# INTERNATIONAL STANDARD

# ISO 14083

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# Greenhouse gases — Quantification and reporting of greenhouse gas emissions arising from transport chain operations

*Gaz à effet de serre — Quantification et déclaration des émissions de gaz à effet de serre résultant des opérations des chaînes de transport*

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# Contents

Page

**Foreword** vii
**Introduction** viii
**1 Scope** 1
**2 Normative references** 1
**3 Terms and definitions** 1
3.1 Terms related to transport chain operations 1
3.2 Terms related to greenhouse gases and energy 6
3.3 Terms related to quantification 9
3.4 Other terms 11
**4 General principles** 11
4.1 General 11
4.2 Relevance 11
4.3 Completeness 12
4.4 Consistency 12
4.5 Accuracy 12
4.6 Transparency 12
4.7 Conservativeness 12
**5 Quantification principles** 12
5.1 General 12
5.2 System boundaries 12
5.2.1 Transport operations and hub operations included 12
5.2.2 Processes included 13
5.2.3 Application of cut-off criteria 14
5.2.4 Processes not included 14
5.2.5 Optional processes 14
5.2.6 Optional quantification of black carbon emissions from transport operations 15
5.2.7 Carbon offsetting and GHG emissions trading 15
5.3 Conversion of energy carrier data into GHG emissions 15
5.3.1 General 15
5.3.2 Global warming potential 15
5.4 Calculation of transport activity 15
5.4.1 Passenger transport 15
5.4.2 Freight transport 16
5.4.3 Combined transport of freight and passengers (including passenger vehicles) 17
5.4.4 Use of distance adjustment factor 17
5.5 Calculation of hub activity 17
5.5.1 Passenger hub 17
5.5.2 Freight hub 18
5.5.3 Combined freight and passenger hub (including passenger vehicles) 18
5.6 Allocation 18
5.6.1 General 18
5.6.2 Allocation between passengers and freight 19
5.6.3 Allocation between passengers of different travel classes 19
5.6.4 Allocation between ambient and temperature-controlled freight 19
**6 General principles related to transport chains, transport chain elements, transport operation categories and hub operation categories** 19
6.1 Transport chains and TCEs 19
6.2 Transport operations and hub operations related to TCEs 19
6.3 Transport operation categories and hub operation categories 21
6.3.1 General 21

6.3.2 Transport operation categories ..... 21
6.3.3 Hub operation categories ..... 24

**7 Quantification actions ..... 26**
7.1 General ..... 26
7.2 Establishment of GHG emission intensity of a TOC or a HOC ..... 27
7.2.1 General ..... 27
7.2.2 Selection of the option ..... 27
7.2.3 Calculation with primary data (option A) ..... 27
7.2.4 Calculation with a model (option B) ..... 28
7.2.5 Selection of a value from a database of default values (option C) ..... 28
7.2.6 Collection of a value from a contracted operator (option D) ..... 28
7.3 Calculation of GHG emissions for a TCE ..... 28
7.4 Calculation of GHG emissions for a transport chain ..... 28

**8 Quantification actions at the TOC level ..... 28**
8.1 General ..... 28
8.2 Quantification of the GHG activity data of a TOC ..... 29
8.3 Calculation of GHG emissions of a TOC ..... 29
8.3.1 General ..... 29
8.3.2 No allocation needed ..... 29
8.3.3 Allocation needed ..... 30
8.4 Calculation of transport activity of a TOC ..... 31
8.4.1 General ..... 31
8.4.2 Transport activity distance ..... 31
8.4.3 Transport activity of a TOC of passengers — General case ..... 31
8.4.4 Transport activity of a TOC of freight — General case ..... 32
8.4.5 Transport activity of a TOC of passengers with multi-class vehicles ..... 32
8.4.6 Transport activity of a TOC of freight with multi-temperature vehicles ..... 33
8.4.7 Transport activity of a TOC with passengers and freight (whether including passenger vehicles or not) ..... 34
8.4.8 Transport activities of a TOC with any other case ..... 35
8.5 Calculation of GHG emission intensity for the TOC ..... 35
8.5.1 General ..... 35
8.5.2 General case ..... 35
8.5.3 Case of a TOC of freight with multi-temperature vehicles ..... 36

**9 Quantification actions at the HOC level ..... 36**
9.1 General ..... 36
9.2 Quantification of the GHG activity data of a HOC ..... 36
9.3 Calculation of GHG emissions of a HOC ..... 37
9.3.1 General ..... 37
9.3.2 No allocation needed ..... 37
9.3.3 Allocation needed ..... 38
9.4 Quantification of hub activity of the HOC ..... 39
9.4.1 Freight hub activity ..... 39
9.4.2 Passenger hub activity ..... 39
9.5 Calculation of GHG emission intensity for the HOC ..... 39
9.5.1 General ..... 39
9.5.2 General case ..... 39
9.5.3 Case of a HOC of freight with multi-temperature conditions ..... 40

**10 Calculation of GHG emissions for a transport TCE ..... 40**
10.1 General ..... 40
10.2 Calculation of transport activity ..... 40
10.3 Selection of a GHG emission intensity ..... 40
10.4 General case ..... 41
10.5 Case of differentiation by passenger classes ..... 41
10.6 Case of differentiation by cargo temperature ..... 41
10.7 Case of transport of passengers and freight in the same vehicle ..... 41

**11 Calculation of GHG emissions for a hub TCE** .......... **41**
11.1 General .......... 41
11.2 Quantification of hub activity .......... 42
11.3 Selection of a GHG emission intensity .......... 42
11.4 General case .......... 42
11.5 Case of differentiation by cargo temperature .......... 42
11.6 Case of transfer of passengers and freight at the same hub .......... 42

**12 Results** .......... **43**
12.1 For one transport chain .......... 43
12.1.1 Calculation of GHG emissions .......... 43
12.1.2 Calculation of transport activity .......... 43
12.1.3 Calculation of GHG emission intensities .......... 44
12.2 For a set of transport chains .......... 44
12.2.1 General .......... 44
12.2.2 Calculation of GHG emissions .......... 44
12.2.3 Calculation of transport activity .......... 44
12.2.4 Calculation of GHG emission intensities .......... 45
12.3 For a transport service .......... 45
12.4 For a set of transport services .......... 45
12.5 For a transport mode .......... 45

**13 Reporting** .......... **45**
13.1 General .......... 45
13.2 Reporting at the organizational level .......... 45
13.2.1 Reporting boundaries .......... 45
13.2.2 Report .......... 45
13.2.3 Periodicity .......... 46
13.3 Reporting at the level of transport or hub services .......... 46
13.3.1 Granularity .......... 46
13.3.2 Report .......... 46
13.4 Supporting information .......... 47
13.4.1 General .......... 47
13.4.2 Description of the calculation method .......... 47
13.4.3 Transparent reporting from the use of modelled data or default GHG emission intensities .......... 52

**Annex A** (normative) **Air transport** .......... **54**

**Annex B** (normative) **Cable car transport** .......... **56**

**Annex C** (normative) **Inland waterway transport** .......... **59**

**Annex D** (normative) **Transport by pipeline** .......... **61**

**Annex E** (normative) **Rail transport** .......... **63**

**Annex F** (normative) **Road transport** .......... **66**

**Annex G** (normative) **Sea transport** .......... **70**

**Annex H** (normative) **Hubs** .......... **76**

**Annex I** (normative) **Approach to account for refrigerant leakage GHG emissions from mobile air conditioning and temperature-controlled freight units during transportation operations** .......... **80**

**Annex J** (normative) **Additional requirements and guidance for GHG emission factors** .......... **83**

**Annex K** (informative) **GHG emission factors and sources** .......... **87**

**Annex L** (informative) **Additional guidance for allocation to passenger according to passenger class of travel** .......... **92**

**Annex M** (informative) **General guidance on the approach to modelling of GHG emissions of transport chains** .......... **98**

**Annex N** (informative) **Additional guidance for use of ICT equipment and data servers related to transport operations** 103
**Annex O** (informative) **Quantification of GHG emissions arising from (re)packaging processes at logistics hubs** 106
**Annex P** (informative) **Quantification of black carbon emissions from transport operations** 108
**Annex Q** (informative) **Selection of sources of default GHG emission intensities** 110
**Annex R** (informative) **Comparison of GHG emission categorization used in the GHG Protocol and this document** 112
**Bibliography** 115

# Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 207, *Environmental management*, Subcommittee SC 7, *Greenhouse gas and climate change management and related activities*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 320, *Transport — Logistics and services,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition cancels and replaces IWA 16:2015, which has been technically revised throughout to expand the framework to a methodology.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

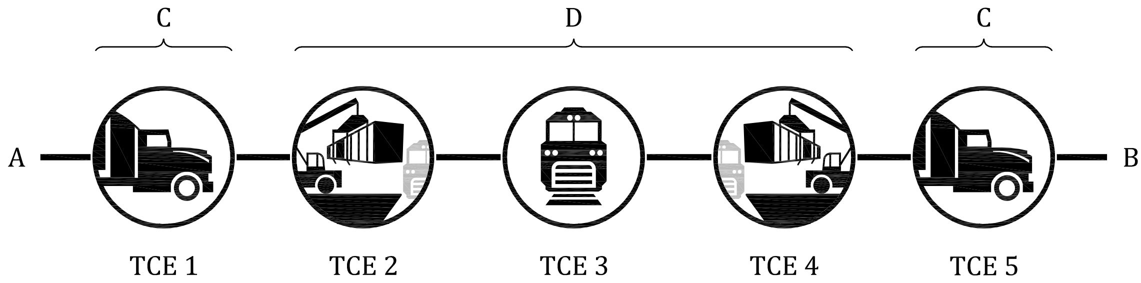
# Introduction

This document provides requirements and guidance for the quantification and reporting of greenhouse gas (GHG) emissions for transport chains for passengers and freight.

This document provides such a calculation with its related reporting. It specifies how to source data as input for the calculation, taking into account that transport operations vary hugely, from multinational organizations operating multiple transport modes to deliver transport services across the globe, through small local operators delivering a simple service to a single user; hence this document has adopted a structure to make it widely applicable. To ensure that values for GHG emissions that result from vehicle and hub operation and associated energy provision are considered, this document takes into account the GHG emissions associated with production and distribution of energy (including, for example, production and distribution of liquid energy carriers or grid transmission of electricity). As a result, calculation results can enable a consistent comparison of possible different energy carriers by transport service operators, users and any other interested parties. Calculation results are only directly comparable if all options chosen are internally consistent.

This document covers all modes of transport (land, water or in the air, irrespective of the means of transport, i.e. vessel, vehicle or pipeline) and includes the operational GHG emissions from hubs where they facilitate transfer of freight or passengers from one element of a transport chain to the next. It takes account of operation of empty trips required for subsequent transportation of freight or passengers. It is applicable at all stages along the entire transport chain (see also illustrative examples in Figure 1 and Figure 2).

Figure 1 provides an illustrative example of a freight transport chain from the point where freight leaves its last point of production or transformation (A, freight consignor) to the point where freight reaches its first non-transport related operation (B, freight consignee). This transport chain consists of five transport chain elements (TCEs), the GHG emissions of which are calculated separately. The first and last TCEs (TCE 1, TCE 5) represent road services (C) covering pre- and on-carriage; TCE 2 to TCE 4 represent a rail freight service (D) composed of road/rail terminal operations (TCE 2, TCE 4) and main carriage by rail transport (TCE 3).




**Key**

A freight consignor

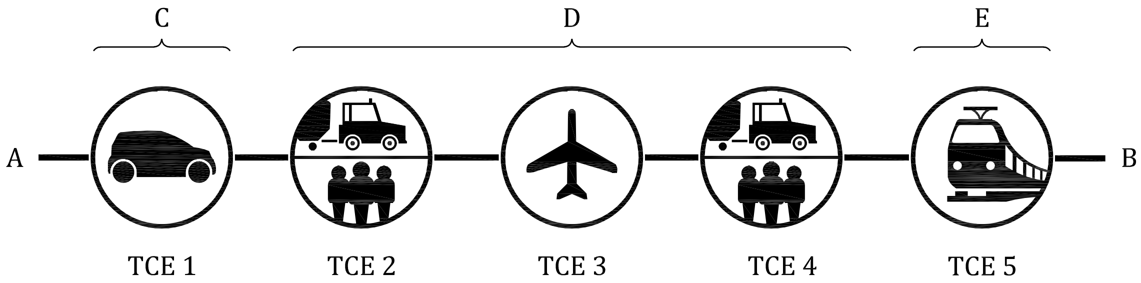
B freight consignee

C road services

D rail freight service

**Figure 1 — Illustrative example of a multi-element freight transport chain**

Figure 2 provides an illustrative example of a passenger transport chain from the point where passengers leave their departure location, A, to their destination, B. This transport chain consists of TCEs, the GHG emissions of which are calculated separately. The first TCE (TCE 1) represents transport of the passenger from home to the airport by private car (C); TCE 2 to TCE 4 represent an air travel service (D) composed of passenger terminal operations for the passenger and luggage (TCE 2, TCE 4) and main carriage by plane (TCE 3). The on-carriage represented by TCE 5 shows shuttle express via rail (E).




**Key**

A departure location

B destination

C private car service

D air travel service

E shuttle express service via rail

**Figure 2 — Illustrative example of a multi-element passenger transport chain**

The reporting set out in this document reflects the need to report information between the parties in a transport chain because information known to the transport or hub operator, when reported to the user of their service, helps the latter to quantify, better manage and reduce the impacts of their transport or hub activities. This is a standard for GHG emission calculation only; therefore, offsetting is not part of this document.

This document is complementary to several existing standards. It is aligned with the ISO 14064 series and ISO 14067 (see Figure 3). It contributes to the carbon footprint of products (see ISO 14067) and the life cycle assessment in accordance with the ISO 14040 family of standards and ISO 14044. Figure 3 shows the relationship of this document to other International Standards of the ISO 14040 family of standards and the ISO 14060 family of standards, using the example of a freight transport chain and including possible stages within the life cycle of a product bought online as well as example topics to be covered by a company's GHG inventory.

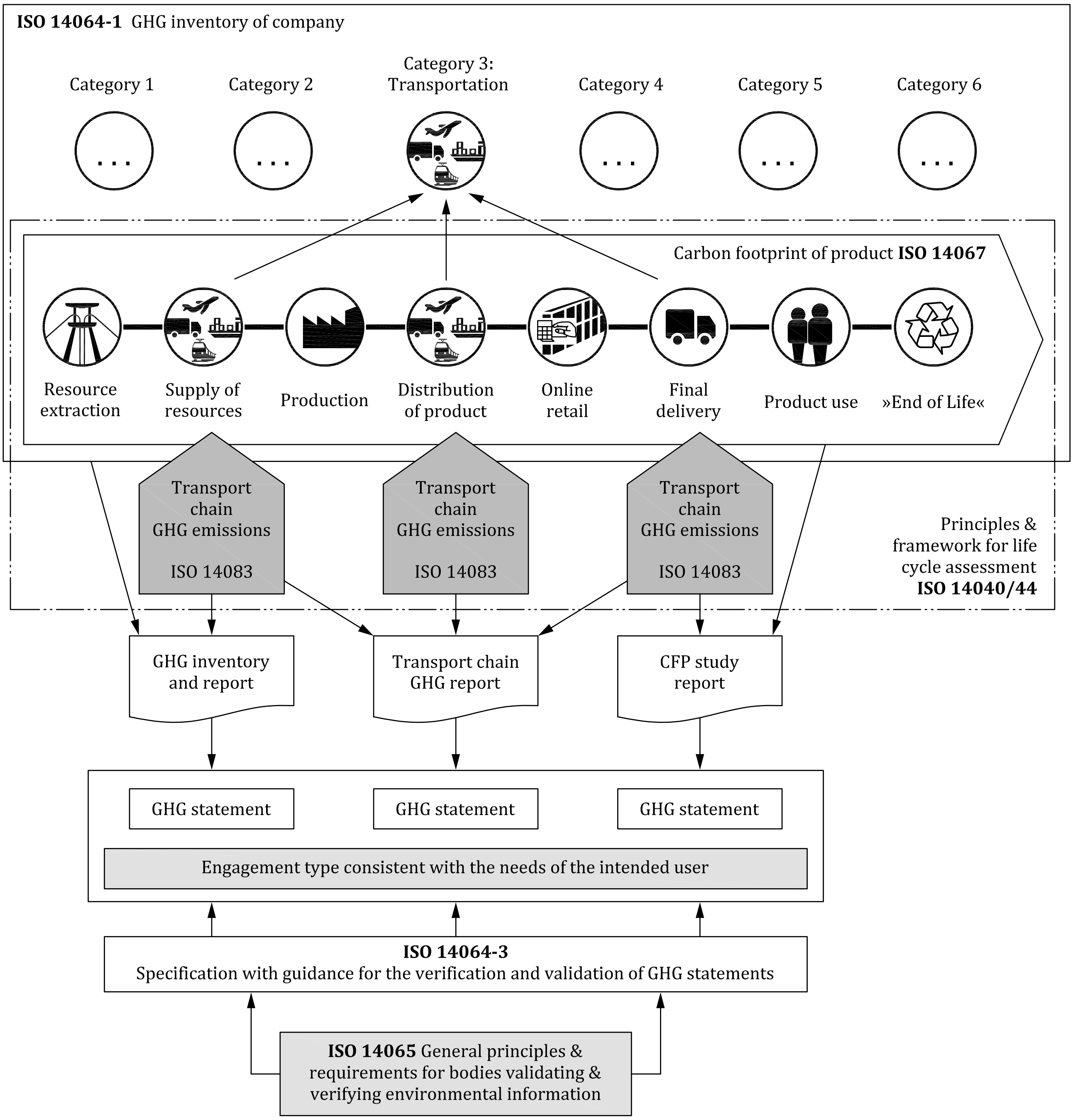



**Figure 3 — Relationship between the ISO 14040 family of standards and the ISO 14060 family of standards, using the example of a freight transport chain**

NOTE GHG emission intensity per tonne- or passenger-km calculated in accordance with this document can be used as primary or secondary data for GHG quantification projects in accordance with ISO 14067 and/or ISO 14064-1. These data require adaptation or modification if full life cycle based GHG-emissions are needed, e.g. vehicle manufacture or transport infrastructure provision.

The approach acknowledges, and is in line with, the valuable work conducted on GHG calculation and reporting that is documented in the aforementioned standards and by other protocols and organizations, including but not limited to, the United Nations Framework Convention on Climate Change (UNFCCC),[37] the GHG Protocol[16] and the Global Logistics Emissions Council (GLEC) Framework for Logistics Emissions Accounting and Reporting[15].

# Greenhouse gases — Quantification and reporting of greenhouse gas emissions arising from transport chain operations

## 1 Scope

This document establishes a common methodology for the quantification and reporting of greenhouse gas (GHG) emissions arising from the operation of transport chains of passengers and freight.

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

### 3.1 Terms related to transport chain operations

**3.1.1**
**cable car**
ropeway
transport system where *vehicles* (3.1.35) are moved by at least one cable motorized by a machinery

Note 1 to entry: Vehicles circulating on cable(s) whose movement is not transmitted by at least one cable are not considered cable cars. Vertical elevators are also not considered cable cars.

**3.1.2**
**charter**
contract for the hire of a specific *vehicle* (3.1.35) from an owner for a specified period of time for the charterer's purposes subject to agreed restrictions

**3.1.3**
**collection and delivery round**
trip with the purpose to collect and/or deliver *freight* (3.1.7) at successive locations along the trip

Note 1 to entry: Typically, but not necessarily, the trip starts and ends at the same location.

**3.1.4**
**consignment**
separately identifiable amount of *freight* (3.1.7) transported from one consignor to one consignee via one or more modes of transport

Note 1 to entry: Although "consignment" and "*shipment*" (3.1.20) are common terms often considered as synonyms, in this document and other technical publications, a consignment is differentiated to a shipment. Indeed, a shipment refers to a grouping of freight corresponding to the shipper needs, whereas a consignment refers a grouping of freight according to a carrier or freight forwarder's transport solutions.

[SOURCE: ISO 26683-1:2013, 3.9, modified — “freight” replaced “goods items (available to be)”. “and specified in one single transport document” deleted. Note 1 to entry added.]

**3.1.5**
**empty trip**
section of the route of a *vehicle* (3.1.35) during which no *freight* (3.1.7) or *passenger* (3.1.16) is transported

EXAMPLE Vehicle (re)positioning trips, empty backhauls.

**3.1.6**
**fleet**
set of *vehicles* (3.1.35) operated by one *transport operator* (3.1.30)

**3.1.7**
**freight**
goods, materials, commodities, parcels, etc. being transported from one location to another

[SOURCE: EN 14943:2005, 3.437, modified — “materials, commodities, parcels, etc.” added.]

**3.1.8**
**hub**
DEPRECATED: node
DEPRECATED: site
DEPRECATED: station
DEPRECATED: facility
DEPRECATED: centre
DEPRECATED: depot
location where *passengers* (3.1.16) transfer and/or *freight* (3.1.7) is transferred from one *vehicle* (3.1.35) or mode of transportation to another before, after or between different elements of a *transport chain* (3.1.25)

Note 1 to entry: Hubs include, but are not limited to, rail/road terminals, cross-docking sites, airport terminals, terminals at seaports and distribution centres.

**3.1.9**
**hub activity**
parameter that quantifies the *throughput* (3.1.21) of a *hub* (3.1.8)

**3.1.10**
**hub equipment**
equipment and facilities used within a *hub* (3.1.8) to transfer *freight* (3.1.7) or *passengers* (3.1.16)

**3.1.11**
**hub operation**
operation in order to transfer *freight* (3.1.7) or *passengers* (3.1.16) through a *hub* (3.1.8)

**3.1.12**
**hub operation category**
**HOC**
group of *hub operations* (3.1.11) that share similar characteristics

Note 1 to entry: Annex H contains examples of HOCs.

**3.1.13**
**hub operator**
entity that carries out *hub operations* (3.1.11) involving carriage of *freight* (3.1.7) or *passengers* (3.1.16), or both

**3.1.14**
**hub service**
service provided within a *hub* (3.1.8) *transport chain element* (3.1.26)

**3.1.15**
**load factor**
ratio of the actual load to the maximum legally authorized load of a particular *vehicle* (3.1.35)

**3.1.16**
**passenger**
person carried by a *vehicle* (3.1.35)

Note 1 to entry: The term and its abbreviation “pax” are also used as a unit for quantity of passengers.

Note 2 to entry: Where the word “passengers” is used, it refers to one or more passengers unless specified in the context.

**3.1.17**
**pipeline**
long continuous line of pipes, including ancillary equipment, used for transporting *freight* (3.1.7)

[SOURCE: ISO 6707-1:2020, 3.1.2.30, modified — “freight” replaced “liquids or gases”.]

**3.1.18**
**pipeline transport**
movement of a medium (liquid, gas, liquefied gas, slurry) through a system of pipes from one location to another

**3.1.19**
**round trip**
group of sequential journeys that start and end in the same place, whatever the intermediate routing

**3.1.20**
**shipment**
identifiable collection of one or more *freight* (3.1.7) items (available to be) transported together from the original shipper to the ultimate consignee

Note 1 to entry: A shipment may be transported in one or a multiple number of *consignments* (3.1.4).

Note 2 to entry: A shipment can be aggregated or disaggregated to different consignments according to the requirements of the means of transportation on any one element of the *transport chain* (3.1.25), e.g. single bulk units and packages can be aggregated on a pallet and such pallet can be handed over as a unit for aggregation in a container, which in turn is treated as a consignment in a *vehicle* (3.1.35).

Note 3 to entry: Although “consignment” and “shipment” are common terms often considered as synonyms, in this document and other technical publications, a consignment is differentiated to a shipment. Indeed, a shipment refers to a grouping of freight corresponding to the shipper needs, whereas a consignment refers a grouping of freight according to a carrier or freight forwarder’s transport solutions.

[SOURCE: ISO 26683-1:2013, 3.34, modified — “freight” replaced “goods”. Notes 2 and 3 to entry added.]

**3.1.21**
**throughput**
quantity of *passengers* (3.1.16) or *freight* (3.1.7) handled, sorted, cross-docked or transferred within and between modes at a *hub* (3.1.8)

**3.1.22**
**transhipment**
action by which *freight* (3.1.7) is transferred from one means of transport to another during the course of one *transport chain* (3.1.25)

[SOURCE: EN 14943:2005, 3.1154, modified — “transport chain” replaced “transport operations”, and the second part of the definition deleted.]

