LEARN

Logistics Emissions Accounting & Reduction Network

Deliverable 4.4

Testing Results

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 723984.

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Deliverable 4.4

Interim Testing Results

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Glossary

Fuel emission factor: expresses the emissions that result from the use of a specified amount of fuel. For Greenhouse gas calculation and reporting, generally expressed as the amount of CO_2, or better CO_2 equivalent (CO_2e), per litre or kg of fuel used. E.g. kg CO_2e per litre

Consumption factor: a fuel intensity metric for logistics that represents the amount of fuel used to move one tonne of freight for one kilometer under a specified set of conditions; i.e. kg fuel per tonne kilometre

Default consumption factor: a consumption factor value that has been derived according to a standard set of assumptions using generic data that is used to estimate transport efficiency when actual data are not available.

Executive summary

This project deliverable, LEARN D4.4 Testing Results, reports on the work carried out in LEARN WP4 on Testing and Validation. LEARN WP4 has tested, validated and evaluated the practical applicability of the agreed framework for harmonized greenhouse gas (GHG) emission calculation (GLEC Framework v1.0) and the eco-label concept in complex logistics settings. Earlier work of LEARN WP4 has defined research questions that need to be answered in WP4 during testing and validation. The research questions can be found in LEARN Deliverable D4.1. The process of testing is specified in LEARN Deliverable D4.2, LEARN D4.3 provided interim testing results. The current deliverable provides the final report on the LEARN testing and validation activities. The deliverable reports on feasibility and applicability of GHG calculation methods, their compatibility and consistency, provides insides on ecolabel design and future developments towards carbon accounting based on primary data at shipment level, reports on experience with direct data exchange between logistic and supply chain partners for calculation as well as reporting of GHG emissions.

The LEARN WP4 involved, on a voluntary basis, companies that provide transport and / or use freight transport solutions as part of their business. The participating companies implemented the GLEC Framework for the purpose of carbon footprinting and carbon accountancy. A company participating in a LEARN test case, also referred to as a testbed company, determines GHGs, expressed in units of CO_2e, of the specified transport and logistics activities. The goal of testing and validation is essentially four-fold:

1) understand company needs and motivation with respect to carbon footprinting and accountancy;
2) test implementability and practicality of the GLEC Framework and suggest improvement;
3) help businesses advance their carbon footprinting and carbon accountancy; and
4) draw lessons on GLEC Framework implementations in order to improve and scale the process for further implementations.

The testing and validation achieved a diverse business representation. 38 companies agreed to take part in testing and validation activities and confirmed their participation by signing the Consent Form. The testbed partner companies include representatives of all transport modes including intermodal transport and terminal operators, covering different geographical regions within Europe and worldwide. Testbed companies are of varying sizes and represent professional carriers, intermediaries, such as freight forwarders, and shippers, who are the users of transport and logistics solutions.

The majority of testbed partners have intrinsic motivation in getting insights in their transport and logistics GHG emissions. The companies are motivated to apply a commonly recognized GHG computation methodology for the emission reporting purposes, though some of the potential testbed partners expressed concerns related to the costs of implementation and overall impact on GHG emission reduction potential in highly optimized transport chains.

The majority of the companies are satisfied with the GLEC Framework methodology. A prior experience with carbon footprinting is a facilitator and an obstacle at the same time: experience with quantification of GHG emissions makes it easier to implement the new method; however, the existing tools may have used a different method, which is not aligned with the GLEC method and produces a different result. The “newbie” companies face a steep learning curve requiring third party support to ensure a proper understanding and implementation.

Overall the test cases show challenges related to data collection, especially transport activity data, and collection of 3rd party data. The use of average default factors is a practical way to overcome the problem of the absence of primary data, although more granularity in the default factors would be preferable. There are some other methodological issues, such as the use of distance and cargo measurements that need to be considered in future iterations of the GLEC Framework to make it more practical and easier to implement.

Once lessons learned in practical GLEC Framework implementations are incorporated in the new version of the GLEC Framework, LEARN WP4 activity suggest concentrating further steps on the following two important aspects. First is standardization of the Framework, preferably at the ISO standardization level, and second, making sure that the method is implemented in Transport Management Systems (TMS) and Fleet Management Systems (FMS) of the leading TMS and FMS vendors. Gaining progress on these two aspects will ensure mutual acceptance and recognition of the emission computations and will hide the complexity of those from the end users.

1. Introduction

The need for a harmonized and standardized way of emission computation in complex transport and supply chains is long acknowledged (Auvinen et. al. (2014), Lewis et. al. (2014), Diekmann et al., (2014)). Nowadays the importance of an accepted harmonized emission computation method has become even stronger. Such a method should be a cornerstone for carbon accountancy and carbon footprinting, where companies and governments can rely and trust computations done by others. The EN 16258 provided a starting point on how GHG emissions should be computed. Although the EN 16258 standard was a breakthrough, it has some, mainly technical, deficiencies (see COFRET D3.3 (2014)) for example:

- scope limitation to individual transport legs, terminals, transshipment points, warehouses, etc. are not explicitly included;
- general orientation on transport service providers (Davydenko et. al. (2014));
- perceived regional European context.

The Global Logistics Emission Council Framework v1.0 (GLEC Framework v1.0, 2016) is the next step in advancement of the agreement and standardization of GHG emission computations in transport and logistics activities. The GLEC Framework v1.0 builds upon methodologies for GHG emission computations that are already well-established and respected by many major industry representatives (e.g. IATA RP 1678 (2014), IMO, Smartway (2009)) and strives for a worldwide coverage of all major logistics operations. The overall aim of the GLEC Framework is to reach a consensus and acceptance among major industry representatives, including not only companies but also green freight programs and industry associations, on the approach to carbon footprinting and reporting as a stepping stone to target setting and emission reduction.

The GLEC Framework v1.0 provides a harmonized basis for the calculation of emissions from freight transport chains across modes and global regions than existed previously. It does this by proposing a uniform approach for data format, collection, analysis and reporting. The approach of GLEC is designed to improve decision-making and effectiveness of reporting within the global logistics sector by carriers, LSPs and shippers (GLEC 2016). The GLEC Framework v1.0 covers Air, Rail, Road, Sea and Inland Waterway modalities, as well as providing a starting point for transshipment centers. Based upon the consensus among the LEARN project stakeholders, testing and validation activity looks at practical applicability of the Framework, and also advances the practice and acceptance of the harmonized GHG emission computation.

The LEARN project considers the GLEC Framework v1.0 as the basis and a starting point to conduct testing and validation activity, though technical methodological implementations are not limited from the start to the GLEC Framework prescriptions, as specified in the section on Advanced Research questions in LEARN Deliverable D4.1. LEARN Deliverable D4.1 has addressed the primary test questions for an assessment of feasibility and applicability of the GLEC Framework for the purpose of carbon accountancy in complex logistics chains. This deliverable provides final answers based on the test outcomes for the research questions posed in LEARN D4.1.

The tests have been carried out by volunteer industrial companies from transport and logistics industry, as well as by the industry's clients, i.e. shippers. The LEARN project partners have helped with the testing activities and supervised them. This deliverable provides information on the testing and validation outcomes, specifically looking in detail into motivation of the companies to perform carbon footprinting and accountancy, measurement of the companies' initial (i.e. before LEARN) carbon footprinting efforts and capabilities, data-related aspects, experiences with the GLEC Framework. 1.0 implementations and companies' ideas on the subject of ecolabel.

1.1 Position within LEARN

This deliverable provides information on the results of the LEARN project DoW task 4.2, responding to the needs identified in LEARN DoW Activity 4.1.2 and research questions of the activity 4.1.3.

The testing and validation activity (WP4) of the LEARN project is at the core of the project (*Figure 1*. The main goal is to test, validate and evaluate the practical applicability of the agreed framework for harmonized GHG emission calculation (i.e. GLEC Framework v1.0) and the eco-label concept (being developed as a declaration template for emission reporting) in complex logistics settings. The testing and validation process of WP4 pays attention to compatibility with available data, to issues related to data exchange, and to verification and certification.

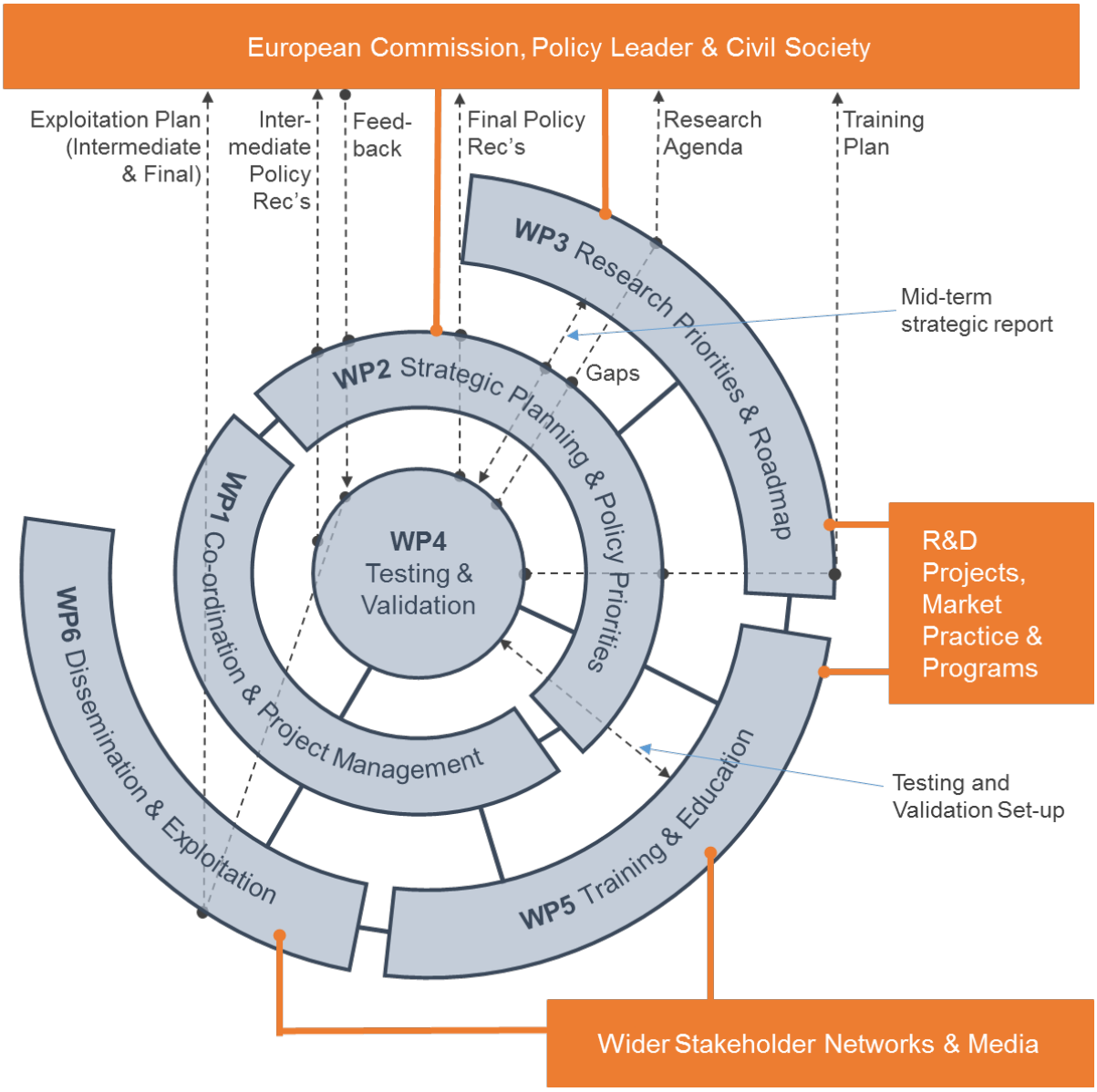


Figure 1 Position of Testing and Validation within LEARN project

WP4 operates in practical business environments in which GHG emissions are calculated by participating businesses. Specifically, testing and validation tasks were concentrated on issues related to practical implementation of the GLEC Framework v1.0 based carbon footprinting method for carbon accounting, emission data computation verification and certification, data exchange and their use in labelling schemes. WP4 also contributes towards awareness creation and education by performing testing and validation tasks.

The testing and validation activity assesses as well compatibility and consistency of GHG calculation framework for the standardized emission reporting. The feasibility of standardized emission reporting was considered on both aggregated and disaggregated emission data, namely the aggregated (company or service) average KPIs and on-going and future developments towards carbon accounting based on primary (directly observed) data at shipment level.

Prior to the start of testing activities at the participating businesses (also referred to as testbed LEARN partners), a set of research questions was defined, which was the main objective of Deliverable 4.1 (see Figure *2* showing the structure of LEARN WP4). The LEARN project prefers to use the term 'Test Questions' instead of 'Research Questions' in its communication with the testbed partners in order to emphasize the practical relevance and applicability of the tests.

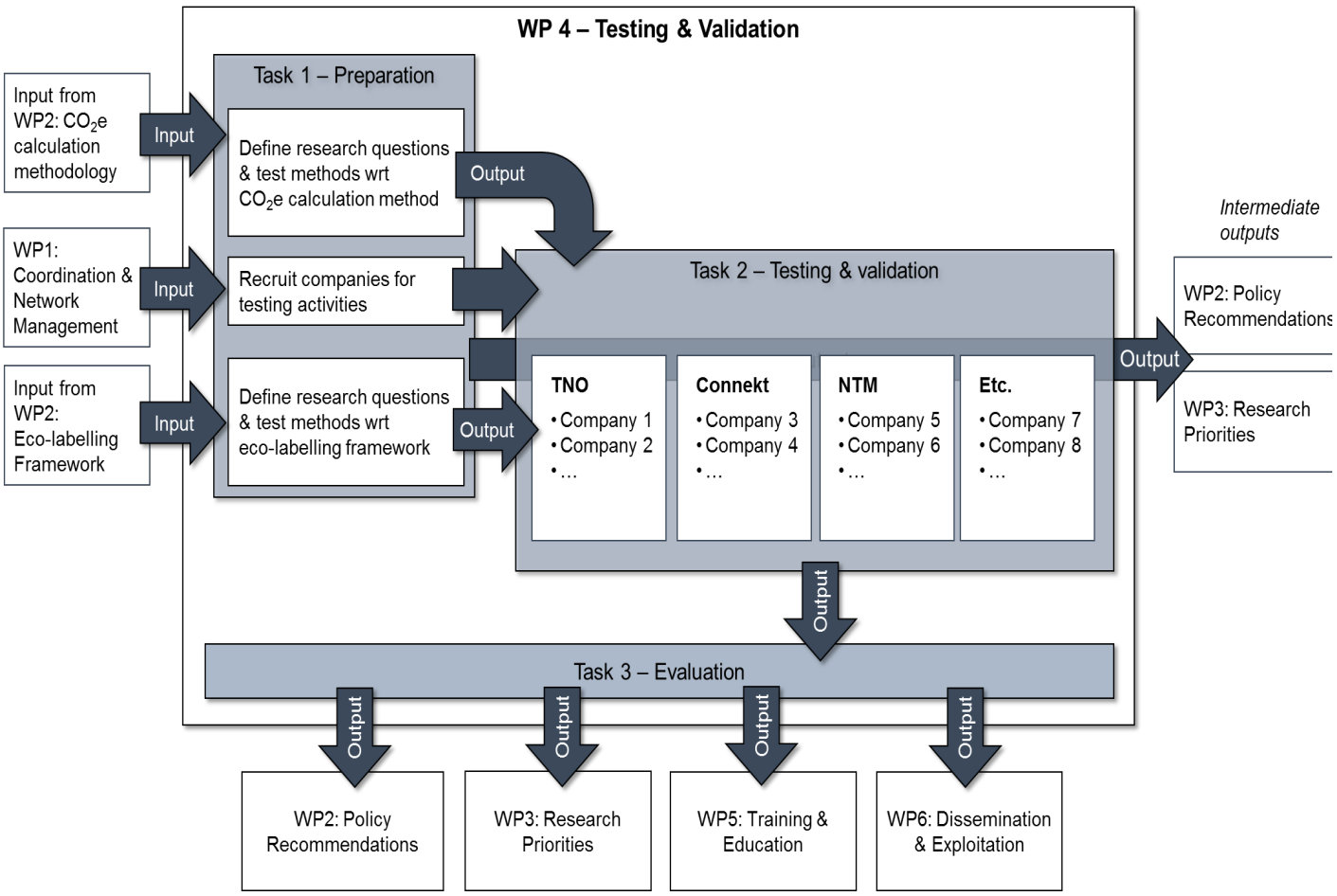


Figure 2 LEARN WP4 organization and interfaces

1.2 Relation to the previously published materials

Earlier work within LEARN WP4 has defined test questions that need to be answered in WP4 during testing and validation phases. These questions can be found in LEARN Deliverable D4.1. The process of testing and responsibilities of partners are specified in LEARN Deliverable D4.2. Deliverable D4.3 provided early (interim) results for testing and validation, which were available approximately one year before (D4.3 was submitted in December 2017).

This document further builds upon LEARN D4.3 deliverable on interim testing results. This current deliverable D4.4 is an extension of D4.3 with the complete information on the LEARN test cases, and analysis of the cases, providing a full account of the testing and validation.

The empirical part of this deliverable is based on the information collected through test recording templates (the template is based on the research questions of D4.1, see Appendix), which have been filled in within the tests to record the findings in a uniform way. The test recording template encapsulates all the test questions of Deliverable D4.1 from the test process point of view, specifically emphasizing test phases. Each test case has been reported using the test case recording template. The test recording templates contain company sensitive data and will not be published: information from the test recording templates is made available in this document in an anonymized way, ensuring anonymity of the participating companies. The test recording templates may be shown to auditors if sufficient privacy safeguarding measures are taken.

1.3 Reading guide

This deliverable is structured as follows. Chapter 2 provides information on the methodology applied to the testbeds in pilot case set up and execution. Chapter 3 provides descriptive information on the LEARN case portfolio, ensuring that identities of individual testbed partners are sufficiently anonymized through generalization and encoding. Chapter 4 provides detailed thematic analysis of the LEARN test cases. Wherever possible we provide quantitative results based on the test case company sample, and extend the quantitative analysis with relevant or representative statements from

the test cases. Chapter 5 provides a concise discussion of the results. Chapter 6 summarizes the deliverable with the conclusions and outlook. Last, but not less important, the testbed reporting template is presented in Appendix 1.

