TOWARD GREENER FREIGHT: TRANSPORTATION STATISTIC SYSTEM AND BEST PRACTICE IN EUROPE

Final report for: The International Council on Clean Transportation

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Executive Summary (Infograph)

TRANSPORTATION STATISTIC SYSTEM AND BEST PRACTICE IN EUROPE

EU transportation policy evolution – Milestones

1957 – Treaty of Rome, Transport as a key policy area

1992 – White paper, on the future development of the common transportation policy

2001 – White paper, European transportation policy for 2010: time to decide

2006 – Mid-term appraisal, Keep Europe moving – Sustainable mobility for our continent

2008 – 'Greening Transport' Package

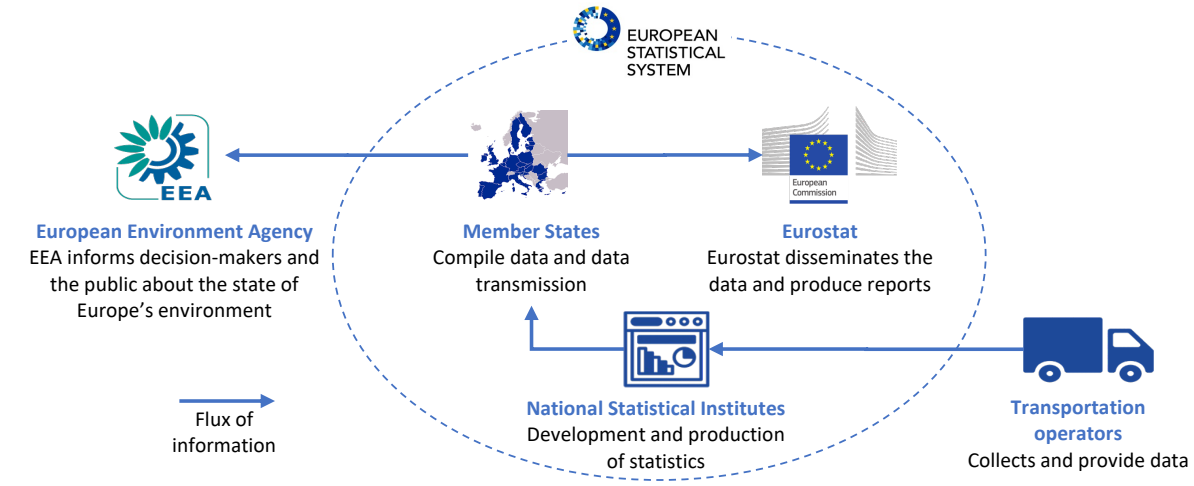
2011 – White paper, Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transportation system

2016 – A European Strategy for Low-Emission Mobility

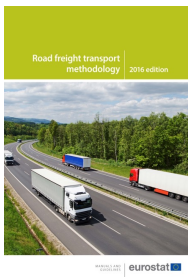
2019 – European Green Deal

2020 – Sustainable and Smart Mobility Strategy

Main stakeholders involved in road freight statistics



Main EU level legislation– freight activity and emissions



- **Road freight transport statistics** (Reg. 70/2012)
- **Rail transport (passengers and goods)** (Reg. 2018/643)
- **Inland waterways goods transport** (Reg. 2018/974)
- **Transport by sea (goods and passengers** (Dir. 2009/42)
- **Transport by air (passengers, freight and mail)** (Reg. 437/2003)

- **Monitoring Mechanism Regulation** (Reg. 525/2013)
- **CO_2 emission performance standards for new HDVs** (Reg. 2019/1242)
- **Monitoring and reporting of CO_2 emissions from and fuel consumption of new HDVs** (Reg. 2018/956)

Lessons Learned

Cooperation at all levels. All entities in the ESS work together to deliver what EU regulations.

Establish a clear methodology for data collection. The EU has put in place a system with uniformed data collection from different Member States

Provide guidance regarding questionnaire design and management. The EU provides guidelines and templates to guide Member States (for both freight activity and emissions), together with recommendations.

Quality control and data checks. Attention should be put in data quality, covering measures of precision, sample size, time-based sampling, and response rate.

Different approaches for GHG emission inventories. Approaches to calculate emissions are based on different territory principles allowing the comparison of data across different perspectives

CONTENTS

GLOSSARY

Abbreviation	
AEA	Air Emissions Accounts
CJEU	Court of Justice of the European Union
eDAMIS	Electronic Data Files Administration And Management Information System
EU	European Union
ETS	Emission Trading System
ESS	European Statistical System
EEA	European Environment Agency
GHG	Greenhouse Gases
HDV	Heavy-duty vehicles
IPCC	Intergovernmental Panel on Climate Change
kt	Kilotonne
MS	(EU) Member States
tkm	Tonne-kilometer
PJ	Peta Joule
QA/QC	Quality assurance/Quality control
NSIs	National Statistical Institutes
NST	Standard Goods Classification for Transport Statistics (Nomenclature uniforme des marchandises pour les Statistiques de Transport)
NTS	National Travel Survey
ONAs	Other National Authorities
UNFCCC	United Nations Framework Convention on Climate Change

1. INTRODUCTION

1.1 PROJECT OVERVIEW

The International Council on Clean Transportation (ICCT) has contracted Ricardo to develop a study reviewing European-level freight statistics. This in turn will support ICCT in their advisory role to Chinese government in its effort to improve the country's transportation statistic system.

ICCT is seeking this review as China is devising a long-term plan for the reduction in the greenhouse gas (GHG) emissions for the transportation industry. Freight demand in China has increased significantly in recent years, resulting in rapid growth in energy consumption and emissions, making freight the largest contributor to transportation emissions. The total freight activity was almost 20 trillion ton-km in 2020, with over 46 billion tons of commodities being hauled. However, the sector lacks a systemic approach to address its rapidly increasing emissions. Comprehensive transportation statistics, especially in relation to freight activity and emissions, will be indispensable in the development of China's policies for the decarbonisation of their transportation sector.

In this study, the European Union's (EU) transportation statistic system is described in order to support a learning process for the relevant Chinese authorities. The goal is not to describe in detail every single aspect of the data collection process (although some details are discussed when relevant), but rather to explain how the overall framework works, what policies are in place to support the data collection exercise, the key requirements in terms of data collection, and which stakeholders are involved.

The work has been based on desk research focusing on official EU documents, including legislative documents (regulations and directives), guidelines, etc., along with other relevant sources. Given the interest of ICCT, the focus of the report is on road freight transport.

1.2 ORGANIZATION OF THE REPORT

The report is organized as follows. After this introduction section, Section 2.1 provides an overall introduction to the EU's freight statistic system, its objectives, and the key policies supporting it. Then Sections 2.2 and 2.3 discuss in detail the freight activity and the freight emissions statistics, respectively. The main body of the study concludes with the main findings and conclusions in Section 3. Three appendices are then presented, the first one including references, and the last two more details on freight activity and emission statistics, respectively.

2. THE TRANSPORTATION STATISTIC SYSTEM IN THE EU

2.1 AN OVERALL INTRODUCTION TO THE EU'S FREIGHT STATISTICS SYSTEM

2.1.1 Objectives of the EU freight statistics system

The European Union (EU) freight statistics system serves as a crucial tool for monitoring and analysing freight transport within the EU. The data collected is important not only for decision-makers, but also for professional organisations, transport companies, researchers and modellers in the field of road transport. By collecting statistical data that are comparable, reliable, harmonised, regular and comprehensive, EU institutions, Member States (MS) and other stakeholders can frame, monitor and evaluate EU and MS policies, and can ensure that the single market for goods is functioning properly

(European Commission, 2020).

This section starts with an overview of the EU overarching transportation policies and climate targets. This is used to give the context on which the statistical system operates. The section then discusses the specific policies related to statistics collection, with a focus on the EU road freight transport sector.

2.1.2 Key policies, regulatory authorities and stakeholders

2.1.2.1 EU transportation policy – general overview

EU-level strategies serve as the primary motivators for developing specific regulations within the transportation sector. These form the basis for regulations that aim to harmonise and standardise processes, facilitating the monitoring and policy evaluation across the EU.

The EU has been making efforts for more than 30 years to enhance policies in the transport system. Already in the **Treaty of Rome (1957)** the importance of a common transport policy was highlighted and a separate title was devoted to it. It put transport in an important place, being clearly one of the Community's first common policy areas. One of the first priorities was the creation of a common transport market, allowing freedom to provide services, and the opening up of transport markets.

While some progress had been made in different areas in the subsequent period, greater impetus came following the 1985 Court of Justice of the European Union (CJEU) decision, that urged the Council to start developing a genuine common transport policy. A few years later (1992), the Commission adopted its **White Paper on the future development of the common transport policy (1992)** (COM(1992)0494), marking a decisive shift towards 'sustainable mobility'. In the same year was also introduced **Directive 92/106/EEC**, establishing common rules for the combined transport of goods between MS, a crucial EU legal instrument promoting intermodal freight transport and to shift to lower emission transport modes (rail, short sea shipping and inland waterways rather than road transport), showing efforts to achieve the goal to reduce negative externalities and carbon emissions (European Parliament, 2023a).

In 2001, the Commission put in place a White Paper entitled '**European transport policy for 2010: time to decide (2001)**' (COM(2001)0370). This included a package of 60 measures, designed to overcome different difficulties across MS, such as breaking the link between economic growth and an increase in traffic and to combat the uneven growth in the various modes of transport, among others. The Commission submitted a mid-term appraisal of the 2001 White Paper (COM(2006)0314) in 2026, entitled '**Keep Europe moving – Sustainable mobility for our continent' (2006),** introducing new instruments to achieve the objectives and in 2008, it was presented the **'Greening Transport' Package (2008)**, focusing on a strategy to internalise the external costs of transport (European Parliament, 2023a).

The **2011 White Paper** entitled **'Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system' (2011)** was one of the first documents recommending emissions reductions and setting targets[1]. The Commission presented in 2016 a working document (SWD(2016)0226) on the progress made in implementing the 10-year programme. In the same year, the Commission **published**

[1] A 20% reduction in transport emissions - excluding international maritime transport - between 2008 and 2030, and a reduction of at least 60% between 1990 and 2050. There is also a target to shift 30% of road freight above 300km to rail and waterborne transport by 2030. These targets are still in place-

'A European Strategy for Low-Emission Mobility' (2016) (COM(2016)0501), which proposed measures to accelerate the decarbonisation of European transport (European Parliament, 2023a).

Targets set in 2011 are below the goals set in the Paris agreement (COP21), which influenced the action plan proposed by the Commission, the **European Green Deal (2019)** (COM/2019/640). This is the key strategy in place at EU level setting the scene for all transport policy. The European Green Deal presented the EU's strategy to makes its economy sustainable and turning climate and environmental challenges into opportunities across all policy areas. Transport emissions represent around 25% of the EU's total GHG emissions and the goal is to achieve a 90% reduction in transport-related GHG emissions by 2050 (European Commission, 2021). The European Commission has proposed ambitious new CO_2 emissions targets for new heavy-duty vehicles (HDVs) from 2030 onwards. These targets will help to reduce CO_2 emissions in the transport sector – trucks, city buses, and long-distance buses are responsible for over 6% of total EU GHG emissions and more than 25% of GHG emissions from road transport (European Commission, 2019b).

In line to support the European Green Deal, the Commission put forward the **Sustainable and Smart Mobility Strategy (2020)** (European Commission, 2020). It consists of an action plan with 82 initiatives, aligning with the objectives set in the European Green Deal. This strategy lays the foundation for how the EU transport system can achieve its green and digital transformation and become more resilient to future crises. Concrete milestones were set for the European transport system's journey towards a smart and sustainable future.

2.1.2.2 Overall structure of the EU statistical system and key stakeholders

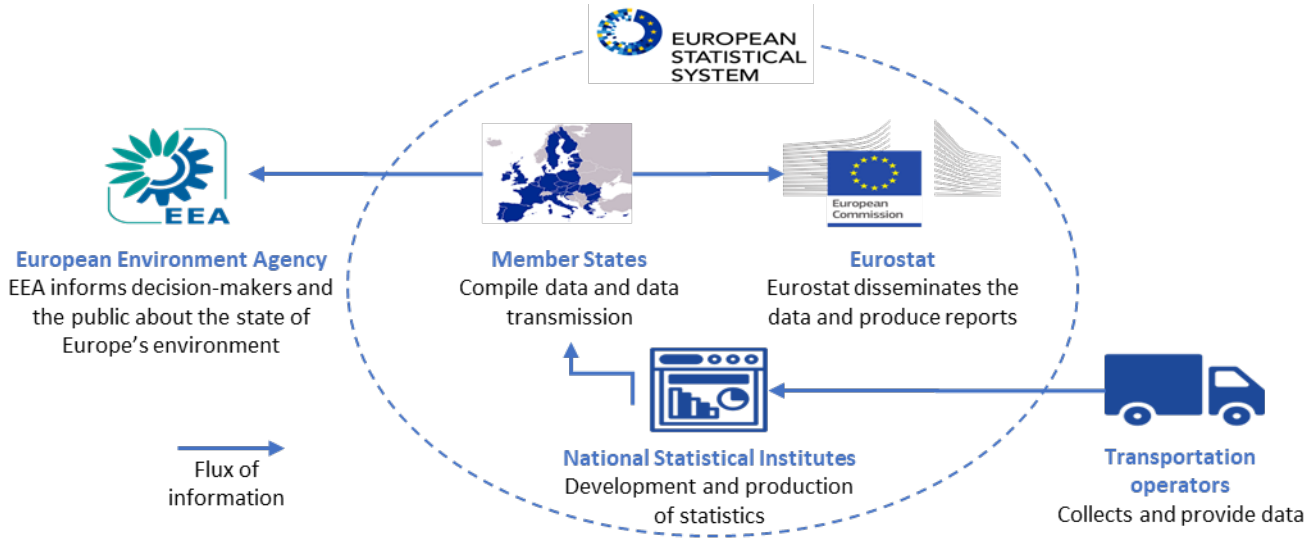
Transport data collection in the EU is governed by several legal acts obliging the MS to report statistical data, as well as voluntary agreements to supply additional data (European Commission, 2023e). However, data for the freight transport sector related to operational characteristics and emissions is not gathered in a single survey nor aggregated in common databases. Typically, freight transport operational data is collected by MS authorities and transferred to Eurostat to be compiled, while emissions statistics are collected by MS and compiled by the European Environment Agency. These statistics are then released by these entities themselves in their respective statistical databases or presented in various outputs like the European Commission's annual "Statistical pocketbook" (European Commission, 2023f) or the Joint Research Centre's biennial "Integrated Database of the European Energy System" (Joint Research Centre, 2024).