**3.1.23**
**transport**
movement of *passengers* (3.1.16) and/or *freight* (3.1.7) from one location to another performed by modes of transport such as air, *cable car* (3.1.1), inland waterway, *pipeline* (3.1.17), rail, road and sea

[SOURCE: ISO 26683-1:2013, 3.37, modified — "passengers and/or freight" replaced "people and "goods", "of transport" added and the following list changed, "and the field comprises the attributes of infrastructure, vehicles and operations" deleted.]

**3.1.24**
**transport activity**
parameter that quantifies *passenger* (3.1.16) or *freight* (3.1.7) *transport* (3.1.23)

**3.1.25**
**transport chain**
sequence of elements related to *freight* (3.1.7) or a (group of) *passenger(s)* (3.1.16) that, when taken together, constitutes its movement from an origin to a destination

Note 1 to entry: A passenger or a group of passengers can include their luggage and, if any, their *vehicles* (3.1.35).

Note 2 to entry: Where there are two or more elements, in the majority of cases, one of them implies that the freight or passengers use a *hub* (3.1.8).

**3.1.26**
**transport chain element**
**TCE**
section of a *transport chain* (3.1.25) within which the *freight* (3.1.7) or a (group of) *passenger(s)* (3.1.16) is carried by a single *vehicle* (3.1.35) or transits through a single *hub* (3.1.8)

EXAMPLE If a multimodal trip of a passenger includes taking a bus from stop "L4" to stop "L7" of bus line "L", then one TCE is the trip of the passenger from "L4" to "L7".

Note 1 to entry: See Figures 4 and 5.

**3.1.27**
**transport distance**
distance between the origin and the destination of a *passenger* (3.1.16), a *consignment* (3.1.4) or a *vehicle* (3.1.35) along a specified route

Note 1 to entry: For the use of this document, the route followed by the passenger, the *freight* (3.1.7) or the vehicle may be different from that originally planned. This leads to two categories of transport distances: *actual distances* (3.1.27.1), and distances used for calculation of *greenhouse gas emissions* (3.2.8), i.e. *transport activity distances* (3.1.27.4).

**3.1.27.1**
**actual distance**
*transport distance* (3.1.27) along the actual route taken by a *vehicle* (3.1.35)

EXAMPLE Distance measured by an on-board device (odometer).

**3.1.27.2**
**great circle distance**
**GCD**
*transport distance* (3.1.27) determined as the shortest distance between any two points measured along the surface of a sphere

**3.1.27.3**
**shortest feasible distance**
**SFD**
DEPRECATED: planned distance
DEPRECATED: network distance
*transport distance* (3.1.27) determined as the distance achievable by the shortest practical route available according to the infrastructure options for a particular *vehicle* (3.1.35) type

Note 1 to entry: "Shortest practical route" implies that small detours from the shortest distance, e.g. to avoid congested city centres or rural roads unsuitable for certain vehicle sizes, can be included.

**3.1.27.4**
**transport activity distance**
*transport distance* (3.1.27) related to *passengers* (3.1.16) or *freight* (3.1.7) moved, used as a parameter for calculation of *transport activity* (3.1.24)

**3.1.28**
**transport operation**
operation of a *vehicle* (3.1.35) in order to transport *passengers* (3.1.16) and/or *freight* (3.1.7)

EXAMPLE If a multimodal trip of a passenger includes taking a bus from stop "L4" to stop "L7" of bus line "L", this requires a transport operation being the operation of this bus on line "L", from the first stop "L1" to the last stop of this bus line.

Note 1 to entry: It includes cases where the destination is the same as the origin passing through other locations on the way.

**3.1.29**
**transport operation category**
**TOC**
group of *transport operations* (3.1.28) that share similar characteristics

Note 1 to entry: Annexes A to G contain recommendations for the characteristics used to specify the TOCs for each transport mode.

**3.1.30**
**transport operator**
entity that carries out *transport operations* (3.1.28) involving carriage of *freight* (3.1.7) or *passengers* (3.1.16), or both

**3.1.31**
**transport service**
service provided to a *transport service user* (3.1.33) for the *transport* (3.1.23) of *freight* (3.1.7) or a *passenger* (3.1.16) from an origin to a destination

Note 1 to entry: A transport service can imply multiple *transport chain elements* (3.1.26), requiring both *transport operations* (3.1.28) and *hub operations* (3.1.11), as shown in Figure 1 and Figure 2.

**3.1.32**
**transport service organizer**
entity that provides *transport services* (3.1.31), within which the operation of some *transport chain elements* (3.1.26) are subcontracted to one or more other entities that operate them

Note 1 to entry: A transport service organizer acts as an intermediary between the *transport operator* (3.1.30) or *hub operator* (3.1.13) and the *transport service user* (3.1.33). A transport service organizer can act as the transport operator or hub operator for some of the transport chain elements that comprise the overall service.

Note 2 to entry: A transport service organizer can be, for example, a freight forwarder, an entity organizing trips/travel (e.g. travel agency, tour operator) or a local authority responsible for public passenger transport.

**3.1.33**
**transport service user**
entity that buys and/or uses a *transport service* (3.1.31)

Note 1 to entry: A transport service user can be a *passenger* (3.1.16), a shipper or a *transport service organizer* (3.1.32).

**3.1.34**
**twenty-foot equivalent unit**
**TEU**
standard unit used to express a number of containers of various lengths and for describing the capacities of container ships or terminals

[SOURCE: EN 14943:2005, 3.1166]

**3.1.35**
**vehicle**
any means of *transport* (3.1.23)

Note 1 to entry: Including, for example, vessels, drones and *pipeline* (3.1.17), whether driven by an operator or wholly (or partially) autonomous.

**3.1.36**
**vehicle operation**
deployment of a *vehicle* (3.1.35) to fully or partially provide a *transport operation* (3.1.28)

## 3.2 Terms related to greenhouse gases and energy

**3.2.1**
**carbon dioxide equivalent**
$CO_2e$
unit for comparing the radiative forcing of a *greenhouse gas* (*GHG)* (3.2.5) to that of carbon dioxide

Note 1 to entry: The carbon dioxide equivalent is calculated using the mass of a given GHG multiplied by its *global warming potential* (3.2.4).

[SOURCE: ISO 14064-1:2018, 3.1.13]

**3.2.2**
**energy carrier**
substance or phenomenon that can be used to produce mechanical work or heat or to operate chemical or physical processes

Note 1 to entry: For the purposes of this document, energy carriers can be electricity, fuels (fossil, biofuels, synthetic and blends), steam, heat, compressed air or other similar media, which can be purchased, stored, treated or used in a piece of equipment or in a process, or recovered.

Note 2 to entry: Where required for the quantification of *greenhouse gas activities* (3.2.6), quantities of energy carriers should be expressed in a manner that is unambiguous for subsequent calculation steps. This may be in units of volume (e.g. litre, $m^3$), mass (e.g. kg) or energy (J, kWh), or multiples thereof.

[SOURCE: ISO 52000-1:2017, 3.4.9, modified — Notes 1 and 2 to entry added.]

**3.2.3**
**energy consumption**
quantity of energy applied

Note 1 to entry: Energy consumption is a specific form of *greenhouse gas activity data* (3.2.7).

[SOURCE: ISO 50001:2018, 3.5.2, modified — Note 1 to entry added.]

**3.2.4**
**global warming potential**
**GWP**
index, based on radiative properties of *greenhouse gas (GHG)* (3.2.5), measuring the radiative forcing following a pulse emission of a unit mass of a given GHG in the present-day atmosphere integrated over a chosen time horizon, relative to that of carbon dioxide ($CO_2$)

[SOURCE: ISO 14064-1:2018, 3.1.12.]

**3.2.5**
**greenhouse gas**
**GHG**
gaseous constituent of the atmosphere, both natural and anthropogenic, that absorbs and emits radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds

Note 1 to entry: For a list of GHGs, see the latest Intergovernmental Panel on Climate Change (IPCC) Assessment Report[32].

Note 2 to entry: Water vapour and ozone are anthropogenic as well as natural GHGs but are not included as recognized GHGs due to difficulties, in most cases, in isolating the human-induced component of global warming attributable to their presence in the atmosphere.

[SOURCE: ISO 14064-1:2018, 3.1.1]

**3.2.6**
**greenhouse gas activity**
**GHG activity**
activity that results in a *GHG emission* (3.2.8)

EXAMPLE Consumption of energy, refrigerant leakage, methane slip.

**3.2.7**
**greenhouse gas activity data**
**GHG activity data**
quantitative measure of *GHG activity* (3.2.6)

[SOURCE: ISO 14064-1:2018, 3.2.1, modified — "GHG activity" replaced "activity that results in a GHG emission or GHG removal". Example deleted.]

**3.2.8**
**greenhouse gas emission**
**GHG emission**
release of a *GHG* (3.2.5) into the atmosphere

Note 1 to entry: It is expressed in mass of *carbon dioxide equivalent* (3.2.1).

Note 2 to entry: GHG emissions are categorized in this document according to their sources, as follows:

— *hub equipment energy provision GHG emissions* ($G_{HEEP}$) (3.2.8.1);

— *hub equipment operation GHG emissions* ($G_{HEO}$) (3.2.8.2);

— *packaging life cycle GHG emissions* ($G_{PL}$) (3.2.8.3);

— *vehicle energy provision GHG emissions* ($G_{VEP}$) (3.2.8.4);

— *vehicle operation GHG emissions* ($G_{VO}$) (3.2.8.5);

— *total operation GHG emissions* ($G_{TO}$) (3.2.8.6);

— *total energy provision GHG emissions* ($G_{TEP}$) (3.2.8.7);

— *total GHG emissions* ($G_T$) (3.2.8.8).

Note 3 to entry: The symbol notation within this document follows the following procedure: "$G_{X,Y}$" refers to the GHG emissions of category X ("X" being vehicle operation, hub equipment operation, etc.) for Y, where "Y" can be a *transport operation category* (3.1.29), a *hub operation category* (3.1.12), a *transport chain* (3.1.25), a *transport chain element* (3.1.26), or any set thereof.

[SOURCE: ISO 14064-1:2018, 3.1.5, modified — Notes 1, 2 and 3 to entry added.]

**3.2.8.1**
**hub equipment energy provision greenhouse gas emission**
**hub equipment energy provision GHG emission**
$G_{\text{HEEP}}$
release of a *GHG* (3.2.5) into the atmosphere during the process of producing, storing, processing and distributing an *energy carrier* (3.2.2) for *hub equipment* (3.1.10) operation

**3.2.8.2**
**hub equipment operation greenhouse gas emission**
**hub equipment operation GHG emission**
$G_{\text{HEO}}$
release of a *GHG* (3.2.5) into the atmosphere as a result of *hub equipment* (3.1.10) operation

**3.2.8.3**
**packaging life cycle greenhouse gas emission**
**packaging life cycle GHG emission**
$G_{\text{PL}}$
release of a *GHG* (3.2.5) into the atmosphere during the life cycle *processes* (3.4.3) of *packaging* (3.4.2)

**3.2.8.4**
**vehicle energy provision greenhouse gas emission**
**vehicle energy provision GHG emission**
$G_{\text{VEP}}$
release of a *GHG* (3.2.5) into the atmosphere during the process of producing, storing, processing and distributing an *energy carrier* (3.2.2) for *vehicle operation* (3.1.36)

**3.2.8.5**
**vehicle operation greenhouse gas emission**
**vehicle operation GHG emission**
$G_{\text{VO}}$
release of a *GHG* (3.2.5) into the atmosphere as a result of *vehicle operation* (3.1.36)

**3.2.8.6**
**total operation greenhouse gas emission**
**total operation GHG emission**
$G_{\text{TO}}$
sum of *GHG emissions* (3.2.8) from operational *processes* (3.4.3) included in the system boundaries

**3.2.8.7**
**total energy provision greenhouse gas emission**
**total energy provision GHG emission**
$G_{\text{TEP}}$
sum of *GHG emissions* (3.2.8) from energy provision *processes* (3.4.3) included in the system boundaries

**3.2.8.8**
**total greenhouse gas emission**
**total GHG emission**
$G_{\text{T}}$
sum of *GHG emissions* (3.2.8) from all *processes* (3.4.3) included in the system boundaries

**3.2.9**
**greenhouse gas emission factor**
**GHG emission factor**
coefficient relating *GHG activity data* (3.2.7) with the *GHG emission* (3.2.8)

[SOURCE: ISO 14064-1:2018, 3.1.7, modified — Note 1 to entry deleted.]

**3.2.10**
**greenhouse gas emission intensity**
**GHG emission intensity**
coefficient relating specified *GHG activity data* (3.2.7) with the *GHG emission* (3.2.8)

Note 1 to entry: It can be expressed as:

— mass carbon dioxide equivalent ($CO_2$e) per tonne kilometre, or equivalent units, for freight transportation;

— mass $CO_2$e per tonne for freight hub *throughput* (3.1.21);

— mass $CO_2$e per passenger kilometre, or equivalent units, for passenger transport;

— mass $CO_2$e per passenger for passenger hub throughput.

**3.2.11**
**greenhouse gas source**
**GHG source**
*process* (3.4.3) that releases a *GHG* (3.2.5) into the atmosphere

[SOURCE: ISO 14064-1:2018, 3.1.2]

## 3.3 Terms related to quantification

**3.3.1**
**allocation**
partitioning the input or output flows of a *process* (3.4.3) or product system between the product system under study and one or more other product systems

Note 1 to entry: In this document, the definition is understood as partitioning *greenhouse gas (GHG) activity* (3.2.6) or *GHG emissions* (3.2.8) related to *transport operations* (3.1.28) and *hub operations* (3.1.11) with multiple functionalities, between groups of entities (*freight* (3.1.7) and/or *passengers* (3.1.16)) carried or transferred that benefit from the same functionality.

EXAMPLE 1 For an air transport operation with an aircraft carrying both passengers and belly freight, the total GHG emissions of the transport operation can be partitioned between freight and passengers.

EXAMPLE 2 For a sea transport operation on a container ship carrying both dry and reefer containers, the GHG activity for temperature control of reefer containers can be allocated to reefer containers only.

[SOURCE: ISO 14040:2006, 3.17, modified — Note 1 to entry, Example 1 and Example 2 added.]

**3.3.2**
**class factor**
*z*
ratio based on a calculation, aiming to characterize a class of *passengers* (3.1.16) in comparison with the lowest class

**3.3.3**
**primary data**
quantified value of a *process* (3.4.3) or an activity obtained from a direct measurement or a calculation based on direct measurements

Note 1 to entry: Primary data can include *greenhouse gas (GHG) emission factors* (3.2.9) and/or *GHG activity data* (3.2.7).

[SOURCE: ISO 14067:2018, 3.1.6.1, modified — Note 1 to entry deleted. Note 2 to entry renumbered as Note 1 to entry.]

**3.3.4**
**secondary data**
data which do not fulfil the requirements for *primary data* (3.3.3)

Note 1 to entry: Secondary data can include data from databases and published literature, default *greenhouse gas emission factors* (3.2.9) from national inventories, calculated data, estimates or other representative data, and data obtained from proxy processes or estimates.

Note 2 to entry: In this document, secondary data are either *modelled data* (3.3.4.1) or *default value* (3.3.4.2).

[SOURCE: ISO 14067:2018, 3.1.6.3, modified — "greenhouse gas" and "and data obtained from proxy processes or estimates" added, and "validated by competent authorities" deleted in Note 1 to entry. Note 2 to entry replaced.]

**3.3.4.1**
**modelled data**
data established by use of a model that takes into account *primary data* (3.3.3) and/or greenhouse gas (GHG) emission-relevant parameters of a *transport operation* (3.1.28) or *hub operation* (3.1.11)

Note 1 to entry: Relevant parameters can be vehicle size, *load factor* (3.1.15), fuel type and quality, topography, speed, etc., thereby reflecting a representative value of the transport operation's *GHG emissions* (3.2.8).

**3.3.4.2**
**default value**
*secondary data* (3.3.4) value drawn from a published source

Note 1 to entry: Such values can be established by use of a model, but they will not necessarily correspond to the greenhouse gas emission-relevant parameters of the *transport operation* (3.1.28) or *hub operation* (3.1.11) being evaluated.

Note 2 to entry: See Annex Q for examples of sources for default values.

**3.3.5**
**distance adjustment factor**
**DAF**
ratio between the *actual distance* (3.1.27.1) and the *transport activity distance* (3.1.27.4), related to same origin and destination locations

EXAMPLE  Ratio between "actual distance" and "*shortest feasible distance*" (3.1.27.3).

**3.3.6**
**cut-off criteria**
specification of the amount of material or energy flow or the level of significance of *greenhouse gas (GHG) emissions* (3.2.8) associated with unit *processes* (3.4.3) or the *transport chain* (3.1.25) to be excluded from a GHG quantification

Note 1 to entry: See 5.2.3 for examples.

Note 2 to entry: "Energy flow" is defined in ISO 14040:2006, 3.13.

[SOURCE: ISO 14044:2006, 3.18, modified — "significance of greenhouse gas (GHG) emissions" has replaced "environmental significance", "the transport chain" has replaced "product system", "GHG quantification" has replaced "study". Notes to entry added.]

**3.3.7**
**passenger equivalent**
peq
unit of quantification of *freight* (3.1.7), *passengers* (3.1.16) and passenger vehicles in the case of combined *transport* (3.1.23) of freight with passengers, for which each of these entities is compared to an average passenger

**3.3.8**
**passenger of lowest class equivalent**
plceq
unit of quantification of *passengers* (3.1.16) in the case of passenger transport with different classes, for which passengers of each class are compared to a passenger in the lowest class

## 3.4 Other terms

**3.4.1**
**offsetting**
mechanism for compensating for *greenhouse gas (GHG) emissions* (3.2.8) of a *process* (3.4.3) through the prevention of the release of, reduction in, or removal of, an equivalent amount of GHG emissions in a process outside the boundary of the process system

[SOURCE: ISO 14021:2016, 3.1.12, modified — "greenhouse gas (GHG) emissions of a process" replaced "the carbon footprint of a product" and "process system" replaced "product system".]

**3.4.2**
**packaging**
materials used for the containment, protection, handling, delivery and presentation of *freight* (3.1.7)

Note 1 to entry: Packaging may be further categorized into:

— primary packaging, which is designed to come into direct contact with the product;

— secondary packaging, which is designed to contain one or more products together with any primary packaging required;

— *transport packaging* (3.4.4).

**3.4.3**
**process**
set of interrelated or interacting activities that transforms inputs into outputs

[SOURCE: ISO 14044:2006, 3.11]

**3.4.4**
**transport packaging**
tertiary packaging
distribution packaging
protective packaging
*packaging* (3.4.2) designed to contain one or more articles or packages, or bulk material, for the purposes of *transport* (3.1.23), handling and/or distribution

Note 1 to entry: Transport packaging does not include road, rail, ship and air containers.

# 4 General principles

## 4.1 General

The application of principles is fundamental to ensure that GHG-related information is a true and fair account. The principles are the basis for, and will guide the application of, the requirements in this document.

## 4.2 Relevance

Select the GHG sources, data and methodologies appropriate to the needs of the intended user.

### 4.3 Completeness

Include all relevant GHG emissions, subject to cut-off criteria, as described in 5.2.3.

### 4.4 Consistency

Enable meaningful comparisons in GHG-related information.

### 4.5 Accuracy

Reduce bias and uncertainties as far as is practical.

### 4.6 Transparency

Disclose sufficient and appropriate GHG-related information to allow intended users to make decisions with reasonable confidence.

### 4.7 Conservativeness

When assessing comparable alternatives, use a selection of data that is cautiously moderate.

## 5 Quantification principles

### 5.1 General

The requirements as outlined below determine the approach set out in the subsequent clauses of this document:

— The methodology for calculating GHG emissions shall be substantively similar for each transport mode or hub across passenger and freight operations.

— All GHG emissions resulting from transport chain operation shall be treated equally, irrespective of the energy carrier used.

— All GHG emissions shall be assigned across the passengers and/or freight carried or transferred.

— In cases of unavoidable divergence, the sum of calculated GHG emissions shall not be less than the total GHG emissions calculated.

In cases where national or international legislative bodies stipulate the use of a specific quantification methodology that takes precedence over this document, the processes of the legislative approach shall be clearly documented.

Annexes A to H include further specifications that shall be followed for transport modes (air, cable car, inland waterway, pipeline, rail, road, sea) and hubs, respectively. Reference values for GHG emission factors are presented in Annex K together with guidance on their production in Annex J.

### 5.2 System boundaries

#### 5.2.1 Transport operations and hub operations included

The quantification of GHG emissions shall include all transport operations by the following modes and means, as well as the hub operations that precede, follow or link them together (see Figure 1 and Figure 2 for illustrative examples):

— air transport;

— cable car transport;

— inland waterway transport;

— pipeline transport;

— rail transport;

— road transport;

— sea transport.

Transport of passengers by lift, escalator, conveyor belt, moving walkway, etc. and transport of freight by forklift, pallet truck, etc. shall be part of hub operations.

### 5.2.2 Processes included

The quantification of GHG emissions of a transport chain shall include the following processes, which produce GHG by combustion or by leakage, regardless which organization operates them:

— vehicle operational processes;

— hub equipment operational processes;

— vehicle energy provision processes;

— hub equipment energy provision processes;

— loaded and empty trips made by vehicle, hence including diversionary and/or out-of-route distance;

— start-up and idling of vehicles, pipelines, transhipment and (de)boarding equipment;

— cleaning/flushing operations for pipelines;

— combustion and/or leakage of energy carriers at vehicle or hub equipment level;

— leakage of refrigerants used by vehicles or hubs.

EXAMPLE 1 For the following vehicles using two different energy carriers, both energy carriers are taken into account for the calculation: road vehicle using liquefied petroleum gas (LPG) and gasoline, road vehicle using electricity (plug in) and gasoline, ship using heavy fuel oil (HFO) and marine diesel oil (MDO).

The vehicle operational processes shall include operation of all on-board vehicle systems including propulsion and auxiliary processes.

EXAMPLE 2 Main engines, auxiliary equipment used to maintain the temperature and/or functionality of the freight and/or passenger space are on-board devices used to facilitate loading or unloading of the vehicle.

NOTE Auxiliary units also include those used to power refrigerated containers when not connected to the primary vehicle energy source or grid; e.g. chassis generators.

Hub operational processes shall include operation of all handling, on-site transportation, transhipment and (dis)embarking equipment and facilities, including heating and temperature control.

Through the use of recommended or best available (e.g. national) GHG emission factors, the energy operational processes shall include the following:

— For solid, liquid and gaseous energy carriers: Production and dismantling of energy source infrastructure, e.g. power plant manufacture, extraction or cultivation of primary energy, chemical processing, transport and distribution (including pipeline) of energy at all steps of the production of the energy carrier used.

— For electricity: Extraction, processing and transport of primary energy, power generation, power generation infrastructure, e.g. solar panel or wind turbine manufacture, grid losses associated with transmission and distribution of electricity.

Where best available GHG emission factors do not include production and dismantling of energy source infrastructure this shall be noted in the reporting, (see Clause 13), in accordance with the cut-off criteria guidance in 5.2.3.

### 5.2.3 Application of cut-off criteria

In general, all processes and flows that are attributable to the analysed system shall be included.

The omission of processes, inputs or outputs from the calculation are not permitted as a general rule. Any decisions to omit processes, activities, inputs or outputs shall be clearly stated; the reasons for and implications of their omission shall be explained. Reference to the use of cut off criteria shall be made if relevant.

Application of cut-off criteria to a given transport chain can rely on the following three possible quantifications:

a) Transport activity: inclusion in the study of all inputs that cumulatively contribute more than a defined percentage of the transport activity within the transport chain.

b) Energy: inclusion in the study of all inputs that cumulatively contribute more than a defined percentage of the transport activity within the transport chain.

c) Environmental significance: inclusion of all GHG sources that cumulatively contribute more than a defined percentage of the GHG emissions of the transport chain.

NOTE This percentage can be specified by national regulations.

### 5.2.4 Processes not included

The quantification of GHG emissions of a transport chain shall not include, in particular:

— production and supply processes of refrigerants;

— waste produced;

— processes at the administrative (overhead) level of the organizations involved in the transport services;

— processes for the construction (e.g. embedded GHG emissions associated with vehicle production), maintenance, and scrapping of vehicles or transhipment and (de)boarding equipment;

— processes of construction, service, maintenance, and dismantling of transport infrastructures used by vehicles (e.g. roads, inland waterways, rail infrastructure) or transhipment and (de)boarding infrastructure;

— businesses co-located within a hub such as retail and hospitality services, whose functions are severable and incidental to the transportation operation of the hub.

