated that it would be too complicated to include Book and Claim in a structured procurement for road freight services.

Action on Efficiency and Technology Measures

Figure 29 on page 38 shows Shippers' action on Efficiency and Technology Measures with their providers; the following Figure 30 indicates if the measure was implemented on the Shippers' request

or their provider's proposal, and if Shippers implemented the measures with an existing provider or with a new provider.

Shippers' action on Efficiency and Technology Measures

Number of times Shippers state ...

	Truck and Rail	Fleet Mgmt	Eco-driving	Vehicle Equipment	Biofuels, HVO	Book and Claim	Electric MHDVs	Hydrogen MHDVs	Gas MHDVs
... implemented with provider	10	7	1	0	9	7	10	0	4
... are planning to request	1	0	0	0	2	1	1	1	1
... their request failed	2	1	0	0	1	1	2	1	0
... are still deciding	0	0	0	0	1	2	0	0	0
# of engaged Shippers	12	7	1	0	11	9	11	2	5

Data from 12 Shippers; multiple answers per interviewee possible to account for different cases with different providers; "# of engaged Shippers" is the number of Shippers who implemented, are planning to implement, and requested the measure but failed so far.

Figure 29: Shippers' action on Efficiency and Technology Measures

Provider choices and initiative

Number of Shippers who state they implemented the measure ...

	Truck and Rail	Fleet Mgmt	Eco-driving	Vehicle Equipment	Biofuels, HVO	Book and Claim	Electric MHDVs	Hydrogen MHDVs	Gas MHDVs
... following their own request	7	5	0	0	9	7	9	0	4
... following their provider's proposal	5	3	1	0	3	2	5	0	2
... with existing provider	6	4	1	0	9	7	8	0	4
... with a new provider	2	0	0	0	2	0	2	0	1
# of engaged Shippers	12	7	1	0	11	9	11	2	5

Data from 12 Shippers; multiple answers per interviewee possible to account for different cases with different providers; "# of engaged Shippers" is the number of Shippers who implemented, are planning to implement, and requested the measure but failed so far.

Figure 30: Shippers' provider choices and drivers of the action

In the set of Efficiency Measures, Shippers' actions mainly focus on **Truck and Rail; Fleet Management** ranges considerably behind, which does not align well with their high ratings of the measure. Shippers do not actively engage in **Eco-driving** (with one reported case) nor **Vehicle Equipment**. Among the Technology Measures, Shippers are most often engaged in **Electric MHDVs**, **Biofuels, HVO** and **Book and Claim**. Given **Hydrogen MHDVs** and green hydrogen's low to non-existing availability, none of the Shippers in this sample has made any experiences yet.

All 12 Shippers in the sample are engaged in **Truck and Rail**, even though at different stages. These findings are in line with the high ratings Shippers gave this measure (weighted mean of 2.8; for details, see Figure 25 on page 31). The initiative to implement Truck and Rail comes almost as often from their providers as from the Shippers themselves—five Shippers stated they implemented the measure following their provider's proposal, seven stated it was following their own request (multiple mentions per Shippers were possible).

For **Fleet Management**, seven Shippers state that they actively engage in the implementation of this measure. These findings diverge from Shippers' consistent high ratings of Fleet Management (10 Shippers rate the measure with a weighted mean of 2.9, resulting in a weighted rank 1, with ratings ranging from 2 to 4) and may suggest a gap between the Shippers' perceived potential of the measure and their active engagement.

As already suggested by the few and rather low ratings for **Eco-driving** and **Vehicle Equipment**, Shippers do not engage in action on these measures; some of them stated however it would be part of their checklist requirements when qualifying providers.

In the case of **Biofuels**, **HVO,** which is in use by nine Shippers, the initiative came more often from the Shippers than from their providers: the nine stated that they implemented the measure following their own initiative, while only three reported that also providers approached them with a proposal. The high adoption rate of Biofuels, HVO, even though at different degrees and ranging from recent adopters to heavy users, aligns well with Shippers' high rating of the potential of this measures (weighted mean and mean of 3.3, see details in Figure 27 on page 34).

Ten Shippers stated that they are engaged, at different early stages, in **Electric MHDVs**; one is still planning to request the measure. While nine of them stated that they actively requested this measure, five also report the initiative coming from their providers. Two complementary explanations for their providers stronger engagement with a relatively complex measure seems intuitive: First, when Electric MHDVs only recently became mature for commercial deployment providers probably already have made experiences with the Shippers in implementing other emissions reductions measures, and knew that some of the Shippers were likely to be interested and anticipated their request. Second, Intermediaries may have seen their presumably 'willing' clients as an opportunity also for themselves, to run pilots in which also they can learn and prepare for the broader integration of Electric MHDVs to their fleet.

The somewhat lower number of Shippers who implemented **Book and Claim** (despite the high rating for this measure with rank 1, weighted mean of 3.5) may well be explained with the relatively recent introduction of the mechanism to road freight. Also, using Book and Claim directly with a provider requires that the provider has biofuels or other low to zero emissions vehicle technologies in operation, has built up a stock of unclaimed emissions savings, and has a reliable and transparent mechanism for accounting. The increased level of complexity may also explain the low level of providers' initiative in proposing the measure. Only two Shippers reported that the provider proposed the measures, whereas seven Shippers stated the implementation was on their initiative.

Shippers engaged in **Gas MHDVs** are also those who rated the measure above the mean and weighted mean of 1.4. Seven of the Shippers do not have any intentions to use Gas MHDVs.

The findings in Figure 30 on page 38 also show that Shippers implement measures to reduce emissions more often with an existing provider than they turn to a new provider for this purpose. Only a few Shippers stated to systematically consult also new providers to see what these can offer. For most of the Shippers, new providers only come into play when existing providers were permanently unable to provide the requested service or when a new provider approached them with attractive proposals for specific measures.

Overall, only few Shippers reported failed requests for Truck and Rail, Biofuels, HVO, Electric MHDVs, and Book and Claim (see Figure 29 on page 38). In most cases, Shippers stated that they would keep working with the provider as they did before even if their request failed. One of the Shippers stated to have reduced a provider's volume as a consequence for his inability to provide a lower-emissions service; one stated that he replaced the provider. Interviewees provided several explicit and implicit explanations for the low rate of failure and consequences. First, many Shippers in this sample seem to have sticky relationships with their providers; this was already indicated by the contextual information

on sourcing approaches (for details, see chapter 6.1.1), where Shippers stated that contracts with the same providers often get renewed, and that they worked with a limited number of providers. Second, the Shippers in this sample may well be important clients to their providers, which encourages the latter to meet their client's expectations. Third, listing new providers with Shippers' strict compliance, safety, and quality requirements—as some of them reported—can be a lengthy process and giving up an approved provider 'only' for his current inability to provide a specific lower-emissions measure may in some cases be less attractive than waiting for the provider to develop the needed capacities.

6.3.2 Intermediaries' action to reduce emissions from road freight

This section presents the findings on Intermediaries' reported client requests, the action Intermediaries take with their carriers, the drivers behind their actions, and their experiences with consequences on failing client requests are presented.

Reported client requests

Intermediaries were asked about the client requests received over the last three years. All of them stated that they receive requests for lower-emissions road freight services; seven stated to receive 'some requests', five reported 'many requests'.

Intermediaries all pointed out that even though these requests increased over the last one or two years, they still made up a small part in the overall demand for road freight services. They largely converged that requests primarily come from larger companies that report emissions or want to start doing so, and from companies operating in a business with high exposure to consumers.

Particularly Intermediaries who report 'many request' stated that these requests are more often unspecified, i.e., clients more often ask for *a* measure than for a *specific* measure to reduce emissions. Intermediaries also report that they had the impression clients request measures for information, not necessarily with the actual intention to implement the measure.

Figure 31 shows the requests Intermediaries report to receive for Efficiency and Technology Measures.

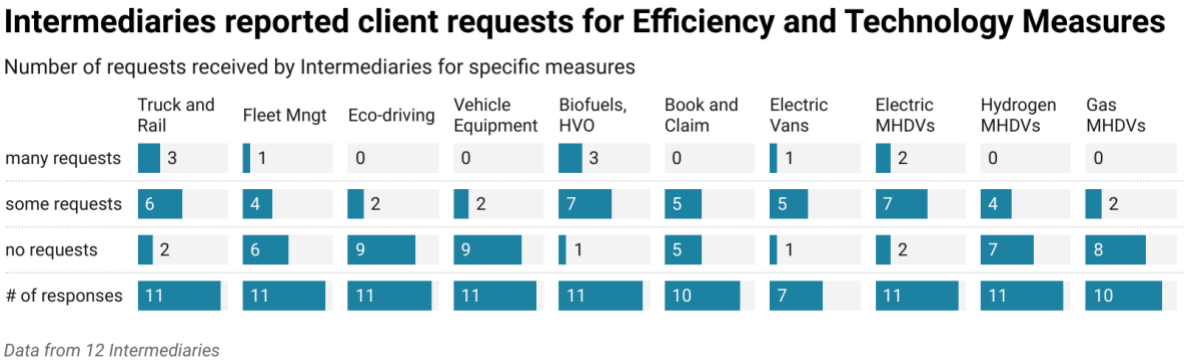


Figure 31: Intermediaries' reported client requests for Efficiency and Technology Measures

Among the Efficiency Measures, clients ask most frequently for **Truck and Rail** as reported by nine Intermediaries who receive some (6) or many (3) requests. **Fleet Management** follows considerably behind, while **Eco-driving** and **Vehicle Equipment** largely play no role in clients' requests.

In the group of Technology Measures, Intermediaries receive most requests for **Biofuels, HVO** and for **Electric MHDVs** and, at a lower level, **Electric Vans** (considering that these play a less important role in

the vehicle portfolio of these Intermediaries, also see chapter 6.1.2). Intermediaries who receive requests for **Hydrogen MHDVs** state that this is mostly out of a client's curiosity rather than backed by true intention. **Gas MHDVs** get the least requests. Experiences with requests for **Book and Claim** vary greatly across the sample, with half of the respondents reporting 'some requests' and the other half stating to receive 'no requests'. Geographic location may partly explain the difference as Book and Claim has typically been in use in combination with HVO, Biofuels, which are recent to some geographies and more established in others. Several Intermediaries also report that many clients are not aware of the existence of this mechanism or have limited knowledge of its functioning.

Overall, the findings from the Intermediaries align relatively well with the findings on Shippers' actions discussed in the above.

Measures that fail on the way from a client's request towards implementation are most often Biofuels, HVO and Electric MHDVs. The reasons for this are primarily the additional cost, which clients may not have expected or for which they have not planned any budget in the ongoing year. Second, particularly Electric MHDVs require substantial up-front analysis to identify the feasible use-case, and a request may turn out to require changes in operations or simply not being feasible on certain lanes. This is often linked to external factors, predominantly the availability of charging infrastructure. For Biofuels, HVO, different levels of availabilities in countries and along lanes pose constraints and may lead to failing requests, also if the client does not accept Book and Claim or the Intermediary is not in the position to offer the mechanism. For Book and Claim, and due to its novelty to the sector, Intermediaries who offer it (eventually with their own fleet) also report a lack of understanding on the client's side.

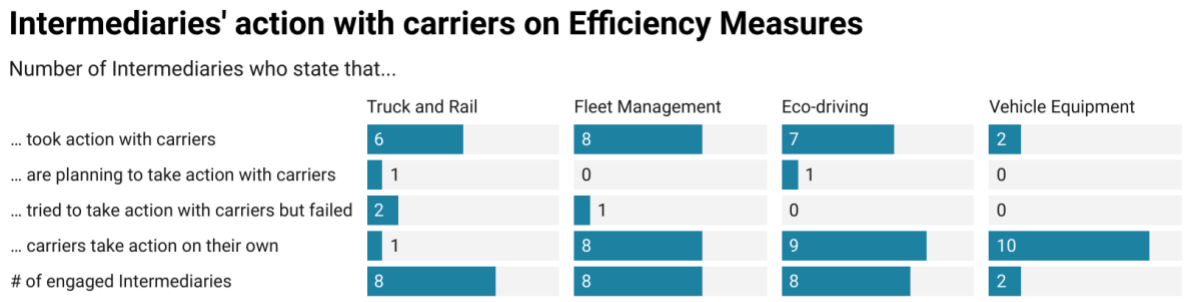
For the Efficiency Measures, Truck and Rail—high rated, often requested—is also a measure which can fail on the way from request to implementation, particularly with clients who are new to rail and see difficulties with longer lead-times and eventual uncertainties related to the rail network's capacity.

In line with Shippers' reporting that it has so far not had many consequences when providers could not deliver on their request, Intermediaries report minimal to no consequences; two Intermediaries reported that the client reduced volume, and one lost a prospective client for his inability to provide a certain service. Intermediaries also report that their clients communicate their expectations to develop certain capacities in the future.

Except for the specific case of Truck and Rail, several Intermediaries in this sample are rather confident that, if they cannot find a solution to a request, it is not very likely that a different provider can do so. This confidence seems to occur more often with Intermediaries who also own a fleet, and who may rely on their own capabilities as a fallback position. Regardless of whether Intermediaries own a fleet or not, they generally see their ability to provide low-emissions services as a competitive advantage with a small but important group of clients, and as a decisive factor for their ability to keep these clients.