2. Methodology applied to test-beds and pilots

LEARN test beds and pilots are one of the central empirical parts of the LEARN project. They consist of the calculation of emissions for each test bed as well as of an analysis of the accompanying discussions and information exchanges between the LEARN partners and the pilot partners. For this accompanying part, a detailed questionnaire was developed (see Appendix 1). Deliverable D4.4 extends deliverable D4.3 on Interim Testing Results and focuses on the analysis of the situation of the confirmed pilot partners, their background, their expectations towards their participation in the LEARN project as well as to their experiences in relation to carbon emission accounting so far.

In order to maximize the level of trust between interviewers and interviewees, each industry partner within the LEARN project was assigned to one specific LEARN consortium partner. This approach allows a continuous relationship building process between LEARN partners and industry participants during the course of the project. As a consequence, all interviews are conducted by different interviewers. In order to still achieve a comparability of interviews, interviews and discussions have been based on a structured interview questionnaire with open questions (see Appendix 1, Phase 1 Initiation / setting up). Each case is studied and reported by using the case reporting template.

The topics covered in this part of the questionnaire can be clustered into the following sub-topics:

- Motivation of companies to introduce or extend carbon footprinting and carbon accountancy
- Collection of real world experiences with implementations of the GLEC Framework
- Footprint computation and data availability
- Emission data exchange needs, capabilities and practice
- Application of the GHG calculation method in the context of eco-labeling
- Applicability of the method and expectations toward its applicability, particularly GLEC Framework

Questions related to the motivation of companies to introduce or extend carbon footprinting and carbon accountancy tools investigate the expectations of the test bed partners for their involvement with the topic of carbon accounting in general as well as with the participation in the LEARN project in particular. These may range from improving the organization's fuel efficiency, to improving the business' sustainability, gaining better insight into cost structures, preparing for expected future legislation and policies related to transport emissions, or as proof of impact of emissions towards third parties, including customers.

Some of the test bed partners have been involved with carbon accounting for several years, some became involved recently and for some LEARN is the first step to get their transport's carbon footprint computed; some partners have developed their own tool, some have used the GLEC Framework already, others have never been confronted with any emission calculation tool for transport and transport chains before. Being aware of the level of experience is important for the further evaluations within the LEARN project in order to understand how accessible the GLEC Framework v1.0 is for new users but also how satisfactory its output is for advanced users and whether it supplies the needed and desired level of accuracy and detail.

As far as footprint computation and data availability are concerned, the questionnaire captures the probability of test bed partners being able to provide the data needed for the emission calculation in the form of measured data or whether default data will be needed. It also gives a first impression on how familiar pilot partners are with sourcing data on a default data basis.

In the next group of questions the communication set up throughout the transport chain of the pilots is investigated: to what extent are information and data exchanged already and whether the trust within the chain is sufficient to disclose fuel use - and therefore cost structure - related information to the transport chain partners. Also investigated is the issue of which technical devices are used currently for the exchange of data and how far is e-freight introduced, which are the currently dominating obstacles related to the exchange of transport related documentation and data.

Furthermore, the questionnaire asks for the relevance and need of the pilot partners for eco-labeling in combination to transport chain emission calculation. It is important to understand from a user's point of view what an eco-label for transport chain emission calculation should signal. For example, should it certify the use of a specific calculation method or rather be related to the level of data quality used for the calculations, for the improvement achieved over a set period or an absolute value of emissions.

The discussion of the applicability in combination with the evaluation of the expectations towards the applicability of the GLEC Framework to the pilot partner's organisation is important to understand the general attitude towards transport chain emission calculation tools: whether a partner is optimistic or sceptical, and how the view of decision makers compares to those who will have to execute the calculations.

The information gathered by means of the questionnaire enables the LEARN consortium to understand attitude and expectations with which industry partners enter into the pilots. This is important to meet the partners' expectations, who invest time and resources into the project on one side and to ensure that they not only invest into the LEARN project, but also gain insights and a return on their investment out of it. On the other hand this understanding is designed to ensure that LEARN is of use to the pilot partners as the basis for a successful cooperation so that, subsequently, the highest possible level of insight can be gained by the LEARN consortium on the current strengths and weaknesses of the GLEC Framework v1.0. This analysis focuses on which gaps still need to be addressed and how the spread of the use of carbon emission accounting can be best encouraged, by which form of communication, training etc. as well as continued methodology development and standardization efforts.

During analysis of the test case reports, the company experiences and statements have been categorized, and wherever possible quantified. For instance, based on the textual information provided by the companies on their data collection process, it has been possible to categorize and quantify the answers. Of the 32 companies, it has been possible to conclude that 16 companies did have data on fuel use / energy use / emissions (the remaining 16 companies might not have data or did not report positively on the fuel data availability). Subsequently, it has been possible to split these 16 companies per primary activity type in order to get a picture on what kind of stakeholder has these data available.

Additionally to the quantitative analysis of the results, the analysis section presents strictly anonymized statements by the companies related to the analysis item. We select informative statements that are relevant and / or informative or representative for the subject of analysis and convey a clear message. This qualitative information helps the reader in better understanding of the context as well as company positions on the subject. The qualitative analysis is furthermore intended to make it more tangible and suitable for a broader category of the readers.

Finally, the testing and validation work provides input for the next version of the GLEC Framework, where the lessons learned in the testing activity will be taken into account. Likewise the testing and validation activity has aimed to check whether the methodology always facilitates and rewards the right choices, namely that a reduction in GHG emissions according to the GLEC Framework v1.0 leads also in practice to the real-world emission reductions. Therefore, deliverable D.4.4 presents assessments on the applicability of the GLEC Framework v1.0 and provides suggestions for improvement.

3. LEARN pilot cases - selection of partners

It is the aim of the LEARN project to empower businesses to reduce their carbon footprint across their global logistics supply chains through emission calculation, reporting and verification, thus contributing to the realisation of the climate targets of the EU White Paper as well as those agreed within the Paris Climate Agreement. The businesses which are meant to be empowered are logistics service providers, transport companies, freight forwarders and shippers. Therefore, test bed partners in the LEARN project are sourced from all groups of actors of the transport chain: manufacturers, shippers, logistics service providers, carriers, ports and logistics hubs. Each of these pilot partners decides individually whether the partner contributes at the level of individual aspects of supply chains, simple or complex supply chains or even several supply chains for carbon emission calculation within the pilot. The aim of the overall mix is to cover all transport modes and all elements of the transport chain, including logistics hubs, in order to fully understand the strengths, weaknesses, gaps and limitations related to the real-life application of the GLEC Framework v1.0.

Table 1 provides an overview on partners who agreed to participate in the test cases to date. Sharing information is still an aspect of major concern in relation to carbon footprinting and accounting, and some of those companies who are interested in further pursuing the matter prefer to keep their identity undisclosed at this point in time. For their protection, no names of test pilot partners are disclosed in the following list, and findings of the test cases are fully anonymized. Following the EU regulations, and for data protection reasons, test pilot partners were asked to sign an agreement covering the use of their information. A non-disclosure-agreement with the LEARN consortium has been offered to the LEARN partners to assure them that any data or specific operations would be sufficiently protected. In some cases, partners requested a Memorandum of Understanding (MoU) in order to confirm their participation.

Table 1. LEARN test case portfolio

N	Mode	Type	Geographical location	Extra information
1	Intermodal	Shipper	International, Europe	CN-Stockholm tradelane
2	Road	Shipper	West Europe	Agriculture
3	Rail	Shipper, operate train (carrier)	West Europe	Paper and pulp
4	Road, Rail	LSP	West Europe	
5	Sea, Ferry, LNG	Carrier	West Europe	
6	Road	Carrier	East Europe	
7	Road	Carrier	East Europe	
8	Road	Carrier, automotive logistics	East Europe	Automotive logistics
9	Road	Carrier, LSP	East Europe	
10	Road	Carrier, LSP / distribution	East Europe	
11	Road	LSP, Carrier	East Europe	
12	Road / Intermodal	Carrier	Turkey, Europe	
13	Road	FF	West Europe	SE domestic
14	Transshipment	Transshipment, hinterland port	West Europe	road, rail, IWW
15	Road, intermodal	shipper	West Europe	Large food retailer in Southern Europe
16	Road, multimodal, warehousing	Shipper	West Europe	Automotive logistics
17	Road ++ FH	Carrier	West Europe	
18	Intermodal	LSP	West Europe	
19	Intermodal	Shipper	US, West Europe	Agriculture
20	Road, warehousing	LSP, FF	West Europe, international	

21	Road	Shipper	West Europe	Wholesaler
22	Road	LSP	West Europe	Centered on Benelux
23	Multimodal	LSP, FF	West Europe	Worldwide, LTL + FTL road EU dominant
24	Road, Multimodal	LSP, FF (air & sea)	International, Europe	Road own trucks, intermodal
25	Multimodal	LSP	International, Europe	
26	Multimodal	shipper, FF	International, US	Agriculture, chemistry
27	Road	Carrier	West Europe	FTL networks in France
28	Road	Carrier	West Europe	FTL networks in France
29	Multimodal	LSP	West Europe, international	LSP with a global scope
30	Air	FF	West Europe	
31	Road	LSP and FF	East Europe	
32	Unspecified	Shipper	West Europe, international	Luxury products
33	Bridge and lock operator	Infra	West Europe	
34	Energy provider	Infra	West Europe	
35	Carrier (IWW, terminal operator)	Intermodal carrier, road and IWW, transshipment terminal operator	West Europe	
36	Bridge operator, infra	Infra	West Europe	
37	Deep sea port	Transshipment	West Europe	
38	Road, IWW, Transshipment	Shipper, Manufactured food products	West Europe, international	

The communication process with the various test bed partners in the different European countries revealed that expectations and communication requirements differ in the various countries. In some countries - and these reactions varied by country, rather than by type or size of organization - potential pilot partners requested right from the beginning to receive a certificate at the end of the project which they can put on display and use for marketing purposes, whereas in other countries the major concern related to the LEARN project was that participation should not be visible to third parties. Furthermore, formalities are perceived in some countries as additional assurance for the professional approach of the project, whereas in other countries the documentation requested for the confirmation of participation in the process is perceived as an unnecessary complication.

Table 2. Geographical scope of the LEARN test cases

Geographical location	Number of test bed partners
West Europe (national/domestic and international)	21
East Europe, (national/domestic and international)	11
Turkey, Europe (domestic/international)?	1
International	5

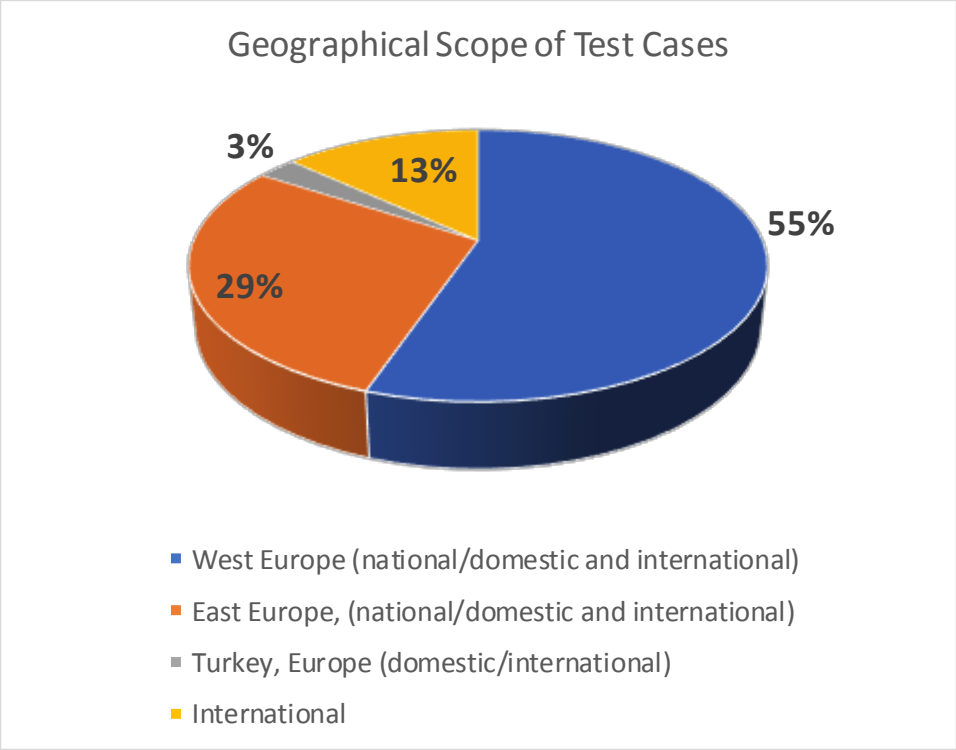


Figure 3. Geographical scope of the LEARN test cases

Table 3. Primary activity type of LEARN test bed partners

Primary company activity type	Number of test bed partners
Shipper	9
Carrier and LSP	22
Freight Forwarder	7
Infrastructure provider	3
Transshipment and warehousing	3

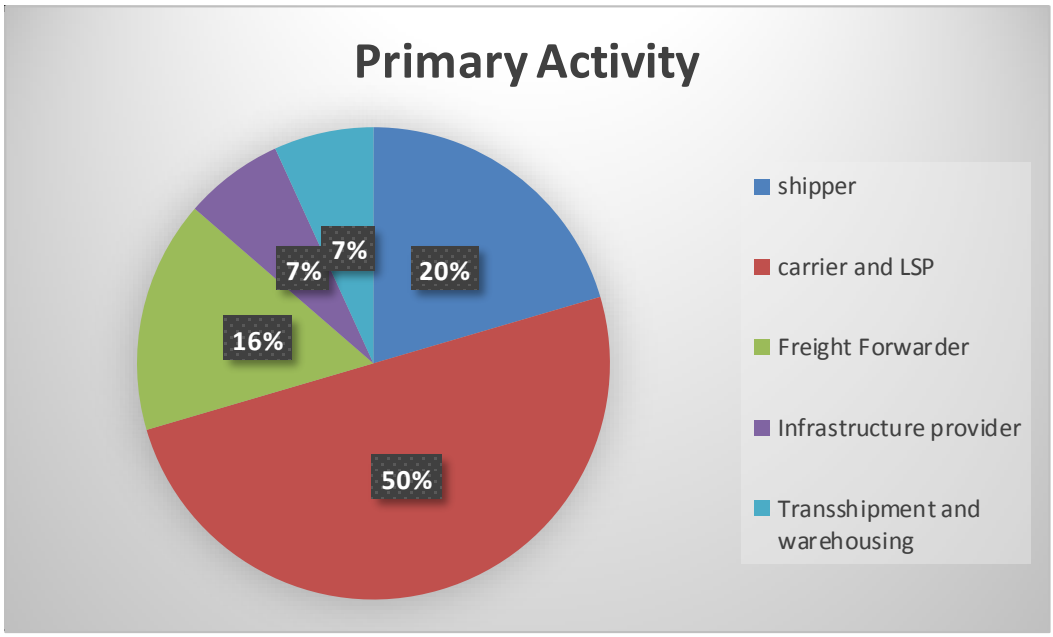


Figure 4 Primary activity type of LEARN test bed partners

Primary transport mode	Number of test bed partners
Road	20
Intermodal, Multimodal	11
Rail	2
Sea	1
IWW and Ferry	2
Air	1

Table 4. Primary transport mode of LEARN test bed partners

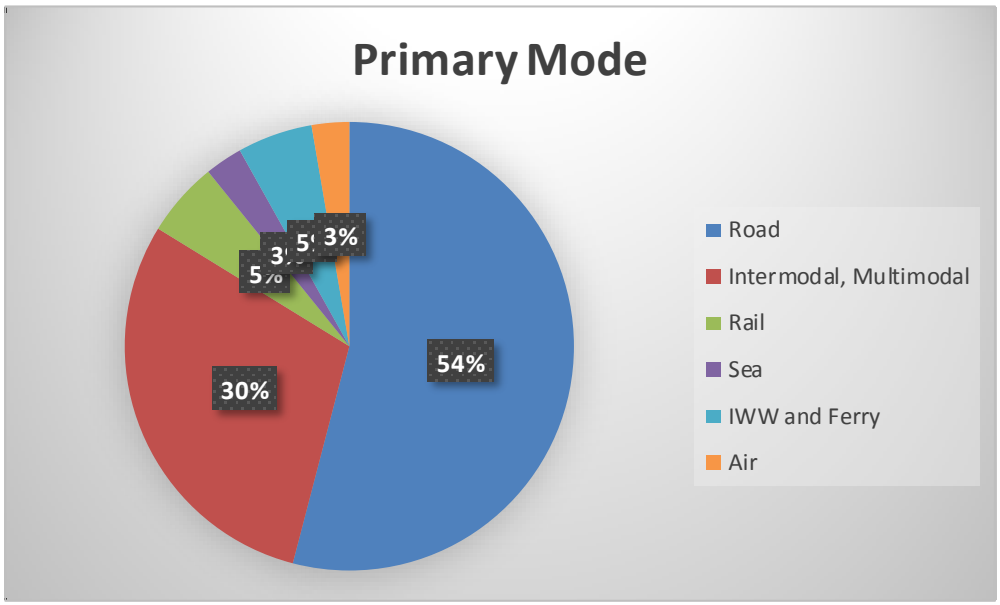


Figure 5 Primary transport mode of LEARN test bed partners

4. Analysis of the test cases

This section presents the main results based on the completed test case reporting template (NB: there are test cases that are carried out by multiple organizations, as well as where one organization carried out a number of distinct test cases). At the moment of writing, there have already been 30 fully completed cases with 32 case reports. The number of organizations that confirmed their participation in the LEARN test cases with a signed LEARN consent form is 38. The cases used as the basis of the analysis have different degrees of difficulty, scope, depth and sophistication. We present here the quantitative analysis of the relevant aspects of testing and validation as well as most relevant analysis of specific test case situations.

4.1 Motivation for participation in LEARN test cases

This section presents information reported by test bed partners on their motivation for taking part in LEARN test cases. Figure 6 presents a summary of testbed partner answers related to their motivation in taking part in the testing and validation activities, multiple choice has been allowed.