From the policy perspective, policy making need to be based on the presence of reliable and comparable statistics. To support this, the **European Statistical System (ESS)** was built up gradually since the creation of the European Community with the objective of providing comparable statistics at EU level, supporting policy decisions, planning, and implementation. The ESS is a partnership between the EU statistical authority (Eurostat), the National Statistical Institutes (NSIs), and Other National Authorities (ONAs) in each EU Members State (European Commission, 2024c). The ESS functions as a network. Eurostat's role is to lead the way in harmonizing statistics in close cooperation with the national statistical authorities. The work of the ESS focusses mainly on key EU priorities, but with the expansion of EU policies, harmonization has been extended to practically all statistical fields. The key bodies and their roles are explained below and are summarized on Figure 2-1:

- **Eurostat** is the statistical office of the EU. Regulation 223/2009 defines Eurostat – one of the European Commission Directorates General – to be the statistical authority of the EU. Eurostat co-ordinates statistical activities at EU level. It is assisted by seven directors, each with their sector of activity within Eurostat, which are: Resources, Standards, Dissemination, Cooperation in the European Statistical System, Macro Economic Statistics, Government Finance Statistics, Sectoral and Regional Statistics, Social statistics, Business and Trade Statistics (European Commission, 2024b). Eurostat's role is to disseminate the received data and produce reports, both on a comparative level between Member States and on an aggregated level for the European Union.
- **National Statistical Institutes/agencies (NSI):** National Statistical institutes/agencies operate under the supervision of the respective national government in its MS and serve as the national contact points for Eurostat. They are the entities responsible for the collection and analysis of relevant data, part of it on freight transport, through the organisation of relevant surveys and data collection activities, ensuring their quality and adherence with the relevant standards and requirements and their eventual transmission to Eurostat. They cooperate with Eurostat when it comes to the design and organisation and data collection activities draw upon national stakeholders and other relevant actors. According to the Regulation 223/2009, Eurostat in in charge of maintaining and publishing a list of NSIs and other national authorities responsible for the development, production and dissemination of European statistics.

- **European Environment Agency (EEA)** is an agency of the European Union founded in 1994 that delivers knowledge and data to support Europe's environment and climate goals. The agency collects and validates data from reliable sources to analyse trends and produce policy-relevant analyses on environment and climate topics. EEA assists the European Commission to implement EU environmental legislation in EU Member States, as well as inform European citizens about the state and outlook of Europe's environment (EEA, 2024).

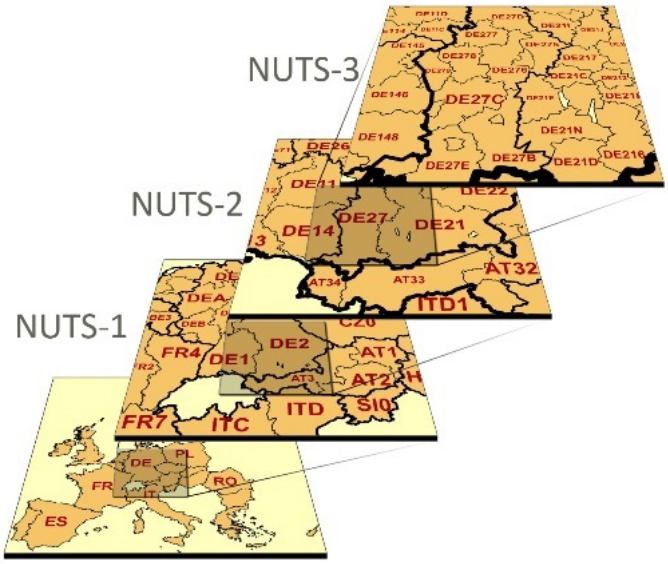
Figure 2-1 Main stakeholders involved in road freight statistics



Source: Own elaboration.

In order to produce regional statistics at a coherent aggregation level, Eurostat set up in the 1970s the NUTS classification as a single system for dividing the EU's territory. The NUTS classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the EU (Eurostat, 2024a).

Figure 2-2 NUTS - Nomenclature of territorial units for statistics



Source: (Eurostat, 2024a)

The NUTS classification system follows three main principles:

- **Favours administrative divisions:** generally mirrors the territorial administrative division of the Member States.
- **Comparability by population size**: defines minimum and maximum population thresholds for the size of the NUTS regions. It should be noted that these thresholds are not meant to be totally homogeneous NUTS regions across the entire EU. As indicated in the previous bullet point, in general NUTS regions should mirror territorial administrative division. Population thresholds simply guide Member States to divide their territory in comparable NUTS regions.
- **Stability over time**: can be amended, but generally not more frequently than every three years. The amendments are usually based on changes to the territorial structure in one or more Member States.

NUTS were given a legal status by 2003, under Regulation 1059/2003. A revised NUTS classification is valid from 1 January 2024 and lists 92 regions at NUTS 1, 244 regions at NUTS 2 and 1 165 regions at NUTS 3 level.

2.1.2.3 Freight activity (goods moved) statistics

In the transport sector, EU level statistics have gradually evolved since the late 1970s and 1980s. During that period, a few relevant EU directives, including Directive 78/546/EEC on statistical returns in respect of carriage of goods by road (amended by Directive 89/462/EEC in 1989), were adopted. They established a common collection and reporting of some fundamental statistical information. In the subsequent years, and in the particular case of road freight transport, *Regulation 1172/98* on statistical returns in respect of the carriage of goods by road was introduced in 1999. With modified amendments up to 2009, it provided a legal base for the collection of a wide range of data, outlining requirements and methodology for the first time in the EU (Eurostat, 2016). To ensure clear and easy understanding of the legal provisions, Regulation 1172/98 and its subsequent amendments have been aggregated into one single legal act, *Regulation 70/2012* on the rules for the compilation of statistics regarding goods carried by road, which is in force since 2012 (Eurostat, 2016).

The overall objective of Regulation 70/2012 is to ensure that collected data is reliable and comparable, and that regular statistical data is provided on the scale and development of road freight transport for the Commission, other EU institutions and national governments. They should facilitate the formulation, monitoring, regulation, and assessment of various EU policies, such as Single European Transport Network development and climate objectives mentioned in the last section. Regulation 70/2012 also supports policy makers in assessing the functioning of EU's internal market for goods, and that goods travel across the EU unimpeded[2].

Besides Regulation 70/2012 for road transport, the EU has adopted different regulations regarding transport statistics collection for the four other transport modes (rail transport, inland waterways, maritime transport, and air transport). These are presented in Table 2-1.

Table 2-1 EU legislation governing freight activity data collection

Regulation	Key provisions	Scope of data collected	Data transmission	Statistics required
Road freight transport – Regulation 70/2012 (European Commission, 2012)	Sets out the rules for the production of comparable EU-wide statistics on goods transport by road. MS required to gather information about how goods are transported.	Freight transported using vehicles registered in the MS It does not apply to some vehicle categories such as those out of the weight or dimensions limits normally permitted in EU countries	MS are required to send data[3] to Eurostat every quarter, without including personal identifiers[4].	Details on vehicle operator information, vehicle configuration, journeys taken in a set amount of time (usually one week), and information on the goods carried in these journeys.

[2] For more on the EU's internal market see the official website of the European Union (European Union, 2024).

[3] Data corresponding to the variables referred to in Article 3 and listed in Annex I in the Regulation document

[4] Additionally, they will provide Eurostat with a report detailing the methods used to compile the statistical data before sending the first quarterly information.

Regulation	Key provisions	Scope of data collected	Data transmission	Statistics required
Rail transport (passengers and goods) – Regulation 2018/643 (European commission, 2019a)	Establishes common rules for producing EU-wide rail transport statistics. MS to provide statistics on rail transport.	MS must report statistics for rail transport within their borders and specify the data by country if the service crosses borders[5]. MS may exclude railways which operate within industrial zones or harbours or provide local tourist services, such as historical steam trains.	MS are required to send data to Eurostat. Regarding the end of the relevant period of observation, no later than: Five months for annual statistics. Three months for quarterly statistics. Twelve months for regional statistics. Eighteen months for statistics on traffic flows. Five months for level of transport activity.	Quarterly and annual data on goods and passengers carried, including per kilometre An annual breakdown by region every five years of goods and passengers transported Traffic flows every five years on the number of goods and passenger trains Detailed classification of the different types of goods, including dangerous items.
Inland waterways goods transport – Regulation 2018/974 (European Commission, 2018b)	Sets out the rules for the production of comparable EU-wide statistics on inland waterways freight transport. Seeks to provide a picture of the volume and performance of freight transport on the EU inland waterway network.	MS will provide data[6] on inland waterway transport within their national territory to Eurostat. Vessels excluded are: -Weight less than 50 deadweight tonnes -Used mainly for transporting passengers, ferrying purposes, used by port and public authorities for non-commercial purposes, for bunkering or storage, or the ones not used to carry goods	MS are required to send data to Eurostat. No later than five months after the end of the relevant period of observation.	Goods transport by type of goods (annual data). Transport by nationality of the vessel and type of vessel (annual data). Vessel traffic (annual data). Container transport by type of goods (annual data).
Transport by sea (goods and passengers) – Directive 2009/42/EC (European Commission, 2009)	It sets out how MS should compile statistics on the carriage of goods and passengers by sea calling at EU ports. MS gather data data[7] on the carriage of goods and passengers by seagoing vessels.	It applies to the carriage of goods by sea calling at MS ports. Vessels with a gross tonnage of under 100 tonnes may be excluded from the data collection.	MS are required to send data to Eurostat. MS need to include the data declared confidential by the MS pursuant to domestic legislation or practice concerning statistical confidentiality.	Cargo and passenger information. Information on the vessel[8].

[5] EU countries may exclude from the statistics railways which operate within industrial zones or harbours and provide local tourist services, such as historical steam trains. It applies for new heavy duty vehicles introduced in the EU

[6] Data shall be collected in accordance with the tables set out in the Annexes of the document (which specify the variables and information to collect). The methods of collecting data shall be such that Community sea transport statistics display the precision required for the statistical data sets described in the Annexes of the document

[7] The characteristics of the data collection, namely the statistical variables in each domain and the nomenclatures for their classification, as well as their periodicity of observation, are set out in the Annexes in the document

[8] Vessels with a gross tonnage of less than 100 may be excluded from the data collection

Regulation	Key provisions	Scope of data collected	Data transmission	Statistics required
Transport by air (passengers, freight and mail) – Regulation 437/2003 (European commission, 2003)	It sets out how MS should compile statistics on the carriage of passengers, freight and mail by air within the EU. MS will create reports on the transportation of passengers, cargo, and mail by commercial airlines, and on civil aircraft movements.	It applies to aircraft movements to and from EU airports, except for state aircraft flights[9]. Airports with fewer than 15,000 passengers do not have to report.	MS are required to send data to Eurostat. No later than 6 months after the end of the period of observation.	Passengers carried. Freight and mail. Flight stages. Passenger seats available. Aircraft movements.

2.1.2.4 Freight transport emissions statistics

In the case of emissions from freight transport, there are three main regulations affecting the monitoring and collection of data. They are focused on monitoring mechanisms, CO_2 emission performance standards for new HDVs and monitoring and reporting of CO_2 emissions from and fuel consumption of new heavy-duty vehicles. The implementation of these regulations had different objectives, such as ensuring the transparency and completeness of EU MS' GHG inventories, encouraging the increase of zero and low emission HDV production and encourage HDV manufacturers to develop more energy-efficient HDVs, and allow transport companies to make well-informed purchasing decisions with comparable fuel consumption information between vehicles. The main elements of these three Regulations are described in Table 2-2.

Table 2-2 EU legislation governing freight transport emissions data collection

Regulation	Focus/content	Scope of data collected	Data transmission	Statistics required
Monitoring Mechanism Regulation – Regulation 525/2013 (European Commission , 2013)	Aims to enhance the monitoring and reporting procedures and rules for GHG emissions. Sets the rules for the collection of GHG emission and sets up an EU-wide GHG inventory system (EU Monitor, 2021)	It ensures the timeliness, transparency, accuracy, comparability and completeness of data reported by the EU and Member States.	No information provided in the document	CO_2 emissions from freight transport on road, kilotonnes (kt). Freight transport on road, tonne-kilometres (tkm). CO2 emissions from domestic air transport, kt. Domestic air-passengers, million. CO_2 emissions from transport, kt. Total final energy consumption from transport, Petajoule (PJ).