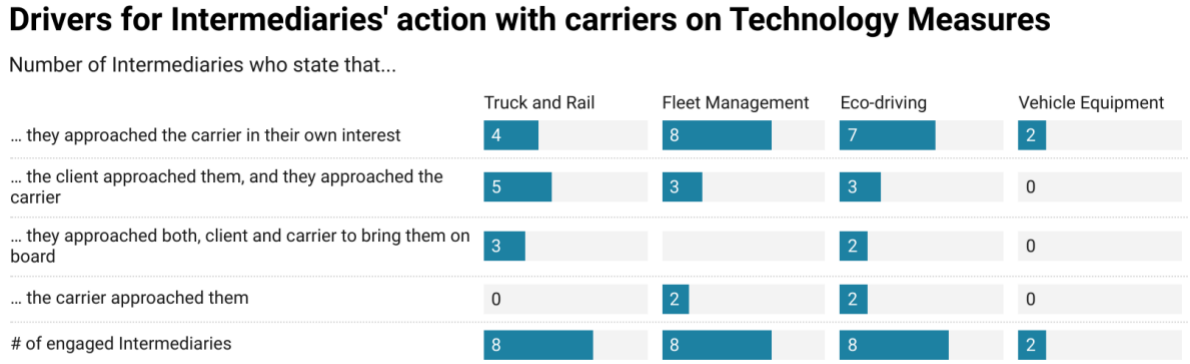
Action with carriers on Efficiency Measures

Intermediaries' action on Efficiency Measures with carriers are shown in Figure 32 on page 42; the drivers for these actions are shown in the following Figure 33.



Data from 12 Intermediaries; multiple answers per interviewee possible to account for multiple cases; "took action" and "planning to take action" are mutually exclusive to distinguish experience and intention; "# of engaged Intermediaries" is the number of Intermediaries who took action, are planning to take action or tried to take action with carriers but failed.

Figure 32: Intermediaries' action with carriers on Efficiency Measures



Data from 12 Intermediaries; multiple answers per interviewee possible to account for multiple cases; "# of engaged Intermediaries" is the number of Intermediaries who took action, are planning to take action or tried to take action with carriers but failed.

Figure 33: Drivers for Intermediaries' action with carriers on Efficiency Measures

Among the Efficiency Measures, Intermediaries are most often engaged with their carriers in **Fleet Management**. Eight Intermediaries stated to have taken action with carriers, and eight stated that carriers take action on their own. It is notable that the four who have not taken action with their carriers in the past have no plans to do so in the future. If Intermediaries take the initiative to work on Fleet Management with their carriers, it is mainly driven by their own interest; only three stated their action was driven by a client request. Intermediaries' relatively high rating of the remaining potential of Fleet Management (weighted mean 2.6, see details in Figure 25 on page 31) in combination with their high reported engagement—eight of them stated to be engaged with carriers—and the fact that the Intermediaries who exclusively stated that carriers take action on their own also gave ratings from 2 to 4, raises questions to which the available information cannot provide more insights: Intermediaries who are engaged with carriers do not seem to achieve satisfactory results, otherwise they would not state the measure has a high remaining potential; Intermediaries who are not engaged with carriers but rate the measure high in potential do not seem to see it in their agency or interest to act on the potential. If Intermediaries saw room for action together with the shipper, it is not clear why none of them stated to have taken the initiative in approaching both, the client and the carrier.

Truck and Rail can be an area where Intermediaries take action with their carriers; those who also own a fleet tend to use their own vehicles in the first place. While Truck and Rail is often driven by a client's request, Intermediaries also approach their carriers out of their own interest to build up their offer.

Failures in taking action with carriers for Truck and Rail were reported by two Intermediaries and due to carriers' unwillingness to forgo their driving activity.

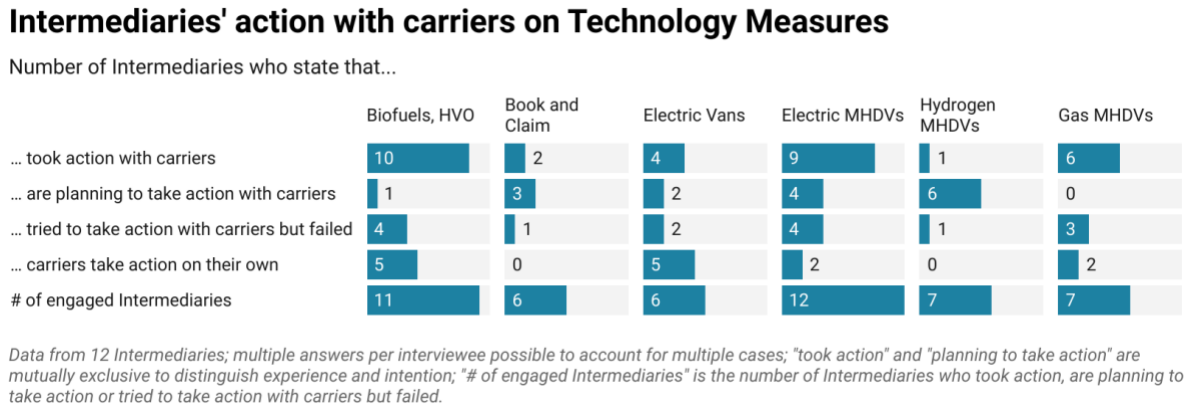
Eight Intermediaries are engaged with their carriers on **Eco-driving;** nine Intermediaries stated that carriers (also) take action on their own. Similarly, as for Fleet Management, Intermediaries' action with carriers on Eco-driving is mainly driven by their own interest, rather than a client request.

Vehicle Equipment is, according to ten out of 12 Intermediaries, an area of carriers' own action. Only two stated that they worked with their carriers on this measure. In line with the findings from Shippers (see Figure 29 on page 38), clients play no role in driving this action. Given Intermediaries' believe that this area still holds some potential—they rated the measure at a mean and weighted mean of 1.8, similar as Eco-driving in which they engage more often—this raises the question why Intermediaries do not engage more with their carriers also in Vehicle Equipment.

Overall, Intermediaries reported very few occasions where carriers approached them to work on any of these measures (Fleet Management and Eco-driving received two mentions each).

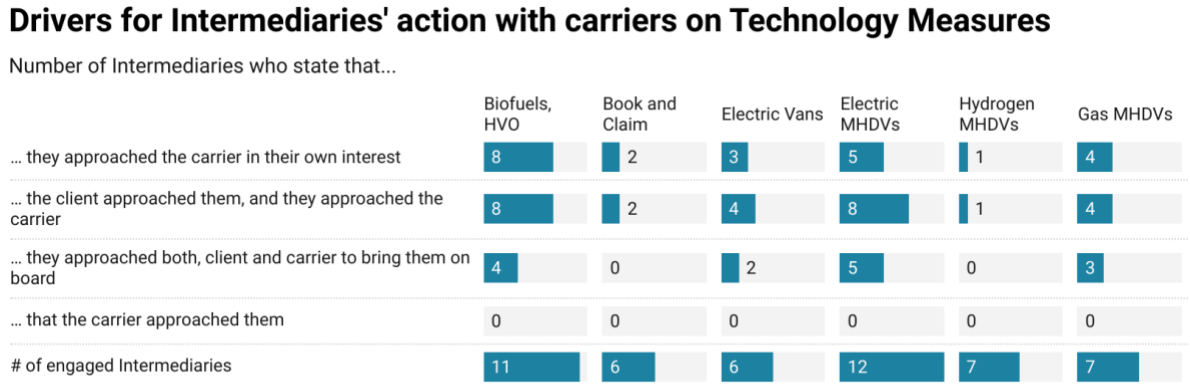
Action with carriers on Technology Measures

Figure 34 shows Intermediaries' action with carriers on Technology Measures; the drivers for their action are shown in Figure 35.



Data from 12 Intermediaries; multiple answers per interviewee possible to account for multiple cases; "took action" and "planning to take action" are mutually exclusive to distinguish experience and intention; "# of engaged Intermediaries" is the number of Intermediaries who took action, are planning to take action or tried to take action with carriers but failed.

Figure 34: Intermediaries' action with carriers on Technology Measures



Data from 12 Intermediaries; multiple answers per interviewee possible to account for multiple cases; "# of engaged Intermediaries" is the number of Intermediaries who took action, are planning to take action or tried to take action with carriers but failed.

Figure 35: Drivers for Intermediaries' action with carriers on Technology Measures

Among the Technology Measures, Intermediaries most often engage with their carriers on **Biofuels, HVO** and **Electric MHDVs**. Intermediaries reported less cases where carriers take action on their own (five for the case of Biofuels, HVO, two for the case of Electric MHDVs). The nine Intermediaries who took action on Electric MHDVs with their carriers are still at an early stage; client requests are the largest driver for Intermediaries to take action with carriers. Even though at a lower level, Intermediaries also take initiative to get clients and carries on board for the deployment of Electric MHDVs (also for Electric Vans) and for Biofuels, HVO. Intermediaries also reported taking action with their carrier on Biofuels, HVO out of their own interest, though it remained somewhat unclear what purpose this action serves if no client is involved, and if Book and Claim is not connected to the action (also see the discussion further below). Those who approached clients and carriers for Biofuels, HVO and for Electric MHDVs often explained this with the need and opportunity to get ready for new market demands, and their initiative in addressing clients whom they suspect interested in the measures.

Intermediaries who have not taken action yet in Electric MHDVs and Biofuels, HVO with carriers are planning to do so in the future (with one explicit exception for Biofuels, HVO). For both measures, Intermediaries also reported a relatively high rate of failure when trying to take action with carriers. For the case of Biofuels, HVO, this mainly goes back to increased reporting requirements (certificates) for the purchase and use of biofuels which carriers may not be qualified or willing to do. Also, Intermediaries' lack of control over purchase and consumption of these fuels is reported as a reason. Few Intermediaries report a lack of carriers' knowledge about the fuels and their (unjustified) fear of impact on engines. For Electric MHDVs, investment cost and uncertainties related to the investment are the primary reasons for failing action with carriers; also, carriers' lack of knowledge or unwillingness to adjust to operational requirements of Electric MHDVs were reported as obstacles in working with carriers. Intermediaries with their own fleet consistently report to take action on Biofuels, HVO and Electric MHDVs first internally before turning to their carriers.

Book and Claim, which had a weighted mean of 2.9 and ranked 3rd in Intermediaries' rating of potential is still a novice area for action with carriers. Interestingly, the two intermediaries who stated that they work with their carriers on the measure, do not own a fleet. As for Biofuels, HVO and Electric MHDVs, Intermediaries with their own fleet implement Book and Claim first in this context.

For **Electric Vans**, five Intermediaries reported that carriers take action on their own; this is driven by the meanwhile competitive total cost of ownership (TCO) of the technology, and by tightening urban regulation on emissions zones.

Gas MHDVs have been an area for Intermediaries' action and failure with carriers; it is also the only vehicle technology for which no Intermediary stated that he would be planning to take action with carriers in the future. This seems partly to be driven by changing external conditions, such as the steep increase in gas prices and ending of financial incentives in some countries (e.g., road toll exemption).

Hydrogen MHDVs are, for the above-mentioned reasons, still an area of intention rather than of experience. Six Intermediaries stated they would start working on it with their carriers once the technology is mature for commercial deployment.

6.3.3 Summary overview of findings regarding action on implementation

Shippers take mainly two approaches when requesting lower-emissions services: they ask for specific action, and they consult their providers for proposals. Following Intermediaries' reports, clients, in general, more often ask for *a* measure, than they ask for a *specific* measure. The more mature a measure, the more likely it is to be part of a structured procurement process like a tender. Measures that are recent to the market or that are new for the procuring party are most likely to be implemented as a joint initiative outside the structured procurement process.

Shippers tend to implement their measures primarily with an existing provider. Failing requests were barely reported by Shippers and if so, they rarely lead consequences, such as the replacement of the provider of the reduction of volumes. Intermediaries largely confirmed that, so far, failing requests have had few consequences; they also reported that requests most often fail due to increased costs which buyers are not willing to pay, or due to external factors that are prohibitive to the implementation.

Shippers in this sample most often engage in Truck and Rail, Electric MHDVs, and Biofuels, HVO. Book and Claim and Fleet Management follow behind. This is largely echoed by Intermediaries who reported a similar distribution of requests. Shippers do not actively engage with their providers in Eco-driving and Vehicle Equipment; Intermediaries reported to receive little interests from shippers for these measures.

If Intermediaries take action on Efficiency Measures with carriers, it is most often in Fleet Management, Truck and Rail, and Eco-driving; with the exception of Truck and Rail, Intermediaries report that carriers equally take action on their own, even more so in Eco-driving. In the Technology Measures, Intermediaries' action with carriers focuses on Biofuels, HVO and Electric MHDVs. Book and Claim is not yet an active field of engagement with carriers. Intermediaries reported that carriers do not take the initiative in approaching them to work on measures, even less so in the case of Technology Measures.

Overall, Shippers reported more cases where the implementation of a measure followed their own initiative rather than a providers' proposal. If providers take initiative, it is most often in proposing Truck and Rail and Electric MHDVs to Shippers. Intermediaries reported that client requests are likely to drive their action with carriers on Electric MHDVs and Biofuels, HVO; they reported that also their own interest drives their work on Biofuels, HVO, Fleet Management, and Eco-driving with carriers.