### 5.2.5 Optional processes

The annexes include specifications for optional elements that can be quantified in addition to the core elements of the GHG calculation. Where these optional elements are calculated, this shall be clearly stated. Guidance regarding the use of default GHG emission intensities is provided for reference purposes in Annex Q.

The following processes may be included in the calculation:

— storage of freight at hubs, such as warehousing;

— use of information and communications technology (ICT) equipment and data servers related to transport and/or hub operations (see Annex N);

— (re)packing (see Annex O).

### 5.2.6 Optional quantification of black carbon emissions from transport operations

In addition to the quantification of GHG emissions, the user may estimate black carbon emissions from transport operations (see Annex P).

### 5.2.7 Carbon offsetting and GHG emissions trading

Outcomes from carbon offsetting actions or GHG emissions trading (e.g. under the European Union Emissions Trading System (EU ETS)[31]) shall not be taken into account for quantification and reporting of GHG emissions from transport operations.

## 5.3 Conversion of energy carrier data into GHG emissions

### 5.3.1 General

Quantification of the conversion of energy carriers (used to power transport operations and associated auxiliary processes or to facilitate hub operations) into GHG emissions shall be done using the corresponding GHG emission factor, expressed as the mass of $CO_2$ equivalent per amount of energy carrier consumed. Annex J provides requirements and guidance on GHG emission factors.

NOTE Annex R provides a table that shows the relationship between the GHG emission scopes used in the GHG Protocol[16] and the categorization of GHG emissions as used in this document.

### 5.3.2 Global warming potential

For the release of GHGs to the atmosphere, the global warming potential (GWP) acts as the conversion factor from the mass of gas released to the mass of $CO_2$ equivalent.

The source of the GHG factors shall be clearly stated and used consistently. The IPCC's latest GWP with a 100 year perspective (not including climate-carbon feedback) should be used.[34] Any deviation should be explained.

## 5.4 Calculation of transport activity

### 5.4.1 Passenger transport

The transport activity for passenger transportation shall be the number of passengers multiplied by the transport activity distance. The quantity of passengers shall account for all individual passengers carried per transport operation plus their baggage.

NOTE For non-commercial transport (e.g. driving an owned vehicle or self-drive hire), the driver and any persons participating in the operation of the vehicle are included in the quantity of passengers. For commercial transport (e.g. taxis, trucks, trains), these people are not included in the quantity of passengers.

The transport activity distance shall be either the shortest feasible distance (SFD) or the great circle distance (GCD). In situations where the transport activity distance travelled by each passenger is unknown, passenger transport activity can be calculated by multiplying the number of passengers by the mean actual distance travelled by passengers on journeys included within this transport operation category (TOC).

The standard unit for expressing distance shall be the kilometre (km). Where alternative systems are in use (e.g. miles or nautical miles), these units may be used.

### 5.4.2 Freight transport

The transport activity for freight transportation shall be the quantity of freight multiplied by the transport activity distance.

The quantity of freight shall be the actual freight mass. The standard unit for expressing units of mass (e.g. quantities of freight) shall be kg or metric tons (1 000 kg or tonnes). Where alternative systems are in use (e.g. pounds and tons) these units may be used as long as this is unambiguously signalled.

NOTE 1 The phrase “ton” is commonly and incorrectly used to denote 1 000 kg, a mistake that can lead to systematic inaccuracies in calculation and reporting. The correct phrases for 1 000 kg are tonne or metric ton.

In specific circumstances (post and parcels operations and containerized transport) alternatives to the standard units for the quantity of freight may be used. If such a choice is made, it shall be clearly documented.

NOTE 2 In these circumstances any references to tonne kilometres in the text of this document can be considered as twenty-foot equivalent unit (TEU) kilometres or item kilometres as appropriate for calculation purposes unless indicated otherwise.

For post and parcel operations, where knowledge of individual items is limited, the quantity of freight may be the number of items.

For container transport, the quantity of freight may be the number of freight number of TEUs. Where such a choice is made, the mass of freight should be calculated using the actual mass of freight per TEU, if known, or otherwise using an average mass per TEU. Any such choice should be justified and documented.

NOTE 3 Alternate container types and sizes exist, e.g. one standard 40-foot ISO Series container is equivalent to two TEUs; one ISO Series 45-foot container is equivalent to 2,25 TEUs; one high cube 40-foot container is equivalent to 2,25 TEUs.

Where the actual mass of freight per TEU is not known, a standard conversion factor of 10 tonnes per TEU may be used (so 20 tonnes for a 40-foot container). Alternatively, a value of 6 tonnes may be used for lightweight cargo or 14,5 tonnes for heavyweight cargo if the use of these categories can be justified.

The quantity of freight shall include the mass of the packaging initially provided by the organization responsible for sending a consignment, and shall not include any additional transport packaging, pallets or containers used by the transport operator specific to the transport operation in question.

In cases of slurry pipelines, the mass of freight shall not include the transport medium (e.g. water).

The transport activity distance shall be either the SFD or the GCD. In cases where the transport operator does not have access to the SFD or the GCD, the actual distance and a distance adjustment factor (DAF), as described in 5.4.4 and 10.4, should be used.

The specific case of the transport activity distance for collection and delivery rounds is described in F.4.2.

NOTE 4 Those who are inexperienced in calculating transport activity can easily make a mistake. The result of multiplying the total mass of all consignments by the total transport distance travelled by all the consignments is a significant over-estimate of the transport activity. The result of multiplying the average mass of all consignments by the average transport distance travelled by all the consignments can introduce a significant error in the estimation of the transport activity. See GLEC Framework,[15] for further information.

The standard unit for expressing distance shall be the kilometre (km). Where alternative systems are in use (e.g. miles or nautical miles), these units may be used.

#### 5.4.3 Combined transport of freight and passengers (including passenger vehicles)

The transport activity for combined transport of freight and passengers (including passenger vehicles where appropriate) shall be the quantity of freight and passengers multiplied by the transport activity distance.

Two options can be required when considering the quantity of freight and passengers for combined transport of freight and passengers. The first option can be used both for allocation and for the calculation of GHG emission intensity. The second option may only be used for allocation in situations where the data needed to apply the first option is not available.

In the first option:

— the quantity of passengers shall be the total passenger mass (as defined in 8.4.7);

— the quantity of passenger vehicles shall be the mass of these vehicles;

— the quantity of freight shall be the actual freight mass.

In the second option:

— each passenger is counted as one passenger equivalent;

— the quantity of passenger vehicles shall be the number of passenger equivalents of these vehicles (guidance on passenger-equivalent values for different types of passenger vehicles is provided in Annexes E and G);

— the quantity of freight shall be the number of passenger equivalents (guidance on passenger-equivalent values for freight transport is provided in Annexes E and G).

The quantity of passengers shall account for all individual passengers carried per transport operation plus their baggage.

The quantity of freight shall include the mass of the packaging initially provided by the organization responsible for sending a consignment, and shall not include any additional transport packaging, pallets or containers used by the transport operator specific to the transport operation in question.

The transport activity distance shall be either the SFD or the GCD. In cases where the transport operator does not have access to the SFD or the GCD, the actual distance and a DAF, as described in 5.4.4 and 10.4, should be used.

#### 5.4.4 Use of distance adjustment factor

A DAF shall be used each time the actual distance is used in the calculation of transport activity. The DAF is used by multiplication of the actual distance by a specific DAF value.

The DAF serves to increase the transport activity distance used in the calculation of GHGs to allow for systematic differences between the actual distance and the SFD or the GCD.

Recommended values of the DAF are provided for different modes in Annexes A to G.

NOTE In cases where the actual distance and the transport activity distance correspond, the DAF can equal 1.

### 5.5 Calculation of hub activity

#### 5.5.1 Passenger hub

The hub activity for passenger shall be the number of passengers.

### 5.5.2 Freight hub

The hub activity for freight shall be the quantity of freight (outbound). In specific circumstances, alternative units for the quantity of freight may be used in addition to the standard units.

EXAMPLE For maritime container hubs, the number of containers or the number of TEUs.

The quantity of freight shall include the mass of the packaging initially provided by the organization responsible for sending a consignment, and shall not include any additional transport packaging, pallets or containers used by the transport operator specific to the transport operation in question.

### 5.5.3 Combined freight and passenger hub (including passenger vehicles)

The hub activity for combined freight and passenger hubs (including passenger vehicles where appropriate) shall be the quantity of passengers and the quantity of freight (outbound).

The quantity of passengers shall account for all individual passengers plus their baggage. The quantity of passengers shall be the total passenger mass (first option) or the number of passenger equivalents (second option).

With the second option, each passenger is counted as one passenger equivalent.

The quantity of passenger vehicles shall be either the mass of these vehicles (first option) or the number of passenger equivalents (second option).

If a value for total mass of these vehicles is not available, the second option should be used. Passenger-equivalent values for different types of passenger vehicles are provided in Annexes E and G.

The quantity of freight shall be either the actual freight mass (first option) or the number of passenger equivalents (second option). Guidance on passenger-equivalent values for freight transport is provided in Annexes A, E and G.

The quantity of freight shall include the mass of the packaging initially provided by the organization responsible for sending a consignment, and shall not include any additional transport packaging, pallets or containers used by the transport operator specific to the transport operation in question.

## 5.6 Allocation

### 5.6.1 General

Allocation may be implemented when multiple functionalities are fulfilled by the same vehicle or hub, and all passengers and/or freight carried do not benefit equally.

Wherever possible, allocation should be avoided by dividing the process to be allocated into two or more sub-processes and collecting the input and output data related to these sub-processes.

In circumstances where it is required, allocation shall partition GHG sources or GHG emissions between the freight and/or passengers that benefit equally from the same functionality.

The implementation of the partitioning between these groups shall consider the different needs of GHG sources and the different GHG emissions resulting from these needs.

EXAMPLE Within a truck carrying ambient and refrigerated freight, the energy consumption for cooling and the leakage of refrigerants are partitioned between these two groups with consideration of this difference of temperature.

The transport or hub activity of each group may be used for this partitioning, but other criteria and parameters can be necessary. Once set, the allocation parameter used within a given TOC or hub operation category (HOC) shall remain constant.

### 5.6.2 Allocation between passengers and freight

For combined transport of passengers (including their vehicles where appropriate) and freight, the transport or hub activity should be used for allocation, in combination with the passenger-equivalent unit.

### 5.6.3 Allocation between passengers of different travel classes

For transport of passengers with different classes, the transport or hub activity should be used for allocation, in combination with the passenger of lowest class equivalent unit.

### 5.6.4 Allocation between ambient and temperature-controlled freight

For freight with different temperature conditions, the GHG activity data related to temperature control for each group of temperature conditions should be collected and used for allocation, when such association of data per group is feasible. If not, the transport or hub activity shall be used for allocation, each entity of freight being quantified with a unit of equivalence based on ambient freight.

# 6 General principles related to transport chains, transport chain elements, transport operation categories and hub operation categories

## 6.1 Transport chains and TCEs

As set out in Clause 5, for the purposes of GHG quantification, the transport chain shall be broken down into the discrete, sequential TCEs that reflect the related vehicle types, pipelines or hubs that carry, handle or transfer the freight and/or the passengers as part of the whole transport chain.

EXAMPLE 1 When a passenger first travels by bus, then by metro and finally using a second bus, with the same ticket, the corresponding transport chain is composed of five elements, including the intermediate hubs such as bus or metro stations.

EXAMPLE 2 When a passenger first travels by local bus and then by long-distance bus, then the corresponding transport chain is composed of either two or three elements, depending on whether there is a hub (bus station) at the point of transfer between buses.

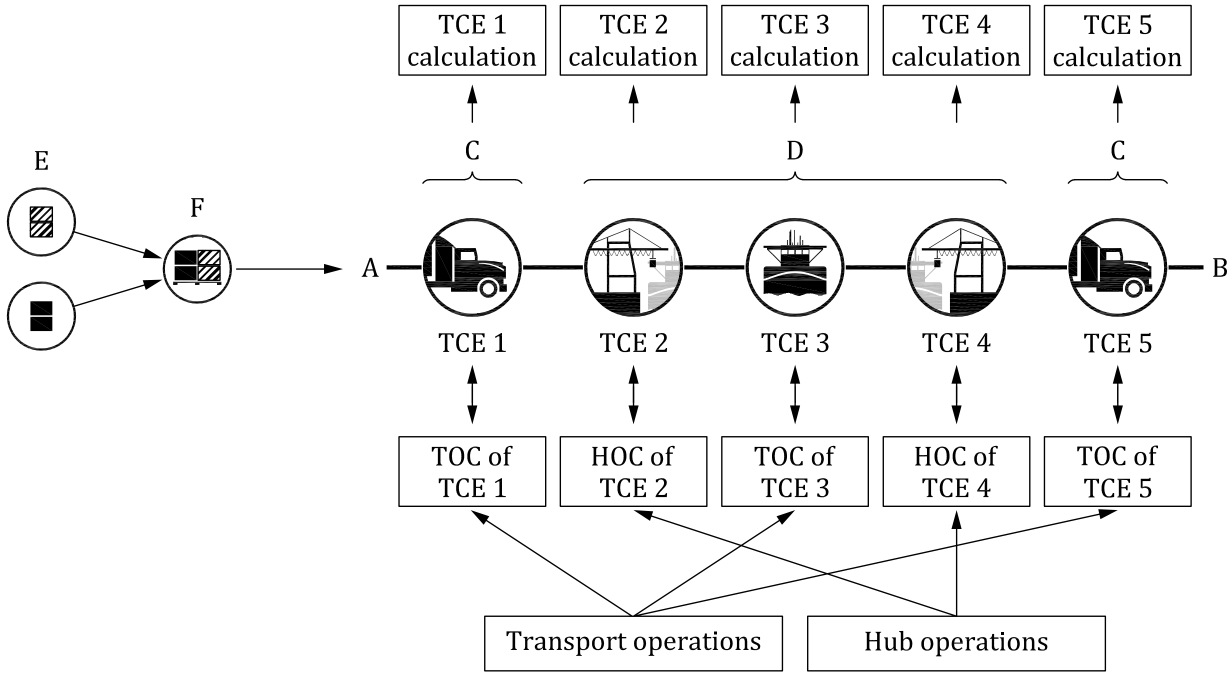
EXAMPLE 3 When a shipment first travels by truck, then is cleared and handled for export at the airport, flown to a different country, cleared and handled for import at the airport, transported by train, reloaded and handled, and finally brought by truck to its final destination, the corresponding transport chain is composed of seven elements, including the intermediate hubs such as airport handling terminals and the logistics hub at the interface rail/truck.

## 6.2 Transport operations and hub operations related to TCEs

Each TCE shall be related to a corresponding transport operation or hub operation, which is the operation of the vehicle(s) or the hub (s) for this TCE.

The relationship between TCEs, transport operations and hub operations is illustrated in Figure 4 for freight transportation and in Figure 5 for a passenger transport chain.




**Key**

A cargo consignor

B cargo consignee

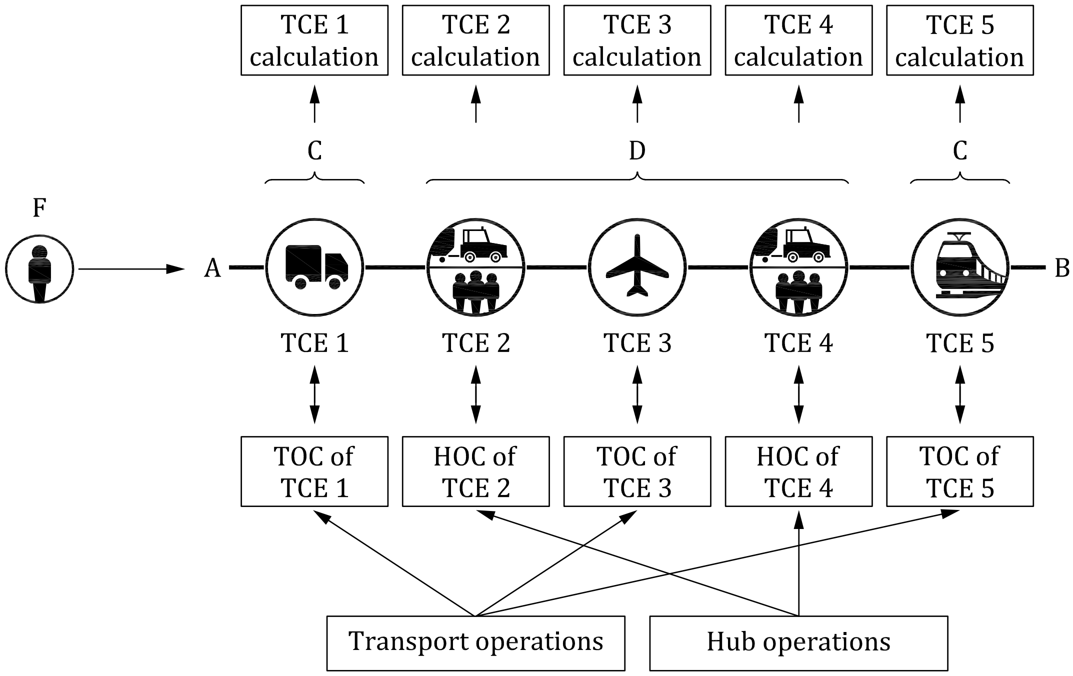
C road services

D maritime shipping service

E shipment

F consignment

**Figure 4 — Diagrammatic relationship between operations and TCEs for an example freight transport chain**




**Key**

A origin

B destination

C private car

D air travel service

F passenger

**Figure 5 — Diagrammatic relationship between operations and TCEs for an example passenger transport chain**

## 6.3 Transport operation categories and hub operation categories

### 6.3.1 General

Any single transport operation or hub operation shall always be considered in the context of the overall system in which it takes place. The concept of a TOC or a HOC, as a group of operations sharing similar characteristics, in a defined time period (up to one year), is the key reference point for the calculation of the GHG emissions of a TCE. The characteristics of each TOC/HOC shall reflect the combined characteristics of the transport mode, hub type and the freight/passengers, as required to meet the relevant contractual agreement.

### 6.3.2 Transport operation categories

#### 6.3.2.1 Categorization of transport operations into TOCs

When defining the characteristics of a TOC, consideration shall be given to factors that affect the scale and composition of the TOC, for example:

— number and type of vehicles, or length and type (diameter) of pipeline, to be included in the TOC;

— nature and consistency of the vehicle or pipeline operations included;

— any processes associated with maintaining the condition of the freight (e.g. temperature control);

— (freight transport only) nature of the freight carried;

— period of activity of the vehicles or pipelines in the TOC.

Annexes A to G provide further examples of how such characteristics can be combined to establish TOCs.

TOCs can have different levels of granularity, for example:

— TOC of a single vehicle on a single journey or specific schedule;

— TOC of a single vehicle in multiple schedules/trade lanes, based on network/trade lane characteristics;

— TOC of a specific vehicle type in a single schedule;

— TOC of a specific vehicle type in multiple schedules/trade lanes;

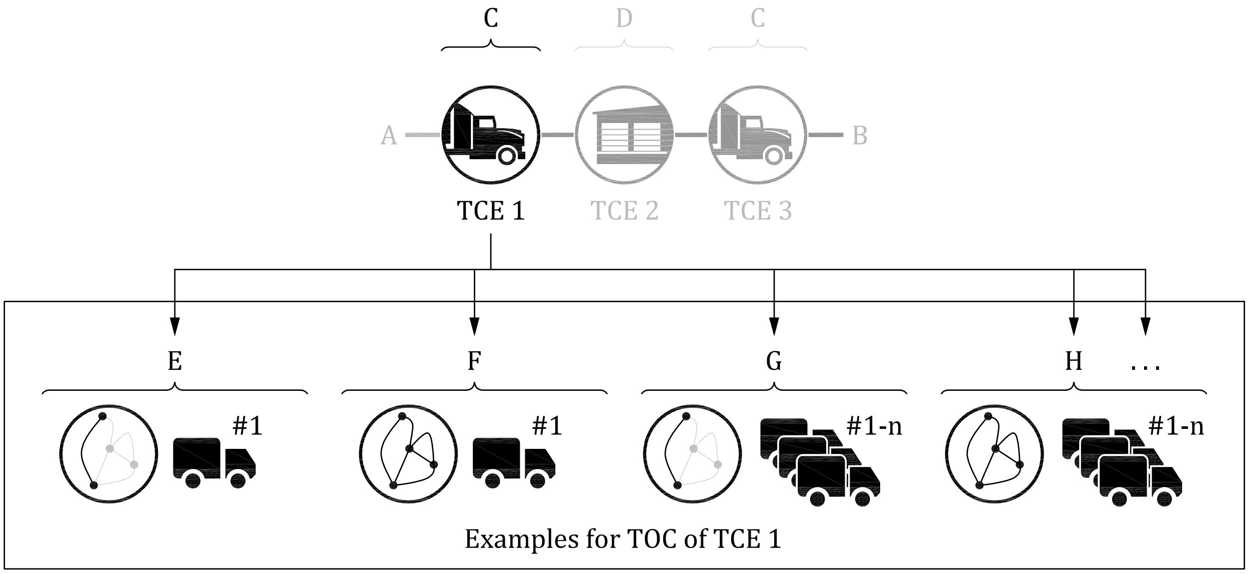
— TOC of a specified group of vehicles in a single schedule;

— TOC of a specified group of vehicles in multiple schedules/trade lanes.

A TOC shall fully include each transport operation, meaning that a transport operation shall not be split between two TOCs, even if this relates to two TCEs (e.g. a TCE for passengers and a TCE for freight) carried by the same vehicle.

A single TOC can include transport operations with vehicles using different energy carriers for propulsion, e.g. a container line operator uses vessels, some powered by MDO and some powered by liquefied natural gas (LNG), interchangeably on a given trade lane.

Figure 6 provides examples to establish TOCs for an example transport chain of freight from the origin (A, cargo consignor) to the destination (B, consignee). The first and last transport chain element (TCE 1, 3) represent road services C, TCE 2 represents hub operation (D). In this step, the user shall establish a relevant TOC for TCE 1, e.g. a single vehicle in a single schedule E or in a multiple schedule (F), a specific vehicle type in single schedule (G) or in a multiple schedule (H), etc.




**Key**

A cargo consignor

B consignee

C road services

D hub operation

E single schedule

F multiple schedules

G specific vehicle type in single schedule

H specified group of vehicles in multiple schedules

**Figure 6 — Diagrammatic relationship between operations and TCEs for an example freight transport chain**

Transport operations which constitute a TOC should include entire round trips made by the vehicles in order to balance out GHG emissions within asymmetric transport flows. Hence, any GHG emission calculation performed by the user of a transport service cannot be performed in isolation from knowledge of the TOC. The calculation shall be based on information provided by the transport or hub operator or transport service organizer or the appropriate default values that takes into consideration all defining characteristics of the TOC.

An exception to this is when a vehicle or vessel is chartered to perform a one-way journey that can be specifically identified within both the transport operator's and transport purchaser's systems. Pipelines are another exception due to the fixed nature of the infrastructure.

NOTE 1 A roundtrip does not require an immediate return to the point of origin. It can be a group of sequential journeys that start and finish in the same place. For a train, that can be its depot at start and end of the day.

NOTE 2 Pipeline TOCs are not concerned by this recommendation, as their transport operations are not performed by moving vehicles.

For the benefit of specific investigations and analysis, the TOC can be limited to the transport operation itself and taken individually.

EXAMPLE 1 A transport user needing to quantify the effect (on load factor, energy consumption and finally GHG emissions) of different palletizations of their products, between their factory and their distribution centre, for a full-truck load.

The TOC should include loaded trips (possibly with varying loading levels) and all the empty trips related to them. Hence, the GHG emissions for a single transport or hub operation cannot be calculated without reference to the TOC or HOC in which it takes place. This means, for example, the GHG emissions from point A to point B for a full truckload truck cannot be calculated without taking into consideration the movements and transport operations of this truck before A and after B that make a complete match to the TOC definition. It is therefore crucial to create transparency on the TOC definition and its level of granularity.

Where empty containers, roll cages or pallets are transported on behalf of a purchaser of transport services for the purpose of relocation in order to move a new load they become a consignment in their own right and GHG emissions should be assigned to them accordingly. In cases where these GHG emissions cannot be assigned to a specific purchaser or transport service, GHG emissions shall be allocated to the network.

NOTE 3 The approaches to inclusion of empty trips and round-trip characteristics depend on the level of detail used to specify the TOC.

NOTE 4 If the fleet and the operation types are homogeneous, then the whole activity of the fleet of a transport operator over one year can be the TOC for all operations performed by this fleet.