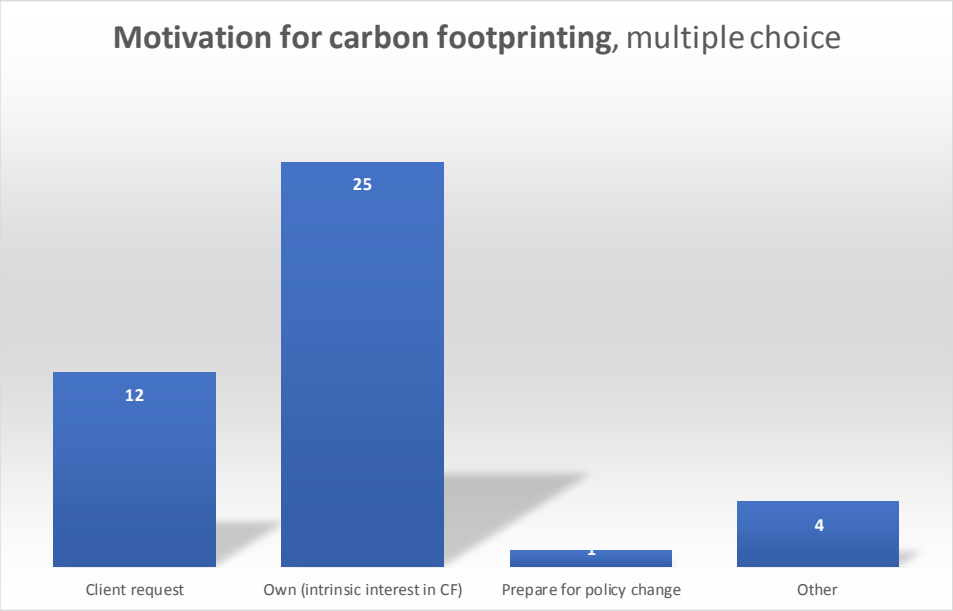


Figure 6 Motivation of LEARN test bed partners for performing carbon footprinting and accountancy.

The majority of the companies have an intrinsic motivation for computing the carbon footprint of their logistics activities. This relates to a better understanding on where and why the GHG emissions are taking place and can provide input for the optimization of logistics processes with respect to GHG emission reductions. 12 companies get or expect to get client requests for carbon footprinting of operations related to the client, with the rest citing other reasons, such as expected policy change and introduction of a compulsory GHG reporting scheme by governments.

Motivation to perform carbon footprinting

*** Requirements by customers and obligation to report sustainability progress (according to EU legislation).

*** The logistics footprint ensures a roadmap that can lead the company to a sustainable logistics success: to achieve this success we want to perform carbon footprinting.

*** The main goals are to provide data for external and internal reporting and to achieve transparency in all our logistics processes.

*** We want to track the emissions and see how we can reduce them. The main attention areas are the route optimization and the use alternative fuels

*** To expand its supply chain visibility by implementing carbon footprinting

Motivation to take part in LEARN cases

Summarizing, the companies were interested in computing carbon footprint of their transport and logistics activities using a broadly accepted method. Some companies that already had carbon footprinting capabilities were willing to compare their own tools / methodologies with the GLEC Framework, assessing the results of computations as well as feasibility and the effort. Emission reporting in a uniform way based on broadly recognized method to be transparent towards stakeholders with respect to carbon accountancy is one of the major drivers. Furthermore, commercial considerations ranging from satisfaction of customer requirements with respect to carbon accountancy to getting more advantageous competitive position in, for instance, transport tenders played a role. The competitive position was considered to be improved by provision of carbon accountancy conforming with a recognized method (functional advantage), as well as the expectation to perform better than competitors in terms of GHG emissions (performance advantage).

*** A reason the company is a LEARN test case partner is the need to understand how the harmonized reporting would affect the company's data processing and reporting protocols in the future The company intends to compare the GLEC Framework with the L&G tool but that is in order to harmonize both, and harmonization is a goal of the EC funded project LEARN. The company is searching for the answers to the following issues: labelling / certifying a tool as approved by GLEC and functioning according to the framework; labelling of the CO_2 (CO_2e) figures based on used data accuracy levels, like those of the L&G program, i.e. gold, silver and bronze levels

*** Know where the company's calculation method differs from GLEC; prepare if it is to be introduced generally; be able to calculate without default values; accommodate different fuel blends. The company intends to examine viability of network-wide emissions calculation using GLEC Framework and differences with own methodology; feasibility of giving customers emissions data specific to their lanes

*** The company intends to develop a Carbon Management Strategy for its logistics activities and it will be good to take the free support from a network. The company has some data and knows a method to calculate, on the other hand it is good to learn the best and easiest calculation method. It is to ensure the correctness of the computations. By taking part in LEARN, the company can identify its strengths, discover weaknesses, and develop improved processes.

*** Benchmarking of existing carbon footprint calculation methods

*** The company wants to be a frontrunner, committed to reduce CO_2 emissions. Interesting to know the difference between GLEC and Lean and Green

*** The aim of the company's participation is to further improve its efficiency, benchmark their own tool and contribute to the further development of a standard for transport chain emission calculation.

*** The company strives to provide relevant and transparent reporting of the work on responsibility and sustainable development. It publishes an integrated Annual Report with Sustainability Report complimented with an Appendix Sustainability Management and Indicators. In a LEARN test case the company wants to improve and find the right ambition level for follow up on GHG emissions from transport and distribution of its resources. Specifically, the company is interested in a report describing different methods and their results on transport flow in its supply chain.

*** The company participates due to a LEARN partner request and due to client requests in the tendering process. Transport, Technical and Quality departments are involved in the test case. The company wants to acquire the necessary knowledge to calculate emissions.

*** The company wants to be more competitive in the tenders and demonstrate social responsibility, being connected to the developments in the field of environmental protection. The company expects the GLEC Framework to be the standard; it wants it to be implemented, involving relevant for the calculation of emissions Transport and Financial departments.

*** The company wants to use the GLEC Framework. It is preparing the XXX Soft information system of the company for future requirements, importing data of fuel correlated to the data on km from the GPS monitoring system and the weight - at this moment estimated - to provide information at the transport / route level. The participation in a LEARN test helps with ISO Certification on Environment 14001, possible customer requirements, the ECO label. The company wants to learn about carbon accounting for Logistics Activities and get support in preparation of the carbon report from logistics activities for the clients.

*** The main participation reason in a LEARN test case is to learn, understand and apply a method of calculating carbon emissions and to participate in identifying the most relevant and applicable calculation methods. Before the start of the LEARN project, there was no distinct compartment with clear attributions in the calculation of emissions. For the future, if this activity becomes necessary, it will definitely be carried out at the level of the Department of Transportation, through 1-2 responsible employees who will receive additional attributions in this respect. At this moment, there is no legal obligation in this respect for the haulers operating medium and large

fleets. It is likely that by the new policies concerning the environment, emissions accounting will soon become necessary for all fleets of motor vehicles considering their impact on pollution indices.

Although so far the company has not received any requests from their clients or authorities, the external auditor asked for the first data in this regard and that determines a proactive approach by the company. The main expectation from the case is to identify together the most relevant method for calculating and measuring carbon emissions. The company is interested to use the GLEC Framework v1.0 provided that this GLEC methodology will qualify as a relevant and generally accepted and applied methodology. The definition of the GLEC fuel consumption factor is very attractive and is one of the reasons to take part in a LEARN trial.

*** The company takes corporate responsibility very seriously, underscoring the goals of the Paris agreement. It implements a broad program of environmental impact reduction, which includes energy and water use and waste management. Transport operations are a part of the activities where environmental impact is to be minimized. The company currently reports CO_2 emissions using national country-specific guidelines and wants to make a change towards internationally recognized guidelines, therefore computing transport and logistics related GHG using the GLEC Framework methodology. It is also important for the company to make a step from average-based GHG emission estimations towards the use of real-world primary data.

*** The company has a high level of commitment to environment-related aspects of its production. Getting involved into the LEARN project is, therefore, an additional aspect of their sustainability commitment.

4.1.1 Reasons for not taking part in LEARN test cases

The three partners who initially showed interest in LEARN but eventually did not participate in the test beds had different reasons for their decision. For all three partners though it would have been necessary to find dedicated staff to cover the pilots. This operational requirement was often the deciding reason for these organisations to step back from their participation:

- One organisation decided that emission calculation is costly yet there is no financial gain to be realised by their organisation. Furthermore, their logistics are optimised already, not for the reason of emission reduction but for the reason of cost reduction; this organisation stated that, as long as there is no financial incentive (in the form of a positive reward or a negative fine) investing resources in the form of staff working time or money is not considered a priority by management; greening of logistics is purely attractive from a financial perspective to them; the organisation publishes a report on its sustainability and eco-balance on a regular basis.
- Another organisation said that the topic of transport chain emissions is not of relevance within their industry at the moment, even though ecological aspects are important as the organisation emphasises its environmental commitment and favours sustainable suppliers and contractors. Instead, the focus in relation to environmental concerns in this industry is on the use of water for production. Furthermore the management emphasised, that a lot of its business is based on using transport units which otherwise would remain empty. They request a marginal emission accounting approach as well as the inclusion of further aspects in the transport chain emission calculation approach in order to deliver a fair and meaningful result, e.g. energy use and emissions of storage, energy use related to product loss due to wrong storage, etc.
- Another organisation already had experience with emission calculation in context with the reduction of the average fuel / fleet consumption; the company began to work systematically on the reduction of its fleet fuel consumption in 2008; meanwhile they have built their own in-house tool for the calculation of emissions. They have analysed their logistics structures and derived necessary actions and tailor-made solutions which are already implemented in their daily logistics operations. The fields of action range from driver training, optimising their logistics plans up to truck body kits (works). In total, the organisation seemed to be very advanced in their actions. As it is a medium sized organisation, their human resources are limited and the effort related to a continuous engagement into the LEARN project were to high so that they were not interested in joining LEARN.

4.2 Experiences with carbon accounting tools to date

This section of the report presents information on the prior experience of the companies with carbon footprinting and carbon accountancy. The information presented in the section is important for understanding the group of test bed partners, as prior experience with the carbon footprinting is a facilitator for adoption of the GLEC Framework. Prior experience can be a barrier in some cases too, as it may require a change in the established computation method and working procedures.

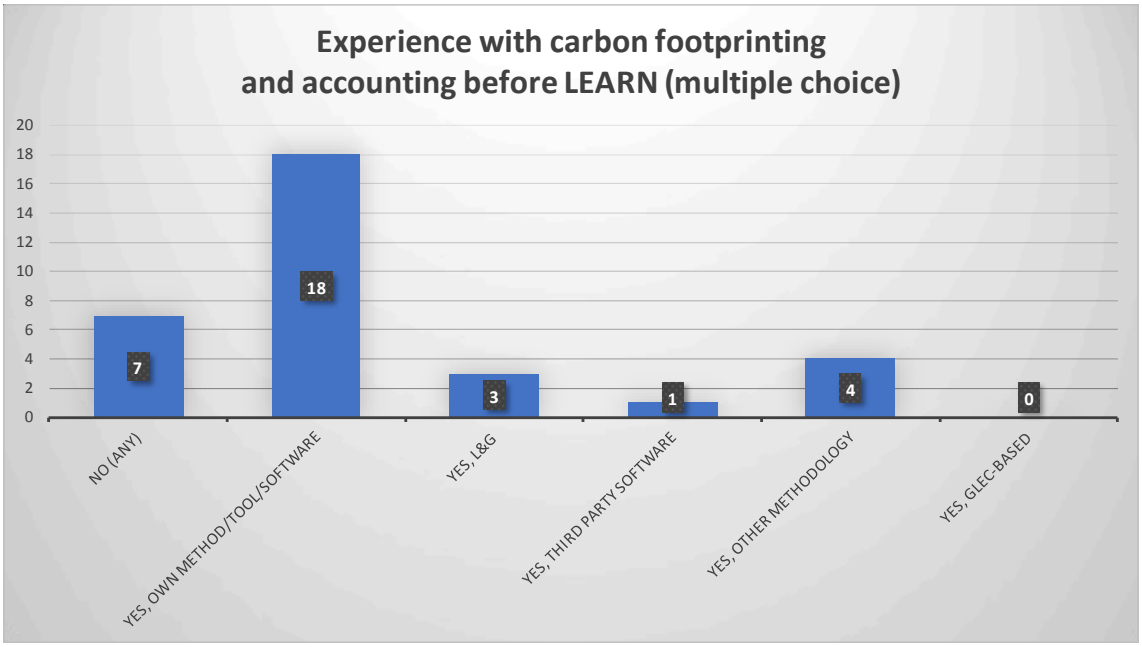


Figure 7 Prior experience with carbon footprinting and accounting

The majority of the companies reported prior experience with the carbon footprinting using own method or software. Only 7 companies reported no any experience with the subject. None of the companies had had a prior experience with the GLEC Framework. The following text presents most relevant statements by the companies on their prior experience with the carbon footprinting and accounting.

*** The company currently uses own software, the system is owned and managed by a 3rd party and customized for the company. The company is new to GLEC. The company participates in a number of programs, such as NTM, CSI, CCWG, SmartWay. The company receives best possible support, but for some suppliers their ability is time consuming.

*** The company gets requests to provide emission data. At this moment, it does not do footprinting, but participates in a number of initiatives (Haga initiative, KNEG, NTM, Fossil free Sweden).

*** The company does not do Carbon Footprinting at the moment, however vehicle (Scania) system provides information about fuel consumption and emissions from Scania trucks operated by the company. The company does not use GLEC Framework at the moment as it is too complicated, administrative burden is too high, it is difficult to obtain data from different company files, computing method is too difficult. They don't believe that in the next years they will be able to have a working system for automatic integration of all data for emission accounting. The company does not participate in green initiatives, but is compliant to Environment standard ISO 14001.

*** The company up to now did not participate in green programs and did not do Carbon Footprinting.

*** The company currently reports CO_2 emissions in its annual reports. There is detailed information provided per activity (e.g. retail, warehousing and transport).

*** Related to its overall evaluations, the company is also investigating its footprint. The company did not have experience with the GLEC Framework before and does not participate in industry green freight programs.

*** The logistics department receives requests from other departments (within the company) to compute emissions. The company currently uses a calculation tool, which is currently further being developed and is to be tested and compared with the GLEC framework.

*** The company receives requests from clients for emissions reports. The company does not currently utilize a paid-for emissions calculation tool but uses in house systems and calculations to provide clients with freight transport emissions reports for provided services. The company does not specifically use the GLEC Framework v1.0 currently but is well aware at a high level of the principles of the framework. The company is interested in a way of reporting to their clients in a harmonized and comparable manner. The company took part in the GFE program including the Multimodal Working Group trying to expand the GFE modal coverage.

4.3 Data availability, collection, exchange and quality

This section presents information on data availability, collection, data exchange between organizations and, when reported, mechanisms to ensure data quality. The test case data concerns transport activity data and fuel use data. The companies describe what data are available or should be made available; if necessary, the companies specify what kind of third party data are to be used in the case.

The absolute majority of the companies report that they collect their own data related to carbon footprinting (28 of the 29 the companies). 17 of 28 companies answered that they need or rely on the data from other companies. With respect to transport activity data (i.e. tonne-kilometers transported), case reports have information on 13 companies (Figure 8). Transport activity data is own company data, and only in 1 instance we have a confirmation that this data is complete.

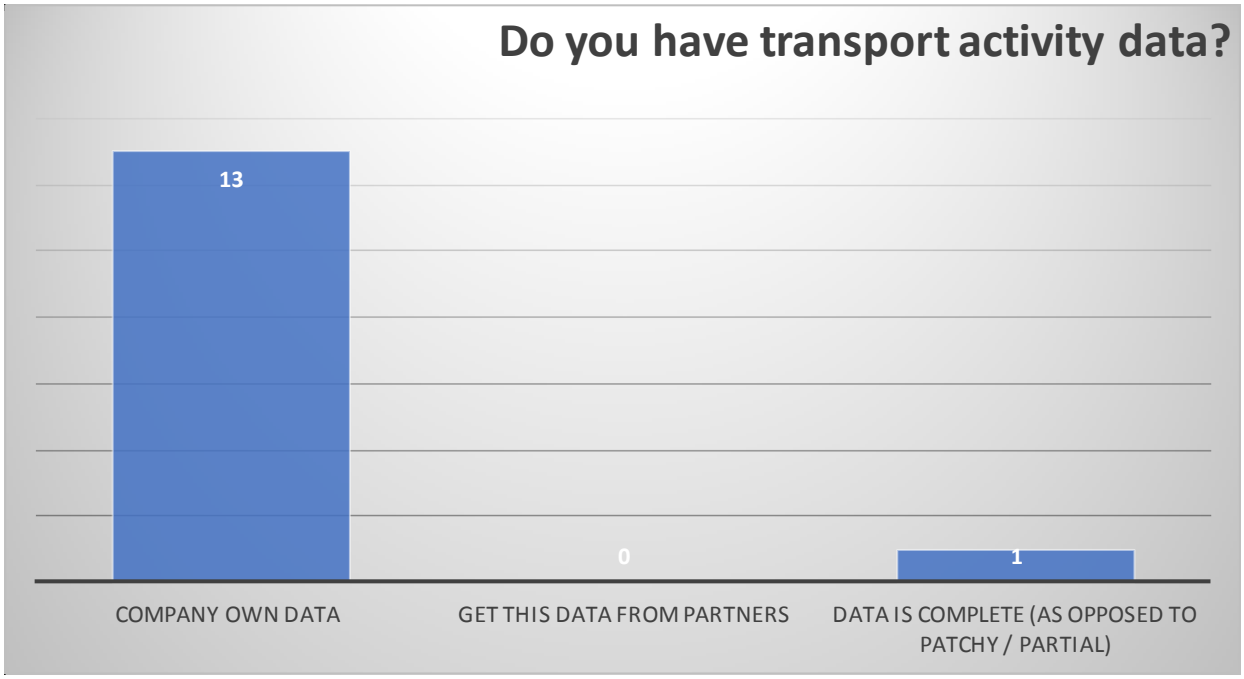


Figure 8 Availability of transport activity data

Figure 9 presents information on the distribution of company types of those companies that have transport activity data. Expectedly, the majority of the companies with own transport activity data is either shipper or freight forwarder; only two carriers report availability of own transport activity data. It should be noted that transport activity data related to the GLEC implementations are measured in tonne-kilometers, as opposed to the traditional carrier's perspective, where transport activity might be assumed to be related to vehicle-kilometers driven. In case of shippers, they often know the origin and destination of their shipments, as well as weight of the shipments. Therefore, depending on the distance measure between the origin and destination, and information availability on the transport chain design, the shippers often possess capability to compute transport activity data measured in tonne-kilometers related to their shipments.