While the action on implementation for Truck and Rail, Electric MHDVs, and Biofuels, HVO for both, Shippers and Intermediaries, largely aligns with the high potential ratings, gaps between action and potential rating exist primarily for Book and Claim and with Fleet Management. For Book and Claim, this gap can most likely be explained with the nascent emergence of the mechanism on the one side, and Intermediaries prioritisation of action with their own fleet on the other side (eight Intermediaries in the sample also operate their own fleet). For Fleet Management, the gaps between the high ratings and the action on implementation cannot be explained with the available data.

Findings also show that Intermediaries that own a fleet prioritise action within their own fleet, before they take action with carriers. Also, asset-owning Intermediaries seem to be more confident that they can find a way to satisfy their clients' requests, given these are reasonable. Several Shippers tend to see asset-owning providers as the better-placed partner to adopt primarily measures that require a change in technology .

6.4 RQ3a: Which mitigation measures require more collaboration than traditional buyer-provider relationships ?

Interviewees were asked which of the measures they were engaged in required more collaboration than a traditional road freight buyer – provider relationship. The answer categories contained 'more collaboration is absolutely needed', 'more collaboration can make it easier' and 'more collaboration is not needed, it is business as usual (BAU)'.

The question was only asked to those interviewees who previously stated having implemented the measure together with their value chain partners (Shippers with their providers, Intermediaries with their carriers) in the case of Efficiency Measures (see results presented in chapter 6.3) and to those who rated the Technology Measures at a potential of 2 and higher on the scale from 0 = no potential to 4 = very high potential (see results presented in chapter 6.2).

With no Shippers engaging in Vehicle Equipment, no results are available to this question for this measure. In the case of Intermediaries, only two reported to engage with carriers; given the low relevance, these findings are excluded in the following. While only one Shipper reported to engage with providers in Eco-driving, findings are maintained in the interest of consistency with the presentation of Intermediaries' results. As in earlier findings, Shift Driving to Off-Peak Times remains excluded given its irrelevance.

In addition to the Technology Measures that were excluded from previous analyses for their low relevance (Megatrucks, Cargo Bikes), Hydrogen MHDVs are excluded from this analysis as only one of the actors in the sample has an actual experience in implementation. Electric Vans are excluded for Shippers for the low relevance, and maintained for Intermediaries (also see chapter 6.1).

Data collected from Carriers is insufficient to provide a meaningful analysis.

6.4.1 Need for collaboration on Efficiency Measures

Figure 36 on page 47 shows the perceived need for collaboration on Efficiency Measures from the perspectives of Shippers and Intermediaries.

For **Truck and Rail**, over half of the engaged Shippers (seven out of 12) stated that more collaboration with the provider is absolutely needed; only three of them consider it as BAU. Also, Intermediaries see the need for more collaboration with shippers, though to a slightly lower extent (it should be noted that the group of engaged Intermediaries is only eight and results are hence less robust than those from 12 Shippers).

Looking at the perceived need for collaboration between Intermediaries and their carriers, four out of six Intermediaries who offer Truck and Rail services together with carriers state that no more collaboration than BAU is needed. Those who stated that more collaboration is needed, found for example difficulties in convincing carriers to give up a part of their driving activity. While interpretations need to be made with care, it can well be that Intermediaries who have offered the service for a long time and at a certain scale (this is the case for two of the four who stated their work with carriers is BAU) have a pool of carriers with whom they have worked in the field of Truck and Rail for many years, and processes and interfaces are likely to be well established.

For **Fleet Management**, again, the perceived need for collaboration by Shippers with their providers is somewhat higher than it is for Intermediaries with their shippers. While six out of seven engaged

Shippers stated that collaboration with their provider is absolutely needed or can make it easier, half of the Intermediaries stated that Fleet Management would not need more collaboration with shippers than BAU. Half of the Intermediaries see a somewhat greater need for collaboration with their carriers; these respondents are not necessarily the same ones who stated that more collaboration with the shipper is needed.

For **Eco-driving,** the findings for Shippers are a result of their low engagement in this measure as shown previously. For Intermediaries, the results regarding the not needed collaboration with shippers largely aligns with previous findings. Intermediaries' views on the need for collaboration with carriers are divided: half (4) of the Intermediaries who stated they took action with carriers say that this does not require any kind of collaboration which goes beyond BAU; the other half sees a need for more collaboration.

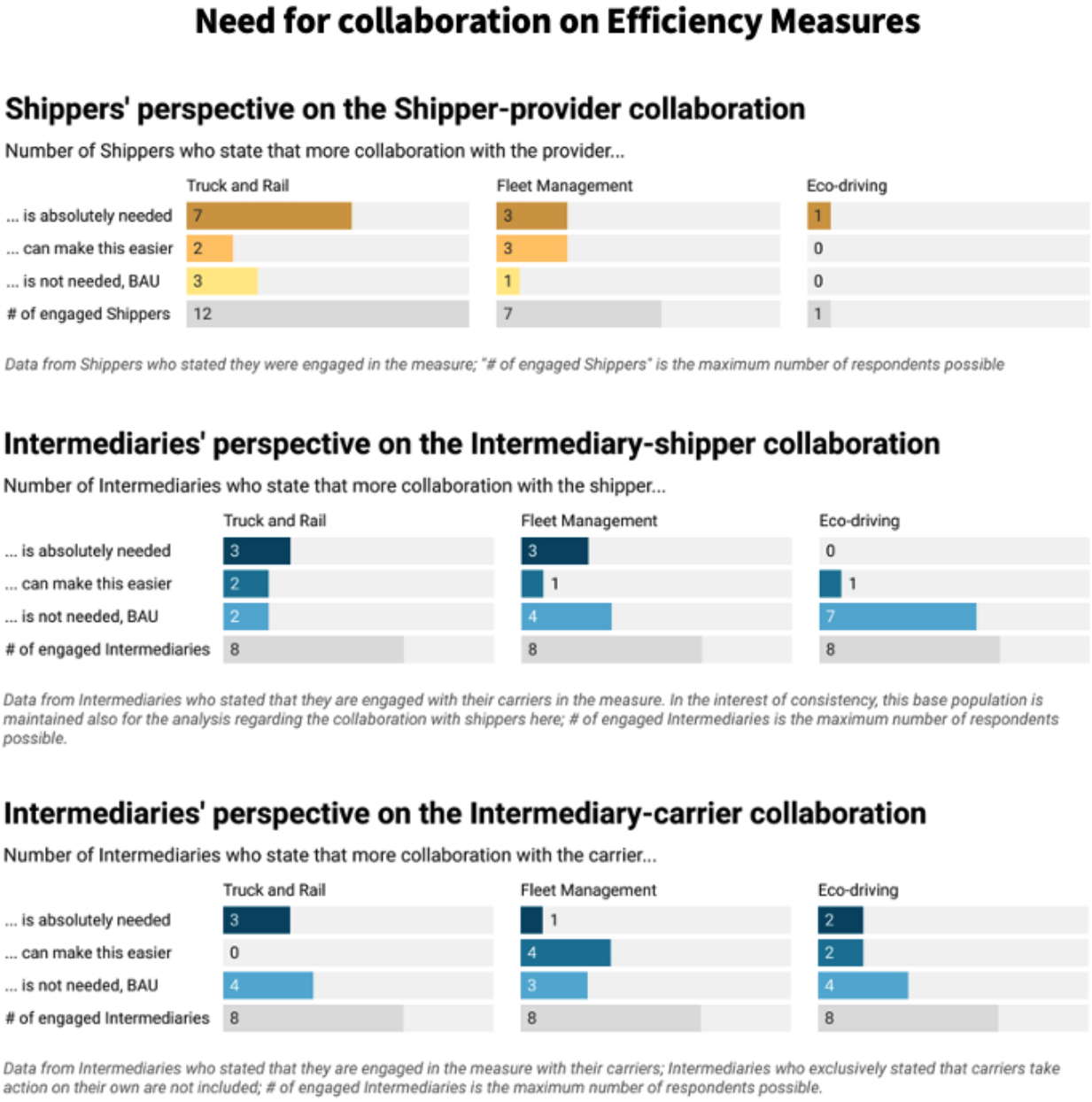


Figure 36: Need for collaboration on Efficiency Measures: Shippers' and Intermediaries' perspectives

6.4.2 Need for collaboration on Technology Measures

Figure 37 shows the perceived need for collaboration on Technology Measures from the perspectives of Shippers and Intermediaries.

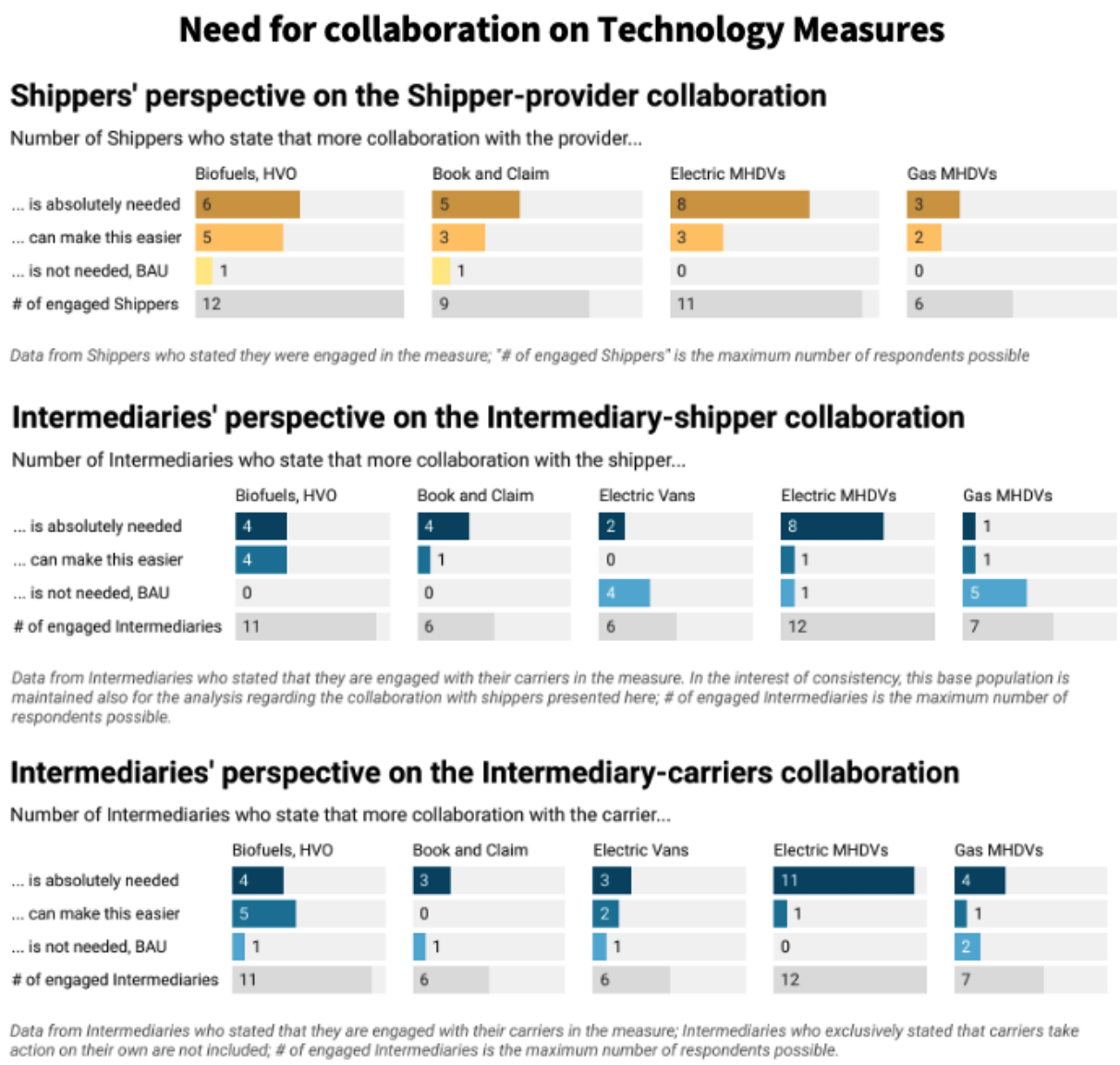


Figure 37: Need for collaboration on Technology Measures: Shippers' and Intermediaries' perspectives

All engaged Shippers stated that more collaboration is needed for **Electric MHDVs**; eight out of 11 stated that more collaboration would absolutely be needed. The large majority of Intermediaries equally stated that more collaboration is absolutely needed for Electric MHDVs with Shippers, and with even greater convergence, with carriers.

For **Biofuels**, **HVO** and **Book and Claim**, all Shippers except for one see a greater need for collaboration; however, a greater share of Shippers than in the case of Electric MHDVs stated that collaboration can make this easier, not that it is absolutely needed. Also, Intermediaries see a great need for collaboration for **Book and Claim**, somewhat more towards the shippers than with the carriers. It must be noted though that only two of the Intermediaries so far implemented Book and Claim with their carriers, not least due to some of the difficulties in documentation that Intermediaries already experienced when

taking action with carriers on Biofuels, HVO (the primary measure to be combined with Book and Claim.)

Biofuels, HVO scores similarly high with Intermediaries regarding the need for collaboration with shippers as it does for carriers, with about a third of Intermediaries stating it is absolutely needed and another third that it can make it easier.