Different processes, among those listed in 5.2.2, can be distinguished within a single movement of a vehicle, in circumstances where they are dedicated to only a part of freight and/or passengers. A single TOC can include transport operations with different categories of freight or passengers in terms of requirements, such as temperature control for freight or classes for passengers.

EXAMPLE 2 If a container ship carries both ambient (“dry”) containers and temperature-controlled (“reefer”) containers, the operation of this container ship is included in a single TOC. Different GHG emission intensities are established within the TOC for the ambient and temperature-controlled consignments to reflect the additional energy consumption of the temperature control processes.

To implement the next steps of the calculation, each TOC shall be identified as part of one of the following types:

— TOC of passengers only (general case);

— TOC of freight only (general case);

— TOC of passengers only with multi-classes vehicles;

— TOC of freight only with multi-temperature vehicles;

— TOC of vehicles with passengers, passenger vehicles and freight;

— TOC of any other case.

#### 6.3.2.2 Associating a TOC with a transport operation

Each transport operation shall be associated with an existing TOC.

### 6.3.3 Hub operation categories

#### 6.3.3.1 Categorization of hub operations into HOCs

When defining the parameters of a HOC, consideration shall be given to factors that affect the scale and composition and characteristics of the HOC such as:

— number and type of hub operations contributing to the HOC;

— for freight: e.g. handling of freight, (un-) loading, (de-) boarding, transport on-site;

— for passenger: e.g. transfer on-site, (de-)boarding equipment, handling of luggage;

— nature and consistency of the hub operations included in the HOC (e.g. electrified or non-electrified);

— inbound and outbound transport mode and relevance of intermodal change;

— any processes essential for maintaining the condition of the freight or ensuring passenger health and safety;

— for freight: e.g. temperature control, repacking (see Annex O);

— for passenger: e.g. air conditioning;

— for freight: nature of the freight handled (e.g. palletized, containerized, piece good).

HOCs can have different levels of granularity, for example:

— HOC of a single hub;

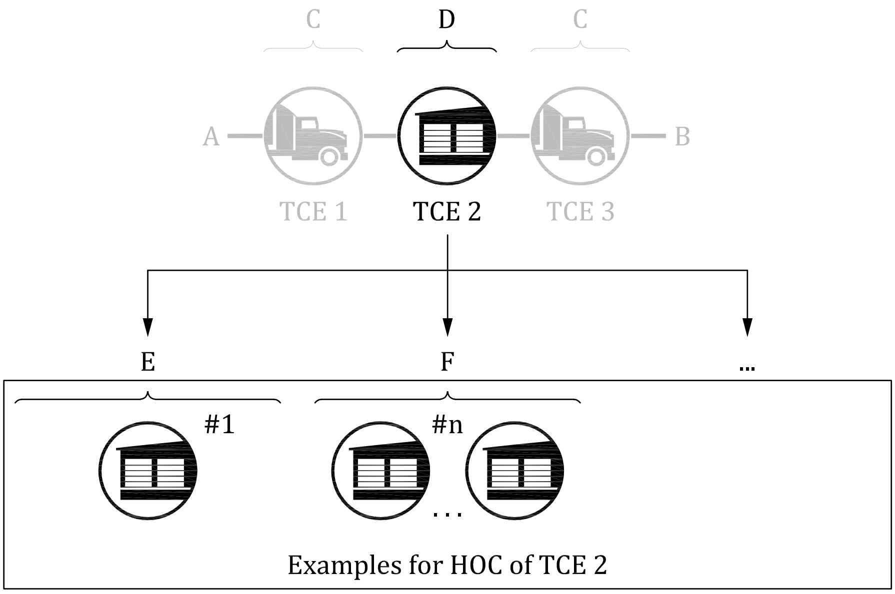
— HOC of a specific hub type.

A HOC may include freight and passengers, mainly when they transit via the same hub.

A HOC shall fully include each hub operation, meaning that a hub operation shall not be split between two HOCs, even if this operation simultaneously benefits different TCEs (e.g. TCEs for passengers and freight, TCEs for ambient and temperature-controlled freight).

A hub may perform different hub operations that form part of different HOCs.

Figure 7 provides examples to establish HOCs for an example transport chain of freight from the origin (A, cargo consignor) to the destination (B, consignee). The first and last transport chain element (TCE 1, 3) represent road services C, TCE 2 represents hub operation (D). In this step, the user shall establish a relevant HOC for TCE 2, e.g. a single hub E or various hubs (F) within a network, etc.




**Key**

A cargo consignor
B consignee
C road services
D hub operation
E single hub
F multiple hubs on one hub type

**Figure 7 — Example transport chain of freight highlighting the potential HOC definitions**

#### 6.3.3.2 Associating a HOC with a hub operation

Each hub operation shall be associated with an existing HOC.

# 7 Quantification actions

## 7.1 General

The implementation of GHG emission quantification can rely on the involvement of different stakeholders and complementary inputs and calculations following several steps, as shown in Figure 8 and then detailed in 7.2 to 7.4.

a) Each transport chain shall be broken down into TCEs.

b) Each TCE shall be related to a transport or hub operation.

c) Each transport or hub operation shall be related to a TOC or HOC. The TOC or HOC shall gather operations sharing similar characteristics, implemented over a defined period. This period should be one year or less.

d) A GHG emission intensity (in some cases, several GHG emission intensities) shall be established or selected for each TOC or HOC.

e) Then the GHG emissions of each TCE shall be calculated based on the corresponding GHG emission intensity and the transport or hub activity of this TCE.

f) Finally, the GHG emissions of the transport chain shall be the sum of the GHG emissions of its TCEs.

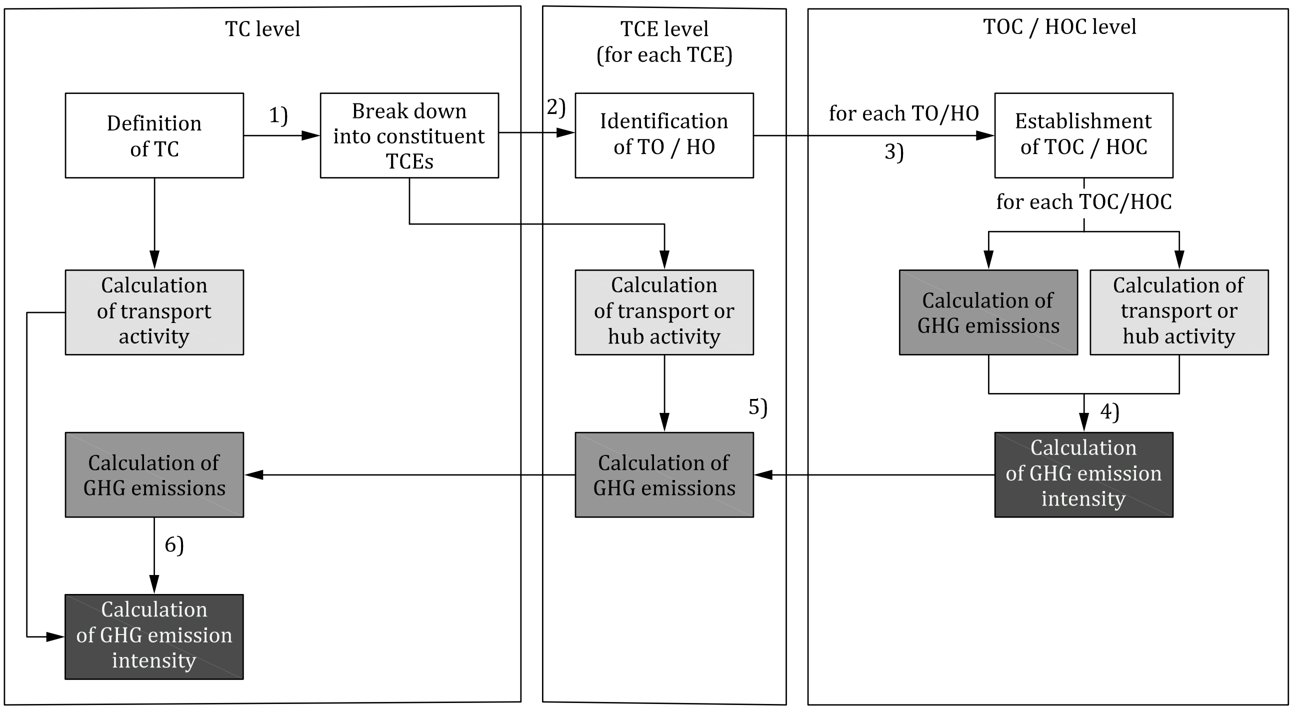



**Figure 8 — GHG emission calculation steps for a transport chain**

## 7.2 Establishment of GHG emission intensity of a TOC or a HOC

### 7.2.1 General

GHG emission intensities of TOCs and HOCs shall be established using one of the four following options:

— calculation with primary data (option A) (see 7.2.3);

— calculation with a model (option B) (see 7.2.4);

— selection of a value from a database of default values (option C) (see 7.2.5);

— collection of a value from a contracted operator that has used option A or B (option D) (see 7.2.6).

NOTE GHG emission intensities can be based on a mix of data sources that combine primary data, modelled data and default values, sometimes making it difficult to clearly distinguish the categories.

### 7.2.2 Selection of the option

Data specific to the transport chain for which GHG emissions are being quantified shall be collected and used for the calculation. The data shall be representative of the processes for which they are collected.

A transport or hub operator should apply option A for all its transport or hub operations.

Option A may also be applied by any other user if the information and data required are available to them. If not, the user should select the option in which they are most confident regarding the accuracy of the outcome.

The values for total GHG activity, the related transport or hub activity, and derived GHG emission intensity shall be prioritized as follows to reflect the level of data access within the transport chain reporting:

— Primary data shall be used. Where this is not available, secondary data may be used. The reasons for using secondary data shall be justified and documented.

— Where secondary data are used, modelled data shall be prioritized over default data.

Commonly combinations of primary and secondary data are needed and used.

Getting the lowest possible value of GHG emission intensity shall not be a criterion for this selection.

### 7.2.3 Calculation with primary data (option A)

The following steps shall be followed:

— Step 1: Identify all the transport and hub operations performed and related to GHG emissions quantification needs.

— Step 2: Establish the TOCs and HOCs related to these transport and hub operations.

— Step 3, for the operations associated with each TOC and HOC:

  — Identify and quantify GHG activity data from all GHG sources (quantity of fuel consumed, refrigerant leakage, etc.) and convert them to GHG emissions.

  — Add these GHG emissions from all GHG sources to obtain GHG emissions for the TOC/HOC.

  — Calculate the corresponding transport or hub activity for the TOC/HOC.

  — Calculate the GHG emission intensity for the TOC/HOC.

NOTE These steps are detailed in Clause 8 for TOCS and Clause 9 for HOCs.

#### 7.2.4 Calculation with a model (option B)

The general guidance given in Annex M may be followed for the calculation of a GHG emission intensity using a model.

#### 7.2.5 Selection of a value from a database of default values (option C)

In cases where there is a need to use default GHG emission intensities, these should be sourced in accordance with guidance given in Annex Q using the closest match between the default GHG emission intensity classification and the characteristics of the TOC or HOC in question. If no clear match exists between the default GHG emission intensity classification and the characteristics of the TOC or HOC, then the sources used to fill this gap, and the reasons for this choice, shall be fully documented.

#### 7.2.6 Collection of a value from a contracted operator (option D)

A GHG emission intensity may be collected from a contracted operator that has used option A or B to establish this value.

### 7.3 Calculation of GHG emissions for a TCE

The following steps shall be followed:

— Step 1: Identify the transport or hub operation related to this TCE.

— Step 2: Select a TOC or HOC GHG emission intensity corresponding to this operation.

— Step 3: Calculate the transport or hub activity of the TCE.

— Step 4: Calculate the GHG emissions of the TCE using transport or hub activity, the selected GHG emission intensity and, for transport, a DAF.

### 7.4 Calculation of GHG emissions for a transport chain

The following steps shall be followed:

— Step 1: Break down the transport chain into its constituent TCEs.

— Step 2: Calculate the sum of GHG emissions of all TCEs of the transport chain.

— Step 3: Calculate the sum of transport activity of all TCEs of the transport chain.

— Step 4: Calculate the GHG emission intensity of the transport chain, with GHG emissions (result of step 2) and transport activity (result of step 3).

## 8 Quantification actions at the TOC level

### 8.1 General

This clause sets out the quantification actions for each TOC.

The actions set out in 8.2, 8.3 and 8.4 shall be carried out by transport operators to quantify the GHG emissions and the transport activity related to all TOCs that comprise their overall transport operations. The results from 8.3 and 8.4 shall be combined at the TOC level to calculate the GHG emission intensity for each TOC (see 8.5).

NOTE Different cases are presented, depending on the TOC being only freight or only passengers, or both, and with or without different conditions for freight (temperature) and/or for passengers (classes, accompanied vehicles).

## 8.2 Quantification of the GHG activity data of a TOC

GHG activity data shall encompass all GHG sources of the TOC, and therefore shall consist of the total consumption of each energy carrier and refrigerant used, as well as any other quantified GHG activity data relevant to the transport operations of the TOC.

In situations where the GHG activity data results from the use of different GHG sources (energy carriers or leakage of refrigerants), GHG activity data shall be quantified separately for each GHG source (energy carrier and refrigerant).

In situations where a GHG source is related to a specific group of passengers or freight within the TOC, the corresponding GHG activity data shall be quantified separately for this group. The sum of the GHG activity data of each GHG source and each TOC shall equal the transport GHG activity data for this GHG source for the overall operation of transport operator.

If refrigerants are refilled at hubs (e.g. refill losses at vehicle or load unit level such as reefer containers), the relevant amount of GHG activity data shall be included within the calculation of the corresponding TOC in accordance with Annex I.

## 8.3 Calculation of GHG emissions of a TOC

### 8.3.1 General

This step shall distinguish the following two situations:

— No allocation needed: when each vehicle operating in the TOC does not include both passengers and freight, and provides the same functionalities to all passengers or all consignments carried, all GHG emissions within the TOC shall be added.

— Allocation needed: when the vehicles of the TOC provide different functionalities (carrying both passengers or freight, and/or providing different functionalities to different groups of passengers or freight), the corresponding GHG emissions shall be calculated for each group.

EXAMPLE Allocation can be needed in the maritime transport of containers when container ships carry both dry and reefer containers, since the use of refrigerants and energy for temperature control benefit only reefer containers, whereas propulsion of the ships benefit all containers.

### 8.3.2 No allocation needed

This subclause shall be applied when no allocation is needed for the calculation of GHG emissions of the TOC in accordance with 8.3.1.

Conversion of GHG activity data into vehicle operation and energy provision GHG emissions shall be conducted using Formulae (1) and (2) for each type of GHG activity $\mathrm{A}_i$:

$$G_{\mathrm{VO,TOC,A}_i} = Q_{\mathrm{TOC,A}_i} \times \varepsilon_{\mathrm{VO,A}_i} \tag{1}$$

$$G_{\mathrm{VEP,TOC,A}_i} = Q_{\mathrm{TOC,A}_i} \times \varepsilon_{\mathrm{VEP,A}_i} \tag{2}$$

where

| | |
|---|---|
| $G_{\mathrm{VO,TOC,A}_i}$ | is the vehicle operation GHG emissions of the TOC for GHG activity type $\mathrm{A}_i$; |
| $Q_{\mathrm{TOC,A}_i}$ | is the quantity of GHG activity type $\mathrm{A}_i$ for the TOC (e.g. $\mathrm{A}_i$ is combustion of diesel fuel and $Q_{\mathrm{diesel}}$ equals 12 000 kg of diesel or $\mathrm{A}_i$ is leakage of refrigerant R-134a and $Q_{\mathrm{R\text{-}134a}}$ equals 100 kg of the refrigerant R-134a); |

$\varepsilon_{\mathrm{VO,A}_i}$ is the vehicle operation GHG emission factor for GHG activity type $A_i$ (e.g. $\varepsilon_{\mathrm{VO,diesel}}$ = 3,22 kg $CO_2$e/kg or $\varepsilon_{\mathrm{VO,R\text{-}134a}}$ = 1 430 kg $CO_2$e/kg);

$G_{\mathrm{VEP,TOC,A}_i}$ is the vehicle energy provision GHG emissions of the TOC for GHG activity type $A_i$;

$\varepsilon_{\mathrm{VEP,A}_i}$ is the vehicle energy provision GHG emission factor for GHG activity type $A_i$ (e.g. $\varepsilon_{\mathrm{VEP,diesel}}$ = 0,56 kg $CO_2$e/kg).

Values for GHG emission factors should be used as set out in Annex Q. Where national legislation mandates the use of specific GHG emission factors, or a government provides GHG emission factors for voluntary GHG emission reporting, the use of these sources of GHG emission factors shall be clearly documented.

Where there are multiple GHG activity types (e.g. the vehicles use different energy carriers or refrigerants), the GHG emissions for each GHG activity type shall be calculated separately and then added together to provide the total GHG emissions of the TOC. Formulae (3), (4) and (5) shall be used:

$$G_{\mathrm{VO,TOC}} = \sum_i G_{\mathrm{VO,TOC,A}_i} \tag{3}$$

$$G_{\mathrm{VEP,TOC}} = \sum_i G_{\mathrm{VEP,TOC,A}_i} \tag{4}$$

$$G_{\mathrm{TOC}} = G_{\mathrm{VO,TOC}} + G_{\mathrm{VEP,TOC}} \tag{5}$$

where

$G_{\mathrm{VO,TOC}}$ is the vehicle operation GHG emissions of the TOC;

$G_{\mathrm{VO,TOC,A}_i}$ is the vehicle operation GHG emissions of the TOC for each GHG activity type $A_i$;

$G_{\mathrm{VEP,TOC}}$ is the vehicle energy provision GHG emissions of the TOC;

$G_{\mathrm{VEP,TOC,A}_i}$ is the vehicle energy provision GHG emissions of the TOC for each GHG activity type $A_i$;

$G_{\mathrm{TOC}}$ is the total GHG emissions of the TOC.

### 8.3.3 Allocation needed

This subclause shall be applied when allocation is needed for the calculation of GHG emissions of the TOC in accordance with 8.3.1.

The principles of the previous subclause shall be adapted, in order to quantify the following separately:

— $G_{\mathrm{TOC,all}}$ : GHG emissions of the TOC that result from GHG activity that benefits all passengers and/or freight equally.

— $G_{\mathrm{TOC,sg}_i}$ : GHG emissions of the TOC that result from GHG activity that benefits a specific group or groups of passengers and/or freight $sg_i$ differently to other passengers or freight within the TOC ($i$ from 1 to $n$, $n$ being the number of specific groups).

This allocation of GHG emissions shall ensure that no GHG emissions are lost or double-counted, and therefore that Formula (6) is verified:

$$G_{\mathrm{TOC}} = G_{\mathrm{TOC,all}} + \sum_1^{n_{\mathrm{TOC}}} G_{\mathrm{TOC,sg}_i} \tag{6}$$

where

$G_{TOC}$ is the GHG emissions of the TOC;

$G_{TOC,all}$ is the GHG emissions of the TOC resulting from GHG activity that is not related to any specific group of the TOC;

$G_{TOC,sg_i}$ is the GHG emissions of the TOC resulting from GHG activity calculated for the specific group $sg_i$ of the TOC;

$n_{TOC}$ is the number of specific groups of the TOC.

The chosen allocation principles shall remain consistent over time and shall be documented transparently, as appropriate.

NOTE 1 In practice, such differentiation can lead to the identification of a limited number of groups of passengers and/or freight. A common example that has been identified is the one of maritime transport of dry and reefer containers, where reefer containers constitute the only specific group of freight. A tri-temperature (ambient/fresh/frozen) transport by truck, in road transport, can lead to considering two specific groups that benefit differently from the temperature control (the fresh items and the frozen items), whereas the ambient items are not concerned.

NOTE 2 In many cases, the GHG activity within the TOC is not dedicated to each of these groups. This means that the actual GHG activity data needed for calculation of $G_{TOC,sg_i}$ (e.g. energy used for temperature control of reefer containers on a container ship) is not always measured directly. In these cases, secondary data (e.g. an estimation of energy consumption requirements) can be conducted, based on the need of energy of the temperature-controlled freight.

## 8.4 Calculation of transport activity of a TOC

### 8.4.1 General

The calculation of transport activity of a TOC shall be adapted, based on the different cases identified in 6.3.2.1.

NOTE In some of these cases, the calculation requires the transport activity to be calculated for the individual groups. The transport activity for the individual groups can be added, with the use of an appropriate unit (passenger-equivalent and/or passenger of lowest class equivalent), to give the total transport activity of the TOC

### 8.4.2 Transport activity distance

Only one type of transport activity distance (SFD or GCD) shall be used for the calculation of transport activity of a TOC.

### 8.4.3 Transport activity of a TOC of passengers — General case

In this general case, calculation of the passenger transport activity of a TOC shall be made using Formula (7):

$$T_{TOC,p} = \sum_{1}^{v_p} p_i \times s_{pi} \quad (7)$$

where

$T_{TOC,p}$ is the passenger transport activity of the TOC;

$p_i$ is an individual passenger $i$ in the TOC;

$s_{pi}$ is the transport activity distance of an individual passenger *i* in the TOC;

$v_p$ is the number of passengers in the TOC.

NOTE In situations where the transport activity distance travelled by each passenger is unknown, passenger transport activity can be calculated by multiplying the number of passengers by the mean transport distance travelled by passengers on journeys included within this TOC.

### 8.4.4 Transport activity of a TOC of freight — General case

In this general case, calculation of the freight transport activity of a TOC shall be made using Formula (8):

$$T_{\mathrm{TOC,f}} = \sum_{1}^{c} M_i \times s_{ci} \tag{8}$$

where

$T_{\mathrm{TOC,f}}$ is the freight transport activity of the TOC;

$M_i$ is the mass of an individual consignment *i* in the TOC;

$s_{ci}$ is the transport activity distance of an individual consignment *i* in the TOC;

$c$ is the number of consignments in the TOC.

NOTE 1 In situations where the transport activity distance travelled by each consignment is unknown, freight transport activity can be calculated either by multiplying the total mass of consignments by the average transport distance travelled by each consignment.

NOTE 2 In situations where an alternative option for the quantity of freight is being used, $M_i$ can be replaced in Formula (8) by the appropriate unit, e.g. number of items or number of TEUs.

### 8.4.5 Transport activity of a TOC of passengers with multi-class vehicles

#### 8.4.5.1 General

In the case of multi-class vehicles within the TOC, the passenger transport activity of a TOC may also be calculated using Formula (7), i.e. without any distinction of the passenger classes.

However, alternatively and preferably, a class differentiation should be made.

Such a differentiation may be implemented based on one or a combination of relevant criteria such as those related to the use of space, volume, GHG sources (energy carrier, refrigerant leakage), etc. In particular, the following criteria may be used:

— area per seat;

— occupancy rate per class;

— mass per seat.

#### 8.4.5.2 Establishing class factors

The class differentiation should lead to the establishment of class factors.

The $f$ different classes $C_k$ ($k$ from 1 to $f$) should be identified and sorted in ascending order, with $C_1$ being the lowest class to $C_f$ being the highest.

The class factor $z$ of the lowest class should be 1; i.e. $z_{C1} = 1$.

The calculation of class factors may follow the additional guidance of Annex L. Class factors may also be taken from published sources.

#### 8.4.5.3 Calculation of transport activity with class differentiation

The calculation of the passenger transport activity of the TOC with class differentiation should use Formula (9) for each of the $f$ classes $C_k$:

$$T_{\mathrm{TOC},C_k} = z_{C_k} \times \sum_{1}^{v_{\mathrm{p},C_k}} s_{pi,C_k} \tag{9}$$

where

$T_{\mathrm{TOC},C_k}$ is the passenger transport activity of the passengers in class $C_k$ of the TOC

$z_{C_k}$ is the class factor for class $C_k$;

$s_{pi,C_k}$ is the transport activity distance of an individual passenger $i$ in class $C_k$ of the TOC;

$v_{\mathrm{p},C_k}$ is the number of passengers in class $C_k$ of the TOC.

Finally, the transport activity for the TOC should be calculated using Formula (10):

$$T_{\mathrm{TOC,p}} = \sum_{1}^{f} \mathrm{T}_{\mathrm{TOC},C_k} \tag{10}$$

where

$T_{\mathrm{TOC,p}}$ is the passenger transport activity of the TOC;

$T_{\mathrm{TOC},C_k}$ is the passenger transport activity of the passengers in class $C_k$ of the TOC;

$f$ is the number of classes.

NOTE The unit of transport activity calculated with Formulae (9) and (10) is the passenger of lowest class equivalent kilometre (plceqkm).