[9] The statistical variables in each area, the nomenclatures for their classification, their periodicity of observation and the definitions are set out in Annexes in the regulation document.

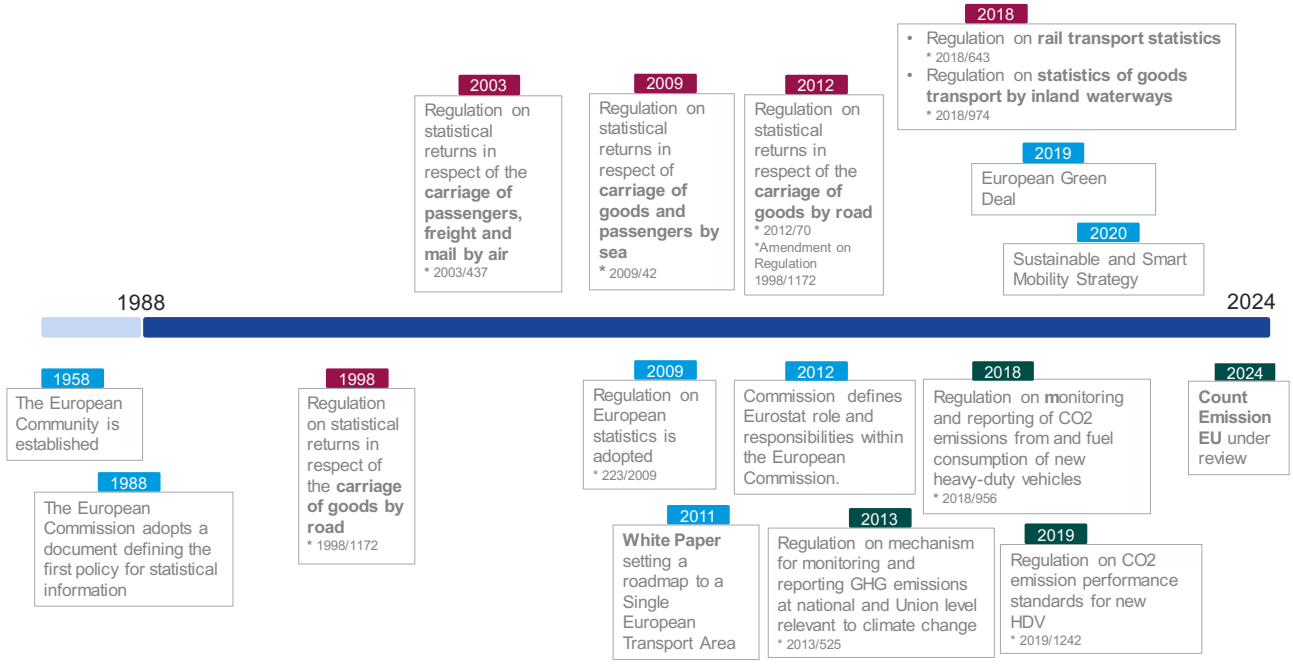
Regulation	Focus/content	Scope of data collected	Data transmission	Statistics required
CO_2 emission performance standards for new HDVs – Regulation 2019/1242 (European Commission, 2019c)	It sets out the EU's CO_2 emissions standards for heavy-duty vehicles. The regulation includes the monitoring and assessment of the real-world representativeness of the CO_2 emissions and energy consumption values of heavy-duty vehicles, though the use on-board fuel and/or energy consumption monitoring devices. Ultimately, this information can augment the quality of emission statistics.	This Regulation applies to new HDVs of categories N2 and N3 that meet the following characteristics: Rigid trucks with an axle configuration of 4×2. Rigid trucks with an axle configuration of 6×2- Tractors with an axle configuration of 4x2 Tractors with an axle configuration of 6x2 .	Data needs to be transmitted annually from MS and manufacturers. .	Vehicle identification number. Fuel and electric energy consumed. Total distance travelled. Payload. For externally chargeable hybrid electric HDV, the fuel and electric energy consumed, and the distance travelled distributed over the different driving modes.
Monitoring and reporting of CO_2 emissions from and fuel consumption of new heavy-duty vehicles – Regulation 2018/956 (European Commission, 2018a)	Sets requirements for HDV manufacturers to report fuel consumption data of new HDVs. Requires MS to monitor new HDV registration data according to standard reporting procedures.	It applies to vehicles of categories M1, M2, N1 and N2 with a reference mass that exceeds 2 610 kg and which do not fall within the scope of Regulation (EC) No 715/2007. Also to vehicles of categories O3 and O	On an annual basis	Monitored by MS: Vehicle identification numbers Manufacturer name Make (trade name of manufacturer) The code for the bodywork Monitored by manufacturers: Vehicles details covering identification, classification, engine specification, among others.

2.1.2.5 Legislation Overview: Freight Statistics Collection and Operational Procedures

As illustrated in previous sections, there are several strategies and policies covering the space of freight data monitoring and reporting, supported by different regulations[10] that MS must comply. Figure 2-3 shows a timeline illustrating the implementation dates of European policies and regulations that governs the collection of freight statistics. It is important to highlight that the policies described in section 2.1.2.1 aim to establish common objectives and create frameworks, whereas the regulations included in the timeline (covered in 2.1.2.3 and 2.1.2.4) focus on the actual process of monitoring and data collection.

[10] Regulations are legal acts. They have general application, are binding in their entirety and are directly applicable in EU Member States. Regulations form part of the EU's secondary law. They are adopted by the EU institutions on the basis of the treaties. They aim to ensure the uniform application of EU law across the EU. A regulation can be a legislative, delegated or implementing act. If it is adopted following an ordinary or special legislative procedure by the Council of the European Union and the European Parliament, it is a legislative act (European Commission, 2022).

Figure 2-3 Timeline of different policies and regulations set in the EU



Source: Own elaboration.
**Blue cells are related to general EU level policies/regulation. Pink cells are related to activity data regulations. Green cells are related to Emissions regulations*

Eurostat role and responsibilities in overall EU statistics were defined in 2012, however the present name of Eurostat as the Statistical Office of the European Communities was adopted in 1959. The first publication issued was on agriculture statistics. Although the Commission decision on Eurostat in 2012 sets an important point in the history of data collection in Europe and its harmonization, it is important to bear in mind that data was already being collected in the EU in the transport sector (in Eurostat webpage is possible to find road freight transport activity data from 1982 onwards). Moreover, regulation on statistical returns in respect of the carriage of goods by road stated that MS had to transmit to Eurostat the data as well as the prepared statistical.

The following two sections (Section 2.2 and Section 2.3) present more specific and detailed information on the relevant procedures, mechanisms and the data collected in relation to freight transport activity and freight transport emissions statistics.

2.2 ROAD FREIGHT TRANSPORT ACTIVITY STATISTICS

2.2.1 Introduction

Regulation 70/2012 is the act providing the legal basis for collecting, analysing, and reporting road freight transport statistics in the EU. For most MS, usually their national statistical offices will be responsible for the collection of the data, according to the relevant requirements, and their transmission to Eurostat. Once the data is submitted to the EU-level, Eurostat is responsible for aggregating the statistics supplied by MS and disseminating the data within 12 months after the end of the period. Eurostat also informs MS about transport activity from foreign vehicles that might have occurred in their MS and they do not have clarity on[11]. The disseminated data is available for European policymakers as a reference, and a publicly available version is also published on Eurostat's public domain (Eurostat, 2024b). The regulation applies to all Member States except Malta[12], and MS with less than 1,000 goods carrying vehicles engaged in international freight transport.

The following sections detail the EU road freight transport activity statistics at the MS-level, i.e, where the data collection takes place. It discusses the indicators collected, followed by good practices in data analysis, quality

[11] For example, Eurostat might inform Belgium about French and Dutch trucks that have travelled through their country.

[12] Malta's was exempted historically and in the latest report due to having fewer than 400 Maltese-registered road freight transport vehicles licensed to engage in international freight carriage.

control, and data transmission requirements to EU authorities. Further processes upon recipient of MS data at the EU-level including finalising results for comparability between MS and dealings with non-compliance issues if problem arises are also included in this section. The last part of this section includes case studies on Member States processes in gathering the road freight activity statistics in their country.

Information in this section is based on the latest *Road freight transport methodology: 2016 edition* published by Eurostat ('the Manual' hereinafter) (Eurostat, 2016). It should be noted that some of the recommendations in the Eurostat manual are not legally binding but forms part of the voluntary cooperation between Eurostat and MS to improve EU statistics.

2.2.2 Indicators collected

The regulation specifies a list of clearly defined activity data related to road freight transport that MS must collect for Eurostat. All variables are clearly defined and available in Chapter 10 of the Manual, which in itself gets the list of variables from Annex I of Regulation 70/2012. Table 2-3 summarises these variables, grouped by various topics covering operators, vehicles, journeys, and goods. Each record entry should contain information on all data required.

To collect all the required information, the Manual recommends designing a questionnaire in the form of internet surveys. Considering implementation costs, results processing, and response rates, this is the preferred option over in-person and postal surveys. Section 2.2.3.2 summarises good practices in designing and managing the questionnaire.

Table 2-3 Types of data (variables) to be collected in the questionnaire, according to Regulation 70/2012

Topics	Data to collect
On the vehicle	• Possibility of using vehicle for combined transport. • Axle configuration. • Age of the road transport vehicles since from its first registration. • Maximum permissible weight. • Load capacity. • Type of business. • Type of transports (own account and hire[13]). • Total kilometres covered during the survey period (loaded and empty). • Vehicle weighting.
On journeys	• Type of journey. • Weight of goods carried. • Distance travelled. • Tonne-kilometre effected during the journey. • Countries crossed in transit (up to five[14]). • First place of loading/ last place of unloading of the goods. • Places of loading/unloading if vehicle was transported by another means of transport for part of its journey.
On the goods[15]	• Type of goods carried. • Weight of goods carried. • Cargo type (how carried, i.e., ISO container or swap body, on pallets, other packaging, liquid/solid bulk, other). • Presence of dangerous goods.

[13] Transport for "hire or reward" is defined as the carriage for remuneration of goods or passengers on behalf of third parties. Transport "on own account" is transport of goods or passengers that is not for "hire or reward"

[14] If there are more than five transit countries for one journey, the first two after the loading of goods and the last 3 before the unloading of goods should be recorded.

[15] Please note that no information is collected on the value of the goods transported.

Topics	Data to collect
	• Places of loading/unloading of the goods. • Distance travelled.

Source: Regulation 70/2012.

2.2.3 Good practices in data collection and analysis

The Manual on Road freight transport methodology provides detailed guidance on good practices for data collection and analysis to ensure the quality and reliability of the data collected.

*2.2.3.1 **Methodology for data collection***

Good quality and regularly updated registers, such as national goods road vehicles registers, allow the sampling frame to enable straightforward and accurate statistical collection. The Manual suggests the register should be extracted at the mid-point of a quarter of a year (for example, 15 February, May, August, and November) to capture a representative snapshot of the vehicle population throughout the year[16]. According to Eurostat, from around 5 million trucks registered in the EU, the questionnaire samples 8,000 of those each quarter.

Part of the methodology suggested by the Manual considers a data stratification process to divide the vehicle into homogeneous subgroups. After it, samples are equally allocated over 52 weeks. Doing this, the statistical analysis can better account for variations within the population, such as differences in transport activity. More details on data stratification and a summary of the stratification methods mentioned in the Manual can be found in Appendix 2 in Section 5.

*2.2.3.2 **Questionnaire design and management***

Chapter 4 of the Manual provides a questionnaire template to guide MS in collecting the required activity data from vehicle operators. The same chapter in the Manual also provides useful recommendations for designing the questionnaire. A full list of questions, including all the data required by Regulation 70/2012 and the optional ones can be found in Table 2-4.

Table 2-4 The Manual recommendations on items to be collected in the questionnaire

Topics	Questions
Operator	1. Name of operator of vehicle* 2. Address of operator* ZIP code - Town/Settlement Street - number 3. Survey reference week 4. Identifier of operator* 5. Private operator or business* 6. Type of business (main activity - NACE)*
Vehicle	7. Vehicle registration mark* 8. Type of vehicle (lorry/road tractor)* 9. Year of first registration* 10. Number of axles on vehicle 11. Unladen weight (kg)* 12. Maximum permissible laden weight (kg)* 13. Load capacity (kg)* 14. If vehicle sold or scrapped 15. Date of selling/scrapping 16. Name of new operator if sold

[16] It means a snapshot of one week during the whole year. This snapshot might take place in any of the suggested quarter mid-points

Topics	Questions
	17. Address of new operator - ZIP code - Town/Settlement - Street - number 18. If vehicle used trailer/semi-trailer in week (#) 19. Number of axles on trailer/semi-trailer (#) 20. Load capacity of trailer/semi-trailer (kg) (#) 21. Body type of vehicle/semi trailer (#) 22. Type of use: - hire or reward - own account - household - mixed activity 23. Type of fuel used 24. Quantity of fuel purchased in the reference week 25. Days in work / out of operation (total 7 days): • In work - Repair - Holiday - No driver available • No work - Driver gone for holiday - Other causes 26. Kilometres in the last 12 months 27. Usage period of vehicle in last 12 months 28-30. Three optional fields for specific country use
Journey	**Journeys with one to four stops:** 31. Date of journey started - Day - Month 32. Place of origin (settlement or country) 33. Place of destination (settlement or country) 34. Distance travelled 35. Weight of goods loaded (kg) 36. Type of goods (according 20 NST divisions) 37. Type of dangerous goods 38. Type of cargo 39. Weight of goods unloaded (kg) 40. Trailer used or not (if lorry) 41. Type of transport - Hire or reward - Own account 42. Number of journeys of exactly the same type during that day **Journeys with five or more stops (collection-delivery journeys):** 43. Date of journey started - Day - Month 44. Place of origin (settlement or country) 45. Place of last destination (settlement or country) 46. Distance travelled loaded 47. Distance travelled empty 48. Weight of goods delivered (kg) 49. Weight of goods collected (kg) 50. Type of goods (according NST) 51. Type of dangerous goods 52. Type of cargo 53. Number of stops on journey 54. Trailer used or not (if lorry) 55. Type of transport – Hire or reward – Own account 56. Number of journeys of exactly the same type during that day

Source: (Eurostat, 2016). *Information that may be available from the sample vehicle register and need not to be asked of the respondent. It is mentioned that it is useful to include this data on the questionnaire and ask the respondent to check the accuracy of the register.