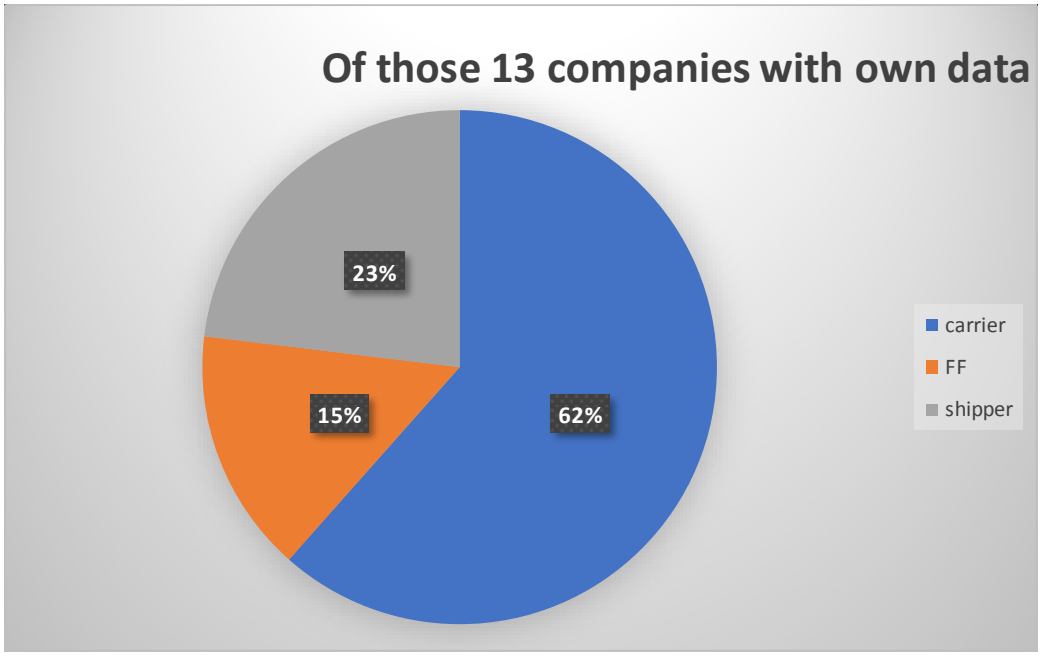


Figure 9. Distribution of company types of those companies that have transport activity data

18 companies have primary (real world, measured) fuel use or energy use data or emission data, which is more than the number of companies having transport activity data. The fuel use or energy use data is directly convertible into GHG emission volumes, as it is generally known how much CO_2e is in one liter or kilogram of fuel or in one kilowatt-hour of electricity. Figure 10 presents information on the companies that reported availability of primary fuel / energy or emission data (note, this is a multiple choice figure, as the companies may have their own data and also get the data from subcontractors). Only one company reported that this data is complete, however, there are probably more companies with a complete fuel data than this one company that stated explicitly completeness of the data.

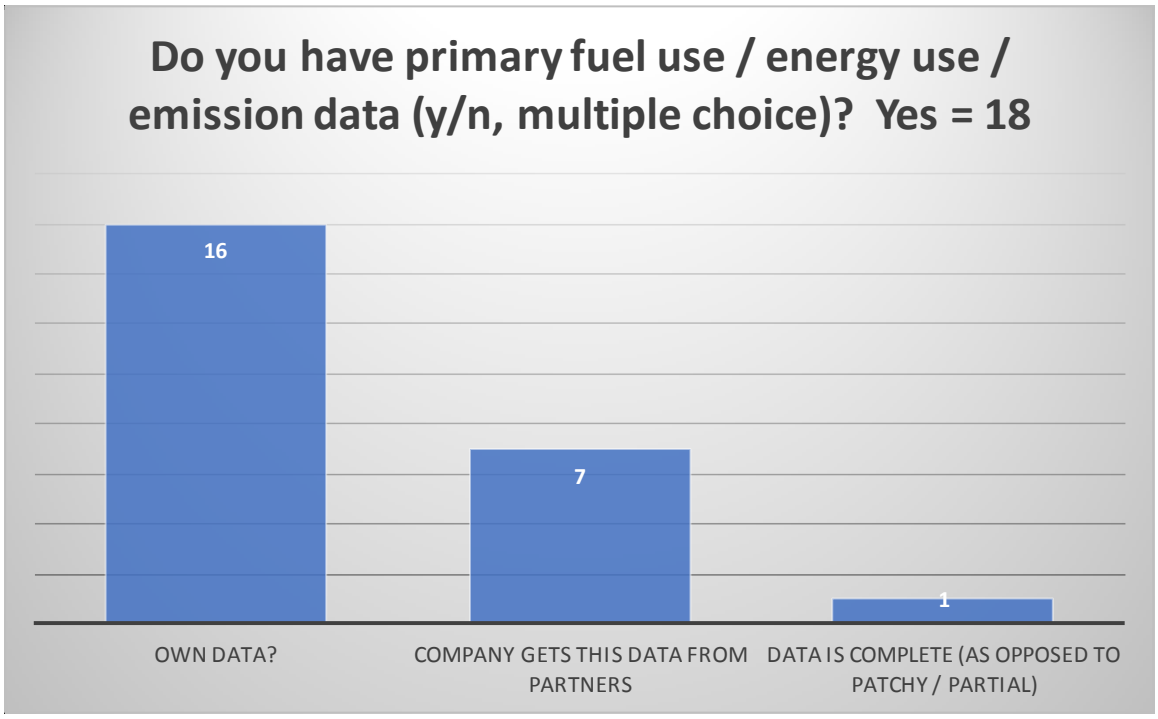


Figure 10 Availability of primary fuel, energy use and emission data

Figure 11 presents distribution of own fuel / energy / emission data available per company type. Expectedly, the majority of companies with the fuel data available is the carrier or transhipment company. Nonetheless, some shippers also have fuel use data available (e.g. in case of own transport, or managed 3rd party transport capacity).

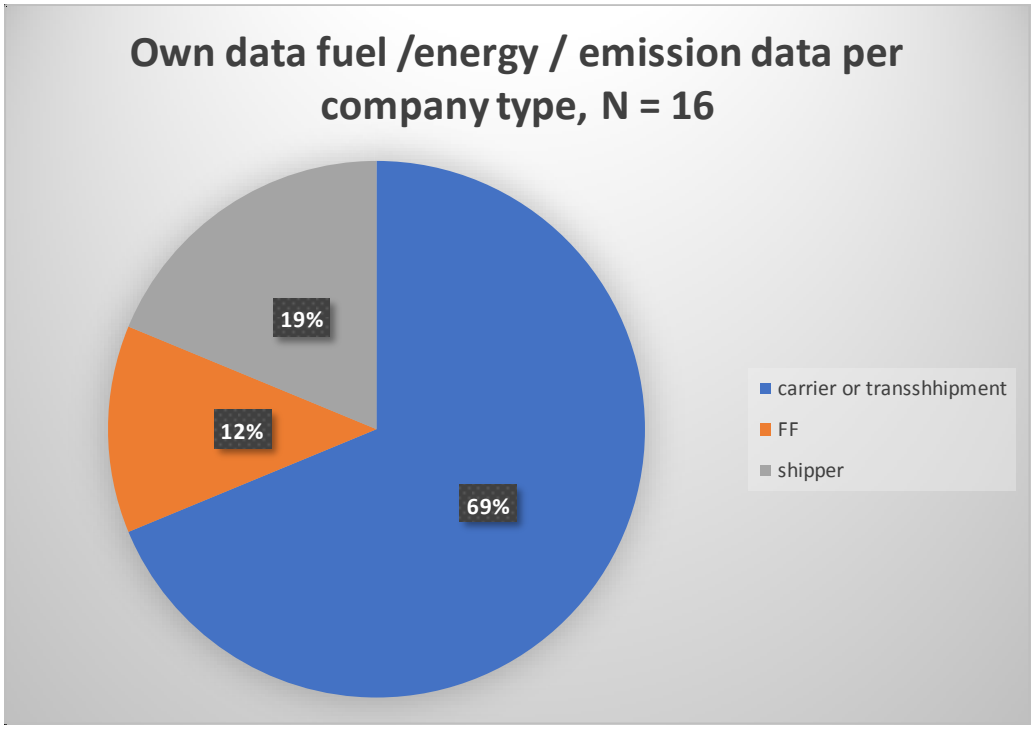


Figure 11 Own fuel / energy / emission data available per company type

22 of 24 companies reported to have a mechanism on data quality monitoring or verification. This mechanism varies per company, between a simple “sanity check” and a more sophisticated cross-check with other data sources. 10 companies stated that they have a data exchange mechanism with other organizations. Figure 12 presents information on the nature of such exchange, note the possibility of multiple choice answers.

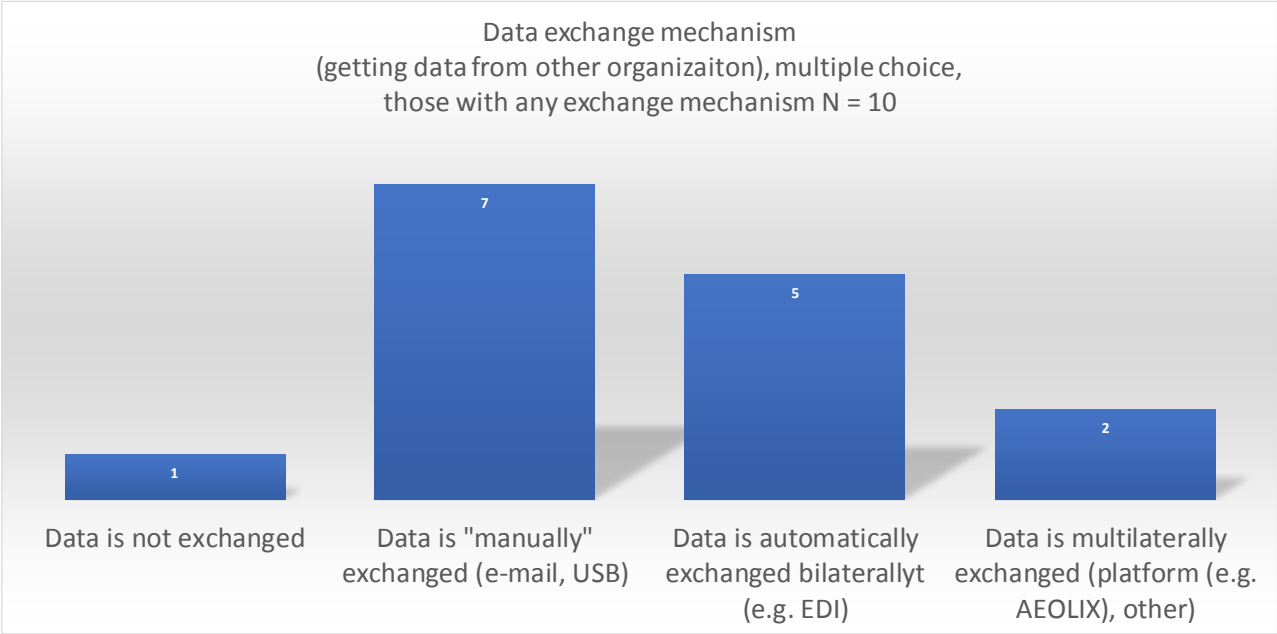


Figure 12. Emission data exchange mechanism

In case primary data are not available, 14 companies reported using default factors. **Error! Reference source not found.** presents information on what default factors are reported to be used by the testbed companies.

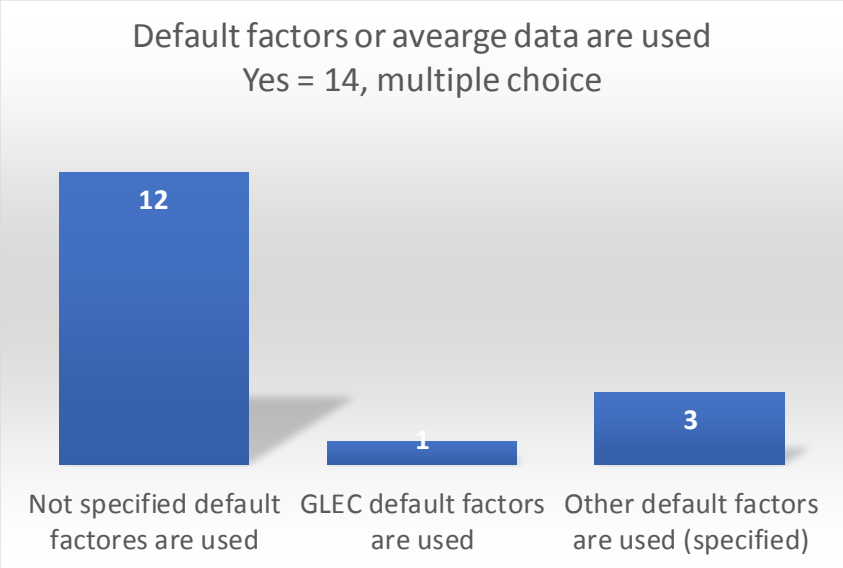


Figure 13. Use of default factors or average data

*** When subcontracted services are utilized then there is a reliance on defaults or assumptions that similar performance is achieved as own fleet. The GLEC Framework has the ability to work with other supply chain stakeholders; however the ones that the company uses in the intermodal supply chains do not currently report according to GLEC so gaps arise. The above means that the company will have to rely on defaults to fill gaps where primary data or outputs derived from primary data exist. Some specific defaults are not currently listed in GLEC Framework v1.0. Examples are short sea shipping RoRo ferries and transshipment centres – ports and road- rail terminals.

*** Straightforward calculation and the default factors for each mode enable the easy calculation.

10 of 14 companies stated that they use, plan to use or in a transition towards automated emission-related data exchange. Figure 14 provides information on the statues of automated emission data exchange development.

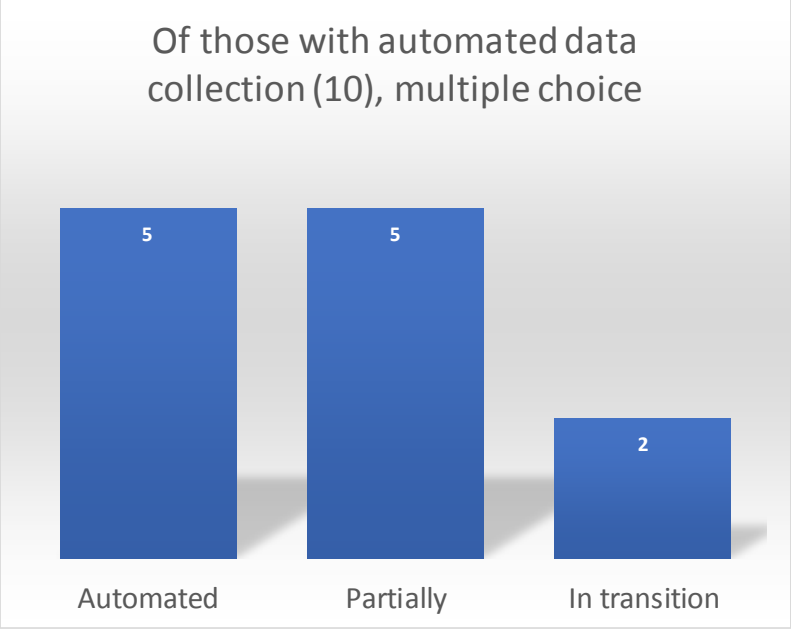


Figure 14 Status of automated emission-related data exchange

*** For collection of data a neutral intermediary is needed. Most logistics providers are not willing to provide data directly to shippers because fuel consumption is a relevant factor for transport prices. A neutral intermediary between logistics provider and shipper could anonymize these information. In addition to this a standard for data exchange (e.g. DIN SPEC 91224) is needed.

*** Every transport supplier provides data to the company software. Some fall back data are used for, among other, calibrating supplier data. For example, Clean Shipping Index provides access to the database of ships and related environmental data. Data quality is monitored by experience and through a judgement on the reasonable data boundaries (max and min) supporting this process, different parallel assessments are used for data verification. For this test case the data were already available, but the company has been "digging" as deep as possible. For this case, the data are transferred by mail in Excel to the Logistics department and to the LEARN supporting partner. The computations involve assumptions; automated data collection is limited by data relevance and data quality.

*** Company collects data based on spend method, relying on the data from other organizations (though no access to those data). It will require a new or updated system for data collection

*** Data are available in different excel files managed by different departments - transport department and technical department, but there are no weight data. For international vehicle transport, the company does not have actual data concerning the weight of each transported car, therefore weight estimation = average weight x load factor. Quality management procedures are used for data quality control; technical quality is managed by FMS and fuel system. Emission computations would require an updated IT system. More data should be integrated in the fleet management system - link between journeys system and fleet management system. The necessary data was available, but it was available at different departments in different excel files:

- Driven km – fleet management system
- Fuel – fueling program with data from fuel cards
- tonnes weight – transport department manages the transport contracts CMR based on volume, excel file for transport orders + portals + orders by email

Transport Department reported data to Technical Department and Quality Department which made the calculations based on assumptions over the weight of goods. Data processing automation would help: it is necessary to use the truck data – the new generation of trucks report these data and can calculate emissions. It is not reasonable to ask transporters to calculate other data, it is too burdensome and may lead to human errors.

The company maintains a database, using software to monitor quality. The necessary data have already been available in the database. The transport department reports data to the quality department. The missing vehicle weight data have been estimated according to the brand and model of the vehicle. The site used as a source: www.topgear.com/car-reviews (except the DACIA brand).