### 8.4.6 Transport activity of a TOC of freight with multi-temperature vehicles

In the case of a TOC with multi-temperature vehicles ($\tau$ different temperature conditions), a freight transport activity shall be calculated separately for each temperature condition $t_k$ for freight, with $k$ from 1 to $\tau$, where $t_1$ is ambient, using Formula (11), which is similar to Formula (8):

$$T_{\mathrm{TOC},k} = \sum_{1}^{v_{\mathrm{c},t_k}} M_{i,k} \times s_{pi,t_k} \tag{11}$$

where

$T_{\mathrm{TOC},k}$ is the freight transport activity of the consignments in temperature condition $t_k$ of the TOC;

$M_{i,k}$ is the mass of the individual consignments $i$ in temperature condition $t_k$ of the TOC;

$s_{pi,t_k}$ is the transport activity distance of an individual consignment $i$ in temperature condition $t_k$ of the TOC;

$v_{c,t_k}$ is the number of consignments of type $t_k$ in the TOC.

Finally, the transport activity for the TOC should be calculated using Formula (12):

$$T_{\text{TOC,f}} = \sum_{1}^{\tau} T_{\text{TOC},k} \quad (12)$$

where

$T_{\text{TOC,f}}$ is the freight transport activity of the TOC;

$T_{\text{TOC},k}$ is the freight transport activity of the consignments in temperature condition $t_k$ of the TOC;

$\tau$ is the number of temperature conditions.

### 8.4.7 Transport activity of a TOC with passengers and freight (whether including passenger vehicles or not)

In the case of a TOC with passengers and freight (whether including passenger vehicles or not), each type of the $y$ entities carried $e_k$ shall be identified ($k$ from 1 to $y$, e.g. $e_1$ is passengers with their luggage, $e_2$ is cars, $e_3$ is motorcycles, $e_4$ is empty trailers, $e_5$ is loaded trailers).

EXAMPLE Aircraft, Ro-Pax ferries for maritime transport, some intermodal trains for railway transport.

The corresponding transport activity shall be calculated separately for each type of entity $e_k$, using Formula (13):

$$T_{\text{TOC},e_k} = \sum_{i}^{b} \Theta_i \times s_{i,e_k} \quad (13)$$

where

$T_{\text{TOC},e_k}$ is the transport activity of the TOC for all entities of type $e_k$;

$\Theta_i$ is the quantity of each entity $i$ of type $e_k$ in the TOC;

$s_{i,e_k}$ is the transport activity distance of each entity $i$ of type $e_k$ in the TOC;

$b$ is the number of entities of type $e_k$ in the TOC.

When using the first option set out in 5.4.3, if a value for the actual total passenger mass is not available, the individual passenger mass based on the typical mass of a passenger with a conventional equivalence of 100 kg per passenger (including baggage) may be used.

When using the second option set out in 5.4.3, i.e. for allocation between the different types of entity, $\Theta_i$ shall be the passenger-equivalent value for each type of entity. Tables E.3 and G.5 provide passenger-equivalent values for the different types of passenger and freight vehicle.

NOTE In situations where the transport activity distance travelled by each group of entities is unknown, transport activity can be calculated by multiplying the number of entities by the average transport distance travelled by the entities on journeys included within this TOC.

Finally, the transport activity for the TOC should be calculated using Formula (14):

$$T_{\text{TOC}} = \sum_{1}^{y} T_{\text{TOC},e_k} \quad (14)$$

where

$T_{\text{TOC}}$ is the transport activity of the TOC;

$T_{TOC,e_k}$ is the transport activity of the TOC for all entities of type $e_k$;

$y$ is the number of types of entity.

This transport activity should be expressed in either in tonne kilometre (tkm) or in passenger-equivalent kilometre (peqkm).

### 8.4.8 Transport activities of a TOC with any other case

When a TOC presents a different case than those presented above, especially a combination of these cases (e.g. a TOC with both freight and passengers, with different classes for passengers and different temperature conditions for freight), then the methodology for calculation of transport activities shall be adapted consistently with the cases already developed.

## 8.5 Calculation of GHG emission intensity for the TOC

### 8.5.1 General

This calculation shall consist of relating GHG emissions calculated as specified in 8.3 to transport activities calculated as specified in 8.4.

As different cases have been identified (two cases in 8.3 and six cases in 8.4), this calculation shall rely on a common approach.

### 8.5.2 General case

If the calculation of GHG emissions for the TOC has been implemented in accordance with 8.3.2 (no allocation), then the GHG emission intensity of the TOC shall be calculated by dividing the total GHG emissions of the TOC by the total transport activity of the TOC using Formula (15):

$$g_{j_V,TOC} = \frac{G_{j_V,TOC}}{T_{TOC}} \qquad (15)$$

where

$j_V$ is either the vehicle operation or the vehicle energy provision;

$g_{j_V,TOC}$ is the GHG emission intensity for activity type $j_V$ for the TOC;

$G_{j_V,TOC}$ is the total GHG emissions for activity type $j_V$ for the TOC;

$T_{TOC}$ is the transport activity of the TOC.

The outcome shall be expressed as mass of $CO_2$e per transport activity.

EXAMPLE 1 GHG emission intensity: 60 g $CO_2$e per tonne kilometre or 60 g $CO_2$e/tkm.

EXAMPLE 2 GHG emission intensity: 4 g $CO_2$e per passenger kilometre or 4 g $CO_2$e/pkm.

In the case of a TOC of passengers with different classes, transport activity shall be expressed in passenger of lowest class equivalent kilometre (plceqkm).

In the case of a TOC of passengers with passenger vehicles and/or freight, transport activity shall be expressed in tonne kilometre (tkm) or in passenger-equivalent kilometre (peqkm) for allocation purposes.

### 8.5.3 Case of a TOC of freight with multi-temperature vehicles

In the case of a TOC of freight of multi-temperature vehicles with $n_t$ different temperature conditions $t_k$ ($k$ from 1 to $n_t$, e.g. $t_1$ is ambient, $t_2$ is refrigerated), the calculation of GHG emissions intensities shall rely on:

— the calculation of GHG emissions in accordance with 8.3.3 (allocation of specific GHG activities);

— the calculation of transport activities of the TOC in accordance with 8.4.6.

Then, the GHG emission intensities of the freight with each temperature condition within the TOC shall be calculated using Formula (16):

$$g_{j_V,\mathrm{TOC},k} = \frac{G_{j_V,\mathrm{TOC,all}}}{T_{\mathrm{TOC}}} + \frac{G_{j_V,\mathrm{TOC},k}}{T_{\mathrm{TOC},k}} \qquad (16)$$

where

$j_V$ is either the vehicle operation or the vehicle energy provision;

$g_{j_V,\mathrm{TOC},k}$ is the GHG emission intensity for activity type $j_V$ for freight of temperature condition $t_k$ in the TOC;

$G_{j_V,\mathrm{TOC,all}}$ is the GHG emission for activity type $j_V$ that is not related to control of temperature conditions (e.g. GHG emissions related to propulsion of the ship in maritime transport);

$T_{\mathrm{TOC}}$ is the transport activity of the TOC;

$G_{j_V,\mathrm{TOC},k}$ is the total GHG emissions for activity type $j_V$ for freight of temperature condition $t_k$ in the TOC;

$T_{\mathrm{TOC},k}$ is the freight transport activity of the consignments in temperature condition $t_k$ of the TOC;

NOTE Direct comparison and/or combination of GHG emission intensities calculated using SFD and GCD is not valid.

## 9 Quantification actions at the HOC level

### 9.1 General

This clause sets out the quantification actions for each HOC.

The actions set out in 9.2, 9.3 and 9.4 should be carried out by the hub operator to quantify the GHG emissions related to all HOCs that comprise their overall hub operations. The results from 9.3 and 9.4 shall be combined at the HOC level to calculate the GHG emission intensity for each HOC (see 9.5).

### 9.2 Quantification of the GHG activity data of a HOC

GHG activity data shall encompass all GHG sources of the HOC, and therefore shall consist of the total consumption of each energy carrier and refrigerant used, as well as any other quantified GHG activity relevant to the hub operations.

In situations where the GHG activity data results from the use of different GHG sources (energy carriers or leakage of refrigerants), GHG activity data shall be quantified separately for each GHG source (energy carrier and refrigerant).

In situations where a GHG source is related to a specific group of passengers or freight within the HOC, the corresponding GHG activity data shall be quantified separately for this group.

Annex H gives examples of allocation principles of GHG activity data for the HOC.

If refrigerants are used to refill losses at vehicle or load unit level (e.g. reefer containers), the relevant amount of GHG activity data shall be included within the calculation of the corresponding TOC, see Annex I.

## 9.3 Calculation of GHG emissions of a HOC

### 9.3.1 General

This step shall distinguish the following two situations:

— No allocation needed: when each hub in the HOC does not include both passengers and freight, and provides the same functionalities to all passengers or all consignments carried, all GHG emissions within the HOC shall be added.

— Allocation needed: when the hub(s) of the HOC provides different functionalities (carrying both passengers or freight, and/or providing different functionalities due to different temperature conditions of freight), the corresponding GHG emissions shall be calculated for each group.

### 9.3.2 No allocation needed

This subclause shall be applied when no allocation is needed for the calculation of GHG emissions of the HOC in accordance with 9.3.1

Conversion of GHG activity data into hub equipment operation and energy provision GHG emissions shall be conducted using Formulae (17) and (18) for each type of GHG activity $A_i$:

$$G_{\text{HEO,HOC,A}_i} = Q_{\text{HOC,A}_i} \times \varepsilon_{\text{HEO,A}_i} \tag{17}$$

$$G_{\text{HEEP,HOC,A}_i} = Q_{\text{HOC,A}_i} \times \varepsilon_{\text{HEEP,A}_i} \tag{18}$$

where

| | |
|---|---|
| $G_{\text{HEO,HOC,A}_i}$ | is the hub equipment operation GHG emissions of the HOC for GHG activity type $A_i$; |
| $Q_{\text{HOC,A}_i}$ | is the total quantity of GHG activity type $A_i$ for the HOC (e.g. $A_i$ is combustion of diesel fuel and $Q_{\text{diesel}}$ equals 12 000 kg of diesel or $A_i$ is leakage of refrigerant R134a and $Q_{\text{R-134a}}$ equals 100 kg of the refrigerant R-134a); |
| $\varepsilon_{\text{HEO,A}_i}$ | is the hub equipment operation GHG emission factor for GHG activity type $A_i$ (e.g. $\varepsilon_{\text{HEO,diesel}}$ = 3,22 kg $CO_2e$/kg or $\varepsilon_{\text{HEO,R-134a}}$ = 1 430 kg $CO_2e$/kg); |
| $G_{\text{HEEP,HOC,A}_i}$ | is the total hub equipment energy provision GHG emissions of the HOC for GHG activity type $A_i$; |
| $\varepsilon_{\text{HEEP,A}_i}$ | is the hub equipment energy provision GHG emission factor for GHG activity type $A_i$ (e.g. $\varepsilon_{\text{HEEP,diesel}}$ = 0,56 kg $CO_2e$/kg). |

Values for GHG emission factors shall be used as set out in Annex J. Where national legislation mandates use of specific GHG emission factors, or a government provides GHG emission factors for voluntary GHG emission reporting, the use of these sources of GHG emission factors shall be clearly documented.

Where there are multiple GHG activity types (e.g. the equipment and facilities use different energy carriers or refrigerants), the GHG emissions for each GHG activity type shall be calculated separately and then added together to provide the total GHG emissions of the HOC. Formulae (19), (20) and (21) shall be used:

$$G_{\text{HEO,HOC}} = \sum_i G_{\text{HEO,HOC,A}_i} \tag{19}$$

$$G_{\text{HEEP,HOC}} = \sum_i G_{\text{HEEP,HOC,A}_i} \tag{20}$$

$$G_{\text{HOC}} = G_{\text{HEO,HOC}} + G_{\text{HEEP,HOC}} \tag{21}$$

where

| | |
|---|---|
| $G_{\text{HEO,HOC}}$ | is the hub equipment operation GHG emissions of the HOC; |
| $G_{\text{HEO,HOC,A}_i}$ | is the hub equipment operation GHG emissions of the HOC for each GHG activity type $A_i$; |
| $G_{\text{HEEP,HOC}}$ | is the hub equipment energy provision GHG emissions of the HOC; |
| $G_{\text{HEEP,HOC,A}_i}$ | is the hub equipment energy provision GHG emissions of the HOC for each GHG activity type $A_i$; |
| $G_{\text{HOC}}$ | is the total GHG emissions of the HOC. |

### 9.3.3 Allocation needed

This subclause shall be applied when allocation is needed for the calculation of GHG emissions of the HOC in accordance with 9.3.1.

The principles of the previous subclause shall be adapted, in order to quantify the following separately:

— $G_{\text{HOC,all}}$: GHG emissions of the HOC that result from GHG activity that benefits all passengers and/or freight equally.

— $G_{\text{HOC,sg}_i}$ : GHG emissions of the HOC that result from GHG activity that benefits a specific group or groups of passengers and/or freight $sg_i$ differently to other passengers or freight within the HOC ($i$ from 1 to $n$, $n$ being the number of specific groups).

This allocation of GHG emissions shall ensure that no GHG emissions are lost or double-counted, and therefore that Formula (22) is verified:

$$G_{\text{HOC}} = G_{\text{HOC,all}} + \sum_1^{n_{\text{HOC}}} G_{\text{HOC,sg}_i} \tag{22}$$

where

| | |
|---|---|
| $G_{\text{HOC}}$ | is the GHG emissions of the HOC; |
| $G_{\text{HOC,all}}$ | is the GHG emissions of the HOC resulting from GHG activity that is not related to any specific group of the HOC; |
| $G_{\text{HOC,sg}_i}$ | is the GHG emissions of the HOC resulting from GHG activity calculated for the specific group $sg_i$ of the HOC; |
| $n_{\text{HOC}}$ | is the number of specific groups of the HOC. |

The chosen allocation principles shall remain consistent over time and shall be documented transparently, as appropriate.

NOTE 1 In practice, such differentiation can lead to the identification of a limited number of groups of passengers and/or freight. A common example that has been identified is the one of maritime container terminal for the transhipment of dry and reefer containers, where reefer containers constitute the only specific group of freight. A tri-temperature (ambient/fresh/frozen) transhipment in a distribution centre, can lead to considering two specific groups that benefit differently from the temperature control (the fresh items and the frozen items), whereas the ambient items are not concerned.

NOTE 2 In many cases, the GHG activity within the HOC is not dedicated to each of these groups. This means that the actual GHG activity data needed for calculation of $G_{\mathrm{HOC},\mathrm{sg}_i}$ (e.g. energy used for temperature control of reefer containers at a container terminal) is not always measured directly. In these cases, secondary data (e.g. an estimation of energy consumption requirements) can be conducted, based on the need of energy of the temperature-controlled freight.

## 9.4 Quantification of hub activity of the HOC

### 9.4.1 Freight hub activity

The hub activity shall be quantified by the quantity of freight (outbound) relevant for the HOC.

The user shall choose the most appropriate unit for the quantity of the hub activity. The choice shall remain consistent over time for each hub (and its HOCs) and shall be documented transparently, as appropriate.

NOTE In cases where the chosen unit of the quantity of freight differs to that of the inbound/outbound transport legs, a conversion can be made.

### 9.4.2 Passenger hub activity

The hub activity shall be quantified by the number of passengers relevant to the HOC.

## 9.5 Calculation of GHG emission intensity for the HOC

### 9.5.1 General

This calculation shall consist of relating GHG emissions calculated as specified in 9.3 to hub activity as specified in 9.4.

As different cases have been identified in 9.3, this calculation shall rely on a common approach.

### 9.5.2 General case

If the calculation of GHG emissions for the HOC has been implemented in accordance with 9.3.2 (no allocation), then the GHG emission intensity of the HOC shall be calculated by dividing the total GHG emissions of the HOC by the total hub activity of the HOC using Formula (23):

$$g_{j_{\mathrm{H}},\mathrm{HOC}} = \frac{G_{j_{\mathrm{H}},\mathrm{HOC}}}{H_{\mathrm{HOC}}} \tag{23}$$

where

$j_{\mathrm{H}}$ is either the hub equipment operation or the hub equipment energy provision;

$g_{j_{\mathrm{H}},\mathrm{HOC}}$ is the GHG emission intensity for activity type $j_{\mathrm{H}}$ for the HOC;

$G_{j_{\mathrm{H}},\mathrm{HOC}}$ is the total GHG emissions for activity type $j_{\mathrm{H}}$ for the HOC;

$H_{HOC}$ is the hub activity of the HOC.

The outcome shall be expressed as mass of $CO_2$e per hub activity.

EXAMPLE 1 GHG emission intensity: 17 g $CO_2$e per tonne or 17 g $CO_2$e/t.

EXAMPLE 2 GHG emission intensity: 4 g $CO_2$e per passenger or 4 g $CO_2$e/passenger.

### 9.5.3 Case of a HOC of freight with multi-temperature conditions

In the case of a HOC of freight with $n_t$ different temperature conditions $t_k$ ($k$ from 1 to $n_t$, e.g. $t_1$ is ambient, $t_2$ is refrigerated), the calculation of GHG emissions intensities shall rely on the calculation of GHG emissions in accordance with 9.3.3 (allocation of specific GHG activities).

Then, the GHG emission intensities of the freight with each temperature condition within the HOC shall be calculated using Formula (24):

$$g_{j_H,\mathrm{HOC},k} = \frac{G_{j_H,\mathrm{HOC,all}}}{H_{\mathrm{HOC}}} + \frac{G_{j_H,\mathrm{HOC},k}}{H_{\mathrm{HOC},k}} \tag{24}$$

where

$j_H$ is either the hub equipment operation or the hub equipment energy provision;

$g_{j_H,\mathrm{HOC},k}$ is the GHG emission intensity for activity type $j_H$ for freight of temperature condition $t_k$ in the HOC;

$G_{j_H,\mathrm{HOC,all}}$ is the GHG emission intensity for activity type $j_H$ that is not related to control of temperature conditions (e.g. GHG emissions related to yard lighting);

$H_{\mathrm{HOC}}$ is the hub activity of the HOC;

$G_{j_H,\mathrm{HOC},k}$ is the total GHG emissions for activity type $j_H$ for freight of temperature condition $t_k$ in the HOC;

$H_{\mathrm{HOC},k}$ is the hub activity of the HOC for freight with temperature condition $t_k$.

# 10 Calculation of GHG emissions for a transport TCE

## 10.1 General

This clause sets out the step of calculation of GHG emissions for one TCE of a transport chain, taking place within a TO.

## 10.2 Calculation of transport activity

The transport activity of the TCE shall be calculated similarly to the calculation of transport activity of a TOC (detailed in Clause 8).

## 10.3 Selection of a GHG emission intensity

The GHG emission intensity for the TOC associated with the transport operation related to the TCE shall be selected.

### 10.4 General case

The GHG emissions of a TCE shall be calculated using Formulae (25) and (26):

$$G_{j_V,\text{TCE}} = g_{j_V,\text{TOC}} \times T_{\text{TCE}} \times \delta \quad (25)$$

where

- $j_V$ is either the vehicle operation or the vehicle energy provision;
- $G_{j_V,\text{TCE}}$ is the total GHG emissions for activity type $j_V$ for the TCE;
- $g_{j_V,\text{TOC}}$ is the GHG emission intensity for activity type $j_V$ for the TOC;
- $T_{\text{TCE}}$ is the transport activity for the TCE;
- $\delta$ is the DAF between the transport distance type used for the transport activity of the TCE and the transport distance type used for the GHG emission intensity of the TOC.

NOTE Use of a DAF is only required in cases where the actual distance is used for calculation of the GHG emission intensity of the TOC. Otherwise, the DAF = 1 and Formula (25) is simplified.

$$G_{\text{TCE}} = G_{\text{VO,TCE}} + G_{\text{VEP,TCE}} \quad (26)$$

where

- $G_{\text{TCE}}$ is the GHG emissions of the TCE;
- $G_{\text{VO,TCE}}$ is the vehicle operation GHG emissions of the TCE;
- $G_{\text{VEP,TCE}}$ is the vehicle energy provision GHG emissions of the TCE.

### 10.5 Case of differentiation by passenger classes

In the case of passengers with different classes, transport activity and GHG emission intensity should be expressed using the passenger of lowest class equivalent kilometre (plceqkm) unit, and Formulae (25) and (26) shall be applied.

### 10.6 Case of differentiation by cargo temperature

In the case of freight with a specific temperature condition, Formulae (25) and (26) shall be applied, using the specific GHG emission intensity for each temperature-controlled freight type.

### 10.7 Case of transport of passengers and freight in the same vehicle

In the case where passengers and freight are transported in the same vehicle, transport activity and GHG emission intensity may be expressed in tonne kilometre (tkm) calculated using either the actual mass or notional masses based on passenger equivalents. The chosen allocation principles shall remain consistent over time and shall be documented transparently, as appropriate. Formulae (25) and (26) shall be applied.

## 11 Calculation of GHG emissions for a hub TCE

### 11.1 General

This clause sets out the step of calculation of GHG emissions for one TCE of a transport chain, taking place within a hub operation.

## 11.2 Quantification of hub activity

The hub activity of the TCE shall be quantified similarly to the quantification of hub activity of a HOC (detailed in Clause 9).

## 11.3 Selection of a GHG emission intensity

The GHG emission intensity for the HOC associated with the hub operation related to the TCE shall be selected.

## 11.4 General case

The GHG emissions of a hub TCE shall be calculated using Formulae (27) and (28):

$$G_{j_{\mathrm{H}},\mathrm{TCE}} = g_{j_{\mathrm{H}},\mathrm{HOC}} \times H_{\mathrm{TCE}} \quad (27)$$

where

$j_{\mathrm{H}}$ is either the hub equipment operation or the hub equipment energy provision;

$G_{j_{\mathrm{H}},\mathrm{TCE}}$ is the total GHG emissions for activity type $j_{\mathrm{H}}$ for the TCE;

$g_{j_{\mathrm{H}},\mathrm{HOC}}$ is the GHG emission intensity for activity type $j_{\mathrm{H}}$ for the HOC;

$H_{\mathrm{TCE}}$ is the hub activity for the TCE.

$$G_{\mathrm{TCE}} = G_{\mathrm{HEO,TCE}} + G_{\mathrm{HEEP,TCE}} \quad (28)$$

where

$G_{\mathrm{TCE}}$ is the GHG emissions of the TCE;

$G_{\mathrm{HEO,TCE}}$ is the hub equipment operation GHG emissions of the TCE;

$G_{\mathrm{HEEP,TCE}}$ is the hub equipment energy provision GHG emissions of the TCE.

## 11.5 Case of differentiation by cargo temperature

In the case of freight with a specific temperature condition, Formulae (27) and (28) shall be applied, using the specific GHG emission intensity for each temperature-controlled freight type.

## 11.6 Case of transfer of passengers and freight at the same hub

In the case where passengers and freight are transferred at the same hub, hub activity and GHG emission intensity may be expressed either using passenger equivalents (peq) or in tonnes. The chosen allocation principles shall remain consistent over time and shall be documented transparently, as appropriate. Formulae (27) and (28) shall be applied.

# 12 Results

## 12.1 For one transport chain

### 12.1.1 Calculation of GHG emissions

The GHG emissions of a transport chain shall be calculated by adding the corresponding values calculated in accordance with Clauses 7 to 11 for all TCEs that compose this transport chain, using Formulae (29) to (34):

$$G_{\mathrm{VO,TC}} = \sum_i G_{\mathrm{VO,TCE}_i} \tag{29}$$

$$G_{\mathrm{HEO,TC}} = \sum_i G_{\mathrm{HEO,TCE}_i} \tag{30}$$

$$G_{\mathrm{VEP,TC}} = \sum_i G_{\mathrm{VEP,TCE}_i} \tag{31}$$

$$G_{\mathrm{HEEP,TC}} = \sum_i G_{\mathrm{HEEP,TCE}_i} \tag{32}$$

$$G_{\mathrm{T,TC}} = G_{\mathrm{VO,TC}} + G_{\mathrm{HEO,TC}} + G_{\mathrm{VEP,TC}} + G_{\mathrm{HEEP,TC}} \tag{33}$$

$$G_{\mathrm{O,TC}} = G_{\mathrm{VO,TC}} + G_{\mathrm{HEO,TC}} \tag{34}$$

where

| | |
|---|---|
| $G_{\mathrm{VO,TC}}$ | is the vehicle operation GHG emissions of the transport chain; |
| $G_{\mathrm{VO,TCE}_i}$ | is the vehicle operation GHG emissions allocated to each relevant $\mathrm{TCE}_i$; |
| $G_{\mathrm{HEO,TC}}$ | is the hub equipment operation GHG emissions of the transport chain; |
| $G_{\mathrm{HEO,TCE}_i}$ | is the hub equipment operation GHG emissions allocated to each relevant $\mathrm{TCE}_i$; |
| $G_{\mathrm{VEP,TC}}$ | is the vehicle energy provision GHG emissions of the transport chain; |
| $G_{\mathrm{VEP,TCE}_i}$ | is the vehicle energy provision GHG emissions allocated to each $\mathrm{TCE}_i$; |
| $G_{\mathrm{HEEP,TC}}$ | is the hub equipment energy provision GHG emissions of the transport chain; |
| $G_{\mathrm{HEEP,TCE}_i}$ | is the hub equipment energy provision GHG emissions allocated to each $\mathrm{TCE}_i$; |
| $G_{\mathrm{T,TC}}$ | is the total (i.e. operation and energy provision) GHG emissions of the transport chain; |
| $G_{\mathrm{O,TC}}$ | is the operation GHG emissions of the transport chain. |

The above results may be obtained from a mix of GHG activity data of different categories (primary data, modelled data and default values).