For Shippers' perception of the need to for collaboration in case of **Gas MHDV**s, the split between 'more collaboration is absolutely needed' and 'can make this easier' is almost equal. Intermediaries see the need for collaboration with shippers on Gas MHDVs rather low, whereas collaboration with carriers is more needed.

For **Electric Vans**, Intermediaries' perceived need to collaborate with Shippers is, on average, on the lower side; in contrast, collaboration with carriers seems more necessary.

6.4.3 Summary overview on needs for collaboration

Overall, Shippers' perceived need to collaborate with their providers is greater than Intermediaries' perceived need to collaborate with shippers. The difference is most prominent with Truck and Rail, where Shippers see a much higher need to collaborate than Intermediaries do. Biofuels, HVO and Gas MHDVs follow in the list of measures where Shippers see more need to collaborate than do Intermediaries.

The greatest need for more collaboration is unanimously seen by Shippers and Intermediaries for Electric MHDVs. Book and Claim and Biofuels, HVO follow; Book and Claim is the only measure were Intermediaries see a greater need for collaboration than the Shippers in this sample do (considering 4 out of 6 Intermediaries think more collaboration is absolutely needed, compared to 5 out of 9 Shippers.)

The opinions on the need for more collaboration on Fleet Management are rather mixed, with Shippers leaning more to needed collaboration than Intermediaries, and the latter being split between 'is absolutely needed' and 'is BAU' when it comes to collaboration needs with shippers. In the case of Eco-driving, Shippers and Intermediaries converge around a low need for collaboration.

In the ranking of needs for collaboration between Intermediaries and their carriers, Electric MHDVs clearly lead the field. For the other Technology Measures, views on the need for more collaboration with carriers is somewhat divided for Biofuels, HVO and Electric Vans, which somewhat aligns with findings presented in chapter 6.3.2, where Intermediaries stated that carriers also take action on their own on these measures.

In the field of Efficiency Measures, Intermediaries' opinions on the need for collaboration with carriers are divided for Truck and Rail, which may be explained with the experiences in this line of business and the well-established processes with carriers they may have, compared to others who are rather new to this activity and face greater challenges with carriers. Fleet Management is not seen as a focus area for collaboration with carriers; opinions on Eco-driving are divided.

6.5 RQ3b: What areas and forms of collaborations are relevant for selected mitigation measures

The findings on areas and forms of collaborations were gathered mainly in the second and semi-structured part of the interviews; relevant comments and additions made during the survey-based part of the interviews are also considered. The use of filtering questions, and ultimately, interviewees' choice regarding the measures to be discussed in the context of collaboration (also see the methodology described in chapter 5.1) led to **Electric MHDVs, Biofuels, HVO**, and **Book and Claim** being the most often discussed measures (see Figure 38).

Also, **Emissions Accounting** (used here as an integrative terminology that includes all necessary sub-activities, like data collection, emissions calculation, emissions reporting) showed to have a cross-cutting and broader relevance to the implementation of emissions reduction measures in general which will be discussed in addition to the specific measures in its own sub-chapter.

Due to the filtering methodology, areas and forms of collaboration regarding the **Efficiency Measures** were less prominently discussed with interviewees; however, the insights collected along the research process are summarized, in a less structured way, in the last sub-chapter of this section.

To illustrate the findings, quotes from interviewees are used in an anonymized way where C stands for Carrier, I for Intermediary, and S for Shipper.

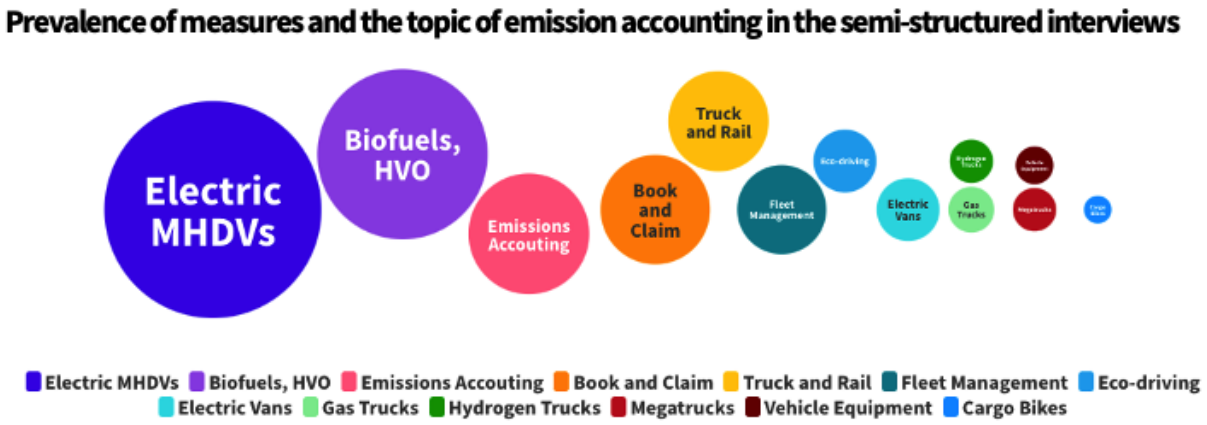


Figure 38: Prevalence of measures and the topic of emissions accounting in semi-structured interviews

6.5.1 Electric MHDVs

Interviewees collectively rated Electric MHDVs' potential high, with a weighted mean of 3.0 (see chapter 6.2.2). As the findings in chapter 6.4 showed, interviewees largely agreed that the implementation of Electric MHDVs requires the highest level of collaboration among all measures to reduce emissions. Ten Shippers and nine Intermediaries (only counting those who took action with carriers) in this sample have experience in implementing Electric MHDVs, even though at different stages: while some are just starting a first pilot, others already moved to permanent lane operations.

Challenges reported

The overview below lists the main challenges with Electric MHDVs, and which actors strive to mitigate through collaboration.

No	Challenge	Details
1	Financial requirements	higher CAPEX than a diesel truck (ca. 3 times as high)
2		additional CAPEX for charging infrastructure
3		as a result, higher total cost of ownership TCO (depending on use case and context conditions, with narrowing trend)
4		lack of financial capacity of smaller carriers
5	Operational limitations requiring planning and eventually changes	access to charging
6		planning of routes, battery charging times, driver breaks
7		impacts on lead times, loading and delivery windows
8	Lack of expertise	for all actors, more pronounced for shippers and smaller carriers

Challenges that lie outside the direct sphere of influence of the actors, but which determine the potential for implementation of Electric MHDVs as well as the need for collaborative action are availability of public charging, national patchworks and uncertainties with policies, including regulations and subsidies, grid capacity, battery range, reduced payload (due to additional weight of the battery), market uncertainty, i.e., evolution of cost and technology, second-hand value, model availability (though only reported for special vehicles).

Collaborative action to address financial challenges

Shippers pay a price premium (addressing challenges 1,2,3)

„Some of the eco-minded [shippers] are open to that. And whenever we've had a success, in 90% of the time, there's a premium in price involved." (I7)

Interviewees largely agreed that the use of Electric MHDVs comes with a price premium on top of the regular transport rate to be paid by the client. All Shippers beyond the pilot stage report to pay a price premium. Intermediaries report that typically uninformed clients or those who seek a marketing activity rather than an emissions reduction strategy, lack the willingness to pay this premium and the discussion usually stops there. It remained unclear from the interviews if the price premium is entirely shifted to the shippers or if carriers and intermediaries swallow parts of it; at least in pilot projects, the latter was reported to occur.

Value chain partners can use an open book approach to allocate costs (addressing challenges 1,2,3)

„We have this open book approach [with our provider]. How much is the cost of the vehicle? They show the cost of the driver, everything that is related to operating that truck. And then we say, what is the daily cost to use the electric truck." (S8)

Electric MHDVs' cost structure is considerably different from a diesel truck's cost structure: higher initial capital expenditure (CAPEX) and lower operational cost (OPEX) (also see ECG Business Intelligence, 2022). In the case of diesel trucks, the total cost of ownerships (TCO) is mainly driven by OPEX, particularly fuel cost. With electric trucks, the TCO is largely driven by the CAPEX while OPEX is lower. Understanding the cost structure and how it can be reflected in a transport rate requires greater transparency between the buyer and the provider of the service. A few interviewees from all three sub-groups reported to therefore having introduced an open-book approach.

Shippers provide longer contracts (addressing challenges 1,2,3)

„We commit to use it [electric truck] long enough that it pays off. I think it is five years." (S9)

As presented in chapter 6.1, transport contracts typically have a duration of one year, in fewer cases, two to three years; also undefined open framework agreements are in use. These arrangements still pose challenges with the implementation of Electric MHDVs as carriers seek certainty that they can recover the investment from the operations of the vehicle with this specific client. The shorter the contract, the shorter the assumed depreciation period and the higher—and unattractive—the resulting transport rate. Similarly in the case of leasing arrangements with OEMs, the lease taker would seek a duration of the road freight contract that is similar, if not equal, to the leasing contract.

Interviewees' indications of requested contract durations largely converge around five years, few report seven years, few report three years. Several Shippers stated that they extended contracts for the implementation of Electric MHDVs or are considering doing so. For some Shippers though, it is not (yet) an option:

„Carriers ask a contract o five or six years with us. And we don't want to put five- or six-years contract because we update the tariff once a year. So, it's a blocking point." (S7)

It seems that a few of the Intermediaries with their own fleet invest in Electric MHDVs also in anticipation of future business opportunities, not only based on committed long-year contracts with clients. This does not seem to be the case for agreements with their carriers, neither for those with fleets nor for the fully asset-light intermediaries.

„It [the electric truck] has to be associated to a shipper. We would not contract them [the carriers] for seven years just for ourselves." (I9)

Shippers take part in charging infrastructure, Intermediaries may facilitate financing of their carriers' electric truck (addressing challenges 2, 4)

The readiness to participate in the investments for Electric MDHVs or their charging infrastructure varies across the sub-groups and within them. For Shippers, getting involved in their provider's truck financing is not an option; however, investing in the installation of charging infrastructure at their premises is a reality for some and a possibility for others—ranging from covering the entire investment to only the cost of installation and cabling, and with different transfer of ownership arrangements.

For some Intermediaries, facilitating the financing of vehicles for their carriers is an option:

„The hardest thing with our carriers is the investment we ask them to make [in the electric truck]; they don't have the financial resources to do it. That's where we want to help them a little bit."(I1)

Three Intermediaries stated they were actively looking for a feasible model to support their carriers in the investment, yet they also reported legal challenges that vary across countries. One Intermediary found a solution with the set-up of a dedicated legal entity which acquires electric trucks to lease them on to carriers. While this solution requires substantial liquidity, it is grounded on a clear separation of roles and control, reducing the potential for conflict of interest.

Intermediaries with their own warehouses and those who operate an own fleet are likely to invest in charging stations, and to give their external carriers access to those. Also, some of them see the possibility to use their market power when negotiating prices with OEMs for their own fleet also in the interest of their carriers. Intermediaries without a fleet and warehouses, who are not in the business of managing assets, seem least likely to burden their balance sheet with investments in charging infrastructure or in vehicles.

Collaborative action to address operational challenges

Joint planning and shippers' acceptance of change (addressing challenges 5,6,7)

> *„It's important to be very clear with the differences from the business as usual [when using Electric MHDVs] from the provider and from the shipper perspective." (S2)*

Even with depot charging and closed loop operations as a response to the lack of public charging infrastructure, interviewees largely reported that the use of Electric MHDVs requires the alignment of several factors and eventual changes in operations: lanes that are suitable for electrification must allow to match battery range, charging times, and driver breaks. Reduced payloads may have to be taken into consideration as well as lead times and loading and delivery windows. Most of the Intermediaries and the Carriers with experience in operating electric trucks believe that it is essential to involve shippers in the planning, so that they can support eventual changes to the existing operations:

> *"You need the client to get on board; it does not always work with existing operations." (I7)*

Shippers who have already implemented Electric MHDVs share the view that it requires changes:

> *"An electric transport network is very different; and it requires flexibility on behalf of shippers. If we didn't change, I don't think we could do it at reasonable cost." (S3)*

These changes may require some effort on the shipper's side. It should be noted though that also in this sample, the share of Electric MHDVs in overall road freight is still small, and greater integration is likely to require a broader transformation, especially with longer-distance operations that are currently still hindered by the lack of public charging infrastructure.

Collaborative action to address lack of expertise

Knowledge sharing and acceptance of the 'learning journey' (addressing challenge 8)

As can be expected with the recent deployment of electric trucks, several interviewees reported that the lack of expertise on different sides poses challenges. Intermediaries and Carriers most frequently stated that shippers lack understanding of the implications of the use of Electric MHDVs, and that many of the requests they received ran dry once shippers learned more about cost eventual changes to operations or limitations. Some Intermediaries reported gaps in knowledge particularly with their

mainly small carriers. Much of the work in filling the knowledge gap is taken on by experienced Intermediaries.

> *"We are doing quite some education on both sides; we sometimes see that our clients talk directly with the carriers [about the potential use of an electric truck]; and what comes out of it may not be feasible at all." (I2)*

Shippers in this sample do not seem to match Intermediaries' description of the 'uninformed shipper'. They largely demonstrated awareness of their own knowledge gaps particularly at the early stages of the implementation. Some of them mentioned their own initiatives to fill gaps, seeking advice from OEMs and exchanging in dedicated networks. Their narrations about the first experiences often sounded like a 'learning journey' they accepted to go through.