The manual provides guidance on the design of the questionnaires to be used so that they elicit full and accurate information and its response rates. It points to the need for the use of simple structures and unambiguous wording throughout the questionnaire to minimise the time required for haulers or drivers to complete it. It also points to the need for collecting only essential information and explaining the aim and purpose of the vehicle activity questionnaire could increase the response rate as well. It should be noted that while the questionnaires collect some sensitive data (like the vehicle registration), this is not shared with Eurostat for privacy reasons.

It also makes reference to possible action to enhance the response rate including:

- Setting up a reminder system. The first reminder to vehicle operators can be sent two weeks after the end of the relevant survey week, and potentially a second reminder in another two weeks if the survey is still not received.
- Using publicity. It is important to make sure that all the publicity gives the reasons why the data are needed. Publicity should be directed at those who will have to fill the questionnaire. Another option is to visit a number of road haulage companies, particularly any company that is considered by the road haulage industry to be a leader in the industry.
- Use of incentives. Receiving a worthwhile sum of money (usually a subsidy from the State) is always an excellent incentive. Getting permission to operate legally is also an incentive for most people.

Another option suggested in the Manual is making use fear of prosecution. The Manual suggests fear of prosecution can be a useful incentive, provided that those who have to sanction the use of the prosecution process are willing to do so. It can also act as deterrent effect, as news that some hauliers have been prosecuted (and hopefully made to pay a reasonably large fine) for not completing the survey will probably spread quickly within the road haulage industry and lead to an increase in response[17]. However, it is not clear that prosecution ever happened in any Member State – or indeed, if it was ever needed.

To ensure effective management of the road freight survey which normally run on a weekly cycle, the Manual recommends setting up a survey management system that carries out the following duties:

- Receipt of the sample.
- Dispatch of the questionnaires.
- Handling telephone calls.
- Receipt of questionnaires.
- Production and dispatch of reminder letters, or initiation of a penalty procedure.

The management system is responsible for ensuring timely and accurate questionnaire dispatch, retrieving completed questionnaires, and keeping track of the overall progress of the survey work. All eventualities including rare situations, such as sampled vehicles reported by the operator as stolen or sold, should be accommodated as far as possible. A well-designed survey management system designed to handle rare situations and unusual responses that might arise can save significant staff time and survey implementation costs. Using a computer-based survey management system is also recommended in order to minimise potential mistakes and reduce workload.

Another important consideration is the burden imposed on the transportation operators by the survey. A survey that is too complicated or too time-consuming to fill is likely to lead to low response rate and partial answers. Eurostat has collected relevant data on this and, according to the MS reports, the burden to provide data is considered “acceptable” (European Commission, 2024d). MS also report that the average time it takes for transport operators to report data for one vehicle with transport activity during the survey period is around 30-45 minutes (European Commission, 2024d).

2.2.3.3 Data processing

The process of extracting results from returning questionnaire begins with identifying and excluding invalid questionnaires from the subsequent analysis. These invalid questionnaires include questionnaires returned late, unreturned, or only partially filled. These instances are considered as non-responses in the Manual and impact the subsequent analyses introducing biases to the results. These non-responses are further broken

[17] Just as equally, threatening to prosecute and never doing so could lead to this fact becoming known in the industry and response rates could therefore fall over time.

down into different categories, with different ways of dealing. More details on the identification and dealing with non-responses from the Manual are detailed in Section 5.2.15.2 in Appendix 2. After the initial interpretation and preparation of the questionnaire, data checks should be performed before the information is coded into a database to remove erroneous results. The Manual does not explicitly mention how to execute the data checks. However, it is implied that the checks might be automated. For example, by setting formatting conditions and rules such that the statistical software flags when suspected error appears. The checks mentioned in the Manual are plausibility checks and logic checks. Plausibility checks involve highlighting inputs that are unlikely but nevertheless possible, while logic checks inspect the range of values, coding, and look for contradictory information. How to perform both checks are detailed in Section 5.2.2.

2.2.3.4 Coding for multi stop journeys

Road freight transport journeys often involve multiple stops. For instance, a hauler might start from their depot empty, pick up one load, then another, unload both at a factory, and return empty to base. If detailed linkage information for each part of these journeys is maintained, even basic analysis would require complex logic and computer programs. Therefore, the data collected for these journeys needs to be simplified while preserve journey linkages and ensure accurate statistics on weight and distance travelled to allow subsequent calculations and analyses to be done. Details on coding multi-stop journeys are provided Appendix 2: in Section 5.2.3, follow by calculation examples demonstrated in the Manual in Section 5.2.4.

2.2.3.5 Data record layout and weightings

After processing and coding information collected in the road freight surveys, coding staff needs to put the simplified information expressed in well-defined codes into specific model layouts designed by Eurostat. Chapter 7.1.3 of the Manual presents six model layouts for the computer records of the survey, detailing which variables, their sources, and the permissible codes in the respective model layout. These six separate model layouts include:

- Operator Register.
- Vehicle Register.
- Basic data entry record for Vehicle.
- Basic data entry record for Journeys (one to four stops journeys, collection and delivery journeys).
- Model vehicle record.
- Model journey record.

Variables in the operator and vehicle registers are pre-recorded since they would be obtained from the survey register, and not include information from the survey. The basic data entry record for vehicle and journeys contains the previously coded survey responses. Finally, the model vehicle and journey records use basic data entry records as sources to compute variables before conducting any analysis.

2.2.4 Quality control

Council Regulation 1172/98 regarding statistical precision standard was jointly agreed by the Eurostat and MS, covering measures of precision, sample size, time-based sampling, and response rate. The recommendation was formalized subsequently following the experience into Commission Regulation 642/2004 and being brought forward to the current Regulation 70/2012 that recast the previous regulation to improve clarity on the provisions (European Commission, 2004).

The precision standard sets out the time periods the survey should cover. MS should cover every possible time period in a year to account for the variations in transport activity over a time period. For MS with less than 25,000 goods carrying vehicles in total or less than 3,000 goods carrying vehicles engage in international transport, the minimum number of weeks to cover in a quarterly survey is seven weeks out of the 13 in each quarter.

In terms of precision, the percentage standard error (95% confidence) for annual estimates of total tonnes transported, tkm performed, and total kilometres travelled loaded for total goods road transport and for national road goods transport are prescribed. The annual estimates standard error needs to be kept within a ±5% range. For MS with less than 25,000 goods carrying vehicles in total or less than 3,000 goods carrying vehicles engage in international transport, the annual estimates standard error limit is raised to ±7%.

MS are required to disclose the survey response rate and register quality rate as defined in the regulation. The former measures the percentage of sample sent out for which a reply is received. The latter has a stricter definition and is defined as "the number of usable questionnaires from sample units divided by the number of questionnaires despatched minus those classified as non-response" expressed as a percentage.

While Eurostat does some checks to assess que quality of the data, the main responsibility for quality control lies with MS. It is the MS that collect the discreet date, check for quality, aggregate it and then transmit it to Eurostat.

2.2.5 Data transmission

Since 2001 (Commission Regulation 2163/2001) the EU has specified the format for the transmission of road freight transport activity data to Eurostat from MS authorities to ensure efficient processing (European Commission, 2001). Regulation 70/2012 currently in force has largely adopted the data transmission requirement from the 2001 Regulation, with a few changes such as the media for data transmission.

For the data structure, the Manual sets specific requirements on the compiled datasets containing fright activity details. Three linked datasets recording for the same quarter period should be set to Eurostat, namely:

- Vehicle-related variables (A1).
- Journey-related variables (A2).
- Goods-related variables in the basic transport operation (A3).

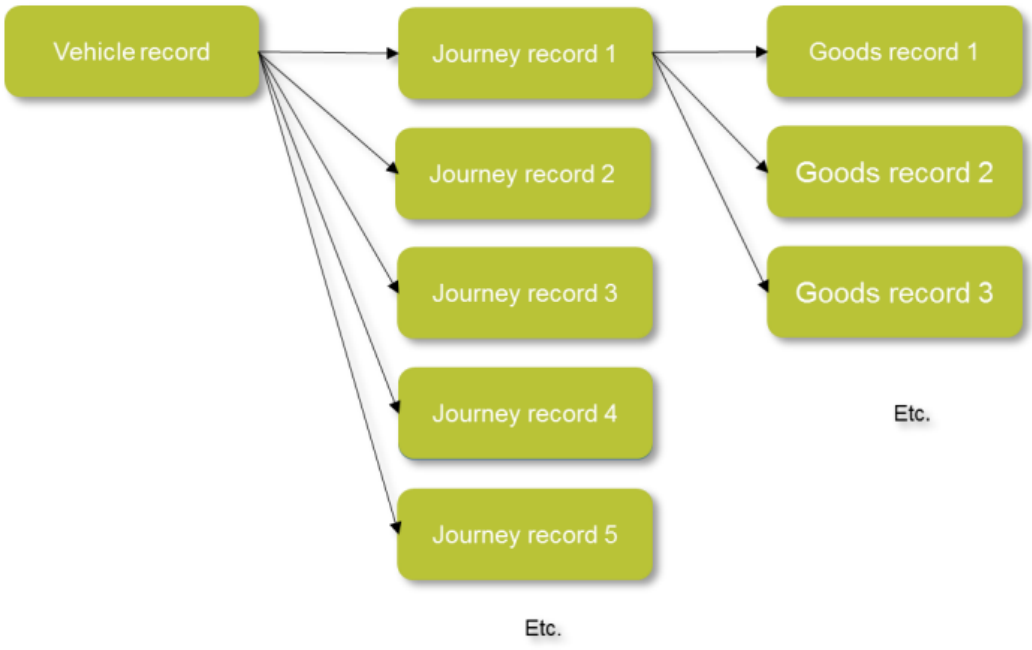
The data structure between the three datasets are illustrated in Figure 2-4. Each A1 "vehicle record" is associated with several "journey records" (A2 dataset) detailing the vehicle's trips during the survey period, typically a week. Each journey record is then connected to multiple "goods records" (A3 dataset) containing information about the transport operations within that journey.

It is important to keep in mind that the main objective of the survey is to collect accurate information of the tonnage of goods carried by road freight transport and their place of loading and unloading, the tkm performed, the kilometers travelled loaded by vehicles and the kilometres travelled unloaded by vehicles. Therefore, information reported in A3 should be of consignments based on goods loading and unloading to avoid inaccurate reporting of the tonnage of goods carried and tonnages unloaded at stopping places.

The dataset transmission takes place through the Electronic Data Files Administration And Management Information System (eDAMIS) web portal, managed by the European Commission for MS to transmit data files to Eurostat. The system allows the user to send data to Eurostat using secure transfer protocols such as PGP encryption (Eurostat, 2024c). Upon receiving MS dataset, eDAMIS will provide an automated confirmation to acknowledge the recipient of the information.

Regarding timeline, MS are required to transmit the data to Eurostat within five months of the end of the quarter. Eurostat will disseminate the data within 12 months after the end of the period

Figure 2-4 Link between road freight transport activity datasets



Source: (Eurostat, 2016).

2.2.6 Enforcement provisions and penalties

There are no specific enforcement provisions on Regulation 70/2012 or other legislative pieces dealing with this matter. However, any EU Regulation is mandatory for MS to follow and enforceable on a court of law. Ultimately, a MS refusing to comply with the provisions of Regulation 70/2012 can be taken to court by the EU. However, according to information gathered from Eurostat officials, that is the last case scenario and in general data is submitted on time. Given the good relations between Eurostat and all NSIs, if a MS is found to not be submitting the data as needed, bilateral discussions take place to assess what the problem is and how it can be solved, and that has proven to be enough to get the data needed from all MS.

2.3 ROAD FREIGHT EMISSIONS STATISTICS

2.3.1 Introduction

In 2021, HDVs were responsible for 28% of the road transport GHG emission, making up 6% of EU overall emissions (ICCT, 2024). While the EU does not produce a dedicated emission inventory just considering road freight transport statistics[18], several European emission inventories initiatives covering multiple industries and economy are used, and transport sector emissions form part of that analysis (EEA, 2023).

This section explores the tools used to capture the emissions of the road freight sector, the indicators collected, the data analysis, quality control measures and data transmission methods. While this section covers data consolidation at EU level, it is important to highlight that other separate statistics exist at the national level.