### 12.1.2 Calculation of transport activity

The transport activity of a transport chain ($T_{\mathrm{TC}}$) shall be calculated by adding the transport activity of all transport TCEs that compose this transport chain.

The unit of transport activity shall the same for all TCEs within the transport chain. For freight transport, this shall be the tonne kilometre, unless one of the specific alternatives outlined in 5.4.2 is used (item, TEU, etc.), in which case this shall be documented. For passenger transport, this shall be the passenger kilometre. Where allocation for combined transport of passengers and freight has been conducted using the total passenger mass, this shall be converted to the number of passengers using the standard mass for a passenger with luggage.

For this calculation, the transport activity of all TCEs within each mode of the transport chain should be established using the same type of transport activity distance (SFD or GCD).

NOTE The hub activities are not included in this calculation.

#### 12.1.3 Calculation of GHG emission intensities

The GHG emissions for the transport chain can be converted into GHG emission intensities ($g_{\mathrm{T}}$ *or* $g_{\mathrm{O}}$) for this transport chain, by dividing the GHG emissions calculated in 12.1.1 ($G_{\mathrm{T,TC}}$ or $G_{\mathrm{O,TC}}$) by the transport activity calculated in 12.1.2 ($T_{\mathrm{TC}}$).

NOTE The hub activities are not included in this calculation, whereas the GHG emissions cover all TCEs, including hubs.

### 12.2 For a set of transport chains

#### 12.2.1 General

Aggregated values can be calculated for sets of transport chains (e.g. this can be for an organization as a whole to allow overall corporate reporting or for defined subset of its business).

#### 12.2.2 Calculation of GHG emissions

The GHG emissions of a set of transport chains shall be calculated by adding the GHG emissions for all transport chains that compose this set, using Formulae (35) and (36):

$$G_{\mathrm{T,S}} = \sum_i G_{\mathrm{T,TC}_i} \quad (35)$$

$$G_{\mathrm{O,S}} = \sum_i G_{\mathrm{O,TC}_i} \quad (36)$$

where

| | |
|---|---|
| $G_{\mathrm{T,S}}$ | is the total GHG emissions for the set of transport chains; |
| $G_{\mathrm{T,TC}_i}$ | is the total (i.e. operation and energy provision) GHG emissions of each $\mathrm{TC}_i$; |
| $G_{\mathrm{O,S}}$ | is the operation GHG emissions for the set of transport chains. |
| $G_{\mathrm{O,TC}_i}$ | is the operation GHG emissions of each transport chain $\mathrm{TC}_i$; |

#### 12.2.3 Calculation of transport activity

The transport activity of a set of transport chains shall be calculated by adding the transport activity of all transport chains that compose this set.

For this calculation, the transport activity of all TCEs within each mode of the set of transport chains should be established with the same type of transport activity distance (SFD or GCD).

NOTE The hub activities are not included in this calculation.

#### 12.2.4 Calculation of GHG emission intensities

The GHG emissions for the set of transport chains can be converted into GHG emission intensities ($g_T$ or $g_0$) for this set, by dividing the GHG emissions calculated in 12.2.2 ($G_T$ or $G_0$) by the transport activity calculated in 12.2.3 ($T_S$).

NOTE The hub activities are not included in this calculation, whereas the total GHG emissions of all hub TCEs are included.

### 12.3 For a transport service

Calculations for one transport service shall be done as specified for a transport chain (see 12.1), considering only the TCEs that form part of this transport service.

### 12.4 For a set of transport services

Calculations for a set of transport services shall be done as specified for a set of transport chains (see 12.2), considering only the TCEs that form part of this set of transport services.

### 12.5 For a transport mode

Values can be calculated that consider only the TCEs carried out by one mode of transport for an organization's business or a defined subset thereof. Calculations for one mode of transport shall be done by combining the provisions of 12.1 and 12.2 but considering only the TCEs that are carried out by a single mode of transport.

## 13 Reporting

### 13.1 General

The implementation of this document shall lead to the establishment of a report.

This report shall be either at the level of an organization (for GHG emissions of all or a part of transport chains operated and/or purchased by the organization), or at the level of transport or hub services (for GHG emissions of a set of transport or hub services, reported by a service provider to a service user).

Depending on practical issues, the report shall take the form of either a single long report, or a short report complemented with other information made available separately.

### 13.2 Reporting at the organizational level

#### 13.2.1 Reporting boundaries

Reporting shall cover either all transport chains operated or purchased by the organization, or only a part of them. The reporting may be split as appropriate to the organizational structure (e.g. by business unit, geographical region of operation, subsidiary or any other relevant criteria).

#### 13.2.2 Report

The report shall comprise, as a minimum, the following information:

a) identification of the transport chains covered by this report;

b) a reference to this document, i.e. ISO 14083:2023;

c) the total (operational plus energy provision) GHG emissions ($G_T$);

d) the total (operational plus energy provision) GHG emission intensity ($g_T$), specifying the type of transport activity distance used;

e) the total (operational plus energy provision) GHG emissions for TCEs of each mode of transport and for hub operations;

f) the total (operational plus energy provision) GHG emission intensity for TCEs of each mode of transport and for hub operations, specifying the type of transport activity distance used; where alternative units for freight transport activity are used (e.g. number of items, TEUs), the GHG emission intensity may be reported expressed in these terms (e.g. GHG emissions per item or per TEU kilometre);

g) a reference to the location where information as specified in 13.4 is available.

The report may be complemented with corresponding operational GHG emission values.

The report shall be complemented with the supporting information specified in 13.4.

The reporting organization may use any medium appropriate to organizational GHG reporting such as annual corporate reports or reporting to voluntary corporate GHG disclosure programmes.

As specified in 13.1, the report may be divided in two parts, the complementary elements being presented in the second part.

#### 13.2.3 Periodicity

The reporting organization should produce at least an annual report including all operations performed or purchased during a period of 12 consecutive months. In addition, a report over shorter periods, or for specific journeys, can be appropriate.

### 13.3 Reporting at the level of transport or hub services

#### 13.3.1 Granularity

This report may apply either to a single TCE or to a set of TCEs that comprise a part of or a full transport chain.

The aggregation of transport chains for reporting purposes may be done using various criteria in accordance with contractual agreements with service users and/or period of implementation of these services.

The identification of transport or hub services covered by the report may be done with an exhaustive list of these services, or by specifying the period of occurrence.

#### 13.3.2 Report

The report shall comprise, as a minimum, the following information:

a) identification of the TCE(s) or transport chain(s) covered by this report;

b) a reference to this document, i.e. ISO 14083:2023;

c) the total (operational plus energy provision) GHG emissions ($G_T$);

d) the total (operational plus energy provision) GHG emission intensity ($g_T$), specifying the type of transport activity distance used;

e) a reference to the location where information as specified in 13.4 is available;

f) the transport activity, specifying the type of distance used;

g) the hub activity;

h) the operational GHG emissions ($G_{\text{VO,T}}$ or $G_{\text{HEO,T}}$);

i) the operational GHG emission intensity ($g_{\text{VO}}$ or $g_{\text{HEO}}$), specifying the type of transport activity distance used; where alternative units for freight transport activity are used (e.g. number of items, TEUs), the GHG emission intensity may be reported expressed in these terms (e.g. GHG emissions per item or per TEU kilometre);

j) the total GHG, transport activity and/or GHG emission intensities for each mode of transport and for hub operations, specifying the type of transport activity distance used, where appropriate.

The report shall be complemented with the supporting information specified in 13.4.

The reporting organization may use any medium that gives the clearest results and associated basis for calculations to its service user(s), including pages on websites. In cases of reporting by transport service providers to transport service users, the reports shall be effectively communicated to the transport service users.

As specified in 13.1, the report may be divided in two parts, the complementary elements being presented in the second part.

## 13.4 Supporting information

### 13.4.1 General

Supporting information shall ensure transparency and a clear understanding of the reporting by the full potential group of users of this document.

The following statement shall be communicated: “These calculation results have been established in accordance with ISO 14083:2023.”

The report shall be easy to access, clearly structured and transparent in its data sourcing and calculation. Additional mode-specific statements may be communicated.

### 13.4.2 Description of the calculation method

The report shall mention any omissions of GHG sources, transport or hub operations in accordance with 5.2.3. The reasons for and implications of their omissions shall be explained. The description may include, in particular:

— an explicit description of the operational implementation of the transport and hub operations;

— any other general information necessary for the understanding of the method, e.g. noting that the impact of contrails and other non-GHG climate impacts are not included in the calculation for air transport.

The report may follow the templates given in Tables 1 and 2. The tables may be simplified according to the transport chain they refer to, providing the report conforms to the stated requirements.

**Table 1 — Examples of reporting details for freight transport**

| Report elements | Details to be provided | Breakdown |
|---|---|---|
| Operations in scope (covered by data) | Indicate what is in and what is out of the report. | All transport services in the system or indicate coverage (e.g. % of total transport activity or production output); all hub GHG emissions. |
| Total GHG emissions of transport and hubs ($CO_2$e) | ***Reporting at organizational level***<br>— Aggregated across all transport chains.<br>— Also disaggregated by mode and hubs.<br>— Share of primary and secondary data (for secondary data, distinguish the share of modelled and default):<br>    — in cases where the share differs for TOC parameters (e.g. vehicle size category, filling rate, street category/topography), indicate per parameter<br>— Split total operational GHG emissions and energy provision GHG emissions:<br>    — disaggregate by energy carrier. | ***Examples for reporting at organizational level***<br>Mode (air/sea/inland waterway/rail/road/cable car/pipeline transport) and hubs:<br>— X tonnes $CO_2$e by mode across all operations in scope and cumulative at the organization level;<br>— % of reported GHG emissions sourced from each data type (or indicate the main source if details not available):<br>    — split into TOC parameters regarding the data source;<br>    — routing/street category and topography: 100 % modelled;<br>    — load factor: primary data from own operations;<br>    — fleet composition: primary data from subcontractors.<br>— Operational GHG emissions split into own assets and third-party assets:<br>    — total GHG emissions from, for example, diesel, LPG, sustainable aviation fuel (SAF), electricity.<br>— Energy provision GHG emissions expressed as total GHG emissions. |
| | ***Reporting at level of transport or hub service***<br>— Split by hub or transport service.<br>— Share of primary and secondary data (for secondary data, distinguish share of modelled and default). | ***Examples for reporting at level of transport or hub service***<br>From a specific hub service or a specific transport service:<br>— X tonnes $CO_2$e;<br>— % of reported GHG emissions sourced from each data type (or indicate the main source if details not available);<br>— details to be provided, for example: |

**Table 1** *(continued)*

| Report elements | Details to be provided | Breakdown |
|---|---|---|
| | — Split total operational GHG emissions and energy provision GHG emissions:<br>— disaggregate by energy carrier. | — air: (modelled/flight number and routing);<br>— road: (primary/fleet data and load factor; default/routing and topography and reference to data source);<br>— rail: (modelled/traction type, engine size, cargo);<br>— hub: (primary/energy consumption metered).<br>— Operational GHG emissions split into own assets and third-party assets; expressed in total GHG emissions:<br>— total GHG emissions from, for example, diesel, LPG, SAF, electricity.<br>— Energy provision GHG emissions expressed in total GHG emissions. |
| GHG intensity | ***Reporting at organizational level***<br>— Average across modes for the overall organization.<br>— Also disaggregate by mode and hubs. | ***Examples for reporting at organizational level***<br>Overall: g $CO_2$e/tonne kilometre (tkm) or per tonne of freight for transport service users (aggregated across all operations in scope):<br>— mode (air/ocean/inland waterway/rail/road/cable car/pipeline transport) and hubs. |
| | ***Reporting at level of transport or hub service***<br>— Split by hub or transport service.<br>— Indicate granularity of TOC/HOC applied per mode and hub type (as indicated in 6.3). | ***Examples for reporting at level of transport or hub service***<br>From a specific hub service or a specific transport service:<br>— overall: g $CO_2$e/tonne kilometre (tkm);<br>— air: X g $CO_2$e/tkm, TOC distance classes and freighter versus belly (or aircraft type);<br>— ocean: Y g $CO_2$e/tkm, TOC: trade lane specific;<br>— inland waterway: x g $CO_2$e/tkm, load factor, vessel type;<br>— rail: x g $CO_2$e/tkm, load factor, GHG emissions factors;<br>— road: Z g $CO_2$e/tkm, TOC: pick up/delivery versus line haul;<br>— hub: X g $CO_2$e/tonne of freight; HOC – type of hub. |
| Sources for GHG emission factors | Provide reference and justification for the use of GHG emission factors in accordance with provisions of Annex J. | Refer to Annex J. Indicate where national and own factors are used for electricity and or other fuels (if certified) including deviation for all factors related to operation and/or energy provision. |

**Table 2 — Examples of reporting details for passenger transport**

| Report elements | Details to be provided | Breakdown |
|---|---|---|
| Operations in scope (covered by data) | Indicate what is in and what is out of the report. | All transport services in the system or indicate coverage (e.g. % of total transport activity or production output); all hub GHG emissions. |
| Total GHG emissions of transport and hubs ($CO_2e$) | ***Reporting at organizational level***<br>— Aggregated across all transport chains.<br>— Also disaggregated by mode and hubs.<br>— Share of primary and secondary data (for secondary data, distinguish the share of modelled and default):<br>    — in cases where the share differs for TOC parameters (e.g. vehicle size category, filling rate, street category/topography), indicate per parameter<br>— Split total operational GHG emissions and energy provision GHG emissions:<br>    — disaggregate by energy carrier. | ***Examples for reporting at organizational level***<br>Mode (air/sea/inland waterway/rail/road/cable car) and hubs:<br>— X tonnes $CO_2e$ by mode across all operations in scope and cumulative at the organization level;<br>— % of reported GHG emissions sourced from each data type (or indicate the main source if details not available):<br>    — split into TOC parameters regarding the data source;<br>    — routing/street category and topography: 100 % modelled;<br>    — load factor: primary data from own operations;<br>    — fleet composition: primary data from subcontractors.<br>— Operational GHG emissions split into own assets and third-party assets:<br>    — total GHG emissions from, for example, diesel, LPG, SAF, electricity.<br>— Energy provision GHG emissions expressed as total GHG emissions. |
| | ***Reporting at level of transport or hub service***<br>— Split by hub or transport service.<br>— Share of primary and secondary data (for secondary data, distinguish share of modelled and default). | ***Examples for reporting at level of transport or hub service***<br>From a specific hub service or a specific transport service:<br>— X tonnes $CO_2e$;<br>— % of reported GHG emissions sourced from each data type (or indicate the main source if details not available);<br>— details to be provided, for example: |

**Table 2** *(continued)*

| Report elements | Details to be provided | Breakdown |
|---|---|---|
| | — Split total operational GHG emissions and energy provision GHG emissions:<br>— disaggregate by energy carrier. | — air: (modelled/flight number and routing);<br>— road: (primary/fleet data and load factor; default/routing and topography and reference to data source);<br>— rail: (modelled/traction type, service type);<br>— hub: (primary/energy consumption metered).<br>— Operational GHG emissions split into own assets and third-party assets; expressed in total GHG emissions:<br>— total GHG emissions from, for example, diesel, LPG, SAF, electricity.<br>— Energy provision GHG emissions expressed in total GHG emissions. |
| GHG intensity | ***Reporting at organizational level***<br>— Average across modes for the overall organization.<br>— Also disaggregate by mode and hubs. | ***Examples for reporting at organizational level***<br>Overall: g $CO_2$e/passenger kilometre (pkm) or per passenger for transport service users (aggregated across all operations in scope):<br>— mode (air/ocean/inland waterway/rail/road/cable car) and hubs. |
| | ***Reporting at level of transport or hub service***<br>— Split by hub or transport service.<br>— Indicate granularity of TOC/HOC applied per mode and hub type (as indicated in 6.3). | ***Examples for reporting at level of transport or hub service***<br>From a specific hub service or a specific transport service:<br>— overall: g $CO_2$e/passenger kilometre (pkm);<br>— air: X g $CO_2$e/pkm, TOC distance classes and aircraft type;<br>— sea: Y g $CO_2$e/pkm,, TOC: trade lane specific;<br>— inland waterway: x g $CO_2$e/pkm, TOC, vessel type;<br>— rail: x g $CO_2$e/pkm, TOC, train operation type;<br>— road: Z g $CO_2$e/pkm, means of transport;<br>— hub: X g $CO_2$e/passenger; HOC – type of hub. |
| Sources for GHG emission factors | Provide reference and justification for the use of GHG emission factors in accordance with provisions of Annex J. | Refer to Annex J. Indicate where national and own factors are used for electricity and or other fuels (if certified) including deviation for all factors related to operation and/or energy provision. |

### 13.4.3 Transparent reporting from the use of modelled data or default GHG emission intensities

As set out further in Annex M, the parameters used for the calculation of modelled data, and the underlying assumptions behind default GHG emission intensities, have a strong influence on the calculation outputs.

In order to provide transparency, calculations that rely on modelled data shall be transparent as to the model type (see Annex M) and the parameters included in the model, while calculations that rely on default GHG emission intensities shall state the source of the values used, justifying the reason for the choice if sources other than those referred to in Annex Q are used.

To help with transparency, the reporting organization shall complete Table 3 for each model used and share it upon request. The table is based on the list of example parameters contained in Annex M, and also provides the option to list any other relevant input parameters used.

The model output and its unit of measure shall be specified.

**Table 3 — List of input parameters required to accompany reporting to ensure transparency of outputs from modelling and use of deviating default GHG emission intensities**

| **Model type** | | |
|---|---|---|
| Energy based | Yes/No | |
| Activity based | Yes/No | |

| **Parameter** | **Included Yes/No** | **Additional information If included, state predominant input data type** |
|---|---|---|
| **Vehicle fleet related** | | |
| Vehicle class/fleet profile | Yes/No/Not applicable | Primary/modelled/default |
| Energy consumption profile | Yes/No/Not applicable | Primary/modelled/default |
| Vehicle configuration | Yes/No/Not applicable | Primary/modelled/default |
| Body type/empty vehicle mass | Yes/No/Not applicable | Primary/modelled/default |
| Engine type | Yes/No/Not applicable | Primary/modelled/default |
| Engine emission class | Yes/No/Not applicable | Primary/modelled/default |
| Energy carrier(s) used in vehicle (electric, liquid fuel, etc.) | Yes/No/Not applicable | Primary/modelled/default |
| Share of energy carrier | Yes/No/Not applicable | Primary/modelled/default |
| **Operational** | | |
| Freight type | Yes/No/Not applicable | Primary/modelled/default |
| Freight requirements (e.g. temperature control/hazardous) | Yes/No/Not applicable | Primary/modelled/default |
| Use of specific container types | Yes/No/Not applicable | Primary/modelled/default |
| Load factor or average load expressed in tonnes | Yes/No/Not applicable | Primary/modelled/default |
| Service type (e.g. full truckload/less than truckload, full container load/less than container load) | Yes/No/Not applicable | Primary/modelled/default |
| Extent of empty trips | Yes/No/Not applicable | Primary/modelled/default |

**Table 3** *(continued)*

| Parameter | Included Yes/No | Additional information If included, state predominant input data type |
|---|---|---|
| **Journey characteristics** | | |
| Routing, including location of intermediate stops | Yes/No/Not applicable | Primary/modelled/default |
| Route characteristics | Yes/No/Not applicable | Primary/modelled/default |
| Location parameters | Yes/No/Not applicable | Primary/modelled/default |
| Direct/via locations/multiple collection and delivery | Yes/No/Not applicable | Primary/modelled/default |
| Drive cycle | Yes/No/Not applicable | Primary/modelled/default |
| Road type/channel type | Yes/No/Not applicable | Primary/modelled/default |
| Urban/mixed/long-haul | Yes/No/Not applicable | Primary/modelled/default |
| Frequency of stops | Yes/No/Not applicable | Primary/modelled/default |
| Speed profile | Yes/No/Not applicable | Primary/modelled/default |
| Topography | Yes/No/Not applicable | Primary/modelled/default |
| Geographic region of applicability | Yes/No/Not applicable | Primary/modelled/default |
| Currents/flow rate/head, cross or tail wind and windspeed | Yes/No/Not applicable | Primary/modelled/default |
| Additional items... | | |
| ... | | |
| ... | | |

# Annex A
(normative)

# Air transport

## A.1 Air transport specific boundary

This annex shall be applied to any energy-consuming solution of air transportation, manned or unmanned, the principal purpose of which is to transport passengers or freight, or both.

## A.2 Recommended approach for defining air TOCs

TOCs for air transport should be structured based on a suitable combination of the influencing factors given in Table A.1.

**Table A.1 — Air TOC characteristics**

| Journey length | Plane configuration |
|---|---|
| Short (e.g. < 1 500 km) | Passenger aircraft without freight |
| Long (> 1 500 km) | Dedicated freight aircraft |
| | Passenger aircraft with belly freight |

## A.3 Calculation parameters

### A.3.1 Transport activity distance

Transport activity distance for air transport shall be the GCD.

### A.3.2 Distance adjustment factor

In accordance with 10.4 and Formula (25), if GHG emission intensities calculated using the actual distance are reported, a DAF shall be applied. This DAF should be calculated based on the best available information regarding manoeuvring and other deviations from the GCD. This should be noted alongside the value provided. The DAF should be relevant to the context in which the transportation occurs. If information specific to the transport chain is not available, a DAF calculated using the ratio GCD plus 95 km divided by the GCD shall be used, where 95 km represents the difference between the actual distance and the transport activity distance due to manoeuvring and other deviations from the GCD.

## A.4 Mode-specific considerations

### A.4.1 General

Practice regarding the process of allocation of GHG emissions between passengers and freight has been split in recent times. Previous industry guidance to include a 50 kg allowance per seat, representing the mass of passenger infrastructure (e.g. seat, galley equipment) in allocation calculations is being withdrawn. This does not preclude future research into possible alternative allocation principles for freight travelling on passenger aircraft that would support the goal of real-world GHG emission reduction through the use of spare belly cargo capacity.

### A.4.2 Transport activity for passenger aircraft with belly freight

In the case of TOCs in which the main function is passenger transportation with belly freight, the provisions of 5.4.3 and 8.4.7 shall be applied for calculation of transport activity.

Two options are provided in 5.4.3 for the general case of combined transport of passengers and freight. In this instance, the first option should be used, based on either the actual mass of passengers or a standard equivalence of 100 kg for a passenger and their baggage.

Then, the unit of transport activity shall be the tonne kilometre (preferred) or the passenger-equivalent kilometre (peqkm).

## A.5 Transport activity for passenger with different classes of travel

In the case of TOCs in which passenger aircraft offers different classes of travel, 8.4.5 shall be applied for calculation of transport activity. Then, the unit of transport activities for passengers shall be the “passenger of lowest class equivalent kilometre” (plceqkm).

NOTE Air transport is probably the mode where allocation according to classes is the most relevant, as GHG emissions per trip are relatively high (due to distances travelled and energy carriers being fossil fuels), and differences in area per seat between the lowest and the highest class are significant (ratio 4:1 or even more). This issue is introduced in 8.4.5 and expanded in Annex L. Examples for flights with four and two classes are presented in L.3.2 and L.3.3, respectively.

# Annex B
(normative)

# Cable car transport

## B.1 Cable car transport specific boundary

This annex shall be applied to any energy-consuming cable car system, the principal purpose of which is to transport passengers or freight, or both.

Any cable car system, even if designed with several vehicles, should be considered as an indivisible transport system, including its dedicated infrastructure.