> *"It is step by step; you need to pilot, to pivot, to change things so you can find the best way to do it." (S2)*

Intermediaries with their own fleet report to benefit from their piloting experiences and that they can use these learning in their collaboration with carriers. It is not fully clear how Intermediaries without own assets currently fill the gap in experience, or if their carriers with vehicles in use become their first source of experience.

6.5.2 Emissions Accounting

Most of the interviewees mentioned Emissions Accounting as a challenge which requires greater collaboration. This sub-section presents the overarching findings, independent from specific measures, and also aims to provide context for the specific discussions of challenges and areas for collaboration with measure where Emissions Accounting has particular challenges, i.e., Biofuels, HVO and Book and Claim in the following sub-chapters. The overview below summarizes the largely unsolved challenges.

Challenges reported

No	Challenge	Details
1	Differing methodologies	different ways to calculating emissions are in use, resulting in incomparable datasets
2	Lack of transparency	reluctance in the industry to share primary data, i.e., fuel consumption and activity information
3	Lack of capacity	particularly smaller providers do not have the knowledge nor personnel

(Missing) collaborative action

In the absence of a common methodology and lack of capacity of their providers, Shippers and Intermediaries revert to their own calculations

The approaches to calculating emissions have been somewhat converging over the last years. Several interviewees stated to use the GLEC (Global Logistics Emissions Council) framework which also informed the development of the recent ISO 14083 standard; yet different methodologies still exist. As

long as actors use different methodologies to calculate emissions, the comparability of the data remains limited.

"It depends very much on methodologies. You want to compare apples with apples. Here we are struggling; it is not possible if our providers use different methodologies." (S2)

In addition, not all providers, particularly the smaller ones, are able to do emissions calculations, no matter what methodology would be required. Also, the formats to present and communicate the data vary, leading to a substantive workload for those who consolidate data from various sources to report on scope 3.

"In the past, we asked carriers to provide their emissions; we gave them the GLEC framework to do that. But what we received was very different, using different emissions factors, different formats and so on. It was too much work to consolidate all this." (S12)

As a response, also Shippers and Intermediaries who stated to receive some emissions reports from their providers state not to use them; instead, all state to calculate the emissions from their carriers' transport activities themselves or to use external service providers.

"We receive reports from some of our carriers; but for the time being, we use our own calculations." (S9)

For Intermediaries, with up to in the ten-thousands of carriers, it seems impossible to align their carriers on a consistent way, not only to calculate emissions but also to transmit the information.

"We probably could launch a huge project, very resource-intensive, to get more usable emissions data from our carriers; but just that workload! rather than using some platform that tells us the aggregated data !?!" (I7)

There is certainly some room for improvement through collaboration between actors. However, the 'missing collaborative action' that would be needed to align the industry on the same methodology to calculate and exchange emissions information would have to happen at a higher level—and would still only address parts of the problem.

Reluctance to sharing and using primary data undermines actors' efforts and Emissions Accounting's credibility.

Aside from differing methodologies, Emissions Accounting mostly uses average values, eventually modelling with more granular assumptions on routes, shipments, and vehicle types. But the many factors that impact the actual emissions cannot all be comprehensively reflected.

"Whether they [providers] are using a 20-year-old truck or a brand new one, it does not make any difference for my calculations because I am using averages." (S11)

It must thus be recognized that these calculations are approximations. They can give an important idea of the overall scale of the emissions and of the priority areas for action to reduce them. But they have severe limitations when it comes to comparing providers' performance and measures' effectiveness. To report emissions correctly, primary data on fuel consumption and transport activity are needed.

„As long as we all calculate with default values, and one takes this guidance, the other one the GLEC framework, and they all get to different results, how do you want to decide ? We need primary data in the system; but we are lightyears away from that." (I6)

As interviewees reported, operators are reluctant to share primary data; this mainly lies with the fear of losing commercial advantages that build on an intransparency of cost in the sector. As fuel cost is a major component in a truck's overall operating cost, using less fuel than the quantities reported to the client leads to a direct increase in the carrier's margin. Disclosing these additional benefits, so interviewees' explanations, could lead to renewed price negotiations and eventually to the loss of this additional margin. Self-reported fuel consumption is widely practiced, as all three groups confirmed.

"We commit carriers to communicate their fuel consumption to us; but we have to rely on what they tell us. 28, 32, 34 [l/100 km], we accept it, but we cannot verify it." (I10)

No Shippers and only a few Intermediaries reported selected cases where sharing of primary data takes place; these cases have in common that it happens on the request of a powerful client, in the context of a large and long contract or a long-standing relationship.

"We have some cases where we get the fuel consumption data from the carrier. It's always under an NDA (non-disclosure agreement) and driven by the shipper. But this does not happen in a spot rate market; it is only with large and long-term contracts." (I7).

Operators who are willing to share their primary data exist; it also allows them do demonstrate their better-than-average emissions performance. Yet, in the absence of a broader data sharing effort, the structures and processes to exchange this data is missing, and it is easier for the next partner in the value chain to use the same standardized way for all providers. As a result, better performing providers are disadvantaged in a system that is meant to reward their emissions savings.

"If I can show with my data that I do better than what my client models for me, and he then tells me 'that's great, but it does not show in my report', it is not only that my emissions performance does not get recognized; it shows the inaccuracy for the entire system." (C1)

Interviewees in this sample largely agree that sharing primary data will be needed for true Emissions Accounting, and to make emissions a criterion in decision-making. But they are also divided in optimism if, how, and when the industry can make this change. Timid signs for change are visible.

"Clients ask us for our road to primary data. We just started conversations with OEMs and providers of transport management systems to see how we can get access to our carriers' fuel consumption and activity information. We are at the very beginning." (I8)

6.5.3 Biofuels, HVO

Biofuels, HVO were rated at a mean average of 3.5 across actors, and achieved the highest potential rating among all measures (see chapter 6.2) Nine Shippers, ten Intermediaries (engaged with carriers), and two of the Carriers have experience with the use of Biofuels, HVO (see chapter 6.3). While biomethane is in use with a few of them, the detailed discussions on biofuels mainly focussed on HVO.

Overall, Interviewees largely agreed that using these fuels requires more than a business as usual buyer – provider relationship; opinions are somewhat divided as to whether more collaboration and with whom can make it easier or is absolutely needed (see chapter 6.4.2). On the one hand, this may partly be explained with the different levels of experience actors have: some have had HVO in operations for many years; some of the Shippers are new to using them, and several Intermediaries are new to using them together with their carriers. On the other hand, Biofuels, HVO inherits a part of the challenges

that were discussed above on Emissions Accounting, which seem to amplify if the chain of command gets longer.

Challenges reported

No	Challenge	Details
1	Lack of transparency	uncertainties regarding the actual quantities of fuels used
at a lower level:		
2	Cost	resulting in an increased rate for shippers
3	Lack of expertise	reported for mainly small carriers
important external challenges that are passed on to actors:		
4	Lack of public indices	resulting in untransparent market prices and requiring efforts to determine fuel prices
5	Lack of availability of fuels	depending on countries, along certain lanes, resulting in network gaps and limitations for cross-border operations

Collaborative action (not) used

Shippers pay a slightly higher rate (addressing challenge 2)

HVO can be used without changes to the vehicle, at least for the more recent generation of engines. The fuel, however, (still) comes at a slightly higher price than diesel. Interviewees largely agree that this additional price is to be paid by the shipper.

"Whatever the cost of the fuel is they put in the truck, we pay for that." (S3)

A generally accepted level of the increase is hard to determine—the reported range is 2 to 12%—not least because countries apply different levels of taxes to fossil diesel, and different levels of subsidies to HVO. Overall, shippers' readiness to pay more for the fuel is rather seen as a simple prerequisite than a major area of collaboration.

Transparency between actors can fill gaps in market price transparency (addressing challenge 4)

Several interviewees raised the issue of the absence of a public index or surcharge mechanism for HVO, as it is available for diesel in most European countries. Across the geographies in this sample, only Finland reportedly has a public index, which is also used as a basis for a surcharge mechanism (also called 'floater') in road freight contracts. In other countries, the absence of such index translates into challenges and additional efforts reported by all sub-groups:

"We put a kind of price mechanism [for HVO] in the contract; but the problem is, it is our estimate. There is no specific index for that." (S7)

"The price is for sure a discussion with the carriers and with the clients. We work with diesel floaters normally. We would also need a separate HVO floater. But we don't have it. With some of our HVO clients, we therefore moved to an open book approach." (I1)

"What is missing [for HVO] is a generally accepted pricing mechanism, like we have it for diesel." (C1)

In line with statements from I1 and C1 above, some Shippers report that they require their providers to document the price at which they purchase HVO.

"We know the price they pay for the biofuels. Usually, they [providers] have an agreement with the fuel supplier, and we know what is in it." (S3)

Exchange of documentation is a prerequisite, yet leaves room for uncertainties (partly addressing challenge 1)

Exchanging documentation on the fuels is a requirement for being able to report emissions savings. This includes a third-party verified certificate from the fuel producers (containing information on the characteristics of the origine of the fuel, feedstock used, carbon content, etc.). Shippers request this documentation along with often self-reported fuel purchases.

"They [providers] send us certificates which are validated by a third party; and they report the amount of fuel they purchased." (S10).

The chain of documentation gets one step longer for Intermediaries with external carriers ; it hence requires a clear process to avoid another layer of potential uncertainty.

"We need to report the numbers, we need a certificate and an audit on it. It takes quite a while until this process is sorted out and agreed upon by all parties [intermediary and shipper] involved." (C1)

Intermediaries who have their own fleet and procure services from external carriers confirm the increase in complexity to ensure correct reporting.

„All this information [on biofuels] that we can share and talk through involves the carrier and involves us as the middleman. It's just a lot easier when it's our fleet." (I7)

For one Intermediary with their own fleet, the perceived uncertainty whether and where the fuels are used remains a definite barrier to the use of HVO with external carriers.

"We use HVO for our own fleet. But how should I control whether carriers actually use it for us and in the quantities they report ?" (I11)

Another Intermediary with no own fleet reports being selective with the carriers for collaboration on biofuels, and that the exchange of actual fuel consumption data is part of these collaborations.

"If we explain why we need this [information on HVO fuel consumption], and assure them [the carriers] that we will not use it for a commercial discussion on pricing, they are usually willing to share it."(I8)

One Carrier sees the self-declared fuel consumption as a barrier to the credibility of the system as such.

„I believe that emissions accounting in many cases is fake. Because it is simply based on the declarations of the carrier[…] There is a need to for collaboration to clean the sustainability claims on biofuels in the sector." (C2)

These findings are closely linked to the discussions under 6.5.2 regarding the unsolved challenges in Emissions Accounting's different methodology in general, and the lack of transparency, in particular.

While increased transparency between individual actors can help mitigate some of the challenges and build trust in between them, the need for collaboration and change lies also on the broader system.

Particularly smaller carriers still depend one 'someone' to share knowledge with them (barely addressing challenge 3)

Shippers in this sample barely work with smaller carriers; two of those who do, reported knowledge gaps for smaller carriers, particularly related to emissions impact and necessary documentation:

> *"One carrier proposed us to use HVO, but he couldn't even tell us what the impact in emissions savings would be." (S6)*

> *"We see the issue with very small carriers; they simply lack personnel that would be able to provide us with certified information."(S5)*

Intermediaries who work with external carriers and biofuels partly fill this gap; though also these may prefer working with carriers who already have experience and are able to provide the data as needed.

> *"If the carrier has been running on HVO for a while already, that's great; things are just clearer than if you go for a brand-new carrier who never used it before." (I7)*

With a still low demand and limited availability of biofuels in the market, small carriers may get around the need to develop capacities to provide biofuels in the next years, and keep serving the remainder of the market. But with no capacity in lower emissions services at all, neither biofuels nor electric vehicles, it may also mean that they are increasingly excluded from necessary market developments and that they are likely to become the laggards in the transition.

Gaps in the biofuels network give rise to Book and Claim (addressing challenge 5)

The best option for actors who want to use biofuels but who operate on a network with insufficient supply is—apart from investing in their own fuelling stations—the use of the Book and Claim mechanism, which will be discussed in the following sub-chapter.

6.5.4 Book and Claim

Book and Claim was rated in potential with a weighted mean of 3.1, and with ratings particularly coming from Shippers (see chapter 6.2). With experiences in the sample with the use of Book and Claim still being recent, a large part of the interviewees agree that the mechanism absolutely requires more collaboration; fewer said more collaboration can make it easier (see chapter 6.4.2).

An explanation of the basic functioning of the Book and Claim is provided in the annex chapter 12.1.

A key challenge that lies outside the direct sphere of action of the actors is the current impossibility to report emissions reductions from Book and Claim under the GHG Protocol, and with it, towards SBTi Targets. Several interviewees expressed that allowing the mechanism under these regimes will make a significant difference and enable its wider adoption in the market.

The overview below summarizes the challenges currently related to the use. Given Book and Claim's primary use in combination with Biofuels, it inherits some of the challenges that lie with Emissions Accounting and differing methodologies which will not be repeated.