The data come from the three departments:

- Transport Department dedicated to YYY client provides data on the number of vehicles, brands and weight;
- The IT Analysis Department provides data on the number of kilometers driven and liters of fuel fed;
- The Financial Department centralizes, calculates and communicates the results.

Data for the test: liters of fuel - based on the Invoice with online report from the fuel supplier website (low degree reliance on third party); kilometers - online report from the monitoring website (low dependence degree on 3rd party); kilograms - dispatcher estimation per trip in the electronic system, low degree (lack of customer information - accuracy problem). For the accuracy, we need data from the customer about weight. Automation of data collection will require a system update and information from the 3rd parties. The data quality is monitored through

- Physical verification of kilometers from the board of the vehicles
- Verification of liters of fuel filled with the liters of consumed fuel
- Kilograms - Dispatch estimation, lack of data from the client.

The company uses actual distance and fuel data, but weight is to be estimated.

For automation of data processes, the company at this moment is in the state of implementing the GPS monitoring system in the IT system- we hope to be functional by the end of November; the import of food related information, taxes from fuel suppliers is in tests. The part related to weight calculation is made by the dispatcher / data operator estimation

*** There is no reliance on third parties for the data, all data will be provided by internal compartments. 80% of the data are reported monthly. 3rd party data are used only for control; i.e. internal duel administration should be in line with the billing.

For the transport activity data quality, a check would be required for the quality of the data concerning the quantities of goods carried. Fuel consumption data quality is monitored by 3 systems:

- consumption reported on board of the vehicle

- consumption reported by the supplier between two fillings
- consumption calculated and monitored by GPS

For the test, fuel data was readily available. Transport activity data are reported by employees with specific tasks to the Department of Transportation. Actual data (as opposed to default values) represents 90% of all data used

*** Being a shipper, transport data availability is not complete. The company will rely on third parties for fuel data, which are expected to be available for October 2017. The data should be available on request in an unstructured form. The data quality is generally good, transport activity data are based on the outbound logistics to the stores. For the absent fuel data, assumptions on fuel consumption are / can be made (based on km driven). The distance data can be verified; fuel data can be verified on average consumption and distance. The environmental reporting data are collected by logistics department and reported to the environment department, which in turn reports to the stakeholders.

The company sees this trial as an opportunity to make a step from estimated fuel consumption to actual fuel consumption data from the vehicle owner. Telematics data are not incorporated yet, but present a useful case in the future.

*** For company's own fleet operations data collection and retention for fuel costs and quantities in relation to their vehicles is well organized. Even for some sub-contractors that use the company's fuel card accounts there is good visibility of fuel quantities and driven distances. Shipment data in terms of tonne-km is less well defined and recorded. There are difficulties in understanding the distance element of their tonne-km values. Also the tonnes shipped is less well defined as the company uses payload weight which can be derived from shipment volume data. For generation of data on fuel consumption per tonne-km some adjustments to systems will be required in terms of recording / determining of weight of goods transported.

The company will rely on input data from subcontractors and when a multimodal transport chain is utilized, for example trucks going on "Roll on - Roll off" (RoRo) ferries or when trucks and/or trailers are transported by train over longer distances when appropriate and their associated transshipment center related emissions data will be needed. However, data exchange mechanisms are not currently established.

Emission-related data quality is not monitored at the moment. The company is ISO 9001 & 14001 certified but the assessments/audits are based on processes/procedures rather than data assessments.

The base data that is available is spread across all operations, for example in terms of total fuel consumption of own fleet along with total distances driven. Dependent on where the subcontracting operations occur, reliance on data from 3rd parties is to be determined within the trial. Data from sub-contracted carriers and other mode transport providers will be required to enable full and more precise emissions calculation and assessment. Third party data availability and usability is to be assessed.

Assumptions: where the company uses own fleet to conduct the transport service then actual fuel data is used, however this is averaged across all fleet vehicles and is based on fuel per km driven rather than fuel per tonne-km transported. When subcontracted services are utilized there is a reliance on defaults or assumptions that similar performance is achieved as own fleet. Where gaps in data exist, such as RoRo ferry operations or Road – Rail or Rail -Road terminal operations then emissions are excluded from calculations.

4.4 Experiences with GLEC calculations

This section looks into the practical experiences with the application of the GLEC Framework in the company settings of the test bed partners. This section first provides quantitative information based on the test reports, then goes in-depth with respect to analysis of the applicability of the GLEC consumption factor, calculation process, usage of the results and the potential for improvement.

There is a general satisfaction with the GLEC Framework, see Figure 15 on the general satisfaction with the GLEC Framework.

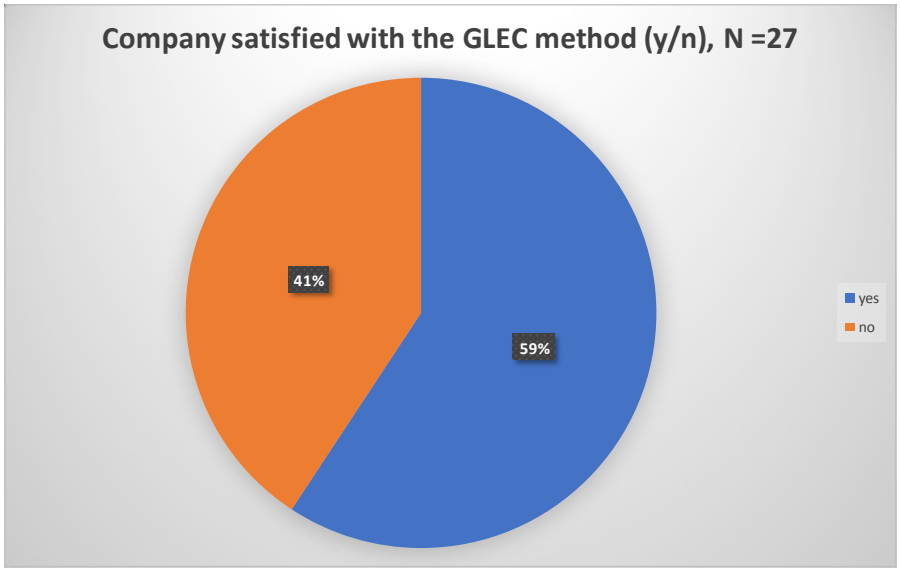
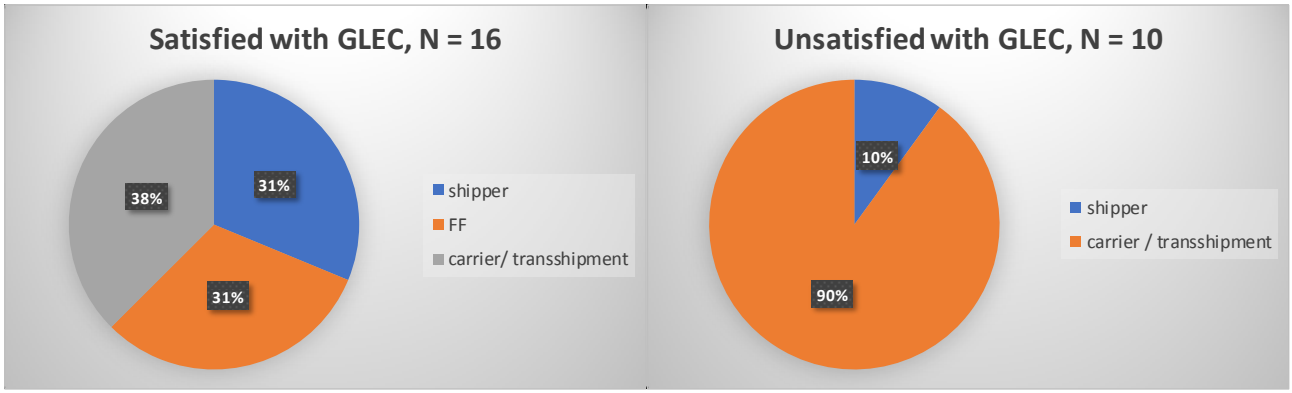


Figure 15 General satisfaction with the GLEC Framework

Of the 16 companies that expressed their satisfaction with the GLEC Framework, the company type is distributed almost uniformly, while those that are not satisfied are predominantly carriers, see Figure 16.



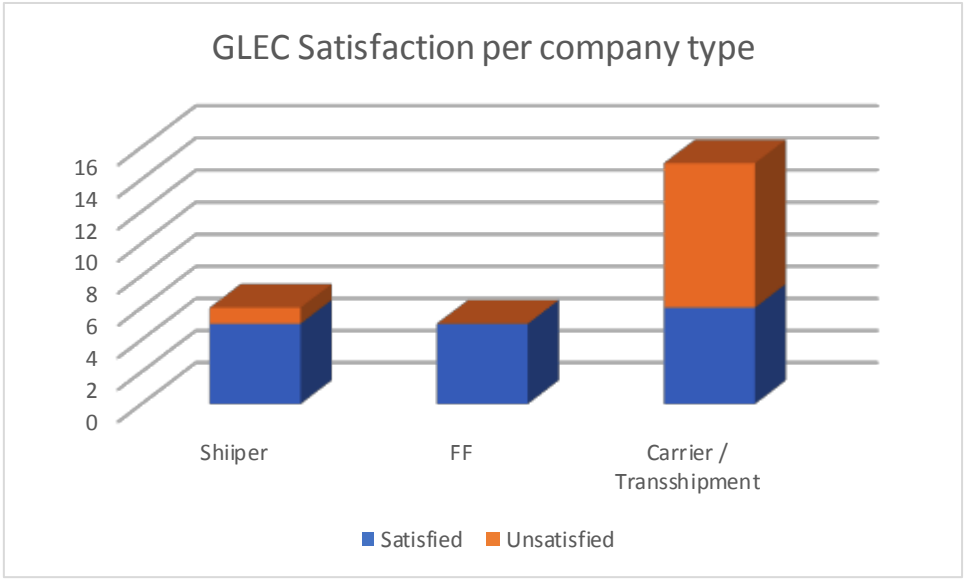


Figure 16 Satisfaction with GLEC per company type

*** Company is partly satisfied with the computation method, the drawback is that data are delivered in a different format. The level of improvement realization is difficult to follow since the company is a shipper and most improvement measures are done by the carriers. If the company makes changes in supply chain design this will have an impact on the KPI's. The calculation output will be used for the annual comparison and for the annual report. It is also the baseline for future improvement work. The results are not used for optimization yet, as it is

still too early and errors are likely. Those have to be first eliminated and work to be done to reduce extreme values. The GLEC transport categories have not been used; the currently used software provides the structure for default data and supplier data. The GLEC's consumption factor is useful, since the currently used software uses it.

*** Satisfaction with the GLEC method is difficult to assess: the company would not be happy if GLEC is imposed, it is hard to use because it is difficult for the company to integrate all the data in order to carry out current calculations.

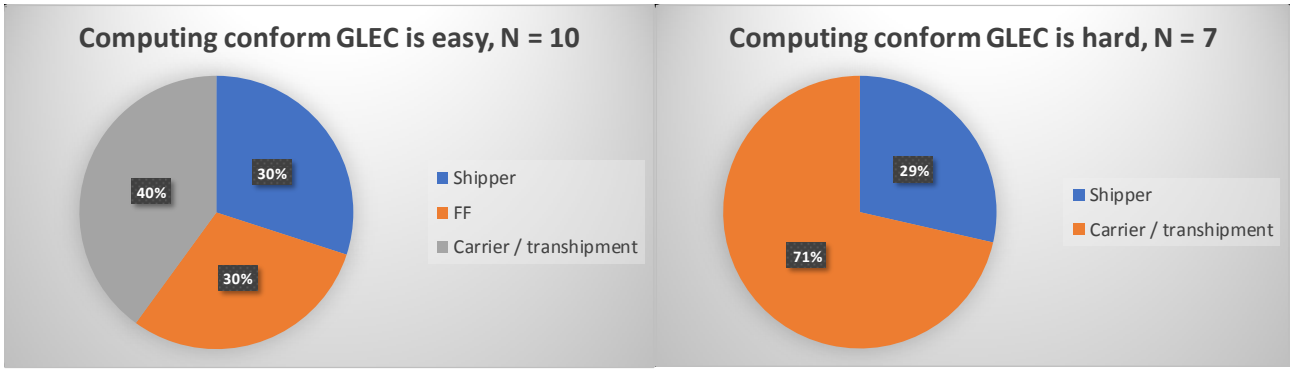
*** The company is satisfied with the GLEC formulations. As no CF had been done before the LEARN test case was initiated, there is no basis for comparison.

*** The company is generally satisfied with the GLEC formulation, but also thinks that it can be improved by an inclusion of yet an influence factor, like the empty runs of the truck to the place of loading and unloading, transport to the service, etc. The company believes that GLEC-based indicators provide right directions meaning that improving emissions indicators can show to the company management an improvement in transport efficiency in terms of capacity utilization of the vehicle and the use of a more environmentally friendly vehicle. There is a potential to increase efficiency using the results through process optimization, though the impact of emission monitoring has not been established. Further TSC segmentation will not help due to homogeneity of the transport activities. The consumption factor is very important and one of the motivating factors for taking part in a LEARN trial.

*** The company expects that due to methodology change to GLEC, which includes indirect emissions (WTW as opposed to the current practice of TTW reporting), the emissions reported will grow by 10-30% (most expected 20%). This is an unfortunate phenomenon, but explainable to the stakeholders. The company is satisfied with the GLEC methodological formulation, but sees the need for weight approximation and that the kilometers driven may deviate from the actually travelled.

*** The computation results will be issued in reports/statements to clients on the emissions associated with the transport services provided. The company would wish that automated calculations are possible as then the effort required to provide clients with their emission reports would be less, however an agreed and standard way of doing this is needed across the industry which isn't happening currently. The company will need to invest in updating data systems but would not do this unless the outputs would be standard and comparable.

17 companies expressed their opinion on the ease of computing conform GLEC formulation, with 10 companies saying or implying that it is easy and 7 companies considering it difficult. Similarly to the results on general satisfaction with the GLEC method, the majority of the companies that find the framework hard are carriers, see Figure 17.



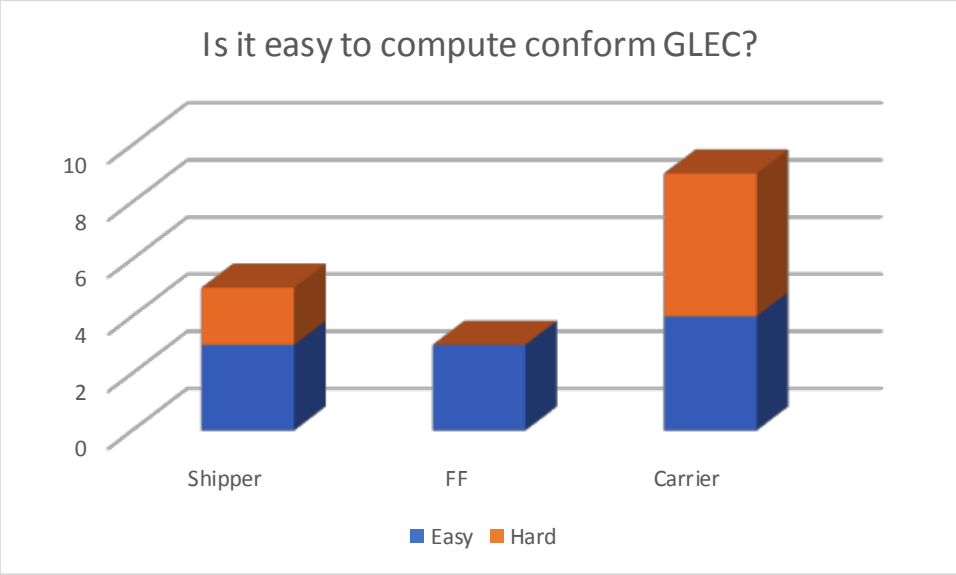


Figure 17 Distribution of company types finding computing conform GLEC Framework easy or hard

Overall there are several reasons for non-satisfaction with GLEC methodology:

- The level of details that is reached with the results of calculation (it is not enough for the purposes of the companies, i.e. the rationale for performing calculations);
- The need for collection of detailed data on transport activity;
- If company have their own tool / method, their feedback for the GLEC formula is usually more negative (in relation to the extensive additional data collection and results not corresponding initial need of the company).

Note, that the reasons for non-satisfaction can be somewhat contradictory, as some companies find GLEC to be too aggregated, while other companies would complain about too much data requirements in their opinion.

Below are specific experiences reported by carriers.

*** High difficulty makes GLEC special but also precise

*** Complex formula: it requires detailed data over each trip of the truck

*** GLEC framework already provides different levels of aggregation. A further simplified version would destroy any comparability between results of different companies.

*** The company accepts the formula for calculations but question how practical it is to conduct the data collection to feed in to the calculation. A major question for the company centers around the WTW approach as they historically look at TTW or tailpipe. As an organization, the company feels they have little or no control over the WTT phase of fuel/energy production. The company also raises issues around the weight used to calculate tonne-kms with a preference to use pay weight. Distance calculation by planned distance is acceptable as planned distances are used in the information / data systems. GCD would be a problem (more of an issue with L&G than with GLEC Framework).

*** The GLEC methodology applied for the flows of a shipper would require returning to manual calculations. A simplified version could consist of a reduced number of parameters; there is a gap on the distances as well as lack of control of the transport links by the client.

*** Difficulty in determining distance driven, as no actual driving distance available for the past trips

Some of the shippers have reflected the following.

*** In order to touch base with reality there is a need to remain flexible with different operations. One division / company in the group may use a dedicated truck and another uses one of the main forwarding companies as a shared service. There is not a “one size fits all” situation if we really want to accomplish measurable improvements.

*** A lot of work to calculate emissions of many LSP’s and modalities.

Some statements of the freight forwarders are presented below.

*** The cost factor of selecting routes is the barrier to choose a certain more environmentally friendly route

*** It might be useful to provide better explanations for the specific choices related to IATA RP 1678

*** Overall and long term we prefer fuel consumption data per vehicle km allocated to transported cargo rather than using the tonkm as fixed factor. When these data are not available it can serve as a fall back solution.

As regards the consumption factor, the majority of the companies find the concept of consumption factor to be a useful one, see Figure 18.