2.3.2 Emissions reporting tools in the EU

Reporting of emissions in the EU takes place through two different instruments, the GHG emissions inventories and the air emission accounts. They are presented in brief below and in more detail the sections that follow.

GHG emissions inventories concern the monitoring of GHG emissions and their recording in inventories submitted to the United Nations Framework Convention on Climate Change (UNFCCC) and forms the official data for international climate policies. Monitoring of the GHG emissions follows the framework set in Regulation 525/2013 (applying to all transport modes). The EEA is the body responsible to compile an annual GHG inventory report on behalf of the EU. Estimates of GHG emissions are produced for a number of sources which are delineated in sectors primarily according to the technological source of emissions, as devised by the Intergovernmental Panel on Climate Change (IPCC) (Eurostat, 2020). Transport emissions are reported as one of the five[19] main emission source sectors, in the category “energy”, in particular in the section of fuel combustion. To support the development of the national emission inventories, a detailed technical guidance has been prepared by the EEA to guide the preparation of national emission inventories “EMEP/EEA air pollutant emission inventory guidebook 2023” (EEA, 2023).

Air emissions accounts (AEA) record flows of gaseous and particulate materials (including seven GHG – including CO_2 –, plus seven air pollutants) emitted into the atmosphere as a result of economic activity. They aim to provide a detailed breakdown by emitting economic activities as defined in national accounts and are aligned with each country’s economic statistics and gross domestic product. Eurostat is responsible for the recording and publishing of the accounts on the basis of the legal framework set in Regulation 691/2011. The “Manual for air emissions accounts”, created by Eurostat (Eurostat, 2015b), specifies the structure for data collection and transmission, as well as the legal reporting requirements. This manual also provides compilation guidelines and possible data sources that could be of interest for AEA compilers, giving an overview on how differently organised these datasets can be across countries.

2.3.3 Indicators collected

Table 2-5 below presents the main features of the two GHG emissions reporting tools. It is important to mark the difference between both procedures mentioned. GHG Emission inventories and AEA differ between the approaches, as different boundaries apply. GHG inventories account for emissions from international aviation and maritime transport (assigned to the countries where the associated fuel is bunkered), which means these

[18] There are inventories produced by other entities that cover the EU MS, including ICCT’s own Roadmap model – the most recent version at the time of writing being V2.5, published in 2024 (ICCT, 2024b).

[19] The other categories are Industrial processes and product use, agriculture, waste, and other sources.

emissions are excluded from the national totals reported by individual countries. However, they are included in the AEA totals. Therefore, total emissions reported in GHG inventory databases can differ significantly from the total reported in air emissions accounts for countries with a large international aircraft and/or shipping fleet.

Table 2-5 Differences between GHG Emission inventories and AEA

Criteria	GHG Emission inventories	Air Emissions Accounts
Scope	GHG emissions classified by technical processes (e.g. energy supply, industry, transport, agriculture, waste, etc.)	GHG emissions classified by economic activities (e.g. mining, agriculture, manufacturing, etc)
Purpose	Official international reporting framework for international climate policies (UNFCCC, EU Monitoring Mechanism Regulation-MMR)	Tailored for integrated environmental economic analyses
Principle	Territory – emissions are assigned to the country where the emission takes place.	Residence – emissions are assigned to the country where the economic operator causing the emission is resident.
Emissions classification	Assigned to processes classified according to their technical nature (e.g. combustion in power plants, solvent use).	By economic activity, following the NACE[20] classification of the system of national accounts.
International navigation and aviation	Emissions from international navigation and aviation are assigned to the countries where the associated fuel is bunkered, irrespective of the operator's place of residence.	Emissions from international navigation and aviation are assigned to the countries where the operator of the ship/aircraft is resident, regardless of where the emission takes place.
Main data sources	Collected from a variety of existing data (e.g. fuel use).	Collected from a variety of existing data (e.g. national emission inventories, energy statistics, trade statistics, transport statistics)
Main emission model	COPERT model, compliant with IPCC Guidelines. MS can use other comparable models-	General model for estimated emissions: Emissions (E) = Activity Data (AD) x Emission Factor (EF). It uses 2006 IPCC Guidelines (updated in 2019).
MS reporting to	EEA	Eurostat

Source: (Eurostat, 2020).

Table 2-6 shows the indicators that shall be monitored around freight transport under each procedure. Indicators are annually collected for both cases, AEA and GHG Emissions.

[20] Statistical classification of economic activities in the European Community (Eurostat, 2008).

Table 2-6 Indicators required to be collected by MS

	GHG Emission inventories	Air Emissions Accounts
Indicators	CO_2 emissions from freight transport on road (kt)[21] Freight transport on road (Mtkm)[22]	CO_2eq emissions from road transport using different fuels (kt)[23]

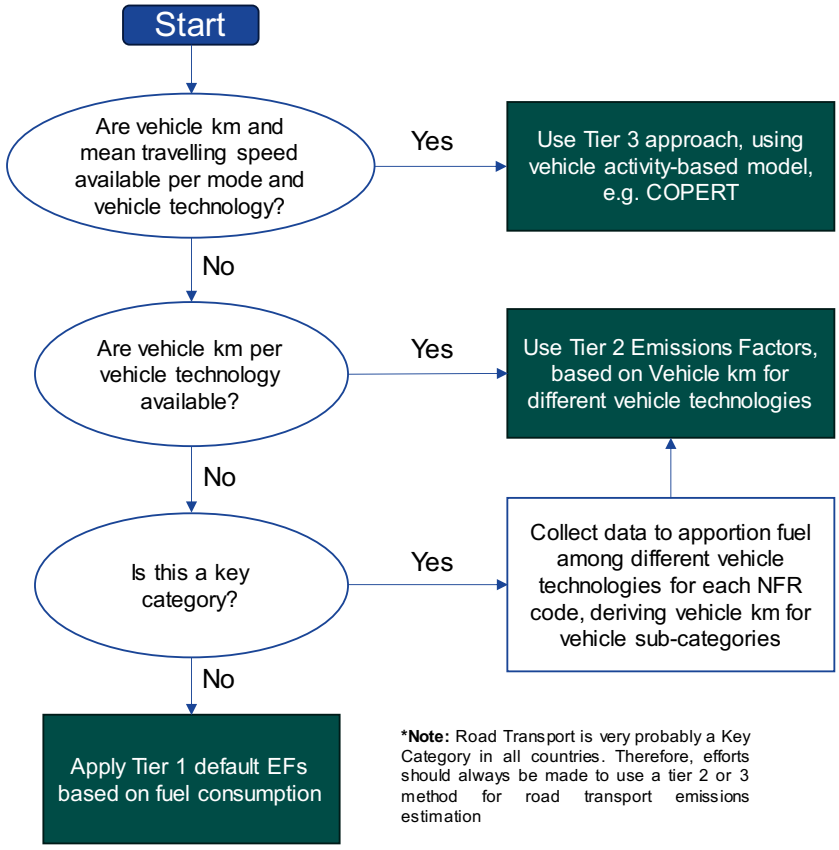
Source: (European Commission, 2013).

2.3.4 Good practices in data analysis

2.3.4.1 GHG Emission Inventories

In the case of GHG emission inventories, a procedure is presented in *the EMEP/EEA air pollutant emission inventory guidebook 2023* to enable a method for estimating exhaust emissions from road transport to be selected (see Figure 2-5). According to this guidebook, it is impractical to measure emissions from all the sources that, together, constitute an emissions inventory. In general, it is suggested as good practice to use higher tier methods for key categories, unless the resource requirements to do so are prohibitive.

Figure 2-5 Decision tree for exhaust emissions from road transport



Source: Own elaboration based on (EEA, 2023).

[21] CO_2 emissions from the combustion of fossil fuel for all transport activity with light duty trucks (vehicles with a gross vehicle weight of 3 900 kg or less designated primarily for transportation of light-weight cargo or which are equipped with special features such as four-wheel drive for off-road operation — IPCC source category 1A3bii) and heavy duty trucks (any vehicle rated at more than 3 900 kg gross vehicle weight designated primarily for transportation of heavy-weight cargo — IPCC source category 1A3biii excluding buses).

[22] Number of tkm transported in light and heavy duty trucks on road; one tkm represents the transport of one tonne by road over one kilometre (source: transport statistics). Note: activity data should be consistent with the emission data, if possible.

[23] Based on indicators from UNFCCC framework. Emissions may be assumed to be proportional to the corresponding volumes expressed in tonne kilometres (tkm) of freight road transport

The tiered methodology suggested in the guidebook considers three approaches, based on data availability (see Appendix 3). In Tier 1, the activity data is derived from readily available statistical information, it uses fuel as the activity indicator, in combination with average fuel-specific emission factors. The Tier 1 approach requires relevant fuel statistics, i.e. the volumes (or weights) of fuel sold for road transport use, and for each type of fuel used. For the majority of fuels (petrol, diesel, LPG) these statistics are usually available at a national level. Tier 2 use similar activity data to tier 1 methods but apply country-specific emission factors which need to be developed. It considers the fuel used by different vehicle categories and their emission standards. Hence, the vehicle categories used in the Tier 1 approach are sub-divided into different technologies according to emission-control legislation. Tier 3 includes using facility-level data and/or sophisticated models (implemented in COPERT[24]). Exhaust emissions are calculated using a combination of firm technical data (e.g. emission factors) and activity data (e.g. total vehicle km). Total exhaust emissions from road transport are calculated as the sum of hot emissions (when the engine is at its normal operating temperature) and emissions during transient thermal engine operation (termed 'cold-start' emissions). In general, Tier 1 is the simple, basic method, tier 2 is intermediate, and tier 3 is the most demanding in terms of complexity and data requirements.

2.3.4.2 Air Emissions Accounts

In the case of the AEA, as part of the transmission obligations of the Regulation 691/2011, each submission of data has to be accompanied by a quality report, covering relevance, accuracy, timelines and punctuality, accessibility and clarity, and comparability and coherence (European Commission, 2011). AEA are compiled from a variety of existing data (e.g. national emission inventories, energy statistics, trade statistics, transport statistics). This requires a conversion and re-arranging process (Eurostat, 2015b).

In principle air emissions are estimated and not directly measured/metered. A general emission model can be expressed as:

$$Emissions\ (E)\ =\ Activity\ Data\ (AD)\ x\ Emission\ Factor\ (EF)$$

In particular for transport emissions, the calculation is likely to be more complex than the above basic model may suggest. Activity data (energy use)[25] need to be decomposed by e.g. power plant type, fuel type, combustion technology, vehicle class, and abatement technologies (e.g. catalytic converters, filters on power plants and waste incinerators). The energy data may then be combined with corresponding emission factors. Emissions factors are pollutant-specific and specific for each of the aforementioned dimensions (i.e. fuel type, combustion technology, vehicle class etc.). Emission factors can be found in the IPCC document "2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories" and are described for different applications (IPCC, 2019). Table 2-7 shows an example.

Table 2-7 Road Transport CO_2 Emission Factors and Uncertainty Ranges

Fuel Type	Default (kg/TJ)	Lower	Upper
Motor Gasoline	69,300	67,500	73,000
Gas/Diesel Oil	74,100	72,600	74,800
Liquefied Petroleum Gases	63,100	61,600	65,600
Kerosene	71,900	70,800	73,700
Lubricants	73,300	71,900	75,200
Compressed Natural gas	56,100	54,300	58,300
Liquefied Natural Gas	56,100	54,300	58,300

Source: (IPCC, 2019).

[24] Alternative Tier3 methods can be found in tools such as Artemis, the DACH-NLHandbook of Emission Factors, and other national models (for example EMV in Sweden, Liipasto in Finland, and Versit+ in the Netherlands). The EMEP/EEA air pollutant emission inventory guidebook notes that while MS can use other models but they need to ensure that accepted methodologies are used and that data are comparable.

[25] At the current level of Eurostat's disaggregation of energy data, the only breakdown for energy consumption available in transport is a split-by-mode: road, water (national) and air (national). Decomposition of transport by purpose, mode and vehicle type is already available in Eurostat's dataset, but it cannot be fully used without further information on energy consumption (Eurostat, 2023).

AEA can be used to analyse environmental implications (in the domains of climate change and air pollution) of European production and consumption patterns. The production perspective focuses on the direct air emissions generated by domestic production activities, allowing for the comparison of environmental performance across various industries (Eurostat, 2015b).

2.3.5 Quality control

Within each framework, specific data quality control processes are outlined in the guidance documents to ensure the accuracy, relevance, and reliability of reported data. These control processes are expected to be followed by MS to ensure data with high quality levels.

2.3.5.1 GHG Emission Inventories

The EEA framework covers different data quality aspects. First of all, it describes how to avoid double counting with other sectors. In particular, gasoline (petrol) and diesel fuel sold by gas stations may also be used for off-road machinery (e.g. agriculture tractors). Attention should be given so that the fuel consumption reported for road transport does not include sales for off-road use. In addition, care should be given not to include CO_2 emissions produced by the combustion of biofuels (bioethanol, biodiesel, and biogas) (EEA, 2023). Also, as it is described in Table 2-5, GHG Emission inventories are driven by the principle of territory, which means that emissions are assigned to the country where the emission takes place. It is important to mention that it is also mentioned that emissions from international navigation and aviation are assigned to the countries where the associated fuel is bunkered/refuelled, irrespective of the operator's place of residence.