## B.2 Recommended approach for defining cable car TOCs

TOCs for cable car transport should be structured based on a suitable combination of the influencing factors given in Table B.1 for cable car freight transport and Table B.2 for cable car passenger transport.

**Table B.1 — Freight cable car TOC characteristics**

| Operation type | Configuration | Technology | System |
|---|---|---|---|
| Industrial transport | Aerial cable car | Unidirectional monocable | Fixed-grip buckets<br>Detachable buckets |
| | | Unidirectional bi-cable | Material 2S<br>Material 3S |
| | | Reversible bi-cable (jigback) | Material cable car<br>Cable crane |
| | Surface cable car | Material train drawn by rope(s) | Bucket train |
| | | Funicular | Material funicular |

**Table B.2 — Passenger cable car TOC characteristics**

| Operation type | Configuration | Technology | System |
|---|---|---|---|
| Urban transport<br>Mountain transport<br>Touristic site transport | Aerial cable car | Unidirectional monocable | Fixed-grip chair lift<br>Fixed-grip gondola<br>Detachable chair-lift<br>Detachable gondola |
| | | Reversible monocable (jigback) | Jigback gondola |
| | | Unidirectional bi-cable | 2S<br>3S<br>Detachable 2S<br>Detachable 3S |
| | | Reversible bi-cable<br>(jigback) | Cable car<br>Aerial tramways |
| | Surface cable car | Train drawn by rope(s) | Horizontal train<br>Automated people movers (APMs) |
| | | Funicular | Funicular<br>Inclined elevators |
| | | Draglift | Draglift with rod<br>Draglift with springbox<br>Low level ski-tows |

## B.3 Calculation parameters

### B.3.1 Transport activity distance

The transport activity distance for cable car transport should be the cable car length corresponding to the longest distance one vehicle can travel in one direction, moved by one piece of machinery, considering the cable car network (the SFD) or the GCD. If two or more cable cars are interconnected, allowing a vehicle to travel along different sections moved by different pieces of machinery, each section shall be considered as one cable car.

### B.3.2 Distance adjustment factor

In accordance with 10.4 and Formula (25), if GHG emission intensities calculated using the actual distance are reported, a DAF shall be applied. The limited number of route options available within the cable car network leads to little opportunity for deviation between the actual distance and the SFD, meaning that a DAF is not required in the majority of cases. However, where there is an unplanned deviation, the DAF is likely to be specific to the individual circumstances of the deviation and can be developed on a case-by-case basis.

## B.4 Mode-specific considerations

For some passenger cable car networks, detailed data on passenger journeys that allow specific passenger journey distances to be derived are not always available. In such circumstances, the average distance per journey derived from a combination of passenger surveys and network modelling may be used.

Assessing GHG emissions for cable cars can be based on primary measured data or secondary (modelled) data. Commonly, combinations of the two are needed and used.

# Annex C
(normative)

# Inland waterway transport

## C.1 Inland waterway transport specific boundary

This annex shall be applied to any energy-consuming mode of inland waterway transportation, the principal purpose of which is to transport passengers or freight, or both. The provisions of this annex apply to energy-related GHG emissions linked to the consumption of energy for the propulsion of the vessel as well as maintenance of freight in the condition required by the owner of the goods and passengers at the required conditions for comfortable passage. When in port, or at other locations where transfer of freight or passengers takes place, GHG emissions related to the vessel's GHG activity data shall be calculated and reported as part of the inland waterway TCE. This implies that any energy supplied from shore that is stored and subsequently used for propulsion or used to maintain goods or passengers that remain part of the ship's freight, particularly electrical energy, shall be included as part of the vessel operator's GHG activity data. Similarly, refrigerant GHG emissions related to the maintenance of freight or passengers at required temperatures shall be considered as part of the inland waterway TOC, even when replenishment of the refrigerants occurs during a port call.

## C.2 Recommended approach for defining inland waterway TOCs

TOCs for inland waterway transport should be structured based on a suitable combination of the influencing factors given in Table C.1 for inland waterway freight transport and Table C.2 for inland waterway passenger transport.

**Table C.1 — Inland waterway freight TOC characteristics**

| Freight type | Vessel size category | Vessel configuration | Condition | Waterway type |
|---|---|---|---|---|
| Dry bulk<br>Liquid bulk<br>Containerized<br>Mass-limited, general freight<br>Volume-limited, general freight | < 50 m<br>50 m to 80 m<br>80 m to 110 m<br>110 m to 135 m<br>> 135 m | Individual vessel<br>Pushed convoy | Ambient<br>Temperature-controlled | Canal<br>River<br>Lake |

**Table C.2 — Inland waterway passenger TOC characteristics**

| Vessel operation type | Vessel size category | Condition | Waterway type |
|---|---|---|---|
| River cruise<br>Ro-Pax river ferry<br>Waterbus<br>Water taxi | Varies by vessel type | Transport only<br>Transport plus other services (restaurant, accommodation, etc.) | Canal<br>River<br>Lake |

## C.3 Calculation parameters

### C.3.1 Transport activity distance

Transport activity distance for inland waterway transport should be either the SFD, taking into account the inland waterway network, or the GCD.

NOTE Appropriate distance calculators can be used to help identify inland waterway distances as accurately as possible.

### C.3.2 Distance adjustment factor

In accordance with 10.4 and Formula (25), if GHG emission intensities calculated using the actual distance are reported, a DAF shall be applied. This DAF should be calculated based on the best available information regarding deviations from the transport activity distance. The limited number of route options available within the inland waterway network leads to little opportunity for deviation between the actual distance and the SFD. In such circumstances, any difference in transport activity used by the transport operator to calculate the GHG emission intensity and the transport activity used by their service users is not likely be significant and a DAF is not required at the calculation stage.

### C.3.3 Alternatives to mass-based calculation

The TEU may be used as an alternative parameter to mass of freight for containerized transport.

## C.4 Identification of water current effects for inland waterway modes

For inland waterway transport operations, water direction (e.g. whether with or against the current) can have an important impact on energy consumption. Any calculation of GHG emissions shall be applied on a round-trip basis to average this impact across the transport operations and conform with the provisions of 6.3.2.

# Annex D
(normative)

# Transport by pipeline

## D.1 Pipeline transport specific boundary

### D.1.1 General

Pipeline transport refers to freight transport only, and no passenger transport is considered within pipeline transport.

### D.1.2 Pipeline operations to be included in GHG emission calculation

Pipeline operations that should be included in the GHG emission calculation are limited to the energy needed by equipment located within the pipeline network to move the product through the pipeline, i.e. transport, and to keep the relevant pressure level.

See ISO 14064-1:2018, Annex B, for pipeline activities and associated emissions or removals that are not covered in this document. ISO 14064-1:2018, Annex B, provides examples of subcategorization and identification of associated sources and sinks, including direct process emissions and removals from industrial processes which include upstream (extraction) and downstream activities (oil and gas processing/refining).

NOTE Direct fugitive GHG emissions can come from systems that deliver fossil fuels (e.g. flanges, valves, unions, threaded connections).

When comparing pipeline transport with other modes, the user shall consider the fact that the commodity can be transported at different pressures or temperature levels. The relevant differential compression, cooling or heating processes with their energy use and related GHG emissions shall be covered in such a comparison.

### D.1.3 Operations to be excluded from GHG emission calculation

Excluded from the GHG emissions calculation of pipeline transport is the initial compression of the medium (e.g. liquefied gas) or pumping needed for feeding the pipeline, located at the production site (start of the transport chain) or at transhipment point/terminal (within the transport chain). The latter shall be allocated to hubs (see Annex H).

## D.2 Recommended approach for defining pipeline TOCs

If the TCE comprises pipeline transport, the TOC related to this TCE can be the activity of a relevant pipeline section or network over one year for all operations and medium transported by this pipeline section or network.

## D.3 Calculation parameters

### D.3.1 Transport activity distance

Transport activity distance for pipeline transport should be either the SFD, taking into account the pipeline network, or the GCD.

### D.3.2 Distance adjustment factor

In accordance with 10.4 and Formula (25), if GHG emission intensities calculated using the actual distance are reported, a DAF shall be applied. The limited number of route options available within the pipeline network leads to little opportunity for deviation between the actual distance and the SFD. In such circumstances, any difference in transport activity used by the transport operator to calculate the GHG emission intensity and the transport activity used by their service users is not likely be significant and a DAF is not required at the calculation stage.

### D.3.3 Alternatives to mass-based calculation

In addition to the quantity of freight expressed in mass, other parameters can be used, e.g. volume.

# Annex E
(normative)

# Rail transport

## E.1 Rail transport specific boundary

This annex shall be applied to any energy-consuming mode of rail transportation, the principal purpose of which is to transport passengers or freight, or both.

The following exclusions apply:

— any internal moves that are entirely contained within the boundaries of a hub and hence are accounted for as part of the HOC;

— any movements by vehicles whose primary purpose is not for the carriage of freight and/or passengers.

For the avoidance of doubt, the following are taken into account as part of the train TCE in accordance with the general provisions of this document:

— electricity transmission losses (included as part of the electricity GHG emission factor);

— energy re-injected to the grid as a result of brake regeneration of electricity;

— energy used for train propulsion even if using energy supplied from a system provided by a hub operator.

## E.2 Recommended approach for defining rail TOCs

TOCs for rail transport should be structured based on a suitable combination of the influencing factors given in Table E.1 for rail freight transport and Table E.2 for rail passenger transport.

**Table E.1 — Rail freight TOC characteristics**

| Operation type | Freight type | Condition | Propulsion |
|---|---|---|---|
| Long-distance freight transport: block train<br><br>Long-distance freight transport: single wagon<br><br>Long-distance freight transport: intermodal wagon<br><br>Short-distance freight transport (feeder services) | Average/mixed<br><br>Containerized/swap bodies<br><br>Dry bulk<br><br>liquid bulk<br><br>Vehicle transport<br><br>Semi-trailers<br><br>Other | Ambient<br><br>Temperature-controlled | Electric motor: fixed electricity supply system (catenary, third rail)<br><br>Electric motor: on train battery energy storage<br><br>Electric motor: fuel cell energy storage<br><br>Combustion engine<br><br>Other |

**Table E.2 — Rail passenger TOC characteristics**

| Train operation type | Passenger experience | Propulsion |
|---|---|---|
| Long-distance passenger trains<br>Short-distance passenger regional trains<br>Urban passenger: suburban trains<br>Urban passenger: tram (streetcar)<br>Urban passenger: underground (subway, metro) | Night trains (slow trains)<br>Vehicle trains (slow trains)<br>Luxury trains (slow trains)<br>High-speed trains<br>Other | Electric motor: fixed electricity supply system (catenary, third rail)<br>Electric motor: on train battery energy storage<br>Electric motor: fuel cell energy storage<br>Combustion engine<br>Other |

## E.3 Calculation parameters

### E.3.1 Transport activity distance

Transport activity distance for rail transport should be either the SFD, taking into account the rail network, or the GCD.

NOTE To help identify rail distances, some rail carriers and GHG emission calculation tools offer a rail distance calculator to their users or make on publicly available.

### E.3.2 Distance adjustment factor

In accordance with 10.4 and Formula (25), if GHG emission intensities calculated using the actual distance are reported, a DAF shall be applied. The limited number of route options available within the rail network leads to little opportunity for deviation between the actual distance and the SFD, meaning that a DAF is not required in the majority of cases. However, where there is an unplanned deviation, the DAF is likely to be specific to the individual circumstances of the deviation and can be developed on a case-by-case basis.

### E.3.3 Alternatives to mass-based calculation

The TEU may be used as an alternative parameter to mass for the quantity of freight for containerized transport.

Area for passengers may be a better allocation basis where the galley, restaurants, sleeping wagon, accompanying cars and class can be embedded (see Clause E.5 on class of travel).

## E.4 Mode-specific considerations

### E.4.1 Consideration of data availability and rail networks

For some rail transport operations, particularly urban rail systems (e.g. streetcar/tram), detailed data on passenger journeys that allow specific passenger journey distances to be derived are not always available. In such circumstances, the average distance per journey derived from a combination of passenger surveys and network modelling may be used.

The full transport chain for cargo wagon load transport by rail can involve a network that comprises pickup/delivery, feeder and long-distance transport, each with their own characteristics, as shown in Figure E.1.

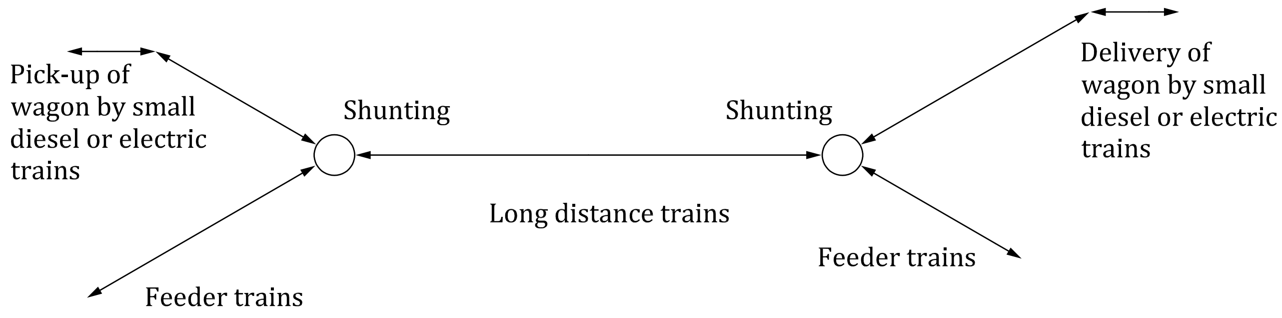



**Figure E.1 — Schematic illustration of the possible elements of a cargo wagon load freight transport chain**

### E.4.2 Allocation for mixed passenger and freight operations in rail transport

For calculation purposes, this shall be treated as a single TOC.

Two options are provided in 5.4.3 for the general case of combined transport of passengers and freight. In this instance, the second option, based on the use of passenger equivalents, should be used.

Table E.3 provides standard values for the number of passenger equivalents that should be used in this calculation.

**Table E.3 — Standard passenger-equivalent values for rail transport**

| Passenger transport | | Freight transport | |
|---|---|---|---|
| | peq | | peq |
| Individual passenger (including luggage) | 1,0 | Small van | 1,3 |
| Passenger car | 1,3 | Large van | 3,5 |
| Bus/coach | 10,0 | Rigid truck | 10 |
| Caravan, small | 1,1 | Articulated truck | 18 |
| Caravan, medium | 2,3 | Unaccompanied trailer | 14 |
| Caravan, large | 3,5 | | |
| Mobile home | 3,5 | | |
| Motorcycle | 0,3 | | |
| NOTE The passenger-equivalent values are based on a combination of mass-based and volume-based equivalence. Using these two inputs appears to provide a balanced outcome that does not unduly favour either passengers or freight at the allocation stage. | | | |

The number of passenger equivalents of a passenger vehicle shown in Table E.3 excludes the passengers transported, meaning that the total number of passenger equivalents for a car carrying three passengers is 4,3, i.e. 1,3 for the car itself plus three for the passengers.

The GHG activity data, and hence the GHG emissions, shall subsequently be calculated at the level of an individual passenger for a passenger transport chain, or a consignment for a freight transport chain, in accordance with the standard rules for passenger or freight transport, respectively.

## E.5 Allocation of GHG emissions to passenger by class of rail travel

Rail transport is a mode where allocation according to classes can be relevant for regional and long-distance TOCs, as differences in area per seat between the lowest and the highest class are clear. This issue is developed in 5.4.3 and 8.4.5 and expanded in Annex L. Examples for rail journeys with two and three classes are presented in L.4.2, L.4.3 and L.4.4.

# Annex F
(normative)

# Road transport

## F.1 Road transport specific boundary

This annex shall be applied to any energy-consuming form of road transportation, the principal purpose of which is to transport passengers or freight, or both.

In some business models, a shift from transportation that uses energy to transportation that does not use any energy is feasible (e.g. replacing vans/trucks in mail and parcel delivery with foot and bicycle delivery). In these cases, the transport activity distance shall be taken into account in the calculation of the transport chain transport activity, although zero GHGs are emitted in this TCE.

Transportation operations with a principal purpose to serve as medically-assistive personal mobility aids shall be excluded (e.g. motorized wheelchairs, ambulance transport).

## F.2 Recommended approach for defining road TOCs

TOCs for road transport should be structured based on a suitable combination of the influencing factors given in Table F.1 for road freight transport and Table F.2 for road passenger transport.

**Table F.1 — Road freight TOC characteristics**

| Freight type | Condition | Journey type | Contract type |
|---|---|---|---|
| Dry bulk<br>Liquid bulk<br>Containerized<br>Palletized<br>Vehicle transport<br>Mass-limited, general freight (heavy cargo)<br>Volume-limited, general freight (light cargo) | Ambient<br>Temperature-controlled | Point-to-point (long haul)<br>collection and delivery | Shared transport<br>Dedicated contract (charter) |

**Table F.2 — Road passenger TOC characteristics**

| Means of transport | Journey type | Level of passenger loading |
|---|---|---|
| Shared public transport (e.g. bus, coach, trolleybus)<br>Shared private transport (taxi)<br>Private transport (e.g. own car, bicycle, scooter, motorbike) | Urban<br>Suburban<br>Regional<br>Long-distance<br>Dedicated lines (e.g. school bus) | Discrete number of individuals (1, 2, 3, etc.)<br>Average occupancy rate |

Additional factors can be relevant for defining a highly specific TOC, e.g. topography, road type (highway versus urban versus rural), vehicle mass category, wagon/trailer body type.

EXAMPLE 1 If the TCE is part of a collection and/or delivery round, the TOC can be a group of similar collection and delivery rounds, e.g. from the same hub.

EXAMPLE 2 If the TCE is a trip of a passenger in a public transport bus, the TOC can be the whole bus line from starting point to the ending point. It is also possible to choose the whole bus network if the network is considered to be sufficiently homogeneous.

## F.3 Calculation parameters

### F.3.1 Transport activity distance

Transport activity distance for road transport should be either the SFD, taking into account the road network, or the GCD. Examples of SFD values include SFD estimates as calculated by distance/route, planning software or maps. For more accurate results, use the most specific and recent information.

### F.3.2 Distance adjustment factor

In accordance with 10.4 and Formula (25), in cases where transport distance type used for transport activity differs from transport distance type used for GHG emission intensity, a DAF shall be applied. This DAF should be calculated based on the best available information regarding deviations from the transport activity distance. The DAF should be relevant to the context in which the transportation occurs. If no specific operational DAF is available, an estimated global value can be used.

In the case of the SFD being used as the transport activity distance and actual distance being used to calculate the GHG emission intensity, a DAF shall be applied. The GLEC Framework[15] recommends using a DAF of 1,05 to increase the SFD by 5 % in order to allow for any incidental transport distance travelled that is not part of the planned route. The impact of any additional detours will already be accounted for in the measured energy consumption value.

If an alternative to the shortest feasible route serves in practice as the primary route (e.g. to avoid tolls, congestion, sharp inclines), then the transport operator should notify the transport user of this alternate route so that a more accurate transport activity distance is used in GHG emission calculations.

### F.3.3 Alternatives to mass-based calculation

Calculations on a per-item basis or a per-TEU basis are likely to be common for mail and parcel collection and delivery rounds, and containerized road transport, respectively.

## F.4 Mode-specific considerations

### F.4.1 Specific case of calculation of transport activity for collection and delivery rounds

Many road transport operations, particularly in urban areas, fall into the TOC “collection and delivery rounds”. These are shared transports which include various stops where parts of the load are discharged and an additional load is picked up, thereby changing the load factor from stop to stop. The start and end point of a collection and delivery round can be the same location, e.g. a hub that forms part of a bigger hub and spoke network, or at different locations.

For collection and delivery rounds with multiple stops, the total energy and GHG emissions for each consignment should be calculated according to its share of the transport activity, based on the loading and unloading points of each individual consignment. In accordance with 5.4, the transport activity should be the quantity of freight multiplied by the transport activity distance (tkm).

### F.4.2 Transport activity distance for collection and delivery rounds

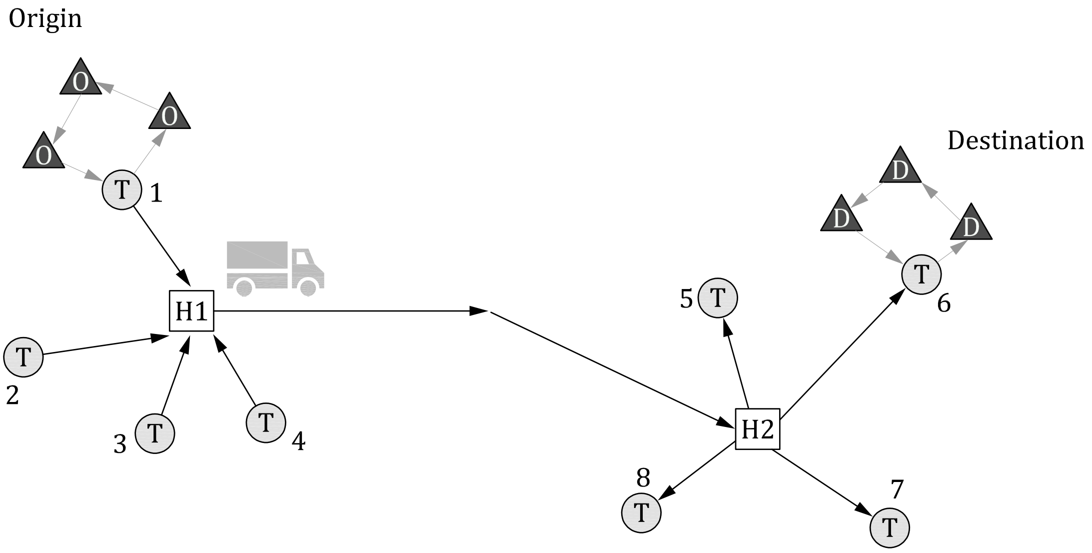
In accordance with 5.4, the transport activity distance should be either SFD or GCD between the loading and unloading points. This may bear no resemblance to the route or actual distance between the loading and unloading points.

For post and parcel services only, where knowledge of individual consignments is limited and delivery tracking is not viable, the total GHG emissions may be calculated on a per-item basis or by share of freight mass. In such circumstances, the transport activity in tonne kilometres between the individual loading and unloading points may be estimated rather than precisely calculated to maintain consistency throughout the full transport chain. This estimation may rely on modelling the collection and delivery rounds, and establishing average values for distances of rounds, distances travelled by consignments and consignment masses in order to fulfil the conditions of 5.4. Linked to this, a GHG emission intensity based on an alternative metric to tonne kilometres may be reported across all TCEs of the transport chain. Any such choices shall be clearly documented.

### F.4.3 Hub and spoke networks

Hub and spoke networks usually consist of multiple primary hubs/distribution centres where cargo is collected and delivered via collection and delivery rounds for a relatively short-distance journey and transferred onto one or more different vehicles to be conveyed long distances (line haul) through a series of hubs of varying sizes. When considering a calculation for a hub and spoke network, the principles of establishing a series of TOCs should be applied as per Clause 6 so that the GHG emissions of each TCE within a transport chain of the hub and spoke network can correspond to a different TOC.

Figure F.1 shows a schematic of a less-than-truckload network with its different elements.




**Key**

- cargo origin and destination (triangle)
- end-of-line terminal (circle)
- hub/breakbulk (square)
- pick-up/delivery (grey line)
- line haul route (black line)

**Figure F.1 — Schematic diagram showing a selection of the different elements that comprise a less-than-truckload network**

### F.4.4 Calculation time period

The operational data for regular transport operations should be aggregated over periods of up to one year (calendar year) to remove seasonal fluctuations or any transient impact on long-term trends. Other time aggregations are permitted under the condition that deviations from the general rule of yearly aggregation are noted and reported. In particular, the short duration and high frequency of some road transport operations makes the use of aggregation periods shorter than one year more relevant than for other modes. An example of where an alternative time period can be appropriate is when a coach service only operates between an airport and a ski resort during the winter months.

### F.4.5 General passenger transport

For some road transport passenger TOCs (e.g. bus), detailed data on passenger journeys that allow specific passenger journey distances are not always available. In such circumstances, the average journey distance per journey derived from a combination of passenger surveys and network modelling may be used.

# Annex G
(normative)

# Sea transport

## G.1 Sea transport specific boundary

This annex shall be applied to any energy-consuming mode of sea transportation, the principal purpose of which is to transport passengers or freight, or both.