Challenges reported

No	Challenge	Details
Important external challenges that are passed on to actors:		
1	Lack of expertise	mainly reported for shippers who are not familiar with the mechanism
2	Lack of common frameworks and registries	a common framework and understanding for its use in the road sector have not yet emerged, leading to actors developing their own solutions
Resulting in challenges between actors:		
3	Lack of trust	resulting from a combination of the above, and from a lack of transparency

Actors' own solutions fill the gap left by the absence of a common framework and a public registry; it requires clear documentation and communication (partly addressing challenges 2,3)

For Book and Claim, an industry-wide standard for its use in road freight has not yet emerged. This is reported as an obstacle on all sides.

"It's [Book and Claim] all in the making; we are still trying to see how it comes together." (S2)

„There's no legitimate registries in place yet. There's different ones, but the lack of a registry in a formal system is a massive issue that needs to be resolved before clients will be really willing to throw money into this [Book and Claim]." (I7)

Also, the views on how Book and Claim should be used diverge considerably, for example, regarding geographic boundaries, i.e., how far can the actual use of the fuels be separated from the location where it is claimed. While this seems of no concern for some interviewees, others see clear limits to it.

"I don't think it should be an option that somebody uses it in the Netherlands, and then we claim it for Spain or Italy. It should not work like that". (S3)

More convergence seems to exist on the point that it should be used within the same modality, i.e., that only emissions savings that were generated in road freight can be claimed for road freight.

Meanwhile, operators are developing their own solutions which vary in quality. Not all solutions meet all Shippers' expectations, and Shippers show a great need to understand what is done so they can choose accordingly.

"I think the emissions savings they offered us [with Book and Claim] were generated by cargo bikes. That's great for them, but we want to help in decarbonizing trucks, not bikes." (S5)

"They [a provider] cannot give us a clear document that convinces us that there is an actual emissions reduction. It's the methodology; there needs to be a maturity curve." (S3)

"We would want to look into their [Book and Claim] system to understand what we are actually buying." (S12)

For the Intermediaries and the Carriers in this sample, getting Book and Claim 'right' requires an effort in documentation and communication.

"We need to have a solid Book and Claim system; it is key to scale the use of biofuels." (I8)

"For Book and Claim, we have created several procedures and a whole team working on it. The implementation with the shipper is then actually easy. They just need to understand the different ways and qualities of doing it." (C2)

As mentioned in previous analyses, Intermediaries with their own fleet started to work with Book and Claim with their own vehicles, as this comes with lower complexity. Particularly the possibility of double counting of emissions savings are an issue of concern intermediaries in the sector in general need to address if they want to transfer their carriers' emissions savings to other clients.

"The carriers need to understand that they are selling the emissions savings to us and cannot offer them again to a different client." (I5)

"Compliance is a main topic [with Book and Claim]; we need to find ways to ensure this with our carriers." (I2)

Interestingly, one Carrier expressed his belief that Book and Claim would solve, not create, issues with the transparency and accountability related the use of biofuels.

"The problem with biofuels is that there is no transparency on the use. I see Book and Claim as a possibility to overcome the situation; because it is much easier to check the overall quantities than to check where they were used. […] We tested it with our own fleet; and I do not believe in the physical traceability of the fuels. It is an illusion." (C2)

With this statement, he alludes not only to uncertainties if the fuels were used, and used not more than once (on paper); he also refers to the complexity of tracing the amount of fuel used for a specific truck, shipment, and distance.

Fuel cards—an emerging solution to strengthen trust and transparency ? (intended to address challenges 2, 3)

To overcome issues of uncertainty on the carrier side, two Intermediaries brought up the use of fuel cards as a possible solution. While one Intermediary reported being in the design phase of a system, the other Intermediary reported having rolled out a pilot with carriers who received fuel cards from the Intermediary. When carriers use the fuel card to purchase biofuels, the Intermediary reimburses the cost, even if the fuel was not directly used for biofuel client. This way, he builds up a stock in emissions savings which the Intermediary can then transfer to another client. A discount on the fuel stays with the drivers, incentivizing them to use the card to purchase biofuels. The use of the fuel card simplifies documentation and exchange of information between the carrier and the Intermediary. While it cannot fill in all gaps linked to different methodologies and absent standards, it can reduce the concern of double counting in the system. These solutions however require a certain scale to justify the effort for the Intermediary.

More sector-wide communication and education is needed to strengthen shippers' understanding of the mechanism (mainly addressing challenge 1)

Reportedly, the community that is familiar with Book and Claim in road freight is still very small. The limited awareness of shippers that the mechanism exists, and their limited knowledge on how it functions, limits their acceptance.

> *"We proposed it [Book and Claim] to some clients, but they just want to be sure that their goods are going in the vehicle which uses the fuels. So we did not take it any further." (C4)*

> *"I hear this every week; clients want their cargo to travel on that specific truck [which uses biofuels]. We need to make people understand this [Book and Claim]." (I3)*

The issue translates on to shippers who are in the middle of a value chain in the B2B industry; if they want to reduce emissions with Book and Claim, they depend on their clients to accept it.

> *"Our client wants to see the truck with HVO pulling up; they do not want to have the diesel truck coming to their warehouse while they pay for HVO through Book and Claim". (S1)*

While Carriers and Intermediaries in this sample seem to share the same challenge, efforts to overcome the lack of information seem to be case by case. This may partly relate to the still absent common frameworks which makes it difficult to communicate; individual solutions, and eventually, competition of the different systems in use may also limit the attractivity and ambition of a collaborative communication effort.

6.5.5 Efficiency Measures: summarized insights

As mentioned in the introduction, the discussions of collaborative action on the Efficiency Measures were less prominent in the interviews. This is partly due to the methodology used. Nevertheless, it seems that some of the insights can provide additional information, not least to perceived lower relevance for collaboration.

Truck and Rail

Interviewees see a high remaining potential for Truck and Rail with weighted mean 2.7; ten shippers use Truck and Rail and eight Intermediaries are engaged. About half of both groups stated that more collaboration is absolutely needed; for shippers with their providers, and for intermediaries with the shippers; their carriers play a lower role (also see 6.3.2).

The main challenges actors face with Truck and Rail lie outside their sphere of action and relate to available rail network capacity and level of service by rail operators across countries. Few insights could be collected on the collaboration between the actors; these mainly concern the planning and consolidating of shipments, and shippers' acceptance of changes in operations with longer lead times and less flexibility. Both Shippers and Intermediaries also referred to the need more for horizontal collaboration, i.e., matching shippers with flows on the same lane and in the opposite direction.

Overall, Truck and Rail has been in use by several interviewees for many years and they have established ways of collaboration. In this area, the study cannot provide any further elements to the discussion.

Fleet Management

Fleet Management left a rather confusing picture: the high ratings of potential with a weighted mean of 2.9 for Shippers and 2.6 for Intermediaries does not match with the diffuse level of action reported (see 6.3.3). Views on the need for collaboration between shippers and providers were mixed (see 6.4.1).

Even though shippers stated, to some degree, that more collaboration with providers has its place, it remained unclear how they practice this collaboration. The exchanges indicated differing views on their responsibility and perceived agency over this measure: a few see it in their own ability to support providers in Fleet Management, e.g., by offering greater flexibility, timely sharing of operational information or even by finding complementary shipments from other shippers on the same lane. One Shipper explicitly stated that it is on the shippers to facilitate this measure, as providers have little influence; the same interviewee added, that shippers lack insight in their providers' networks and that providers need to flag options to them. Some shippers mentioned the importance of sharing operational information to enable this; though only one explicitly referred to existing IT integrations intended for this purpose. Others see Fleet Management largely in the hands of their providers and rely on those to act independently. A third group, especially from the B2B area, finds it difficult to adjust their planning to help improve their providers' Fleet Management as their deliveries are often mandated by their clients. While Shippers confirm efforts of their providers to optimize loads, some also suspect that there are limits regarding the opportunities providers flag to them at the potential expense of losing turnover instead of reducing cost, and increasing complexity for their own operations. Intermediaries had a very split view on how much collaboration is needed with shippers on the one side, and carries on the other side. Some reported being proactive in their collaboration with shippers indicating opportunities to reducing empty or optimizing routes. One mentioned to be working with integrated systems. Some reported not having enough information on their shippers' operations which could enable them to propose improvements, others saw it completely in their carriers' responsibility.

Overall, interviewees suggestions for how collaboration between actors on Fleet Management could be improved in the context of emissions reductions across the value chain remained scarce.

Eco-driving and Vehicle Equipment

For Eco-driving and Vehicle Equipment, interviewees rated the remaining potential at the lower end, but still in the ranges of 1.7 on a scale from 0 to 4. Neither of the two played no role in shippers requests (except as a prerequisite in the provider qualification process) or actions with carriers; while Eco-driving played some role in action of Intermediaries with their carriers, Vehicle Equipment did not. Findings above show that both measures are seen to require no to little collaboration.

While it could simply be assumed that collaboration is absent because it is not needed, the discussions with some interviewees provide explanations to why these measures are not areas of collaboration:

> *"I think it [Eco-driving] has potential, but I don't have visibility over that reduction. We are not getting fuel consumption from our drivers. How should I address it?!" (S2)*

> *"It [Eco-driving] still has important impact to make; but if I can't measure it, it's not in my focus." (S4)*

"If we cannot report it, it does not exist and has no monetary value." (I5)

"Eco-driving is not a reduction that I can sell to clients; it does not have a baseline and no documentation." (I6)

On the side, these statements closely relate to the discussion on lack of transparency and reluctance to share primary data. On the other sides, they also point to a critical incentive for collaboration to take place: emissions must be measurable for all actors, and savings must be given value.

6.5.6 Summary overview on areas and forms of collaboration

The findings above showed that different mitigation measures not only require a different intensity of collaboration, but also play in different areas for collaborations. Electric MHDVs were unanimously found to require the highest degree of collaboration: allocation of cost, financial certainty (i.e., contract duration), overcoming barriers of liquidity (with small carriers) along with joint planning and acceptance of changes to operations appeared as the primary areas that require collaboration between all three parties, Shippers, Intermediaries, and Carriers.

On a more general level Emissions Accounting holds challenges: differences in methodologies and the absence of primary data in the system compromise fair and comparable accounting. Actors can only partly address these challenges through more collaboration between them; also, broader collaboration on a higher level is required.

The use of Biofuels, HVO, and, with some variations, the use of the Book and Claim mechanism inherit some of the challenges from Emissions Accounting; a lack of transparency and, in the case of Book and Claim, the co-existence of several approaches requires clear documentation and communication.

Among the Efficiency Measures, Truck and Rail requires more collaboration between shippers and providers which seems in general to be well-established. Fleet Management left a confusing picture, not only in terms of a gap between high potential rating and reported action, but also regarding the need for collaboration, the perceived roles and responsibilities, and the collaborative action taken. Eco-driving and Vehicle Equipment receive little collaborative interest as the system in place does not make their impact on emissions measurable for all actors.

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6.6 RQ3c: What are the enablers and barriers of collaborations to implement emissions reductions measures ?

The enablers and barriers of the collaborations were distilled from interviewees' answers to specific questions but also from their contextual narrations. As shown in the discussion above, financial aspects play a role with several measures and cannot be ignored. But underneath, there seem to be more profound elements that work as enabler or barriers. It must be noted though that the enablers and barriers apply well beyond collaborations to reduce emissions from road freight.

6.6.1 Having a vision and communicating about it

Particularly Shippers emphasized the role of having a vision (the term is used to subsume a range of vocabulary used by interviewees, e.g., targets, pathways, roadmap, etc) of what they want to achieve in terms of emissions reductions on the one side, and communicating about it on the other side.

Shippers seemed to use their vision and the communication with providers as a 'development agenda' in which they try to engage their partners. By repeating the relevance the vision has for them and by sharing their targets, Shippers aim to give their providers certainty about the forthcoming changes, and the opportunity to move along.

"We have been communicating on this for years [….] since a couple of years, we have reached the point where the service providers are also coming proactively with their proposals because they know what we want." (S3)

"We have targets, and we talk with our providers. We tell them what is important to us, and we ask them how this can be achieved." (S10)

"You really need to have a dedicated conversation; the provider needs to be involved in this and understand your motivation behind it." (S2)

As also reported by some of the Carriers and Intermediaries, Shippers use their communication on their targets as a 'heads-up' for more stringent sourcing policies to come in the future:

"We have clients who tell us that they expect us to develop certain services; we know it will not have consequences if we cannot deliver next week; but we also understand that we need to move in the direction if we want to keep working with them."(I4)

Shippers, and, though at a somewhat lesser extent, Intermediaries and Carriers, see the alignment of visions and their implementation pathways as a prerequisite for their collaborations' success.

"It requires to have clear and aligned targets on both sides; otherwise, it won't work." (I8)

"You really need to make sure that you have a common vision on where you want to go." (S11)

Interviewees also gave examples where the misalignment of the parties' vision or implementation pathways acted as a barrier. Seemingly, larger organizations of both types, buyers and providers may have less flexibility in making use of unexpected opportunities and aligning with their partners.

"They [shipper] want to decarbonize, we want to offer solutions. But timing and priorities do not always match. They decided to start in a region where we do not work for them." (C1)

"Especially larger providers may have their own plan of what they want to implement where; and in this case, it did not match with what we had in mind." (S6)

6.6.2 Internal alignment, incentives and processes

The role of the vision and how external partners are brought on board stands on one side; on the other side, companies also need to engage their own people in changing certain ways of working. Silos and conflicts of interest within the company was mainly reported as a barrier with shippers, by Shippers but also by Carriers and Intermediaries.