Regarding verification, there are different techniques proposed. On one side, the soft verification method, referring to a comparison of alternative estimates: alternative estimates can be compared with each other to infer the validity of the data, based on the degree of agreement. This process can help to homogenise the data collected with different methods. On the other side, ground truth verification methods, referring to alternative scientific methods that can be used to physically verify the model calculations. These methods may be applied to verify either the complete inventory or the emission factors used to develop the inventory. Some of the methods suggested are: remote sensing studies, tunnel studies, on-board and laboratory measurements, inverse air quality modelling and mass-balance techniques (EEA, 2023).

Uncertainty of emission factors is also covered in the guidebook mentioned above. It mentions that in all cases of the application of the estimation methodologies, the results obtained are subject to uncertainties. Since the true emissions are unknown, it is impossible to calculate the accuracy of the estimates. Errors when compiling an inventory may originate from two major sources: 1) Systematic errors of the emission calculation methodology. These may include errors in the determination of the emission factors and other emission-related elements (e.g. cold start modelling, default values of metals, etc.) or, 2) Errors in the input data provided by the inventory compiler. These refer to the activity data (vehicle parc, annual mileage, etc), fuel properties, and environmental conditions (EEA, 2023).

2.3.5.2 Air Emissions Accounts

Since 2013, MS are required to submit AEA to Eurostat on annual basis, using an electronic questionnaire (European Commission, 2023a) and a quality report (Eurostat, 2015a). The quality report (developed by Eurostat) covers several aspects such as relevance, accuracy, timelines and punctuality, accessibility and clarity, comparability and coherence, which are described below:

- Relevance: it has to be specified the main users of air emissions accounts data at national level. Also is suggested to comment on how much policy need is there for AEA data.
- Timelines and punctuality: based on the regulation, it is required to MS to provide data by September 30 every year. It is suggested to mention when the data was transmitted to Eurostat and which years were covered in the report.
- Accessibility and clarity: it is required to add when AEA data was published (explaining the reasons if it was not).
- Accuracy, comparability and coherence: it is required to add the approach used (inventory-first or energy-first), descriptions of the methods used in compiling AEA (data sources used, adjustments for residence principle, discontinuities in time series, problems adapting statistics, among others).

2.3.6 Data transmission

Data transmission is an important process that includes collating data into standardized formats for analysis and quality control. Within the GHG Emission Inventories and Air Emissions Accounts frameworks, data

transmission varies between countries. For both approaches, MS are responsible for collecting and providing the data, reporting to EEA or Eurostat, as applicable.

2.3.6.1 GHG Emission Inventories

According to EEA, there are many different data management systems used by countries. Some use sophisticated database tools connected to the internet and available for users to upload data and to operate from remote locations. However, many Member States still use a collection of spreadsheets, databases and bespoke software systems for calculating estimates. For analysis and reporting, inventory data needs to be collated into a coherent set of tables that can be aggregated to produce detailed reporting formats, national totals, and summary tables. This collation of data into a single format enables general quality assurance/quality control (QA/QC) to be applied more easily using tools that can identify anomalies in trends and missing data points. A suggested standardized structure for collating data within a database on emissions, removals, and relevant activity data from the range of categories, gases, fuels and other subcategories is presented in the guidebook mentioned above (EEA, 2023).

EEA specifies in its data policy that there is an expectation for data providers to follow the principle that all data and products financed with public means should be fully available for use by public bodies. Furthermore, these data should be made available for others to use with as few restrictions as possible. It is mentioned that the data provider shall clearly specify intellectual property rights, use or re-use conditions, including statistical confidentiality, and quality statements in metadata information for each type of data (metadata, raster/image data etc.).

2.3.6.2 Air Emissions Accounts

Since 2013, MS are required to submit their AEA to Eurostat on an annual basis using an electronic questionnaire and a quality report. The AEA questionnaire is an MS Excel workbook. There are 14 spreadsheets, one for each greenhouse gas or air pollutant. Emissions of CO_2 are reported in thousands of metric tonnes, while all other substances are reported in metric tonnes. The AEA questionnaire includes the entire time series because national emission inventories – which may form an important data source for compiling AEAs – are potentially revised for the entire period (Eurostat, 2015b).

2.3.7 Enforcement provisions and penalties

As with transport activity statistics, emission statistics collection is regulated by EU-level regulations, which are enforceable in courts of law. See section 2.2.6 for more details.

2.4 COUNT EMISSIONS EU

In 2023, the European Commission put forward a legislative proposal to create a common framework to calculate and report transport related GHG emissions that applies to both freight and passenger services, the so-called “Count Emissions EU” regulation (European Commission, 2023d). The main objective of this regulation is not to provide statistical data for MS-level inventories (as discussed in section 2.3), but rather to provide reliable and comparable data that can be used, among other things, to incentivize sustainable choices and behavioural change.

As such, the proposed legislation aims to ensure that the GHG emissions data provided regarding transport services is reliable and accurate, to allow fair comparison between transport services. It aims to fill a gap, as there is not a universally accepted framework for greenhouse gas emissions accounting for transport services. The Commission highlights that without a unified framework, transportation stakeholders have the freedom to select from various methodologies, calculation tools, and emissions default values, resulting in notable discrepancies in outcomes (European Parliament, 2023b). This complicates the life of consumers (both individuals and businesses), which do not have clarity about which transport choices are more environmentally friendly.

The draft regulation proposes a common methodology ensuring that calculations of the GHG emissions are performed in a standardised way across the transport sector. It stipulates that EN ISO standard 14083:20231 should be the reference methodology for those calculations. This standard establishes a common set of rules and emissions calculation principles for transport operations based on the 'well-to-wheel' concept, including emissions from both vehicle use and vehicle energy provision (European Parliament, 2023b).

To maximize the reliability of calculations the text requires organisations to prioritize the use of primary data – i.e. data obtained during actual carrying out of a transport operation - for calculating the GHG emissions of a

transport service. The use of secondary data will be allowed under certain conditions. If primary data is unavailable or too expensive to generate, secondary data, including default values and modelled data will be allowed[26]. For this purpose, the regulation provides a harmonised set of default values (European Parliament, 2023b).

If approved, Count Emissions EU will introduce a methodological framework, but does not govern where it has to be used. However, future initiatives developed after Count Emissions EU's establishment may require the adoption of its methodologies. In the case that organizations decide to compute and disclose GHG emissions from transport services (e.g. to disclose to consumers the emissions that their trips will produce) they will be required to use the provided methodology. The proposal exempts small and medium-sized companies from mandatory verification of adherence to the rules. Ultimately, Count Emissions EU could provide a stepping-stone to improve the methodologies used to collect emissions statistics at the very discreet level (i.e. one single trip). Over time, and if the methodologies are widely adopted, there is the potential that national level emission statistics will use this information gathered at the trip level to inform the national level statistics.

[26] In this respect, this initiative will offer a harmonised set of default values that, depending on their type, will be published in central EU databases, or provided through external databases developed by third parties. The external databases will undergo a specific quality check. As regards the modelled data, they may be used if the model is established in accordance with CEN ISO 14083 standard.

3. CONCLUSIONS

3.1 OVERVIEW OF FINDINGS

The importance of the freight statistics system in the EU lies in establishing the foundations for monitoring and analysing freight transport in Europe. The data collected is crucial for policy and decision making in relation to freight transport activity regulation, traffic management as well as for monitoring compliance with emissions reduction and transport mode targets. This document described the road freight statistics system in the EU, covering the underlying regulations, applicable standards, and good practices in data collection and analysis. Both freight activity and emissions statistics were covered.

The structure of the EU statistical system relies on legal obligations and voluntary cooperation and agreements (e.g. MS delivering data in the formats outlined in non-binding guidelines) for data collection. Within the freight transport sector there is a division between operational data (i.e. on the operators, on the vehicles, on the goods) and emissions statistics. Operational data is primarily collected by MS authorities (usually their national statistical offices) and compiled by Eurostat while emissions statistics are collected by MS and compiled by the European Environment Agency (EEA). The ESS, comprising Eurostat, EEA, and National Statistical Institutes, functions as a network to harmonise statistics at the EU level.

To support MS in the collection of freight activity statistics, the document “Road freight transport methodology: 2016 edition”, published by Eurostat, covers the details in most of the aspects related to the collection and analysis of freight activity data, including the indicators to be collected, data collection good practices (including survey sampling, questionnaire design, data analysis), quality control and data transmission. Regulation 70/2012 is the act providing the legal basis for collecting, analysing, and reporting road freight transport statistics in the EU.

Reporting freight emission statistics in the EU takes place through two different instruments, the GHG emissions inventories and the air emission accounts:

- GHG emissions inventories concern the monitoring of GHG emissions submitted to UNFCCC and forms the official data reported for international climate policies. This process follows the framework set in Regulation 525/2013. It is the responsibility of the EEA that compiles the annual GHG inventory report on behalf of the EU using the methodology described in the “EMEP/EEA air pollutant emission inventory guidebook 2023”.
- Air emissions accounts record flows of gaseous and particulate materials emitted into the atmosphere as a result of economic activity. They aim to provide a detailed breakdown by emitting economic activities as defined in national accounts and are aligned with each country’s economic statistics and gross domestic product. Eurostat is the entity responsible for the recording and publishing of the accounts on the basis of the legal framework set in Regulation 691/2011. The “Manual for air emissions accounts” sets the guidelines for the data collection, transmission, among other aspects.

For both types of data, enforcement provisions and penalties are not covered in legislation. On basis of the analysis conducted, there does not seem to be formal enforcement activities or any penalties. The system seems to be based on mutual cooperations between all entities involved at EU and MS level.

The road freight statistics system in Europe is expected to evolve further as new demands for data reporting are created. Initiatives such as Count Emissions EU, which is currently under discussion, will impact freight statistics monitoring to some extent. This initiative aims to establish a common framework for calculating and reporting transport related GHG emissions that applies to both freight and passenger services. Although the proposal, initially, is not presented as mandatory, it establishes a common framework for the calculation of GHG emissions to allow fair comparison between transport services. Over time, and if the methodologies are widely adopted, there is the potential that national level emission statistics will use this information gathered at the trip level to inform the national level statistics, but at the moment it does not serve that purpose.

3.2 LESSONS LEARNED

Some lessons can be learned from EU statistical system, and how it integrates data collected at national and regional level in order to inform overarching policy goals:

- **Cooperation at all levels:** while the EU has set up a number of legislative instruments mandating data collection, all entities in the ESS work together to deliver what those regulations stipulate and engaging in voluntary cooperation to improve the data collection processes.
- **Integrate databases:** the EU (through Eurostat and other entities including the EEA) has put in place a system with uniformed data collection from different MS, which is essential to produce analysis, design policies and make comparisons between countries possible.
- **Establish a clear methodology for data collection:** frequency for updated registers, sampling size and reporting deadlines are some of the measures that are important to achieve a level of standardization of data among MS.
- **Provide guidance regarding questionnaire design and management**: the EU provides guidelines and templates to guide MS, together with recommendations. A template and a list of questions can help to harmonize data collected across different actors.
- **Quality control and data checks:** it is highlighted in the guidelines that attention should be put in data quality, covering measures of precision, sample size, time-based sampling, and response rate. Different parameters can be suggested for each of the measures (e.g. time periods the survey should cover based on number of vehicles per country, the percentage standard error for annual estimates of key variables, or a survey response rate). Also, it is suggested to implement automation in data checking to detect possible errors or invalid questionnaires (check ranges of values, identify contradictory information, or detect missing information).
- **Different approaches for GHG emission inventories**: the EU considers different approaches to calculate emissions based on different territory principles, and these are collected by different organisations. These allow to create figures, design policies, and compare data across different perspectives, but can also complicate the assessment of the emissions of a specific sector of the economy, like the freight transport sector. Care should be taken to ensure different methods produce comparable figures.
- **Maintain efforts in improving data collection. Development of a harmonised methodology:** in the EU efforts are ongoing to establish a common framework to calculate emissions through the proposed framework Count Emissions EU, filling the gap of a lack of a universally accepted bottom-up framework for GHG gas emissions accounting system for transport services.

4. APPENDIX 1 – REFERENCES

EEA. (2023). *EMEP/EEA air pollutant emission inventory guidebook 2023*. Retrieved from EEA: https://www.eea.europa.eu/publications/emep-eea-guidebook-2023

EEA. (2024). *Who we are*. Retrieved from EEA: https://www.eea.europa.eu/en/about/who-we-are

EU Monitor. (2021). *Regulation 525/2013*. Retrieved from EU Monitor: https://www.eumonitor.eu/9353000/1/j4nvk6yhcbpeywk_j9vvik7m1c3gyxp/vjs5ga5aifou#:~:text=This%20regulation%2C%20the%20Monitoring%20Mechanism,and%20rules%20for%20GHG%20emissions.