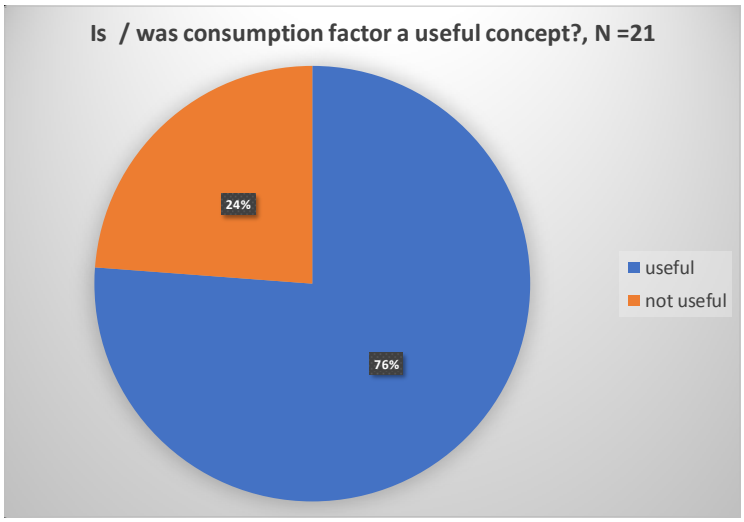


Figure 18 Usefulness of the GLEC's consumption factor concept

One company reported that "The company would use the Consumption Factor for estimating emissions related to sub-contracted services, if this factor was provided. The company would supply the factor to their clients but have reservations about the calculation of activity in terms of tonne-kilometers".

4.4.1 Comparison of GLEC method to the other carbon footprinting methodologies

When other tools or methods are used, the companies notice a major difference between the results computed using different methods. The mentioned reasons are:

- Difference in fuel emission factors used
- Insufficient granularity of the default consumption factors
- Difference between actual fuel and default figures
- Basis of calculation is different
- Different allocation principles
- Difference in CO_2 emissions per unit of fuel used, especially a step from TTW to WTW emissions

Statements below illustrate concrete experiences of the test bed companies from the perspective of different stakeholders. The shippers have highlighted the following major reasons for the differences.

*** It is not easy to make a comparison. The current method used by the company is based on average consumption and the km recorded in our systems. The GLEC Framework v1.0 method uses consumptions and km given by our suppliers. The two sources of information are diverging. At this time, we were unable to validate the information received by suppliers. We realize that more intense validation of the information received is needed: the current method is excluding a few extra km from our analysis. Using an average consumption for the vehicles is also not correct because we have several typologies of vehicles, with very different consumption. In the future, we could assume an average consumption per vehicle type. In this way, we are closer to the real data.

*** Our approach was to benchmark calculation methodologies at the same case study. The results showed that the main source to different outcome was different underlying electricity factors.

*** Our approach was to benchmark calculations methodologies at the same case study. The results showed that the main source to different outcome was different underlying default factors. There were some default data issues related to distance (sea and air), load factors (sea) and allocation (belly freight).

*** In general the default factors presented by GLEC seem to be higher than more specific data. In general we have this balance of doing precise calculation versus more automatic assessment based on data in our existing TMS. At present we use transport costs related to consumption factors to enable automatic calculations, i.e. simplicity, regularity, comparability (and good enough) prioritized over precision.

*** Difference in emissions factors explain computation differences

*** Huge difference between actual fuel used and default figures.

The perspective of carriers is illustrated in the statements below.

*** The RoPax data in GLEC is non existing, hence the sea based data was difficult to use. Based on calculations overall we see that our way of calculation is of acceptable credibility and will not lead to any differences in reporting for now. Our approach was to benchmark calculations methodologies at the same case study. The results showed that the main source to different outcome was different underlying fuel data and allocation principles for RoPax

*** There is a difference because due to distance measurement discrepancies and different consumption factors used

*** The company's calculator does not compute the consumption factor defined by GLEC (tonne-kilometer) as a seed datum. The allocation of the vehicle share to each client in case of grouping is doubtless the highest variability factor. There is no questioning of the credibility of the current calculations; however, with any emission calculation tool we tend to expect very precise and detailed data, forgetting that this reduces the sample and increases the margin of error (already significant for such calculation – 10 to 30%). The own tools shows emissions to be slightly smaller compared to the GLEC framework computations, in particular due to difference in kilometers driven.

*** There is an important difference for the milk runs where we are doing the allocation according to weight, include in our calculations the complexity of the milk runs where we do not allocate according to tkm. There is a large difference in terms of total GHG emissions when using default values from GLEC. Concerning the methodology, we do not apply the fuel/tkm but CO_2e/kg for the 1st and last mile. The learnings are: The current GLEC consumption factor of GLEC is not adapted to the 1st and last mile: CO_2e/kg or per transport unit makes more sense. The notion of shipment urgency is currently not integrated, and this makes a huge difference in calculations: with express services, there is far less possibility to consolidate, smaller vehicles are operated and therefore the total emissions are higher. Only a carrier or an LSP can integrate the complexity of the network in its emissions calculation: it is the core business of a transport service provider. A calculation done by a shipper will never integrate the details of the complexity of the transport chain. This means that the GLEC Framework works when the calculation is done by the transport service provider.

*** The Framework works, however, if the details of the routing are not correctly taken into account then the result is inconsistent. E.g.: we have seen in this test that applying GLEC Framework can lead to huge differences in the calculation compared to company's own calculation tool. The GLEC Framework should be a "journey"-based. Benchmarking based on GLEC could only be done if there would be a verification standard (ISO).

*** There is a difference in allocation and consumption factors compared to the own method. For accounting both methods work fine, however, for emission reduction Green Freight programs have a better fit.

*** The differences are related to the accuracy of weight data and to the mixing of the temperature controlled transport with the ambient transport. These should been dealt with as different TSC in the test case

*** Calculations varied dependent on default consumption factors, fuel emission factors and distances used.

Freight forwarders have highlighted the following differences.

*** The calculations revealed a large disparity between results obtained using the GLEC Framework's emissions factors and those obtained using company's approach, due to the default factors in the GLEC Framework not being appropriate for the biofuel mix being used. The final emission numbers obtained using the GLEC framework are scientifically higher due to the emission factor being set at a too high level given the specific biofuel mix being used[1].

*** Application of general default consumption factors is trivial, but should be discouraged, as real world emission data (or well estimated emission data) provide better foundation for making greener decisions in choosing carriers

*** There are huge differences when using default values from GLEC, especially for air & ocean. The default values provide higher results: GLEC default values are 4.5 times higher for ocean freight and 1.5 times higher for air. The first lesson learned should be that footprint calculation is a journey: it can start with default values, then modeled data's and finally verified and comparable carriers' data (which are currently only available for ocean freight). The second lesson learned is based on the fact that we could not get any data from any carrier (except one) and therefore platforms are needed to collect these data.

4.4.2 GLEC methodology improvement potential

The companies have suggested concrete improvement potential for the future versions of the GLEC framework:

[1] It should be noted that for biofuel mixtures the GLEC Framework v1.0 provides liberty to use the fuel emission factor as specified by the biofuel supplier. As such this flexibility appears to have been overlooked in the test case.

- Provision of more granular consumption factors
- Provision of calculation tools, even a spreadsheet would be of help to some companies
- Better guidance on emission allocation between cargo and passengers
- Suggest using great circle distance for emission allocation
- Allow usage of different allocation principles, not only tonne-kilometers, but also pallet-kilometers or m3-kilometers
- Better guidance and educative courses, as some companies do not fully understand the GLEC framework
- Guidance for transshipment points is necessary

Specifically, the shippers suggested the following.

*** It could provide general fall back data (default factors for the situation when primary data are not available), but at present their relevance needs to improve. At present default data are not adequate for high resolution calculation but for general shared services it can provide an optional approach.

*** GLEC Framework should be better aligned to Scope 3 accounting (GHG Protocol). GLEC should incentivize reporting companies to continuously improve their data quality and completeness (e.g. data quality levels that have to be reported as well)

*** Yes, we are satisfied with the formulas, but it would be helpful in the future for the GLEC Framework to provide a tool (e.g., spreadsheet) which already encompasses the formulas.

GLEC improvement potential as seen by the carriers.

*** The distance for allocation should be chosen carefully. E.g. a carrier or LSP providing to shipper consumption factor in the form of fuel/tkm. The inconsistency would arise in the fact that the LSP and the shipper would use different distances: planned or actual distance is / was known to the LSP at the moment of transport planning, while the shipper may only know shortest or fastest distance between the loading and unloading locations. A use of great circle distance would resolve this problem as both parties would use always the same distance for emission allocation.

*** For our organization, we should use volume and not mass units. It can be a success if it would be developed a goods monitoring system taking into account the specifics of postal activity, parcels, timetables, volumes.

*** It is a simple calculation, but it should be differentiated by vehicle type, differentiated on each country due to the factors involved in this calculation, starting with the type of fuel, the routes made, etc. One cannot compare the results obtained on the vehicles involved in this project from different firms, if you do not take into account the factors described above, the type of vehicle, the fuel used, the route (the atmospheric environment could be a factor).

Several points were suggested by freight forwarders and transshipment points.

*** There is a need for more explicit guidance / data for biofuels. Ability to use specific values on fuel consumption, load factors.

*** The framework should not give more preference to dedicated freighter cargo, but give advantage to the belly cargo: current allocation rules favor dedicated freighters over belly cargo transport. In many instances belly cargo is underused, as airplane flies the route due to passenger demand. Getting belly cargo on these flights essentially results in a marginal increase of emissions, while flying a dedicated freighter results in a much larger emissions

*** There is no published method nor guidance for the GHG assessment of terminals. Suggestion by company: coverage of empty container handling has to be reported separately. Basically, we find that this is an adequate and applicable method for calculating carbon footprinting. However, from our point of view a separate consideration of the empty containers is necessary.

4.4.3 Barriers and enablers of the calculation process

Several overall calculation barriers can be identified:

- For the “newbies” there is a steep learning curve: time and knowledge on how to calculate
- Data collection from other people in the supply chain/subcontractors
- The lack of specific fuel emission factors and consumption factors: e.g. renewable fuels, aviation, transshipment points, etc.
- Manual working out of some information and not automated computation formula

Besides those, some shippers specific barriers were also reported in the test bed cases:

- Full GLEC compliance requires knowledge of the actual transport network with all legs and logistics sites. For shippers these information is seldom or only to limited extent available
- Experienced missing data, missing emissions factors
- For international shipments: differences in tracking and reporting shipments in different regions

Those can be confirmed with the following statements.

*** Time. Knowledge on how to calculate, but the method itself is easy.

*** Ready to use tools are needed (Data collection, Calculation..)

*** The main barrier is the dependency on the third-party data. The greatest challenge was the validation of the data used to make the calculation

*** Full GLEC conformance requires knowledge of the actual transport network with all legs and logistics sites. For shippers these information is seldom or only limited available (e.g. LTL forwarding networks. Most LSP don't provide information about routing or used cross docks and hubs). There are missing data, missing emissions factors

*** Limited feasibility in implementing the Framework on a larger scale due to differences in tracking and reporting of shipments by the various regions in which the company operates.

The following barriers can be identified as carrier specific:

- WTW versus TTW approach
- Issues with retrospective tonne-kilometer transport activity calculations as big effort required for monitoring of weight and distances
- Data from subcontractors is missing or unreliable
- Weight data on the shipments is not always available
- Fuel consumption factor is subject to commercial sensitivity, and related issue of trust
- Desired level of data aggregation is varying among the companies

*** A detailed calculation can create possible management and operating obstacles

*** Data availability on transport activity is a barrier. Some parts of fuel / energy data, such as electricity use by storage, handling equipment is not available.

*** Calculation of subcontractor emissions, especially if trucks and specific consumption are unknown is an issue. Specific emission of carriers are not available, consumption factors are given in the framework, but are higher than in EN 16258.

*** For own fleet operations the focus is on vehicle fuel efficiency. For overall freight/shipment/supply chain efficiency the level of improvement may be more difficult to assess as there may be too much aggregation. Reluctance to take a WTW approach. Issues with retrospective tonne-km activity calculations as big effort is required. The costs of additional verification of self-declared outputs could be a barrier for uptake of the Framework.

*** Monitoring of tonnes by the carrier: the principle of a shared calculation per TSC is compatible with company's own method. However, using the TKM as a pivot is not possible here because the company does not get weight of shipments from the customer.

*** Difficulty in determining the quantities of goods carried; transforming volume of goods to an equivalent weight

*** Obtaining data of actual weight – may occur differences of up to 1000 kg; Integration of data from different files is a challenge

*** Lack of customer information about the weight of the transported goods and the need to estimate it (the inability to get real data on the weight loaded on the vehicle). The need for weight approximation impacts accuracy of the emission data. Customer order data contains km and weight - but the driver can either confirm or not, based on his experience. Getting weight through a weighing system is a possibility, but a weighing system costs from 1,000 euros upwards - operating costs increase.

*** No data on driving distances

On a top of this, there are statements confirming the overall barriers.

*** The lack of data of renewable fuels in GLEC. As a user you need to be able to use more specific data (on emission factors for fuels, fuel consumption etc.[2]) collected for example in your network if you have those data available. Need to communicate to subcontractors and align emissions factors/get real fuel data.

*** Provided known emission data and transport activity data, reporting conform GLEC does not present a challenge. Getting data from carriers is the biggest challenge. The main barrier is in the up to now absence of real data on airline consumption factor.

[2] This statement overlooks that in GLEC Framework v1.0 flexibility to match biofuel blend supplied is allowed.

Together with barriers, the enablers were also reported in the questionnaires. Overall enablers, facilitating the calculation process are:

- Previous experience with CF methods and tools
- Available data/access to data
- Automated data collection processes
- Good commonly accepted default consumption factors and guidance how to handle gaps in data
- Very specific knowledge of their own operation
- Marketing efforts
- Training and guidance

*** Good default emissions factors for logistics sites and for alternative fuels

*** A software tool, with calculations embedded in it would ease adoption of the Framework. Hosting webinars or providing online trainings for such a tool would also be beneficial. In addition, a toolkit that contains an editable presentation about the background of the GLEC/SFC would help companies in sharing this with other internal stakeholders

*** More detailed guidance in next version of the GLEC Framework.

*** Difficult to implement because knowledge about the framework is needed: provide training

The following statements illustrate some shipper specific enablers.

*** It is very important to get all the information from telemetry systems, but it has not yet been possible. It is also important to have specific people dedicated to this calculation, with some critical and analytical ability to obtain the desired results.

*** Good default consumption factors and guidance how to handle gaps in data. An already existing carbon footprinting tool, due to which the data collection already happened. Without previously available data the implementation would've taken much longer.

*** Satisfaction of the emission reporting needs.

*** Creation of national or European platform where carriers' data would be collected (fuel/tkm or fuel/tkm), comparable and verified

Carrier specific enablers were identified as well.

*** Clear guidance on calculation approach, on how to estimate missing information.

*** Simple guideline, explanations and trainings.

*** Our very specific knowledge of the sea operation and legal demands.

*** Communication with the transporter

*** The sharing of most of the GLEC framework principles

*** Use of actual emissions reported per truck and loaded km (human error is avoided)

*** Access to data from company's electronic management system

*** The fact that we use the data required by the GLEC methodology for calculating the consumption of our vehicles. The distance is monitored via GPS, the fuel used is reported by the fuel supplier.

Finally, freight forwarders have reported that the following factors facilitated the GLEC calculation process for them.

*** Straightforward calculation and the default factors for each mode enable the easy calculations. The training provided by the LEARN supervisor is an enabler.

*** Provided data on transport activity and emission data, GLEC Framework. Is easy to implement. Marketing efforts on the part of airlines with the most direct routings and most efficient aircraft might get things started.

4.4.4 Use of results

This section looks at the intentions and practice of the participating companies with respect to the use of the carbon footprint results obtained by application of the GLEC Framework to their logistics processes. Figure 19 presents an overview of the outcome usage, with the majority of companies intending to use them for the internal company purposes. 7 companies are going to use it for the clients or public reports.

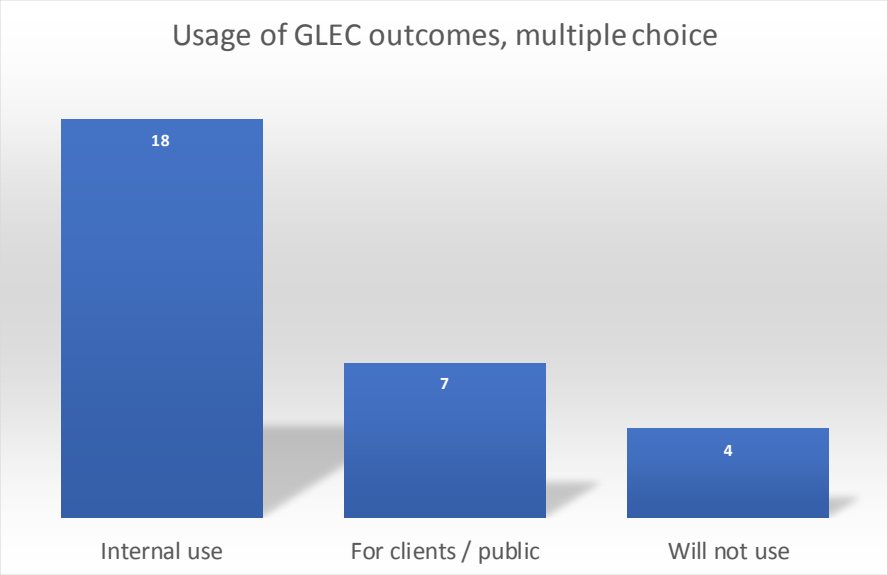


Figure 19. Reported use of GLEC computation results

Difference between usage of GLEC results and usage of CF own results is an issue to overcome. The companies are not ready yet to publish the results of GLEC computations, only in couple of cases results will be used within yearly sustainability reporting.

The shippers specifically gave the following reasons.

*** The company will not further use GLEC framework, because it provides less in depth information than the L&G method used before. The GLEC Method is easy to use, for a company who wants to know the GHG emission. But the information after calculation does not help you to reduce CO_2.

*** At this moment, the implementation has no viability as intensive data validation is required. It was very helpful in identifying weaknesses and what we should work on to improve our own emissions calculation.