"It's a classic. Every department has its own incentives, and maybe they receive different messages. It should not be that way, but it happens." (I2)

"Different departments have different priorities; the sustainability department wants CO2 reductions, the procurement department wants the best price, and the supply chain people want to have it just when they need it. We therefore need to take the decision together." (S7)

Intermediaries and Carriers experience the differing priorities which may prevent implementation, slow down collaborations, and ultimately discourage further proposals coming from them.

"If you only talk to the sustainability department, you may feel like 'great we have a project'; but when we then turn to procurement, they tell us 'thanks but we don't need this'." (C1)

"You need to have the right people together in the room. If we just talk to procurement, we may not get far. We try to have also the sustainability people in these conversations." (I2)

A few Shippers feel they have largely succeeded in embedding the new direction in their incentives and processes; others are still finding their ways how to best translate the corporate-level decision into business units' processes and local teams. Some of them consider internal CO_2 pricing as a potential solution to align operations with targets.

Challenges in internal alignment and processes are also reported for Intermediaries and Carriers, but seemingly with less counteracting impact on the collaborations with their value chain partners.

6.6.3 Building relationships

Many of the Shippers converge around the critical role of relationships with their providers when it comes to working on emissions reductions. Long-standing relationships and partnership approaches were repeatedly mentioned as key enablers of their collaborations.

"It goes well beyond the contract; it is the relationship that we have with the provider." (S2)

"We started really trimming down our pool of providers so that we can work with less but more in-depth [...] It needs a partnership approach." (S3)

"You need to move away from this short-term procurement and move to a long-term relationship so you can create a partnership and achieve what you need." (S8)

The tendency towards more concentrated sourcing approaches and longer contracts in this sample was already discussed in chapter 6.1.1. The further findings showed that an 'opportunistic' procurement approach frequent changes of providers seems to work as long as the service procured is widely available on the market, and if it does not require much more than the transaction of payments.

"I don't think these things work if you just go to the market; it usually happens in a strategic business partnership." (C2)

Similarly, some Intermediaries reported about the role of relationships in the work with their carriers.

"We implemented a training programme; this is for carriers we work closely with and where we have a good long-term relationship." (I7)

"If it is a trucker with whom we have been working for many years, we do not replace him easily. We try to have a conversation and get him on board." (I4)

6.6.4 Greater transparency

Greater transparency has been brought up by interviewees of all groups as both, a facilitator and a result of collaboration. It is considered to have advantages in various contexts: regarding costs, as in the example of an open book approach; regarding the exchange of operational data that can help to optimize processes and efficiency, particularly on the side of shippers; and regarding primary data, particularly information on fuel consumption and activity on the side of carriers.

"Somehow it always comes to transparency and exchange of information; those are very critical if you want to start any kind of collaboration around this [emissions reductions]." (S2)

"It's not just about accounting. It's real openness to connect and share information. And that is the tricky part here." (S4)

"I hope it will become the new normal for us to we work together in greater transparency; it has so many advantages." (I8)

While interviewees see the need of greater transparency, there seem to be many organizational barriers and conflicts of interest that stand in the way. While these findings are not new, nor specific to road freight, overcoming the lack of transparency also in this area might well be critical for organizations to meet their own ambition.

"You need to discuss openly; some of the data that is considered sensitive, we need to become more comfortable in sharing it; otherwise, this transformation will not succeed." (S1)

7 DISCUSSION

This work aimed to fill a niche in the existing research and to provide further insights regarding the needs and areas of collaboration between buyers and providers of road freight services to reduce emissions. To do so, it took the perspectives of three groups of actors: shippers, intermediaries, and carriers, with a focus on intermediaries in their role as a buyer of external road freight services (not as the owners of the assets). The research looked at a different efficiency and technology measures to reduce emissions from road freight, and the areas and forms of collaborations that are relevant for their implementation. Using interviews with a sample of 28 companies that are committed to reducing their value chain emissions from road freight, the research was based on the assumption that ambition to reduce value chain emissions is a driver for action and for collaboration. The findings allow several observations with respect to existing literature:

First, on the methodological level. Several studies looked at measures to reduce emissions regarding the needs in collaboration in an aggregate way. For example, Sallnäs (2016) examined the coordinating behaviour between buyers and providers of road freight across a broad range of 'green measures' with one sub-set called 'distribution strategies and transport execution'; the set comprised the use alternative fuels, less polluting vehicles, consolidation of loads, mode choice, and efficient driving. This level of aggregation may be suitable for very generic analyses. Yet, the findings of this study showed that differentiating measures at a more granular level has value in understanding their different requirements in terms of areas and action for collaboration.

Similarly, previous studies used very high levels of aggregations to distinguish types of collaborations. For example, Jazairy et al. (2021) used two main collaboration mechanisms and examined which of them would be relevant to a set of five mitigation measures, comprising efficiency and technology measures. One of them, the knowledge sharing mechanism, combined learning exchange, personnel exchange, and IT integration for exchange of operational information. The results of the present research showed that different mitigation measures require different areas and types of collaboration. For example, learning exchange, framed here under 'sharing of knowledge' comes into play at various occasion where one party has more experience than the other (examples were Book and Claim, Biofuels, HVO, Electric MHDVs) and to a certain degree, takes place relatively easily, even though not necessarily in a structured manner. IT integration for exchange of operational information, however, is much more complex and permanent, and was mentioned to be in use only in very close relationships, primarily to optimize operations (efficiency measure).

In that sense, the findings of the study could demonstrate that different measures have different relevance and come with different challenges which require different types of collaborative action. While generalizing and grouping measures and types of collaborative action helps to simplify and summarize, taking a more granular approach towards both, mitigation measures and forms of collaborations can generate more nuanced insights.

On the side of content, some of the findings from previous research regarding the adoption of investment-intensive measures, such as Electric MHDVs, could be confirmed. For example, the practice of short contract lengths was found to be an obstacle to which some shippers responded with longer contracts equally by Dahlgren and Ammenberg (2022). Similarly, the white paper *Unlocking Your Carrier's Electrification Buy-In* (Smart Freight Centre, 2024b) highlights this issue, and suggests lengthening of contracts in combination with more attractive transport rates as a response.

Other findings in this area stand in contrast to some of the proposals made by the afore mentioned white paper: All shippers in this sample were presented with several options to facilitate vehicle financing for their carriers, i.e., the participation in the investment in the vehicle, providing access to finance through advance payments, credits, securities, or, on a more abstract level, using their market power to negotiate with third-parties, in this case, the vehicle manufacturers or leasing companies (also see chapter 5.1). These options are proposed, in slightly different wording, in the white paper (p.26) as options for shippers to facilitate vehicle financing for their carriers. As shown under 6.5.1, none of the shippers in this sample would consider any of these options (note that this was different for charging infrastructure).

Interestingly, the results here showed that financial support from Intermediaries to carriers is up for discussion—a finding which could not be anticipated from existing literature. And while appropriate models are, with one reported exception, still in the making, the findings underscore the particular role that larger intermediaries may take on in support of smaller carriers. This also confirms the value of distinguishing logistic service providers who work exclusively with their own fleet, and those who source external services, as it was done in this research.

The research also found that emissions reductions measures, particularly those that are not readily available on the market and which may be new for the shipper, are often first implemented outside standardized procurement, as standard processes to request and procure are not fit for this purpose. These findings are in line with the Smart Freight Centre's proposals (Smart Freight Centre, 2024a) of a new procurement approach, framed as 'transformational procurement', which is more suitable to implement emissions reductions measures with impact on existing procedures.

Turning to measures that stood out in the discussions on collaboration for their absence despite their remaining potential, primarily Vehicle Equipment and Eco-driving, the findings of this research can complement earlier observations and provide a new piece of explanation: Jazairy & von Hartmann (2020) found that even though shippers listed the measure in their requests for proposal when procuring 'green' logistic services, their interest in the measures faded just after the sourcing process; their LSPs however still followed up on the measure. The authors rightfully concluded that LSPs interest to maintain the measure despite shippers' indifference must be rooted in their own interest to save fuel and cost, and that it their action was not driven by shippers' requests. The findings here are very similar in the way that shippers stated having eco-driving as a requirement in their provider qualification process; but they were not found to engage any further than that, and, with the exception of some collaboration between intermediaries and their carriers in training on eco-driving, the measure is largely left to the party that operates the vehicle (which was found to be even more the case for vehicle equipment). Considering the incentive behind shippers' action, which is not just to *reduce* emissions, but to *report* the reductions, their lack of interest becomes understandable: in a system that uses average values of fuel consumption as a basis to calculate emissions, and where fuel consumption is self-reported, emissions savings from eco-driving and from vehicle equipment do not exist for the shipper.

While also Fleet Management might seem just one step away to fall under the same explanations that emissions savings cannot be measured, hence have no value for the shipper—the measure as such is much more complex than interventions at the level of the vehicle, and it is not under the control of one individual actor; hence, improving Fleet Management can only be solved collaboratively. However,

the findings here left an unclear picture of who feels in power or responsible to do what, and rather add questions than answers to the existing and wide-ranging body of research on fleet management.

The lack of primary data, which makes some of the emissions reductions non-reportable, has shown to have wider implications: it undermines those operators' efforts who perform better than average, and it compromises fair reporting and comparability. The finding that particularly scope 3 reporting suffers from the absence of primary data has been a long-standing discussion, not just in transport but across all sectors, as was pointed out by Schaltegger & Csutora (2012), Depoers et al., (2016) and others. Given the long-known existence of the issue, the situation seems barely to have changed. While the main reason for difficulties with primary data is, in other sectors, the complexity of collecting it, the reason in transport remains to be the reluctance to sharing the data, which was already pointed out by McKinnon (2018). The findings are somewhat encouraging though as some actors reported that sharing of primary data increased, even though only in selected cases where long contracts and long relationships provided the context.

As findings showed, more transparency is already practiced for the case of Electric MDHVs, where value chain partners use open book approaches, or with Biofuels, where fuel invoices are in some cases shared openly. In that context, it will be interesting to observe in the forthcoming years how greater transparency further develops in the industry, and how it will enable collaboration.

The underlying enablers and barriers to collaboration in emissions reductions that could be distilled from the interviews—vision and communication, alignment of processes, relationships with value chain partners, and transparency—are not specific to road freight and have become the subject of debate in the context of companies' 'sustainable' developments (also see Kantabutra, 2020). In that sense, the findings may not be new in general, but they underscore once more the relevance of these levers, also in the field of emissions reductions measures in road freight.

8 LIMITATIONS AND FUTURE RESEARCH

8.1 Limitations

The research's findings are constrained by several factors, which are discussed in the following:

Size of the sample and its sub-groups combined with the sample members' diversity

The sample counted 28 companies—12 Shippers, 12 Intermediaries, four Carriers—and was selected based on the characteristic 'shows ambition to reduce emissions'. While the sub-group of Shippers showed coincidentally at least some commonalities beyond this defined selection criterium, e.g., in the type of services they procure and vehicles they have in use (FTL and use of HDVs dominated in the sample), the Intermediaries and even more so the already too small group of Carriers showed a considerable diversity in terms of size of their road freight activity, types of shipments, and vehicles in use. For intermediaries, asset ownership (even though all Intermediaries were interviewed regarding the part of their business where they do not own the assets) seemed to impact the findings; ultimately, the granularity of the European road freight market came into play. All these factors limit the comparability of findings within the sub-groups, and results must be interpreted considering their specific context conditions.

For illustration: first, and even though the research focused 'only' on the European road freight market, national context conditions such as policies, regulations and availability of fuels and infrastructure vary greatly across countries. While most interviewees operate in several countries, their experiences and level of progress with certain measures are also constrained by these national factors. Second, the road freight activity and the fleet in use also determines the optionality and complexity of certain measures: e.g., long-distance operations are more complex to convert to low-emissions services given refuelling or recharging needs compared to local and closed loop operations; LTL and groupage are more complex to transition as they require several shippers to align or the use of the Book and Claim mechanism to separate physical flows of goods and fuels from emissions savings. Third, with a larger company size and relevance of road freight comes typically a greater level of expertise, as personnel can be dedicated to certain tasks; Intermediaries and Carriers of a larger size also benefit from greater flexibility in matching clients' requests with available capacities. Lastly, asset ownership turned out to make a difference. While this research explicitly set out with a focus on non-asset owning companies, the sample contained also companies that own assets, but that run most of their business by sourcing external services. This coincidental mix in the sub-group led to an unsought yet interesting finding on the differences between the two, but it also split the sub-group further, and reduced the number of truly comparable sub-group members.

Differences in understandings of terminology and concepts across the sample

Throughout the research, it became apparent that the same terminology seemed to have slightly different meanings to the interviewees. This could particularly be observed for interviewees' understanding of the concept of 'collaboration'; even though the interview material contained illustrations of areas of collaborations and ways to collaborate, interviewees seemed to have their individual interpretation when speaking about collaboration. Logically, these different understandings then transcended to the categories 'more collaboration is absolutely needed', 'more collaboration can make this easier', and 'more collaboration is not needed, it is business as usual'. The relative component

'more [than in business as usual]' added another layer of individual interpretation: 'business as usual' refers to the way certain things have been done over a long time. This may well be different for different companies, and also heavily depend on the interviewees' level of experience in an area. While this does not affect the overall direction of the findings, it is not possible to precisely define the boundaries of the concept 'collaboration' as it is used in this research.