European Commission. (2001, November 7). *Commission Regulation (EC) No 2163/2001 concerning the technical arrangements for data transmission for statistics on the carriage of goods by road.* Brussels: European Commission. Retrieved from EUR-LEX: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02001R2163-20080101

European commission. (2003). *Regulation 437/2003 - Transport by air*. Retrieved from European commission: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32003R1358

European Commission. (2004, April 7). *Commission Regulation (EC) No 642/2004 of 6 April 2004 on precision requirements for data collected in accordance with Council Regulation (EC) No 1172/98 on statistical returns in respect of the carriage of goods by road.* Brussels: European Commission. Retrieved from EUR-LEX: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32004R0642&qid=1714010399897

European Commission. (2009). *Directive 2009/42/EC - Transport by sea*. Retrieved from European Commission: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32009L0042

European Commission. (2011). *Regulation (EU) No 691/2011 on European environmental economic accounts*. Retrieved from European Commission: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:192:0001:0016:EN:PDF

European Commission. (2012). *Regulation 70/2012 - Carriage of goods by road*. Retrieved from European commission: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32012R0070

European Commission. (2013). *Regulation (EU) No 525/2013 on a mechanism for monitoring and reporting greenhouse gas emissions*. Retrieved from European Commission: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:32013R0525

European Commission. (2018a). *Monitoring and reporting of CO2 emissions from and fuel consumption of new heavy-duty vehicles*. Retrieved from European Commission: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R0956

European Commission. (2018b). *Regulation (EU) 2018/974 - Statistics of goods transport by inland waterway*. Retrieved from European Commission: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32018R0974

European commission. (2019a). *EU rail transport statistics*. Retrieved from European Commission: https://eur-lex.europa.eu/legal-content/EN/LSU/?uri=CELEX:32018R0643

European Commission. (2019b). *European Green Deal*. Retrieved from European Commission: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_762

European Commission. (2019c). *Regulation (EU) 2019/1242*. Retrieved from European Commission: https://eur-lex.europa.eu/eli/reg/2019/1242/oj

European Commission. (2020). *Sustainable and Smart Mobility Strategy*. Retrieved from European Commission: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12438-Sustainable-and-Smart-Mobility-Strategy_en

European Commission. (2021). *Transport and the Green Deal*. Retrieved from European Commission: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/transport-and-green-deal_en#:~:text=Our%20goal%20of%20being%20the,greenhouse%20gas%20emissions%20by%202050.

European Commission. (2022). *European Union regulations*. Retrieved from European Commission: https://eur-lex.europa.eu/EN/legal-content/summary/european-union-regulations.html#:~:text=Regulations%20form%20part%20of%20the,legislative%2C%20delegated%20or%20implementing%20act.

European Commission. (2023a). *Air Emissions Accounts Questionnaire 2024*. Retrieved from European Commission: https://ec.europa.eu/eurostat/documents/1798247/6191529/AEA+Questionnaire/

European Commission. (2023b). *ETS 2: buildings, road transport and additional sectors*. Retrieved from European Commission: https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/ets-2-buildings-road-transport-and-additional-sectors_en

European Commission. (2023c). *Questions and Answers: CountEmissionsEU*. Retrieved from European Commission: https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_3774

European Commission. (2023d). *Proposal for a regulation on the accounting of greenhouse gas emissions of transport services*. Retrieved from European Commission: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52023PC0441

European Commission. (2023e). *Transport statistics introduced*. Retrieved from European Commission: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Transport_statistics_introduced#Broad_transport_policies

European Commission. (2023f). *Statistical pocketbook 2023.* Brussels: European Commission. Retrieved from https://transport.ec.europa.eu/facts-funding/studies-data/eu-transport-figures-statistical-pocketbook/statistical-pocketbook-2023_en

European Commission. (2024a). *CountEmissionsEU*. Retrieved from European Commission: https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/757562/EPRS_BRI(2023)757562_EN.pdf

European Commission. (2024b). *Eurostat role*. Retrieved from European Commission: https://ec.europa.eu/eurostat/web/main/about-us/policies/co-ordination-role

European Commission. (2024c). *What is the European Statistical System?*

European Commission. (2024d). *Report on the implementation of Regulation (EU) No 70/2012 of the European Parliament and of the Council of 18 January 2012 on statistical returns in respect of the carriage of goods by road, COM(2024) 9 final.* Brussels: European Commission. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52024DC0009

European Parliament. (2023a). *Common transport policy: Overview*. Retrieved from European Parliament: https://www.europarl.europa.eu/factsheets/en/sheet/123/common-transport-policy-overview

European Parliament. (2023b). *CountEmissionsEU*. Retrieved from European Parliament: https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/757562/EPRS_BRI(2023)757562_EN.pdf

European Union. (2024). *Internal market*. Retrieved June 21, 2024, from EUR-Lex: https://eur-lex.europa.eu/summary/chapter/24.html

Eurostat. (2008). *NACE. Statistical classification of economic activities in the European Community*. Retrieved from Eurostat: https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF

Eurostat. (2015a). *Manual (2015) for Eurostat's Air Emissions Accounts (AEA)*. Retrieved from Eurostat: https://circabc.europa.eu/sd/a/c0a0cdaa-aa03-4f16-9cde-a62fc351f385/ENV_ACC_WG_2015_03.2%20AEA%20Manual.pdf

Eurostat. (2015b). *Manual for air emissions accounts*. Retrieved from Eurostat: https://seea.un.org/sites/seea.un.org/files/airemissions_ks-gq-15-009-en-n.pdf

Eurostat. (2016). *Road freight transport methodology: 2016 edition.* European Commission. Retrieved from https://ec.europa.eu/eurostat/documents/3859598/7731279/KS-GQ-16-005-EN-N.pdf/555702cd-f4f4-491e-92d3-e725a6656389

Eurostat. (2018). *Eurostat guidelines on Passenger Mobility Statistics.*

Eurostat. (2020). *Greenhouse gas emission statistics - emission inventories*. Retrieved from Eurostat: https://www.congreso.es/docu/docum/ddocum/dosieres/sleg/legislatura_14/spl_11/pdfs/50.pdf

Eurostat. (2023). *Energy consumption decomposition analysis on EU-27 and EU-27 members - 2023 edition*. Retrieved from Eurostat: https://ec.europa.eu/eurostat/documents/3888793/18455312/KS-TC-23-006-EN-N.pdf/943cee29-14a9-4003-70f4-6ead6912f00a?version=1.0&t=1707312893910

Eurostat. (2024a). *NUTS - NOMENCLATURE OF TERRITORIAL UNITS FOR STATISTICS*. Retrieved from Eurostat: https://ec.europa.eu/eurostat/web/nuts/history

Eurostat. (2024b, March 15). *Road freight transport statistics*. Retrieved from Eurostat: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Road_freight_transport_statistics

Eurostat. (2024c, March 12). *Electronic Data Files*. Retrieved from Eurostat CROS: https://cros.ec.europa.eu/dashboard/edamis

ICCT. (2024a). *The revised CO2 standards for heavy-duty vehicles in the European Union*. Retrieved from ICCT: https://theicct.org/publication/revised-co2-standards-hdvs-eu-may24/

ICCT. (2024b). *Roadmap Model Documentation*. Retrieved June 26, 2024, from GitHub: https://theicct.github.io/roadmap-doc/

IPCC. (2019). *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Retrieved from IPCC: https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html

Joint Research Centre. (2024, May 22). *JRC-IDEES-2021*. Retrieved June 21, 2024, from Joint Research Centre Data Catalogue: https://data.jrc.ec.europa.eu/dataset/82322924-506a-4c9a-8532-2bdd30d69bf5

5. APPENDIX 2 – ROAD FREIGHT ACTIVITY STATISTICS

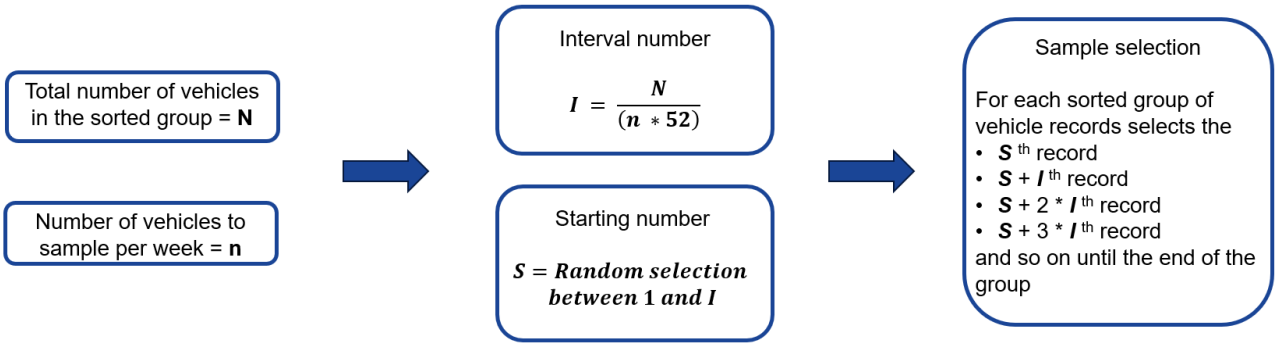
This appendix complements section 2.2, providing more details on some of the aspects covered there.

5.1 DATA COLLECTION

This section details the sample survey methodology recommendations found in the manual "Road freight transport methodology: 2016 edition", with a summary of the recommendations outlined in Table 5-1. Starting from survey design, the survey employs a sample approach from a representative population size, which minimizes implementation costs for MS. Additionally, the sampling approach enables more frequent sampling, which is crucial for meeting the regulation's quarterly requirements in order to have regular updates in a way that meaningful data comparisons can be made across different time periods. It is important that sampling is carried out throughout the period to account for seasonal variations in the goods weight carried and the tonne-kilometres (tkm) performed between different vehicle types (for example small rigid goods vehicle and large articulated road tractors with semi-trailers). These seasonal variations can be indicative of trade patterns and seasonal effects.

The sampling frame should consist of a random selection of HDVs from the MS HDV registration database or the equivalent that records all HDVs within the territory. As the type of transport activity, geographical nature of the operating areas, and the stratification of the survey that is possible vary between MS, it is unrealistic to provide a one-size-fit-all value or range of sample size for all MS. The Manual does not stipulate the minimum sample size but recommends keeping the size manageable for what the MS can handle, but more importantly, the sample size should be sufficient to meet the chosen maximum standard error, which is covered in section 2.2.4 under precision standards. For most MS, the percentage standard error of the annual estimates should be within ±5% range with a 95% confidence level. For MS where the total HDV population is less than 25,000 vehicles, or the total HDV population engage in international transport is less than 3,000 vehicles, the percentage standard error limit is raised to ±7%. As a rough estimate, if there are at least 5,000 vehicle-week record entries annually if data is collected over a week or at least 35,000 vehicle-day record entries if data is not collected over a week. In case of difficulty meeting the recommended sample size due to either a small HDV population size or geographical coverage, Eurostat reported some MS were able to achieve the desired precision standards with a reduced sample size as low as 1,000 vehicle-week record entries per quarter. See Figure 5-1 for the sample population allocation process over an annual period of 52 weeks.

Figure 5-1 Sample population allocation process over an annual period of 52 weeks



Source: Own interpretation.

A stratified sampling approach based on the load capacity (recommended) or gross weight of the vehicles should be employed to account for variances in both the volume of goods carried and the volume-distances travelled by different types of vehicles. This is to ensure a representative sample that accounts for the disparate capabilities of different vehicle types, thereby enhancing the accuracy and reliability of subsequent analyses. For MS with a larger geographical area split into multiple regions, the Manual also recommended stratifying the data by its regions or other geographical divisions.

Several stratified sampling methods, specifically by vehicle load capacity, are recommended by the Manual. Proportionate stratified sampling divides the samples into subgroups, with sample sizes proportional to their

representation in the whole population. However, this method can lead to oversampling of groups with fewer vehicles and underrepresentation of larger ones. To reduce misrepresentation of the sample group, either optimal or equal allocation of the disproportionate stratified sampling methods should be used to find the optimal number of samples across different strata.

That said, estimating both tkm and tonnes carried such that both estimates have reasonable precision requires further modification on the stratified sample design. In essence, finding the optimal number of samples across different strata requires some trial and error using different stratified sampling techniques, making compromises on standard error values of multiple stratas. The Manual provided several examples to find the optimal number of samples, and ultimately it boils down to either by prioritising better overall estimate with equal stratum standard error or favouring proportionate sampling without making significant changes to individual strata sample size.

Table 5-1 Sampling methodology recommendation summary

Topic	Recommendations
Timeline	The sample survey should last for a calendar year, with continuous records of sampling units throughout the survey period to account for seasonal variations. For individual sampling unit, record the sampled vehicles' activity for a consecutive period of seven days normally. The starting day for the sampled vehicles needs to stay the same throughout a year (for example, all vehicles have their journeys recorded from Monday to Sunday). For journeys started before the start of a week, ended during the week and after the end of the week, the solution is to record all journeys start during the week and record the full journey even if the journey ends after the selected week.
Sampling frame	A register listing all road freight vehicles registered on the MS territory is preferred. If a vehicle register is not available, a register of licensed entities (person or company) to operate as road haulers or a business register of companies could be considered. The Manual recommends using a tractive vehicle as a sampling unit. If unavailable, using a transport enterprise/truck operator as a sampling unit can be an alternative.
Sample size	The sample should have the same number of vehicles for each of the week covered by the survey. In terms of the total sample size over the survey period (assuming 12-month period), a separate Eurostat guidance to MS suggested: • A minimum of 5000 vehicle-weeks of vehicle activity over a 12-month period shall be reported to the Eurostat. • A minimum of 35000 vehicle-days of vehicle activity over a 12-month period if the MS does not ask for activity of vehicle over a week. Such that the desired attributes of the population are estimated to a known precision according to standard statistical theory. However, in the Eurostat manual it is suggested some MS would produce the desired precision standards with 1000 vehicle-weeks of vehicle activity per quarter (approximately 4000 vehicle-weeks over 12-month period). The option to have a single transport enterprise/vehicle operator as a sampling unit is stipulated in the Manual but using tractive vehicle is the preferred method. Hence, no guidance is mentioned when comes to the use of enterprise as a sampling unit.
Exemptions from sampling population	In order to obtain meaningful analysis of long and medium-distance international road freight transport operations across the EU, the regulation outlined the following exception for these vehicles from the regulation based on the vehicle size and purpose below: • Vehicles that exceed the normal authorised weight and dimensions permitted in the MS.