*** Based on own calculations and GLEC based output, we see that our way of calculation is of acceptable credibility and will not lead to any differences in reporting for now.

*** Not likely at this time. We will wait for GLEC 2.0 and final results from LEARN

*** This is the first step for the company to begin a full Scope 3 GHG emission inventory.

*** Limited degree as the carrier does not share its consumption data but its emissions by tonne. Furthermore the company has no view on transport link

For the carriers, the following statements are illustrating the reasons of usage or not of the GLEC results.

*** GLEC has to be a common and accepted standard to become our first choice. It has to be without charges so that anybody will use it with same restrictions to make KPI comparable. The results are too difficult to explain as GLEC is not a standard yet. Due to that we will go on with our own approach

*** The results will be used in continuous improvement process; consumption factor is useful as the company calculates efficiency based on the loaded km and empty km.

*** The company will implement GLEC if concerns around harmonization and comparability can be addressed

*** It is too early to conclude if sound decision making is possible from the outputs obtained; however, being able to report consistent and with a basis or aim of comparability then there is the potential for decisions to be made and internal benchmarks to be set. Not until wider acceptance of GLEC outputs is achieved could external benchmark/comparisons be made.

*** The company wants GLEC implementation, but it should be considered the difficulty to implement is in small companies

Overall, when used, the GLEC results are to be used internally to:

- Improve current (own) carbon footprinting method
- To understand what to expect in case if it becomes standard methodology
- To improve their own operations (especially when a (optimization) tool is used for the first time)

*** Getting carbon footprint for the reporting purposes, but the computation result does not help you to reduce CO_2.

*** We currently use the results internally to track evolution and we use the carbon footprint calculation to optimize transport plans from our customers (consultancy on supply chains)

*** The company will present the findings of this study to internal stakeholders (e.g. procurement and supply chain operations) for further discussion to promote increased visibility of logistics emissions as part of the company's overall environmental footprint. The results will be used to help inform procurement team's decisions when considering new contracts with logistics providers (in addition to cost and time for deliveries).

*** Since it gives comparison trade lane wise, sound decision making on selection of the routes with the lowest emission can be performed.

At the same time, overall the carbon footprint results are used in order to:

- Communicate to clients, considering their green projects involvement
- Calculate customer emission reports
- Implement fleet renewal programs
- Optimize transport plans from the customers
- Internally: to track down own evolution of emissions

*** Shippers get help on the choice of the most environmentally friendly booking options for their air freight. Shippers are presented with the most actual information related to CO_2 emissions concerning booking with different airlines and using different routings

*** Logistics services need a mandatory standard to make emission calculation comparable and transparent for customers. This can be a GLEC framework but also a global version of EN 16258 or others.

4.5 Relevant issues for eco-labelling

This section reflects on the companies' opinion with respect to 'eco-labeling' of transport and logistics. Please note that this report does not provide a design for an eco-labeling scheme nor provides a suggestion on how such a scheme should be designed. The information in this section reflects only opinions of the test bed companies, which should be a valuable input into a broader discussion on eco-label. The vast majority of the companies provided input on eco-labels find the concept to be useful or potentially useful, see Figure 20.

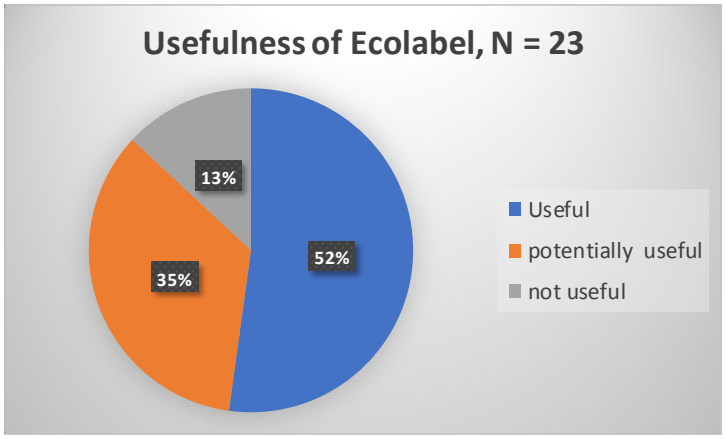


Figure 20. Usefulness of eco-label of transport and logistics operations

Among the reasons for introduction of eco-label dominate those commerce-related, such as accrual of new business and standing out from competition, see Figure 21.

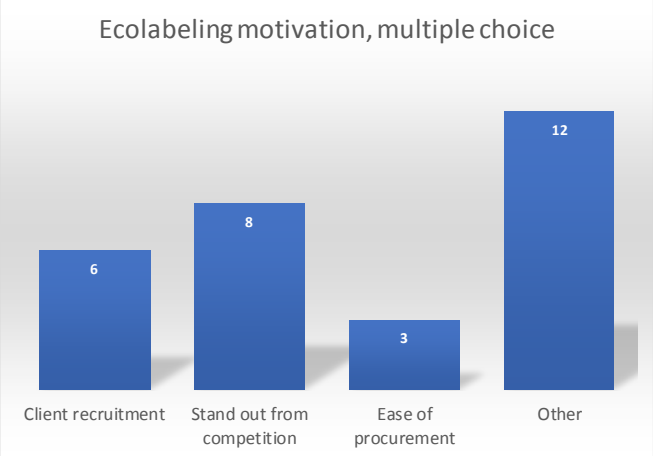


Figure 21. Stated reason for participation in an eco-labeling scheme

There are several examples for stated motivation for participation in eco-labelling (EL) schemes.

*** If requested by customers, it can be a unique selling point.

*** Customer demands and marketing.

*** To demonstrate environmental credentials on a standardized basis. To use as a marketing tool and to respond to client requests with a credible "label" or declaration that is understood and trusted by buyers.

*** Use in procurement process to compare different offers without the need for broad knowledge regarding emissions.

*** EL would only be needed in case of customer demand.

*** EL is useful, could be shown on the vehicles.

*** EL is not needed at this moment. It might be needed only for reporting to auditors and monitoring the evolution of indicators in time.

*** The company is interested in the concept of EL, but is concerned about what is involved in getting a label and on how it is assessed and issued. The main motivation for participation in an EL scheme would be a demonstration of environmental credentials on a standardized basis.

With respect to the type of eco-label and its scope, the companies have a slight preference for performance-based ecolabel, i.e. the one based on the quantities of GHG emitted, though this is not stated by the majority of the companies. For the scope, the majority of companies want it to be at the level of the transport network. Figure 22 provides some more details on the type and scope of eco-label. It should be noted that this reflects opinion of the companies from the LEARN testbed pool of companies, which might not be representative for the larger group of stakeholders and should be treated as input to a broader stakeholder discussion on the subject ecolabel in transport and logistics.

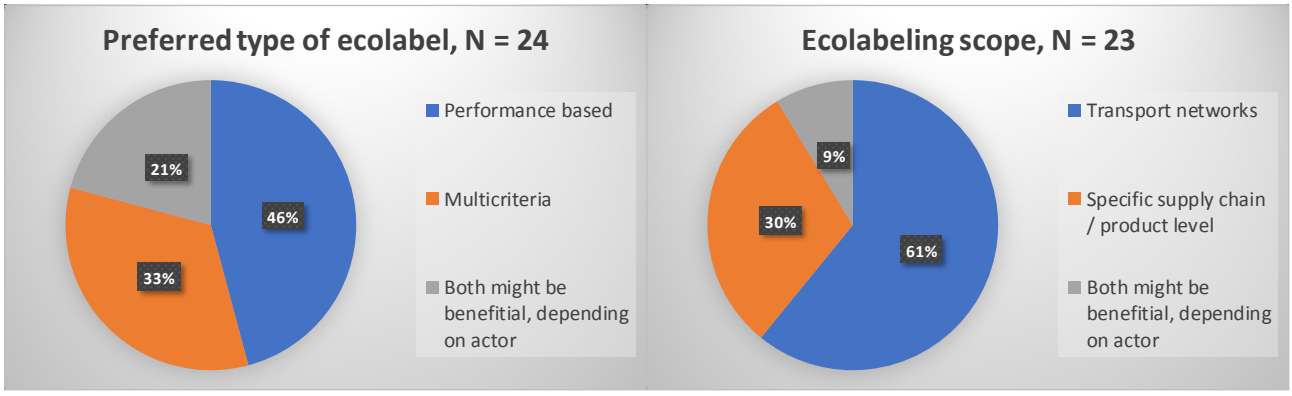


Figure 22.Stated preference for ecolabel type and scope

Companies have reflected on the conditions for the eco-label success.

*** EL will be useful for tendering. The company would acquire EL for tenders, clients, image and company's environmental policy.

*** Being able to map the differences between labels, would help the market. To understand the current labels / background better.

*** The EL should provide for a fair comparison, guidance on when to use what label. The differences and comparison should be clear, honest, open and auditable.

*** If the GLEC framework becomes a global standard for carbon emission reporting, an eco-label will become more interesting for us. Conditions for success: a mandatory standard, comparable to other calculation methods and tools. A standardized ECO label for all companies should make it easy to compare results.

*** Willingness from costumer to pay more or ignore not labeled services / products. Transparency, credibility and low fees to the label. Well known label

*** A label used to make decision when procuring transport services has to be based on a standardized methodology. A small amount of labels (e.g. if there are 20 different labels from different labeling-companies there is no way to compare)

*** EL should reflect on certification of company's efforts to protect the environment and sustainable development. In case a soft criteria is used, it is necessary to determine how it is to be quantified. The EL should be at the labeling of transport networks, annualized per company.

*** EL should be based on a quantified transport service database within predefined parameter categories established by a qualified third party and verified by that third party or another qualified third party. The feasibility and operability in reporting are success conditions. Scope of the EL should be labeling of transport networks

*** Global acceptance.

*** Sufficient segmentation and broad acceptance in the market / stakeholders

*** Credibility in the market

*** Be flexible and adaptable, taking in account warehouse activities and market segment

*** EL should be reliable, based on scientific studies, have a selective character. It should be issued by authorities in the field. It should be dynamic and have evolving character. EL should be visible, covering a wide range of products.

*** EL should be easy to obtain, so that the companies will become involved in obtaining it. Otherwise, few will be interested

*** Voluntary participation of an increasing number of companies

*** The label should be a standard without any confusion! As an example, the European Tagging Label CE often confused with the sign of China Export. Proof of contribution to reducing the environmental impact of industrial activities and production, transport, distribution and consumption of all forms of energy.

*** GLEC linked EL would be useful given the fact that the EU Ecolabel is not awarded for food and medical products and we transport food, it would be welcome. EL should be under condition of no extra costs to the carriers. To succeed, it has to be voluntary with an increasing number of companies. The EL design should be multi-criteria, applied to TSC-specific transport networks.

*** The company cannot define specific success factors for an EL, but considers a scope of a possible EL as labeling supply chains between production and consumption by labeling each logistics segment. The company suggests that segmentation should be done in relation to the specificity of each type of goods and their means of commercialization. The analysis may be broader and may lead to a conclusion depending on the specific logistic chain for each type of goods, food, genera goods, etc.

*** EL should be on the invoice or present a dashboard system to display the emission results.

*** For a successful EL scheme it is important to have clear criteria, ease of implementation, cost of implementation to be appropriate, comparability of outputs and differentiation of performance. The EL type is to be determined, but preliminary suggestion is to have a combination of both qualitative performance and qualitative multi-criteria.

*** Market-wide acceptance and application

5. Summary assessment of test cases

This chapter summarizes main findings related to GLEC framework implementations in industrial environments of the LEARN test bed partner companies. The main question related to the testing and validation activity has been to test, validate and evaluate the practical applicability of the agreed framework for harmonized GHG emission calculation and the eco-label concept in complex logistics settings, paying attention to compatibility with available data, to issues related to data exchange, and to verification and certification. LEARN WP4 further specified research questions for testing and validation (see LEARN Deliverable D4.1), which LEARN task 4.2 answered through testing and validation activity.

The transport and logistics sector understands the problem of GHG reduction and severity of actions required. This understanding has led to a number of initiatives, such as Green Freight programs, Global Logistics Emission Council, ECO Stars and others, where the industry representatives participate voluntarily. These initiatives allow businesses to make practical advances with respect to GHG emission reductions, be prepared to the anticipated mandatory regulations and send the signal towards policy makers that the issue is being treated seriously by the sector itself.

Many large shippers, who are the customers of the transport and logistics sector, have set their own voluntary targets for reduction of GHG emissions resulting from their activities. Some companies have set specific quantitative GHG reduction goals for 2020; the progress towards these goals is published in their annual reports and monitored by the auditors. These large shippers require high quality, real world emission data from their service providers, as relying solely on the average consumption factors does not reflect the sustainability efforts by the shippers. This fact provides an incentive for the Logistics Service Providers (LSP) to report on emissions related to the specific customers. For the LSPs it is also a way to differentiate from the competition, including GHG emissions quality dimension in their product offerings in addition to the price and service level agreements.

Another participation driver is the need to use real world primary data, get a better grip on reporting and optimization, and establish these procedures in a uniform and standardized way. Many companies see the GLEC Framework as the standard method on the type of data to be collected and on the computations to be performed. The companies want to do GHG reporting, to do it right, and to stick to one generally recognized and accepted method. Participation of the businesses in the testing activities likewise provide more visibility to the GLEC Framework, thus firming its position as the GHG computation and reporting method.

These real drivers for GHG emission computations led a number of companies to become LEARN testbed partners in order to implement the GLEC Framework in their business settings. While implementing GLEC methodology in companies, LEARN partners observed the process, together with the testbed companies completing test recording template. The experiences of LEARN testbed partners in implementation of the GLEC framework help drawing conclusions on feasibility and applicability of CO_2e calculation methods, compatibility and consistency of the CO_2e computations, experience with the direct data exchange between logistics providers and their customers, as well as ideas for the possible future eco-labels. The following sections provide a concise account on these issues.

5.1 Feasibility and applicability of CO_2e calculation methods

Test cases conducted in LEARN related to practical implementations of the GLEC Framework demonstrate feasibility and applicability of the CO_2e calculation method. The test cases demonstrate that the GLEC Framework can be successfully implemented in industrial settings of shippers, carriers, LSPs and Freight Forwarders; the test cases show implementation potential within different organization sizes, from SME to multinational organizations, covering different geographical scopes. The tests also demonstrate applicability of the framework for all transport modalities, including intermodal and combined transport.

The test cases show positive view by the majority of the companies on the GLEC Framework implementation results, and their general proper directionality, i.e. reduction of emissions according to the GLEC Framework would generally lead to a reduction of real world emissions. However, there are some attention points that need to be looked at in the future iterations of the Framework, see more on these in section 5.5 the GLEC Framework assessment.

5.2 Compatibility and consistency of the CO_2e calculation

The LEARN test cases have shown that the choice of CO_2e emission calculation methodology has an impact on the computed emission quantities. The companies that did not have carbon footprinting capabilities prior to the start of LEARN testing and validation, generally accept the computation outcomes related to the application of the GLEC methodology. The apparent inconsistencies revealed in the cases are related to the use of common data, as for instance, distance measurement by the service provider may differ from the distance measure by the shipper, thus introducing an error in emission computation based on consumption factor by the shipper.

More attention should be paid to the situation at the companies who had carbon footprinting capabilities prior to the start of the LEARN testing and validation activity. One of the motivations stated by these companies to be a LEARN test bed partner is to ensure a proper application of a universally recognised carbon footprint methodology. The practical applications of the GLEC methodology at these companies revealed issues related to compatibility with the previously developed solutions. These can be summarized along the following criteria.

1) *Compatibility and consistency with the existing corporate CO_2 emission computation software*. None of the existing carbon footprinting solutions that existed at the companies before LEARN implementations were GLEC-based. This fact resulted in GLEC-based computations being different from those done by the company software.
2) *Use of different fuel emission factors and default consumption factors*. There are different sets of emission factors for the carbon content of fuel and electricity; and also for the carbon emissions related to carrying out transport work (default consumption factors). Application of different factors provides for possible discrepancies in the resulting emission computations. This possible inconsistency is not directly related to the GLEC Framework, but to the way it is applied in the implementations, thus warranting attention to correct implementation.
3) *Use of different allocation principles*. The main sources for inconsistencies are the use of different time aggregations (i.e. single journey vs. aggregation of all journeys over one year), allocation proportionally to weight vs. volume, use of actually driven distances vs. great circle distance.
4) Use of WTW emission scope as opposed to TTW emission scope. Historically most of the CO_2 computations for the transport and logistics used Tank-To-Wheel (TTW) emission scope, which is also known as tailpipe emissions. The GLEC formulation requires the use of Well-To-Wheel (WTW) emissions to ensure consistency with biofuel blends and accounting for electricity-related emissions. A step from TTW to WTW nominally increases emissions due to accounting for upstream emissions related to the production of fossil fuels.

The issue of compatibility and consistency strongly suggests intensification of the work related to standardization of the CO_2e computation method. Once the method is formally standardized, ideally at the ISO standardization level, it becomes a reference point for all computations that are to be recognized by the third parties.

5.3 Experience with direct data exchange between logistic and supply chain partners

Emission data exchange is an important part of any carbon footprinting and carbon accountancy scheme. There is emission-related information flow from emission reporter, i.e. the company, which is carrying out transport activity (GHG protocol scope 1 emissions), to the beneficiary of transport activities, the company on which behalf the transport is carried out (GHG protocol scope 3 emissions). The information flow can take an opposite direction, as for instance transport providers would need the data on the quantity of goods (weight) carried.