For illustration: a company may have been working for many years on a measure, and it may have established a close collaboration with its value chain partners. Since this has become a normal way of working for the company and the interviewee, the respondent may see this collaborative effort as 'business as usual'. For another interviewee, adopting the same practices would signify a major increase in collaboration compared to her established 'business as usual' way of working. It can be assumed that interviewees took, to some degree, a meta-perspective that let them compare their own doing with what can be considered 'business as usual' in the industry. However, uncertainties regarding the common understanding, particularly with abstract concepts like 'collaboration' remain.

Subjective perspectives of the interviewees and influence of the interviewer

The main part of the research captured experiences and perspectives rather than factual information. While all interviewees held positions related to sustainability, freight transport and logistics in their company, they all have their individual experiences, set of values, and expectations. In that sense, the same interview with the same company but with a different interviewee might have produced slightly different results. Also, as it is the case in all semi-structured interviews, the interviewer influences the discussion. Even if the researcher consciously applies a consistent approach to the interviews, the interactions between her and her interviewees is likely to impact the findings.

8.2 Areas for further research

Together, the findings and the limitations of the research point to several ways to expand and deepen the research.

First, further research with a clear differentiation and comparison between asset-owning carriers, non-asset owning intermediaries, and hybrid intermediaries could be carried out with the objective to better understand the different constraints these different actors face, and the opportunities these have in positioning themselves in the transition towards low-emissions road freight services.

Second, subsequent research could focus on certain measures, and control certain variables that may impact companies' potential to adopt these and to collaborate with value chain partners in the implementation. According to the findings from this research, particularly Electric MHDVs, Biofuels, HVO and Book and Claim are measures that deserve more in-depth research on collaboration mechanisms under certain conditions, i.e., different types or road freight services (FTL vs. LTL and groupage), country-specific circumstances, cross-border operations vs. local operations, etc.

Third, further research is needed to better understand the ways, the barriers and enablers for companies in their collaboration on Fleet Management. Among all measures, Fleet Management showed the largest inconsistencies between actors' rating of potential to reduce emissions and actors (lack of) collaborative effort to make use of this potential. Yet, the information collected through this research was insufficient to explain this gap.

Fourth, future research could differentiate between companies that have successfully reduced emissions, and companies that have not made any progress in emissions reductions. For this research, the sample was selected based on companies' stated ambition to reduce emissions. However, given the early stage of the transition in general, the research took not into consideration how ambitious these ambitions were, nor how much measurable progress had already been made. Looking at a sample of companies with a proven history of success and their approaches to collaboration and comparing it to a control group that does not show any progress could provide better understanding of the actual role of collaboration for companies' success in reducing road freight emissions.

Lastly, it will be interesting to observe how certain market developments change the need for and the practices of collaboration. For example, a decrease in cost for low- to zero carbon technologies on the one side, and an increase in price for carbon-intensive transport (e.g., through more stringent carbon pricing and the expansion of the EU ETS to road transport in 2027 with the ETS II scheme) on the other side is likely to considerably reduce the still existing cost barrier to the implementation of several low- to zero -emissions services. To overcome this barrier today, companies have turned to greater transparency between them. In that sense, future research could investigate if companies maintain their ways of collaborating more closely even if the initial reason fades; in the given example, if companies will wind back their transparency or if it will become a permanent practice, even if the initial need no longer exists.

9 PRACTICAL IMPLICATIONS

The findings from this research have several practical implications for shippers, intermediaries, and carriers who wish to engage in collaborations on emissions reduction measures for road freight.

In general, the implementation of emissions reduction measures for road freight should be integrated in a broader vision for the sustainable development of the company; on the one hand, to engage value chain partners, on the other hand, to align processes and ways of working internally. Transitioning from opportunistic procurement approaches to strategic partnerships and longer contracts is seen as an important step to work on joint initiatives. Particularly for shippers, close coordination between departments in charge of sustainability, procurement, and logistics can support alignment and prevent and failure and delay in engaging with providers.

Actors should be aware that different measures have different challenges and require different types and areas of collaboration. For example, while the implementation of truck and rail and electric trucks is likely to require shippers to accept changes in operations (alongside with additional cost for the latter), the use of biofuels and Book and Claim comes with requirements in documentation and exchange of information, particularly on the side of carriers and intermediaries. As experiences on both sides showed, greater transparency can help to build trust and help allocate cost fairly, particularly in the case of investment-intensive measures.

Intermediaries and carriers who want to position themselves as early partners for emissions reductions measures can propose pilots to their clients. As results showed, shippers are more likely to implement new measures with existing providers, and often do so outside standardized procurement procedures. Also, the early market phase seems to leave more space for joint learning experiences, which is likely to fade as experience in the market grows.

Intermediaries without their own fleet depend more on their carriers' experience than do intermediaries with their own fleet. To participate in the evolving market, they can start early to screen their network for carriers that already developed certain capacities, and seek collaborations which also allow them to generate learnings for their work with carriers that may come new to the field.

Particularly smaller carriers seem to have a window of opportunity to get on board of the transition with the initial support from intermediaries. As Intermediaries in this study reported, carriers rarely approach them proactively to develop new capacities in emissions reduction measures. While carriers may be able to delay their engagement in the transition for some time as there will be enough demand for traditional transport services without emissions reduction requirements, it will be harder to get into the market as soon as more carriers will have developed the necessary capacities, and when onboarding support by intermediaries may decrease.

While emissions accounting in scope 3 will most likely have flaws in the beginning, continuous improvement and the use of more and better data is important for decision-making and allocation of resources. Sharing of primary data is ultimately a prerequisite to develop fair and comparable emissions accounting, and can be supported through agreements that define how the data will be used, and by separating fuel consumption and activity information from commercial negotiations. On a sector-wide level, further harmonization of methodologies and implementation of compliance mechanisms for emissions reporting and the transfer of savings through Book and Claim will be essential to strengthen credibility and monetization of savings.

10 CONCLUSIONS

The purpose of this research was to provide insights regarding the need and areas for greater collaboration between buyers and providers of road freight services to reduce carbon emissions from their transport activities. Using interviews, perspectives from 28 European shippers, logistics service providers in their role as intermediaries and buyers of transport services from external carriers, and carriers with a demonstrated commitment to reducing value chain emissions were collected.

Overall, the findings indicate that commitment to reducing value chain emissions drives and requires collaboration to implement measures. The quality of the collaborative action needed, i.e., its area, action, and intensity, depends primarily on the measure and its particular challenges, as well as on the level of experience the value chain partners have in implementing it. In that sense, the results point to the value of more granular approaches also in research towards both, mitigation measures and forms of collaborations.

Beyond the measure-specific areas and topics for collaboration, the research could highlight four underlying enablers—or barriers, if absent—of collaborations between value chain partners: Having a vision and communicating about it, aligning vision and the company's internal processes, building strategic relationships with partners, and practicing greater transparency in cost and exchange of operational information.

The results of this study build on the recent experiences of a few front-runners in the area; it can provide a first orientation for actors who want to engage in emissions reduction measures with their value chain partners.

Yet, the emissions reductions that the road freight sector needs to achieve to align with climate targets are substantial, and the market for lower-emissions services still in its early development stage. Further in-depth research and a better understanding of the interdependencies between companies' collaborative action and their progress in emissions reductions will be needed to help the sector accelerate its transformation.

„It's been difficult, it's going to be difficult, and we're going to have a lot of challenges in the future. But I really think we can do it; otherwise, I wouldn't be here doing this."

(quote from an interview with a shipper)

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12 ANNEX

12.1 Background note on the Book and Claim mechanism

The Book and Claim mechanism decouples the physical flow of fuels from their emissions. It allows thus the trading of emissions savings between companies that generate emissions savings but are not interested in reporting them, and companies who cannot generate their own emissions savings, but want to have them. For illustration: a transport company has a client A who wants to reduce emissions from his road freight by using biofuels. However, there are no refuelling stations for biofuels along the routes where client A's good travel. The transport company also has a client B; she is not interested in emissions savings, but has its goods transported along routes where refuelling stations for biofuels exist. The transport company uses biofuels in the vehicles that transport the goods of client B, and 'books' the resulting emissions savings in a registry. Since client B is not interested in these savings, nor in paying for them, she is charged the regular transport rate and reports emissions as if fossil diesel was used as a fuel. The transport company can now offer the emissions savings it 'booked' from its use of biofuels to transport the goods of client B to client A. Client A accepts, pays a surcharge which covers the gap between the cost of fossil diesel and biofuels (and eventually includes other administrative charges), and 'claims' the emissions savings to state them in its emissions report. To avoid double counting, the trading history remains documented in the registry, and no other company can now claim the same emissions savings.

While the illustration uses an example where Book and Claim helps to overcome company A's lack of access to a low-emissions fuel, Book and Claim can also be used to overcome barriers which may occur with consolidated loads: If the carrier combines several shippers' loads on the same vehicle to increase his fleet's efficiency, but only one of the shippers wants (and pays for) emissions savings from the use of biofuels, the carrier would need to transport this shipper's goods on a dedicated vehicle, eventually a half-empty vehicle. This would increase fuel consumption and cost for everybody. With Book and Claim, the carrier can combine all shippers' loads on one truck, and separate the use of fuels from the emissions. He can then fuel this specific truck with biofuels and 'book' the savings in which the other shippers on that vehicle are not interested in the registry to sell them later to other interested shippers. Book and Claim can also be applied across different transport companies, if an independent registry, stringent documentation and reporting across actors are in place.

For further readings, refer to Smart Freight Centre (2023).

12.2 Interview questionnaire (shippers' version)

Contextual information (survey-based interview part)
A1. What is the volume of your annually purchased road freight activity ?
A2a. What share of your purchased road freight services do the different types of services represent ? rough estimates in %
Full truck load
Less than truck load
Groupage
Parcel
A2b. What role do the different types of vehicles play in the services you purchase from your road freight service providers ?
Heavy Duty
Medium Duty
Light / Van
Cargo Bike
A3b. What share of your purchased road freight services do the different types of operators represent ? rough estimates in %
LSPs who source services from carriers
Large or medium LSPs and carriers with their own fleets
Small carriers
A4a. To what extent do you work with contracts or on the spot market to purchase your road freight services ?
A4b. How long are your contracts typically with your top providers of road freight services ? multiple answers are possible to account for different clients
A4b. How concentrated or diversified are your relationships ?
Highly concentrated: more than 75 % of our purchased road freight services are carried out by a few key providers
Somewhat concentrated: around 50% of our purchased road freight services are carried out by a few key providers
Diversified: we have a large pool of equally important road freight service providers
A5d. What share of the road freight services you purchase are highly specialized (e.g., goods that require special handling: heavy, temperature-controlled, hazardous, white glove, etc.) or highly customized (e.g., with customer-specific vehicles or processes) ?
A5e. Is the demand for the road freight services your purchase currently greater than the supply on the market ?

Emissions targets (survey-based interview part)
E1a. Does your company measure emissions from purchased road freight services ?
E2a. Does your company have a target to reduce emissions from purchased (road) freight services ? If so, what does it state ?
E3. How satisfied are you with the progress you have made so far to reduce emissions from your purchased road freight services ?

Actions to reduce emissions (survey-based interview part)
A5a. Do you think the following actions still hold potential for your provider to reduce road freight emissions ?
Eco-driving (e.g. driver training, fuel consumption monitoring)
Shift driving to off-peak times
Vehicle equipment : aerodynamics, low rolling resistance tires etc.
Fleet management: reduce empty runs, increase vehicle loads, etc.
Combined: truck and rail
A5b. Where do you see the biggest potential to reduce emissions from your purchased road freight services today and in the next 3 to 5 years ?
Low-emissions fuels, e.g., biofuels, HVO, biogas (if gas vehicles already operated)
Megatrucks
Lower-emissions vehicles: gas
Zero-emissions vehicles: electric (light/van)
Zero-emissions vehicles: electric (medium/heavy)
Zero-emissions vehicles: hydrogen
Mode shift: to cargo bikes
Book and Claim
A6a. Do you request specific actions from your providers to reduce emissions or do you request "lower emissions", leaving it to the provider how to achieve reductions ?
A6b. What actions have you requested from your providers or which ones have providers proposed and implemented over the last 3 years?
A7a. In what context did you implement or do you plan to implement the action ?
tender
existing or new provider
following your or your provider's initiative
A7b. For actions that were intended but failed: What has kept you / what keeps you from implementing XX ?

Collaborations to reduce emissions (survey-based interview part)
C1. Do you think achieving emissions reductions requires more collaboration between you and your provider than does 'business as usual' ?
more collaboration is absolutely needed
more collaboration can make is easier
more collaboration is not needed, business as usual

Collaborations to reduce emissions (semi structured interview questions)
C2. How do you and your provider collaborate regarding XX ? What do you think is needed, would be helpful ?
C3. What difficulties have you encountered with your provider regarding XX ?
C4. In summary: What are the key success factors in implementing action X with a provider?
C5. What could new forms of collaborations between shippers, LSPs and carriers look like to facilitate the implementation of X ?