Topic	Recommendations
	• Agricultural, military, and central and local public administration owned vehicles. • Small vehicles up to 3.5 tonnes payload or 6 tonnes maximum permissible laden weight. Malta is exempted from the regulation to report its road freight transport data provided that the number of vehicles in scope operate in international road freight transport is less than 400 vehicles
Data requirement	The content for the sample survey requires the recording of the three areas below: • Vehicle details such as vehicle age, axle configuration, mileage, load capacity. • Journeys made by the vehicles such as the type of transport, how many country borders are crossed. • Goods and carriage information such as weight, distance travelled, good category and types
Stratification	A stratified sampling approach based on the load capacity or gross weight of the vehicles should be employed to accommodate the expected substantial variability in both the volume (tonnes) of goods carried and the volume-distances (tkm) travelled by different types of vehicles. For MS covering a larger geographical area, data should be stratified by regions or by other geographical divisions.
Historic data	The regulation came into effect in 2012, with a requirement to backdate the statistics to cover the first quarter of 1999 in their first transmission to Eurostat.

5.2 DATA PROCESSING

5.2.1 Non-responses

When conducting a large scale survey using questionnaires, It is inevitable that not all questionnaires sent out will be returned promptly and giving all information requested, regardless of the efforts put to ensure forms are correctly filled as designed before the closedown date of the survey. Some forms might not returned at all, and others might be partially filled. The lack of completeness in the information sought from the questionnaire might reduce the sampling population below what is intended and in turn increases the sampling errors of estimates. Box 6-1 contains the Manual's definition on different types of non-responses and recommendations on processing these non-responses respectively.

Box 5-1 Identify and dealing with non-responses

The Manual provides some guidance to account for non-response, so that to avoid reducing the sample size that can increase the sampling error of estimates.

In some instances, a part of questionnaire results might be unusable due to the to the information on the register being wrong, incomplete or outdated. When calculating overall response rate to the survey, the usable response should be counted towards the usable responses. The following situations should not be counted as non-response:

- Responses indicate that the vehicle has been sold, leased, or scrapped
- Vehicle operators or hauliers have gone out of business
- Failed delivery of the survey to respondents such that postal authorities returned the questionnaire as non-deliverable

In the following situations, questionnaires should be discarded and treated as if questionnaire were never returned, such that they are not counted towards the sampling population as mentioned in the Manual:

- Responses indicate that the vehicle has been sold or stolen
- Vehicle operators or hauliers are excused from returning the questionnaire

Non-responses can be categorized into **unit non-response** and **item non-response**. The Manual defines unit non-response as when no information at all is received in respect of a particular form by the time of the closedown of the survey. The most common unit non-response includes no reply, refusal to complete by the respondent, or effective refusal such that no information from the survey is usable. Regarding item non-responses, the Manual defines it as where information is received in answer to some questions on the form but not all and it is possible to use the data provided (often with some imputation of missing information). In this case, the information must be interpreted before coding the responses into a database. The Manual recommends two approaches when handling item non-response, either by directly imputing the missing item with the average of similar units in the stratum or by adjusting the weighting factor so that it differs from different questions on the questionnaire. In some cases, when a more complicated imputation is possible, the imputation should be based on the available information on the form and averages of others in similar situations. For example, if the amount of fuel used is not recorded on the form, an estimate can be made from the average fuel consumption of similar vehicles and the distance travelled by the vehicle for which the information is missing.

A more detrimental effect of the lack of completeness of information is that the missing values might introduce biases to the results. If an estimate of the weight of freight transported is taken from a sample with a large number of non-responses without any adjustment, this estimate will be misleading and not be an accurate reflection of the population. In such case, the following equation can estimate the error in the unadjusted mean for respondents for a particular variable, by assuming the deviation of averages for non-respondents from the equivalent for respondents for a particular variable, represent by ***d*** per cent, and input the response rate for that particular variable as ***r*** per cent. For example, for a variable with a 90% response rate if the error in the unadjusted mean for respondents is 2%, the mean for non-respondents does not differ by more than 20% from the mean for respondents. At a 50% response rate, a sample mean within 2% of the true mean requires the non-respondent mean to differ by no more than 4% from the respondent mean; and at 20% response no more than 2.5%.

$$Error\ in\ the\ unadjusted\ mean\ for\ respondents = d\left(\frac{100 - r}{100}\right)$$

5.2.2 Data checks

Both plausibility and logic checks for all data inputs should be conducted in the check process. For plausibility checks, the outputs should highlight inputs that are unlikely but nevertheless possible (e.g., national journeys over 750 kilometers, a weekly total greater than 7000 kilometers). That said, plausibility checks should be kept to an absolute minimum to avoid invalidating inputs that are, in fact, correct. For logic check, all inputs should undergo the following examination with outliers highlighted:

- Range checks (e.g. dangerous goods code must be in the range 10 - 90),
- Valid value checks (e.g. commodity code must be coded according to one of the 20 unique classification for transported goods established by the European Commission, known as Standard Goods Classification for Transport Statistics (NST), see Annex IV of Regulation 70/2012 for the full list),
- Contradictory information (e.g. load capacity exceeds gross vehicle weight).

It is essential to confirm that questionnaires are interpreted consistently and correctly, by having the correct codes assigned to variables. The codings are available in the Annexes of Regulation 70/2012. The Manual suggests that coding rule checks should be implemented using both automated checks and manually by a supervisor during different stages of the analysis. To begin with, the Manual recommends that the same person responsible for checking the questionnaire to code the information and have something contain in the database and questionnaire to identify the individual person responsible. This is to allow tracing and rectifying coding mistakes by providing additional training to the person responsible. This is then followed by a separate check by a supervisor or team leader to check the questionnaire to ensure they are correctly interpreted and coded. Finally, periodic checks should be done to ensure the coded questionnaires are error-free and stored methodically in a way that individual questionnaires can be easily retrieved. Aside from coding checks, the periodic checks also provide a chance to identify questionnaires that, whilst having been recorded as returned, have not been coded.

5.2.3 Coding multi-stop journeys

The coding staff first needs to restructure complicated lorry movements into one of the below three classifications as defined in the Manual (a 'stage' is that part of a journey between two stops).

- One stop journeys: one stage journey, out or back loaded or empty, the return stage being a separate journey
- Two to four stops journeys: a journey with two to four stages where the load decreases and where there is no loading or where the load gradually increases and there is no unloading
- Collection/delivery: where it is not feasible to collect details of every stage of the journey (in general, journeys of 5 or more stops may be treated as collection/delivery journeys)

For journeys of more than one stop the coding staff must first work out from information recorded on the questionnaire what work the lorry actually did and breakdown each journey into the three classifications above.

If a journey comprised of five or more stops (classify as collection/delivery), the haulier is not asked to complete information for every single stage as it is not feasible to ask the transport operators to describe the individual transport operations. Instead, operators are asked for the following summary information:

- Origin
- Final destination
- Type of goods
- Total loaded distance travelled (LM)
- Total empty distance travelled (LE)
- Total weight of goods delivered (TD)
- Total number of delivery stops (ND)
- Total weight of goods collected (TC)
- Total number of collection stops (NC)

These five or more stops journeys are then further breakdown by the nature of the journey base on the number and sequence of collection and deliveries, and whether the number of stops is known.

The main difference in the information collected compared to one stop and two to four stops journeys is that "Weight of goods" is replaced by "Total weight of goods collected" and "Total weight of goods delivered". The "Number of stops for delivery" and "Number of stops for collection" are also recorded. This information allows a rather involved calculation to be made of the journey's total tkm. It should be noted that only accounting for the totals could lead to a loss of data. For example, a haulier could transport more than a single type of commodity but he will only record the main type of commodity transported. Another example might be only the final destination of such journeys is recorded so there will not be complete detailed data about inter-regional flows.

5.2.4 Calculate multi-stop journeys

Chapter 6.5 and 6.6 of the Manual provides some clear examples of how to conduct these calculations.

5.2.5 Data record layout and weightings

During the model records stage, weighting factors are calculated separately for each stratum before any analysis is conducted. Adding weighting factors to the sampled records forms the last step of creating a usable database where analyses can be conducted for dissemination. Weighting factors essentially indicate how many other vehicles in the country are represented by a single sample vehicle. The purpose of the weighting factor is to acquire an accurate estimate through the sample that is representative of the population totals. For each stratum of the sample population, the Manual recommends calculating the weighting factor on a quarterly basis, as the recommended frequency will provide sufficient accuracy without over-complication by conducting more frequent calculations. The weighting factor for each stratum (***W***) is calculated using this formula,

$$W = \frac{N_p \times P}{N_a + N_{nw}}$$

Where $\boldsymbol{N_p}$ represents the total number of vehicles in the stratum at the mid-point of the study period and $\boldsymbol{P}$ represents the number of weeks of the survey (13 or 14 for a quarterly survey); while $\boldsymbol{N_a + N_{nw}}$ represents the

sum of the number of active vehicles and non-working vehicles that are still part of the active stock during the survey period. This weighting factor should be applied to the sampled vehicle and journey records in the respective stratum of the stratified sample for that time period. It should be noted that the prerequisite of applying the weighting factor is that the vehicle register is reliable and regularly updated. For vehicle register that is out-of-date and inaccurate, an alternative weighting factor methodology is provided in Chapter 7.2.3 of the Manual, which create additional allowances for the scraped and sold vehicles in the denominator of the weighting factor.

6. APPENDIX 3 – EMISSION STATISTICS

This appendix complements section 2.3.4.1, providing more technical details on the good practices in data analysis.

6.1 GOOD PRACTICES IN DATA ANALYSIS, USING TIERED METHODOLOGY

As mentioned in section 2.3.4.1, the tiered methodology suggested in the guidebook for the calculation of GHG emission inventories considers three approaches, which depend on the availability of data. These approaches are described below.

The **Tier 1** methodology uses fuel as the activity indicator, in combination with average fuel-specific emission factors.

$$E_i = S_j (S_m (FC_{j,m} \acute{} EF_{i,j,m}))$$

Where:

$E_i =$ emission of pollutant i [g]

$FC_{j,m} =$ fuel consumption of vehicle category j using fuel m [kg]

$EF_{i,j,m} =$ fuel consumption − specific emission factor of pollutant i for vehicle category j and fuel m [g/kg]

This equation requires the fuel consumption/sales statistics to be split by vehicle category, as national statistics do not provide vehicle category details (emission factors are specified in the document). The Tier 1 approach requires relevant fuel statistics, i.e. the volumes (or weights) of fuel sold for road transport use, and for each type of fuel used. For the majority of fuels (petrol, diesel, LPG) these statistics are usually available at a national level. The Tier 1 methodology also requires that the fuel sales are disaggregated according to the four vehicle categories. Hence, the inventory compiler should also make sure when using the Tier 1 algorithm that the total amount of each type of fuel sold is equal to the sum of the fuel consumed by the different vehicle categories.

The **Tier 2** approach considers the fuel used by different vehicle categories and their emission standards. Hence, the vehicle categories used in the Tier 1 approach are sub-divided into different technologies according to emission-control legislation.

$$E_{i,j} = S_k (N_{j,k} \acute{} M_{j,k} \acute{} EF_{i,j,k})$$

Where:

$N_{j,k} =$ number of vehicles in the nation's fleet of category j and technology k.

$M_{j,k} =$ average annual distance driven per vehicle of category j and technology k [km/veh]

$EF_{i,j,k} =$ technology − specific emission factor of pollutant i for vehicle category j and technology k [g/veh − km]

Vehicle categories j are passenger cars, light commercial vehicles, heavy-duty vehicles and L-category vehicles (emission factors are specified in the document). In principal, traffic activity data are available from the national statistics offices of all countries, and international statistical organisations and institutes

In the **Tier 3** method described here, exhaust emissions are calculated using a combination of firm technical data (e.g. emission factors) and activity data (e.g. total vehicle km). Total exhaust emissions from road transport are calculated as the sum of hot emissions (when the engine is at its normal operating temperature) and emissions during transient thermal engine operation (termed 'cold-start' emissions)

$$E_{total} = E_{hot} + E_{cold}$$

$E_{total} =$ total emissions (g) of any pollutant for the spatial and temporal resolution of the application

$E_{hot} =$ emissions (g) during stabilised (hot) engine operation

$E_{cold} =$ *emissions* (g) *during transient thermal engine operation* $(cold\ start)$

Total emissions are to be calculated by combining activity data for each vehicle category with appropriate emission factors. The emission factors vary according to the input data (driving situations, climatic conditions). In principle, vehicle statistics are readily available from the national statistical offices of all countries, and from

international statistical organisations and institutes (e.g. Eurostat, IRF). However, it must be stressed that these statistics are almost exclusively vehicle-oriented (i.e. comprising fleet data), with information about aggregated categories only (e.g. passenger cars, trucks, buses, motorcycles). In addition, little information referring to the age and technology distribution can be found in a consistent form, and very little information is available as regards activity (except for fuel statistics). In addition, more detailed traffic data required for the calculations (such as average trip length for cold start emissions) are available only in a few countries.

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