LEARN test cases show that emission data exchange is probably the most challenging area related to carbon footprinting. In some cases the companies have difficulty in understanding on what data to be exchanged, by whom, in what format, and why such data exchange should take place. One of the successful strategies for organization of data exchange is inclusion of the requirement for a transfer of the emission-related data into the tendering of transport contracts. The challenge is related to the following aspects:

1) Specification and initiation of the emission data exchanges.
2) Trust in the data being exchanged, including verification and validation (in the future also certification).
3) Trust in the partners with whom the data is exchanged
4) Protocols on what data are to be exchanged and how
5) Technical instruments for the emission data exchange

5.4 Data availability

Calculation of carbon footprint of logistics activities requires collection of relevant data. The GHG footprinting, though an intrinsically interesting research subject in itself, should serve the purpose of behaviour change, facilitating greener choices. The goal of facilitation of greener choices depends on the level where it is taken and results in different KPIs. For instance, large shippers set goals with respect to decreasing total GHG emissions of their transport activities, as for instance, decreasing transport and logistics GHG emissions by 40% between 2010 and 2020. For this shipper, their total emissions matter. For a service provider it makes more sense to measure emissions per transport activity unit, in other words, to measure *GHG productivity* of transport activities. For instance, a transport service provider may set the goals to reduce emissions per tonne-kilometre transported as a measure of carbon productivity, which is decoupled from the actual level of market growth or growth in transport assignments by the customers. (In order to remind companies of their responsibility to limiting total emissions the GLEC Declaration, developed through LEARN WP2, delivers a requirement for reporting total emissions and emissions intensity values to deliver this transparency.)

5.4.1 Transport service providers and shippers have different data types available.

Transport companies generally have a good insight in fuel data and data on kilometers driven, especially for the road transport companies. Transport companies have a mixed level of data availability on the loading and offloading locations for the goods transported. The data on weight transported are generally poor. The data on actual route driven per shipment is also poor; moreover some companies get confused on how to compute it. The challenge of actual route data from known start and end points can be to some degree alleviated by the use of planned distances (as opposed to actually driven) under the assumption that these two do not deviate substantially – GLEC currently uses a 5% correction factor for road trucking operations.

Shippers and freight forwarders generally have a good insight on the shipment data, namely the ultimate origin and destination locations. Shippers have a relatively good data on the weight or volume of goods transported. On the other hand, the customers of transport companies have poor or no data on the routes, fuel use, emission allocation, etc.: namely the full range of variables related to determination of fuel use and /or fuel use per tonne-kilometer shipped. This is a particular problem where shipments are routed via intermediate points in the supply chain such as transhipment locations that exist for optimization purposes within the LSP's network but which are unknown to the shipper.

Fuel emission factors and default consumption factors. The fuel emission factors are related to conversion of a quantity of fuel to a quantity of GHG emissions (CO_2e) when that fuel is burned or electricity is used. The default consumption factors are related to a way to overcome the absence of real world (primary) emission data, using certain average emissions level per unit of transport activity. Ideally, the need for the default consumption factors should decrease with time, as more and more businesses start using primary data. The fuel emission factors will remain very important, especially so as it can be expected that different types and blends of biofuel will become more common, as well as differentiation in carbon intensity of electricity production. The GLEC Framework provides both types of factors, but at a limited level of granularity, which opens up discussions on the use of appropriate factors, as well as data that are not provided by the GLEC Framework in v1.0. The later fact underscores the need for an agreement on the use of fuel emission factors and default consumption factors in a consistent manner to ensure comparability of the GHG computation results.

5.5 GLEC Framework assessment

The majority of testbed companies are generally satisfied with the GLEC framework v1.0. In some cases companies suggest some changes into the formula for computation of the consumption factor, as for instance relaxing the condition that transport activity is computed as distance times weight by, for instance, distance times volume. The companies also understand that the fuel consumption factor is an elegant[3] way to communicate key emission data between the carrier and its customer.

However, there are some areas for improvement to be taking into account for the next versions of the GLEC Framework, as well as improvement measures related to the process of GLEC Framework implementation in practice.

5.5.1 Methodological considerations

In the fuel consumption factor formula, computation of the denominator (i.e. the tonne-kilometer as quantification of transport activity) is generally challenging for the transport companies. The newbie companies tend to make the common

[3] Besides the fuel consumption factor, there are other ways of emission data communication for the purpose of carbon footprinting. For instance, a communication method based on the EN 16258 standard in the form of a shipment-level emission calculation result.

mistake of computation transport activity as the total tonne volume multiplied by the total kilometers driven. Once this mistake is understood and for the more advanced capability carriers, the following four challenges exist:

1) Determination of actual distance over which shipments are driven. Under the condition of known loading and offloading locations, the actual distance is often not the shortest or fastest route, but a network route, which is determined, among other things, by the other shipments in the vehicle and operational considerations. Therefore, the actual distance that a specific shipment follows is generally unknown. The GLEC Framework recommends using the planned distance to overcome this. Another aspect of using actual or planned distances in determination of the consumption factor is that even if the service provider is capable of computing the consumption factor, the shipper that uses consumption factor to determine its GHG emissions may not be aligned in terms of the usage of the same distance as the service provider. The practical discrepancy of the distance measure between the LSP and the shipper can result in significant error margin in determining shipper-related emissions [4]. The issue can be alleviated by pooling information from both the shipper and the carrier in order to calculate the emission intensity KPI for the emission allocation in shared network operations.
2) It should be noted that the use of the Great Circle Distance (GCD) could present a useful alternative that may alleviate the issue of distance consistency and lead to simplified distance-related requirements. GCD is not currently very well known among land-based carriers; indeed, GCD was considered in the formulation of the GLEC Framework, but did not have sufficient support among GLEC members at that time to be accepted for land-based transport calculations; however, in the future, when automation of data transfer and calculations might become commonplace, the use of GCD may gain traction as it could be calculated automatically from data on loading and unloading locations in the right format.
3) Getting the data on weight carried. Theoretically the weight data should be available, because it is a part of bill of lading. In practice these data are often not available to the carriers as freight data may be stored differently, or be not known altogether. The weight data presents a more fundamental problem for computation of transport activity than the distance. The future versions of the framework should consider permitting dimensions other than weight for determining transport activity. For instance, in LTL networks the number of pallets carried is generally known; a consistent substitution of the weight carried with the number of pallets carried should not change the results of emission allocation to the customers, but will alleviate the problem of data availability on shipment weight. The future versions of the GLEC Framework may even consider making further steps into direction of the usage of allocation weight as described in Davydenko et al (2014) and COFRET Deliverable D3.3 (2014).
4) Emission allocation between cargo and passenger in case of combined operations (e.g. Ro-Pax ferries, belly airfreight on passenger aircraft) deserves some special attention. There is some ambiguity presently w.r.t. emission allocation in ferries. Also testing of the methodology related to airfreight suggests that GHG emission optimization based on either IATA RP 1678 or EN16258 may lead to sub-optimal choices with respect to use of available and underutilized belly freight capacity. Therefore, a discussion of a harmonized approach to emission allocation across belly cargo and freighters that would also remove the ongoing division between IATA RP 1678 or EN16258 would be desirable.

5.5.2 Soft and interorganizational issues

LEARN project test cases have identified a number of attention areas, which are not directly linked to the GLEC methodology itself, but closely related to the deployment of the GELC Framework in practice. These attention areas can be structured as follows

1) Trust and Confidentiality
2) Data quality of data marked as actual
3) Assurance
4) Willingness to comply with the GLEC Framework
5) Legal issues
6) Costs of deployment and compliance
7) Training and education
8) Availability of software implementations of the GLEC Framework
9) Methodology standardization

The LEARN deliverable D4.5 on Evaluation will provide more in-depth information on these issues. Nonetheless we raise attention of the reader that soft and interorganizational issues and play a critical role in the real world success of carbon footprinting and carbon accountancy of transport and logistics operations.

[4] A practical solution to the distance issue exists, as if a shipper delegates transportation to a shared network then they should also delegate the emission calculation, rather than trying to do it with incomplete information. For the FTL networks the shipper often specifies a lot more of the info and therefore has a better chance of getting a good outcome.

5.6 Eco-label positioning

It is important to note that the testing and validation activity of the LEARN project does not provide a blueprint for a future eco-labelling scheme. However, this activity has collected information from the companies that can facilitate a proper debate on the future EL schemes.

The absolute majority of the testbed partners who expressed their opinion on the eco-label find the concept to be useful or potentially useful. The companies who would take part in an eco-labelling scheme would use the results to stand out from the competition and to recruit new customers. The companies understand that an EL may be used by the market for a quick-and-dirty assessment of transport options, and therefore, survival and wellbeing of the business may depend on it. Therefore if such a scheme is to be introduced in the future, the companies require a fair, transparent and not too costly EL.

Although there is a slight preference by the companies for the performance-based eco-labelling scheme (i.e. a scheme that is based on the actual performance), the companies understand that realizing this in practice might be challenging due to heterogeneity of the transport market and difficulty to reach a consensus on the technical and organizational sides of a possible implementation. The 'GLEC Declaration' template that addresses the harmonized reporting of emissions results both between transport provider and customer and in public reporting, provides a first step for performance-based reporting.

Further work and industry consultations would be necessary to make further steps related to development and introduction of a comprehensive, multi-criteria EL scheme in the domain of transport and logistics. The complexity of such a scheme has, to-date, been off-putting to industry bodies.

6. Conclusions

This deliverable presents results on the LEARN WP4 testing and validation activity. LEARN WP4 has conducted work related to testing, validation and evaluation of the practical applicability of the agreed framework for harmonized GHG emission calculation and the eco-label concept in complex logistics settings. Practically, WP4 tests and validates the GLEC Framework v1.0 and draws conclusions for improvements to be included in the next version of the Framework.

The testing has been done in practical environments of real businesses, covering different transport modalities, different company sizes and including both providers of transport solutions and the users of transport solutions. The project has worked with 38 testbed organizations that formally agreed to be LEARN testbed partners by signing a consent form.

The participating companies are interested in a proper carbon footprinting and accountancy method that is broadly recognized and accepted. The agreement within LEARN project stakeholders is that the GLEC Framework should be seen as such a method.

Application of the GLEC Framework in company settings allows carriers to differentiate from the competition by provision of emission data to their customers, also showing their green credentials and, wherever applicable, outcompeting on the basis of emission reduction. The shippers are interested in the total reductions of their mostly GHG protocol Scope 3 emissions related to transport and logistics activities carrier out on their behalf. The shippers are motivated to use the carbon footprint data for emission minimization and for their sustainability reporting.

The testing and validation of the GLEC Framework has produced generally positive results. It can be used by the service providers to determine their consumption factor, which may be communicated to the shippers as a way of sharing emission data and helping shippers determining their emissions based on real world primary data. In case shipment distance is aligned between the carrier and shipper, both carrier and shipper are involved in emission computations: the carrier computes consumption factor and the shipper multiplies it with its tonne-kilometer transport activity data and emission factor to get the absolute volume of the shipment-related emissions. Thus, the GLEC Framework works well on the side of transport users (freight forwarders and shippers), who can apply the consumption factor of their service providers to the volume of transport activity to determine their own emissions. The GLEC Framework provides a way of dealing with cases where primary data are missing: in this case default consumption factors can be used to estimate emissions related to the shipments of freight forwarders and shippers. Conceptually the GLEC Framework is a sound basis for emissions computation (carbon footprinting) and emission accountancy

Expectedly, the testing has shown that there is a challenge related to data collection and data sharing. For instance, computation of the consumption factor and data exchange between the companies can be challenging. The computation of consumption factors requires two data elements: the fuel use data and transport activity data. The carriers generally have a good insight in their fuel use data, but the availability of transport activity data is not always assured. There is also an issue related to consistent application of the distance measures, as carriers and shippers may have misaligned distance values, partly because shippers may lack knowledge of intermediate points on the transport network, and also due to the use of different methods to specify distance that are, by definition, different (GCD vs planned vs actual distances).

Future versions of the GLEC Framework may consider allowing a consistent use of other measures of shipment than restricting to weight as the only option, provide more fine-tuned default consumption factors, provide more specifications related to data exchange between supply / transport chain parties. It is also recommended that the GLEC pays attention to the softer issues related to carbon footprinting and carbon accountancy related to building trust and education activities.

Being a workable methodology for carbon footprinting and carbon accountancy for logistics and transport chains, the GLEC Framework should concentrate on becoming a recognized standard. The testing and validation activity of the LEARN project has provided feedback to GLEC such that the lessons learned are to be taken into account in the next version of the Framework. After that step, standardization preferably at the ISO level should be the next step in its development.

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Appendix 1

Testbed recording template

LEARN partner:
Testbed company:
Starting day of the project:
Finishing day of the project:

Time spent by the LEARN partner in the different stages of the project (# days)	
Setting up the testbed	
Supporting calculation	
Evaluation	

Time spent by the company in the different stages of the project (# days)	
Setting up the testbed	
Supporting calculation	
Evaluation	

General description of the company and company's logistic activities relevant in terms of GHG emissions calculations. Please describe, among other, most dominant modes and routes; type of goods transported; process for choosing logistics partners and whether emissions are a criterion for the choice; how often are logistics partners evaluated; whether sustainability plays a role in this context: if so how it is sustainability defined.

Phase 1: Initiation / setting up

i. Please give a short company description e.g. description of the relevant department, processes	
ii. What are the reasons for performing carbon footprinting?	
iii. What are the reasons for taking part in the LEARN trial?	
iv. What do you specifically expect from the LEARN trial?	
v. Did your company receive any request to provide emission/fuel data from its clients/authorities?	
vi. Does your company use a calculation tool already? If so, what are the purposes of the existing footprinting? What is the relevance of the results to the company?	
vii. Does your company use the GLEC Framework?	
viii. Does it participate in an industry program, such as Green Freight Europe or Connekt Lean & Green? Please specify which program if applicable	
ix. What is the physical / organizational scope of the trial (e.g. all transport activities of the company, specific department, specific trade lane, etc)	
x. What is the specific time period of the scope?	
xi. What is the expected degree of reliance on data from the partners (service providers)?	

Phase 2: Data availability / Data analysis

i. What is the current data collection / data retention mechanisms at your company?	
ii. Do you need / rely upon data from other organizations?	
iii. Do you have access to the data of other organizations? If so, what is the data exchange mechanism?	
iv. How is the data quality monitored?	
v. Does it require a new or an updated system for the collection and the processing of data?	
vi. Does it require more or different information from carriers?	
vii. Was the necessary data already available?	
viii. How is the data quality verified?	
ix. How is the data reported, by whom and to whom?	
x. What is the level of assumptions and reliance on default values versus actual data for your company's calculation?	
xi. What are the feasibility and limitation of automated data collection and data processing for carbon accounting?	
xii. How do the GLEC-based outputs will differ from what your company is doing already? Namely, will it lead to a major difference in the reporting? Will the company be able to preserve the credibility of their past, current and possible future GHG computations?	

Phase 3: Calculation

i. Are you satisfied with the formula to calculate the emission?	
ii. Compare current logistics emissions calculation results with the result of calculations based on the GLEC Framework v1.0. In cases where there are differences, what are the reasons? E.g. the learning is more important than the calculation results themselves.	
iii. Are the dynamic results directionally correct? For instance, improvement in practice means the same level of improvement in indicators, expressed in percentages.	
iv. What is done with the output of the calculation?	
v. How do you (would you) use the results of carbon footprinting for the adjustment (optimization) of the relevant processes?	
vi. Has the impact of the emission calculation been monitored and, if so, how?	
vii. Did the Transport Service Categories help you in categorizing your operations?	
viii. Is the use of the Consumption Factor useful for the calculating process?	

Phase 4: Evaluation

i. For this GLEC Framework v 1.0 trial, what a. Resources were needed (e.g. time/budget)? b. Operational practices were introduced (e.g. teams involved, communications)? c. Calculation practices were needed (level of difficulty higher or lower)? d. Final emissions values were (lower or higher?)?	
ii. If applicable, compared to existing logistics carbon emissions calculation practices of your company, what difference does the use of the GLEC Framework make? a. Resources needed (e.g. time/budget) b. Operational practices (e.g. teams involved, communications) c. Calculation practices (level of difficulty higher or lower) d. Final emissions numbers (lower or higher?)	
iii. Does the GLEC Framework v1.0 work for all stakeholders in the supply chain (a shipper, LSP or carrier)? a. Where it does/doesn't work and in which situations (i.e. which service types, modes or stakeholder type)?	
iv. Are the results of GLEC Framework application consistent or comparable and how "robust" are they? Can it lead to sound decision making or benchmarking?	
v. What are the possible barriers and enablers of using the GLEC Framework to calculate emissions?	
vi. What is the feasibility of the implementation?	
vii. What did ease the implementation?	
viii. Where do you experience challenges when using the GLEC Framework v1.0?	
ix. Do you consider the use of the GLEC Framework v1.0 a success for your organization? Why?	
x. What support e.g. guidance/tools/standards/training, would you need for a more successful use of the GLEC Framework?	

xi. Is the GLEC Framework v1.0 applicable by newbie companies (e.g. companies that do not perform carbon accounting at the moment) in practice? a. Can a simplified version of the GLEC framework be devised and applied in practice for the newbies?	
xii. For expert companies (e.g. companies that perform carbon footprinting), how does the GLEC Framework v1.0 compare in usability to their current computation methods? a. When GLEC Framework v1.0 is applied to the same situation, what is the difference between existing methodology results and GLEC results? b. What is the difference process-wise (effort, money, knowledge required)?	
xiii. How compatible are Green Freight Programs and the GLEC Framework in practical settings?	
xiv. Did the company find the testing of the GLEC Framework in the context of the LEARN project useful? Why?	
xv. How adequate is the GLEC Framework for the carbon footprinting at your organization? What would you like to change or adjust in the methodology?	

Questions related to application of the GHG calculation method in the context of eco-labeling

i. Do you need ecolabeling of transport and logistics operations? If so, how would you use the ecolabel?	
ii. What is the main motive(s) for your company to acquire eco-labelling related to logistics emissions?	
iii. What are the expectations of your company from an eco-labelling scheme, which could be linked to the use of the GLEC Framework?	
iv. What kind of eco-label design is most desirable and acceptable in the market?	
v. What are the conditions for eco-labelling to succeed?	
vi. Which type of eco-label would you prefer to use? a. Performance based. This design is based on hard computable GHG performance indicators, such as GHG quantity emitted while carrying out one ton-kilometer of transport activity. b. Multicriteria based. This design would combine hard performance data with the soft levels of environmental awareness / efforts realized by the businesses	
vii. How do you see the ecolabel concept: labeling of transport networks or labeling of specific supply chains at the product level (e.g. between production and consumption locations)	
viii. How to segment the transport and logistics markets into comparable segments, within which the labelling is applicable?	

https://365tno.sharepoint.com/teams/LEARN/TeamDocuments/Team/WP4 Testing & Validation

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