The provisions of this annex apply to energy-related GHG emissions linked to the consumption of energy for the propulsion of the vessel as well as the maintenance of freight in the condition required by the owner of the freight and passengers at the required conditions for comfortable passage.

When in port, or at other locations where transfer of freight or passengers takes place, GHG emissions related to the vessel's GHG activity data shall be calculated and reported as part of the sea TCE.

This implies that any energy supplied from shore that is stored and subsequently used for propulsion or used to maintain goods or passengers that remain part of the ship's freight, particularly electrical energy, shall be included as part of the vessel operator's GHG activity data. Similarly, refrigerant GHG emissions related to the maintenance of freight or passengers at required temperatures shall be considered as part of the sea TOC, even when replenishment of the refrigerants occurs during a port call.

## G.2 Recommended approach for defining sea TOCs

### G.2.1 General

TOCs for sea transport should be structured based on a suitable combination of the influencing factors given in Table G.1 for sea freight transport, Table G.2 for sea passenger transport and Table G.3 for combined sea transport of passengers and freight.

**Table G.1 — Sea freight TOC characteristics**

| Vessel type | Freight condition | Service type |
|---|---|---|
| Bulk carrier<br>Chemical tanker<br>General cargo<br>Ro-Ro<br>Liquefied gas tanker<br>Oil tanker<br>Other liquid tanker<br>Container<br>Vehicle carrier | Ambient<br>Temperature-controlled<br>Mixed ambient and temperature-controlled | Scheduled (by origin and destination pairs)<br>Tramp |
| **Key**<br>Ro-Ro: roll-on roll-off freight | | |

**Table G.2 — Sea passenger TOC characteristics**

| Vessel type | Vessel size | Service type |
|---|---|---|
| Passenger ferry<br>Cruise ship | Varies by vessel type (see Table G.4) | Scheduled (by origin and destination pairs)<br>Chartered |

**Table G.3 — Mixed sea freight/passenger TOC characteristics**

| Vessel type | Vessel size | Service type |
|---|---|---|
| Ro-Pax ferry | Varies by vessel type (see Table G.4) | Scheduled (by origin and destination pairs)<br>Chartered |
| **Key**<br>Ro-Pax: mixture of roll-on roll-off freight and passengers | | |

### G.2.2 Vessel-based categorization

The list of ship types set out in the International Maritime Organization (IMO) Fourth GHG Study,[38] and presented in Table G.4, combines freight type, vessel type, vessel size categories and freight condition (for fully temperature-controlled ships), into a commonly applicable set of TOCs for use where a vessel-based categorization is helpful. (For further detail of the process of developing the list of ship types, see section 2.2.1 of the IMO study.[38]) This is particularly the case for charter services where the individual vessel is known to both parties in the charter agreement. In such circumstances, the use of primary data is preferred, meaning that the TOC categorization is merely for information. However, if primary data are not available then the TOC parameters become relevant to specify modelling or choice of default values.

**Table G.4 — List of ship types set out in the IMO Fourth GHG study[38]**

| Ship type | Size category | Unit |
|---|---|---|
| Bulk carrier | 0 to 9 999 | dwt |
| | 10 000 to 34 999 | dwt |
| | 35 000 to 59 999 | dwt |
| | 60 000 to 99 999 | dwt |
| | 100 000 to 199 999 | dwt |
| | 200 000+ | dwt |
| Refrigerated bulk | 0 to 1 999 | dwt |
| | 2 000 to 5 999 | dwt |
| | 6 000 to 9 999 | dwt |
| | 10 000+ | dwt |
| Chemical tanker | 0 to 4 999 | dwt |
| | 5 000 to 9 999 | dwt |
| | 10 000 to 19 999 | dwt |
| | 20 000 to 39 999 | dwt |
| | 40 000+ | dwt |
| General freight | 0 to 4 999 | dwt |
| **Key**<br>dwt: deadweight tonnes<br>cbm: cubic metres<br>GT: gross tonnes | | |

**Table G.4** *(continued)*

| Ship type | Size category | Unit |
|---|---|---|
| | 5 000 to 9 999 | dwt |
| | 10 000 to 19 999 | dwt |
| | 20 000+ | dwt |
| Liquefied gas tanker | 0 to 49 999 | cbm |
| | 50 000 to 99 999 | cbm |
| | 100 000 to 199 999 | cbm |
| | 200 000+ | cbm |
| Oil tanker | 0 to 4 999 | dwt |
| | 5 000 to 9 999 | dwt |
| | 10 000 to 19 999 | dwt |
| | 20 000 to 59 999 | dwt |
| | 60 000 to 79 999 | dwt |
| | 80 000 to 119 999 | dwt |
| | 120 000 to 199 999 | dwt |
| | 200 000+ | dwt |
| Other liquids tankers | 0 to 999 | dwt |
| | 1 000+ | dwt |
| Container | 0 to 999 | TEU |
| | 1 000 to 1 999 | TEU |
| | 2 000 to 2 999 | TEU |
| | 3 000 to 4 999 | TEU |
| | 5 000 to 7 999 | TEU |
| | 8 000 to 11 999 | TEU |
| | 12 000 to 14 499 | TEU |
| | 14 500 to 19 999 | TEU |
| | 20 000+ | TEU |
| Ferry: Pax only | 0 to 299 | GT |
| | 300 to 999 | GT |
| | 1 000 to 1 999 | GT |
| | 2 000+ | GT |
| Cruise | 0 to 1 999 | GT |
| | 2 000 to 9 999 | GT |
| | 10 000 to 59 999 | GT |
| | 60 000 to 99 999 | GT |
| | 100 000 to 149 999 | GT |
| | 150 000+ | GT |
| Ferry: Ro-Pax | 0 to 1 999 | GT |
| | 2 000 to 4 999 | GT |
| | 5 000 to 9 999 | GT |
| | 10 000 to 19 999 | GT |
| **Key**<br>dwt: deadweight tonnes<br>cbm: cubic metres<br>GT: gross tonnes | | |

**Table G.4** *(continued)*

| Ship type | Size category | Unit |
|---|---|---|
| | 20 000+ | GT |
| Ro-Ro | 0 to 4 999 | dwt |
| | 5 000 to 9 999 | dwt |
| | 10 000 to 14 999 | dwt |
| | 15 000+ | dwt |
| Vehicle | 0 to 29 999 | GT |
| | 30 000 to 49 999 | GT |
| | 50 000+ | GT |
| **Key**<br>dwt: deadweight tonnes<br>cbm: cubic metres<br>GT: gross tonnes | | |

### G.2.3 Service-based categorization

Service-based categorization provides a useful basis for defining the TOCs where the transport service user purchases transport for freight or passengers between the origin and the destination without knowing, or being able to choose, the specific vessel they or their freight will travel on. This is often the case for container, Ro-Ro, Ro-Pax or Pax only ferry lines.

In such cases, the transport operator is sometimes able to provide aggregated values that are representative for the overall operation based on the schedules that are in place.

## G.3 Calculation parameters

### G.3.1 Transport activity distance

Transport activity distance for sea transport should be either the SFD, taking into account the overall route and specific channels available to the vessel in question, or the GCD. Several specific sea transport distance calculators are available. For more accurate results, use the most specific and recent information.

### G.3.2 Distance adjustment factor

In accordance with 10.4 and Formula (25), if the transport distance type used for transport activity differs from the transport distance type used for GHG emission intensity, a DAF shall be applied. This DAF should be calculated based on the best available information regarding deviations from the transport activity distance. The DAF should be relevant to the context in which the transportation occurs. If no specific operational DAF is available, a default global value can be used, e.g. Clean Cargo recommends using a DAF of 1,15 to increase the SFD by 15 %.[15] This is based on actual sea transport distances being, on average, 15 % greater than the shortest feasible port-to-port route.

### G.3.3 Alternatives to mass-based calculation

For containerized shipping, the number of TEU slots available onboard is both the primary limiting characteristic and the mechanism by which bookings are made. As such, the TEU is the unit established within the industry for calculation and is recommended as the unit to be combined with the transport activity distance when calculating transport activity in this specific subsector.

## G.4 Mode-specific considerations

### G.4.1 Calculation time period

This methodology can be applied over a defined period during which multiple journeys occur, provided that all input values represent transportation operations that occur during the same time period. For journeys with multiple elements, GHG emissions for each element shall be calculated individually over the same time period according to the manner described for individual journey legs and chartered routes before aggregation.

In practice, for high frequency, regular, repeatable or short duration transport (e.g. container shipping operations), it is common for the operator to aggregate a year's worth of operational data for transportation operations that occur during that time period. This has the benefit of removing seasonal fluctuations from the reported results that can obscure more significant long-term trends.

The charter operations that are common within bulk shipping represent an example of where it is appropriate to deviate from the use of annual data aggregation and instead perform journey-specific quantification and reporting because they are often one-off, non-repeating journeys, with specific characteristics and for which the data are identifiable for the individual journeys in the systems of both the transport operator and the transport service user. The opportunity still exists for both the transport operator and the service user to subsequently aggregate journey data into annual reporting.

### G.4.2 Allocation for mixed temperature-controlled consignments

In some circumstances, it is necessary to transport freight that needs to be kept under specific conditions (e.g. within a defined temperature range) on the same vessel as freight that is at ambient conditions.

For calculation purposes, this shall be treated as a single TOC. The GHG activity data and hence the GHG emissions shall subsequently be allocated between the ambient and temperature-controlled consignments based on the share of energy required to move the freight, applicable to all consignments, and the energy used specifically to maintain the temperature-controlled freight within the required temperature range.

### G.4.3 Allocation for mixed passenger and freight operations — Ro-Pax ferries

For calculation purposes, this shall be treated as a single TOC.

For sea transport, the main instance of combined transport of passengers and freight is the case of Ro-Pax ferries, which are identified within the IMO classification as a ship type with 5 size subcategories (see Table G.4). Two options are provided in 5.4.3 for the general case of combined transport of passengers and freight. In this instance, the second option, based on the use of passenger equivalents, should be used.

Table G.5 gives standard values for the number of passenger equivalents that should be used in this calculation.

**Table G.5 — Standard passenger-equivalent values for Ro-Pax ferries**

| Passenger transport | | Freight transport | |
|---|---|---|---|
| | peq | | peq |
| Individual passenger (including luggage) | 1,0 | Small van | 1,3 |
| Passenger car | 1,3 | Large van | 3,5 |
| Bus/coach | 10,0 | Rigid truck | 10 |
| Caravan, small | 1,1 | Articulated truck | 18 |
| Caravan, medium | 2,3 | Unaccompanied trailer | 14 |
| Caravan, large | 3,5 | | |
| Mobile home | 3,5 | | |
| Motorcycle | 0,3 | | |
| NOTE The passenger-equivalent values contained are based on a combination of mass-based (including the mass of passenger decks) and volume-based equivalence. Using these two inputs appears to provide a balanced outcome that does not unduly favour either passengers or freight at the allocation stage. | | | |

The number of passenger equivalents of a passenger vehicle shown in Table G.5 excludes the passengers transported meaning that the total number of passenger equivalents for a car carrying three passengers is 4,3, i.e. 1,3 for the car itself plus three for the passengers.

The GHG activity data and hence the GHG emissions shall subsequently be calculated at the level of an individual passenger for a passenger transport chain, or a consignment for a freight transport chain, in accordance with the standard rules for passenger or freight transport, respectively.

# Annex H
(normative)

# Hubs

## H.1 Hub-specific boundary

### H.1.1 General

This annex shall be applied to any hub enabling the transport chain from:

— the shipper to the consignee (for freight);

— the origin of a journey to the final destination of the journey (for passengers).

Hubs include, but are not limited to, rail/road terminals, cross-docking sites, airport terminals, terminals at sea ports and distribution centres. Hubs for freight, also known as “logistics hubs”, are self-contained facilities for handling freight, including freight acceptance and release, security and documentation that connects freight within or to other modes of transport. The equivalent for passengers is self-contained facilities for the connection of passenger transport within or to other modes of transport, such as ferry terminals, airport terminals and railway stations.

### H.1.2 Hub operations to be included in hub GHG emission calculation

All hub operations (enabling the transport chain from the originator of a consignment to the consignee or the origin of a journey to the final destination of the journey) that consume energy or cause refrigerant leakage are included.

GHG emissions resulting from energy use by dedicated vehicles or other equipment that move vehicles/vessels, trailers or containers (e.g. shunting, push boats, aircraft pushers) within a hub, or shuttles that transport employees who steer self-driving vehicles within a roll on/roll off terminal, or relating to air conditioning of these vehicles/vessels, shall be included in hub operation calculations, regardless of whether outdoor or indoor, as are e.g. pilot boats or tug vessels.

GHG emissions related to electricity used to cool refrigerated containers or vehicles, whether indirect GHG emissions from purchased electricity or direct GHG emissions resulting from on-site electricity generation shall be allocated to hub operations.

GHG emissions resulting from energy use for handling luggage accompanying passengers shall be included and allocated to hub operations for passenger transfer; GHG emissions resulting from energy use for handling pre-shipping luggage shall be allocated to hub operation for freight transhipment as they refer to package freight.

GHG emissions resulting from processes for storage of goods at hubs, such as warehousing, may be calculated as described for transhipment processes.

### H.1.3 Operations to be excluded from the hub GHG emission calculation

Inbound or outbound transport operations of the previous or subsequent TCE (e.g. vehicles or vessels entering or leaving the hub) are not part of the calculation. Any related GHG emissions caused by energy consumption or refrigerant leakage shall be accounted within the relevant TCE. As is any grid electricity used to charge electric vehicles leaving the hub (e.g. electric vans or cars).

GHG emissions related to energy used by vehicles or vessels while temporarily at a hub should be allocated to the transport operation. Examples include energy used by auxiliary or main engine of a vehicle/vessel/aircraft or provided by ground power units (airports) or shore power (in ports). Users may, alternatively, assign such GHG emissions to hub operations but shall do this in a consistent manner in order to ensure all GHG emissions are allocated and documented transparently.

Refill of refrigerants into refrigerated containers or vehicles shall be allocated to transport operations of respective inbound or outbound TCE (in accordance with Annex I).

Hosting of people for the purpose of staying (e.g. hotels, restaurants) is excluded, as is the parking of cars for previous or subsequent passenger transport legs (e.g. car parks, including car rental facilities), commuting of hub employees and shopping malls.

Energy consumption needed for ICT services purchased by external server providers shall be excluded from the hub GHG emission calculation, see Annex N. GHG emissions resulting from self-driving cargo (e.g. in roll on, roll off terminals) are also excluded.

## H.2 Recommended approach for describing HOCs

The choice of HOC should reflect the needs of the user of this document, taking into account GHG activity data availability and relevance to the particular transport chain under consideration. HOCs should be structured based on a suitable combination of the influencing factors given in Table H.1.

Main stations and regional stations within a national rail network may be grouped separately to reflect the different characteristics of each.

**Table H.1 — HOC characteristics**

| Processes | Freight type | Condition |
|---|---|---|
| Freight transhipment only | Average/mixed | Ambient |
| Passenger transfer only | Containerized/swap bodies | Temperature-controlled |
| Combined passenger and freight transfer | Palletized | |
| Freight transhipment and storage | Piece goods/break bulk | |
| | Dry bulk | |
| | Liquid bulk | |
| | Vehicle transport | |
| | Other | |

## H.3 Calculation parameter

For freight the calculation parameter “tonnes throughput” shall be used.

NOTE In addition to the mass other relevant allocation units, e.g. $m^2$, $m^3$, TEU, number of containers, number of vehicles can be used.

For passengers the allocation parameter “passenger throughput” shall be used.

## H.4 Hub-specific considerations

### H.4.1 Transport nodes covering a number of hubs

Transport nodes, such as maritime and inland ports, railway stations and airports, may need to be broken down into a number of hubs directly enabling the transport chains. When defining the individual hubs located at a transport node, approaches may be used such as:

— control approach, e.g. operational or financial control;

— geographical boundaries.

The chosen approach shall be consistent for all hubs at one transport node.

The hub boundaries specify the processes and related GHG activity data to be included in the quantification of GHG emissions of each hub. On-site transport between different hubs of a transport node shall be allocated in its entirety, i.e. either to one or other of the hubs or divided between the hubs.

EXAMPLE 1 A port facilitates the loading and unloading of passengers or freight from ships, ferries and other commercial vessels. Activities associated with ports include the operation of vessels, freight handling equipment, locomotives, trucks, and storage and warehousing facilities related to the transportation of freight or passengers as well as the development and maintenance of supporting infrastructure. Ports typically have multiple terminals which are designated areas used for the transfer of freight and/or passengers from marine transport to road or rail transport and vice versa. Terminals can consist of multiple hub types, such as wharves and/or bulk freight loading and/or unloading structures, landings and receiving stations. GHG emission sources at terminals include freight handling equipment (e.g. gantry cranes, forklifts) as well as the electricity used by the terminals for purposes of lighting and temperature control (heating and cooling) of the building.

GHG emissions produced within the port boundary from mobile sources that travel beyond the geographic boundary, such as ocean-going vessels, locomotives and trucks, are included in transport TCE calculations.

EXAMPLE 2 An airport enables the transhipment of freight from air transport to road and vice versa as well as the transfer of passengers from air transport to road or rail transport and vice versa. For this airport, three different hubs can be identified: the air freight handling terminal (departure and arrival), the passenger terminal (departure and arrival) and the railway station.

EXAMPLE 3 A railway station enables passenger transfer from rail to road and local public transport and vice versa. Depending on materiality, this railway station can be used as one hub or subdivided into two hubs using geographical boundaries: rail hub and local public transport hub.

### H.4.2 Allocation of GHG emissions of the HOC level

Allocation of GHG emissions is needed when the hub(s) of the HOC provide(s) different functionalities and the corresponding GHG emissions shall be calculated for each group (as set out in Clause 9). This is eased by separate data collection (e.g. metering) at the equipment level; however, this separate data collection is rarely possible in practice. Therefore, if GHG activity data are not available for the selected group, the user shall allocate the GHG activity data following the principles of extrapolation and proportionality (see the examples in Table H.2). The chosen allocation principles shall remain consistent over time for each hub related to the HOC and shall be documented transparently, as appropriate.

This allocation shall follow the relevant requirements of the freight or passengers as set in 9.3.3.

**Table H.2 — Example allocation principles and areas of application within hubs**

| Operational area | GHG activity | Example allocation principles |
|---|---|---|
| Material handling equipment | Energy | — Regarding activities (e.g. transhipment, shunting) and the respective quantity of freight requiring these activities.<br>— Including the consideration of basic processes used for all shipments, where energy consumption is difficult and/or time consuming to allocate (e.g. freight receipt, dispatch, IT infrastructure, offices). These may be summarized in one general group, the GHG emissions of which are allocated evenly to all shipments. |
| Transfer equipment | Energy | — Regarding zones or activities (e.g. de-/boarding, shuttles, restrooms, waiting areas) and the respective quantity of passengers requiring these activities.<br>— Including the consideration of basic processes used for all passengers, where energy consumption is difficult and/or time consuming to allocate (e.g. luggage handling, rest rooms, IT infrastructure, offices). These may be summarized in one general group, the GHG emissions of which are allocated evenly to all passengers. |
| Lighting | Electricity | — By the use of functional areas which are defined zones of the hub in which specific operations take place and the respective amount of freight or number of passengers passing through these functional areas. |
| Temperature requirements | Energy | — By the energy consumption of the relevant temperature control equipment and the quantity of ambient and refrigerated freight. |
| | Refrigerants | — By the quantity of refrigerants refilled and the quantity of refrigerated freight. |

# Annex I
(normative)

# Approach to account for refrigerant leakage GHG emissions from mobile air conditioning and temperature-controlled freight units during transportation operations

## I.1 General

The function of a transportation refrigeration system is to maintain a specified temperature during transport. All transport refrigeration systems must be robust and sturdy so that they can perform properly while withstanding movements and accelerations during transportation. However, leaks within the refrigeration system still occur due to vibrations, loose connections and general degradation of the refrigeration system.

This annex shall be applied to any transportation refrigeration system, the principal purpose of which is to maintain temperature control of passenger spaces or freight, or both, linked to an energy-consuming form of transportation.

## I.2 Refrigerant leakage in operations to be included in GHG emission calculation

As introduced in 6.2, the quantification of GHG emissions from any transport operation within a transport chain shall start with the selection of a TOC related to this TCE. This TOC shall be a consistent group of transport operations relevant to the TCE.

When establishing a TOC, consideration should be given to characteristics that affect the scale and composition of the TOC and the needs of the users of this document (i.e. both transport operator and the transport service user).

## I.3 Recommended approach for calculating refrigerant leakage GHG emission

NOTE Sources and methods consulted: Reference [34] Chapter 7, Volume 3, Table 7.9: “Emissions of Fluorinated Substitutes for Ozone Depleting Substances”. Also referenced: various industry sources for capacity volumes for temperature-controlled mobile freight units for freight trucks.

### I.3.1 Step 1: Determine the refrigerated transport application type as part of the TOC

For example:

— automobile type;

— commercial truck type.

When the vehicle type is unknown, or no factors exist, consider using factors for the “most-similar” type of vehicle to the one that would be likely to be used in that transportation operation.

### I.3.2 Step 2: Determine a charge capacity quantity of refrigerant for the TOC

For example:

— for automobiles, where charge capacity is unknown, use a default charge capacity range of 0,500 kg to 0,750 kg refrigerant for mobile air conditioning units, with a middle point of 0,625 kg;

— for commercial trucks, where charge capacity is unknown, use a default charge capacity of 1,5 kg refrigerant for mobile air conditioning units;

— for commercial trucks, where charge capacity is unknown, use a default charge capacity range of 3 kg to 8 kg refrigerant for temperature-controlled mobile freight units (e.g. a trailer with a transportation refrigeration unit), with a middle point of 5,5 kg.

### I.3.3 Step 3: Determine an annual leakage rate of refrigerant for the TOC

For example:

— for automobiles, where annual leakage rate is unknown, use a default leakage rate of 10 % to 20 % of refrigerant capacity for mobile air conditioning units, with a middle point of 15 %;

— for commercial trucks, where annual leakage rate is unknown, use a default leakage rate of 10 % to 20 % of refrigerant capacity for mobile air conditioning units, with a middle point of 15 %;

— for commercial trucks, where annual leakage rate is unknown, use a default leakage rate of 15 % to 50 % of refrigerant capacity for temperature-controlled mobile freight units (e.g. a trailer with a transportation refrigeration unit), with a middle point of 32,5 %

### I.3.4 Step 4: Multiply to derive an annual leakage mass for the TOC

For example:

— for automobile mobile air conditioning units: (0,625 × 0,15) = 0,093 75 kg annual refrigerant leakage;

— for commercial truck mobile air conditioning units: (1,5 × 0,15) = 0,225 kg annual refrigerant leakage;

— for commercial truck temperature-controlled mobile freight units: (5,5 × 0,325) = 1,787 5 kg annual refrigerant leakage.

### I.3.5 Step 5: Multiply the annual refrigerant leakage by the GHG emission factor of the refrigerant used

If the refrigerant used is not known, consider using a default GHG emission factor that represents either:

— the refrigerant most commonly used in a given region for that type of transportation operation;

— a default GHG emission factor representing a weighted average of the values for refrigerants commonly used in a given region for that type of transportation operation.

For example:

— for automobile mobile air conditioning units, using GHG emission factor of 1 430 kg $CO_2$e/kg for R-134a: 0,093 75 kg annual refrigerant leakage × 1 430 = 134,1 kg $CO_2$e from leakage for the example air-conditioned automobile transportation TOC;

— for commercial truck mobile air conditioning units, using GHG emission factor of 1 430 kg $CO_2$e/kg for R-134a: 0,225 kg annual refrigerant leakage × 1 430 = 321,75 kg $CO_2$e from leakage for the example air-conditioned commercial truck transportation TOC;

— for commercial truck temperature-controlled mobile freight units, using GHG emission factor of 1 430 kg $CO_2$e/kg for R-134a: 1,787 5 kg annual refrigerant leakage × 1 430 = 2 556 $CO_2$e from leakage for the example temperature-controlled commercial truck TOC.

### I.3.6 Step 6: Assign to transport activity of the TOC to derive GHG emission intensity

Divide by the appropriate transport activity value for the TOC to derive a mass of $CO_2$e/passenger km or $CO_2$e/tonne km as an input to the overall GHG emission intensity factor for the TOC.

This approach can overestimate leakage for very short trips of less than one-day duration. However, it is more likely that the methodology is conservative, and underestimates total hydrofluorocarbon GHG emissions attributed to the transportation operation, as it does not account for pro-rating of GHG emissions from recharges and eventual disposal (less any refrigerant reclamation). Additionally, the wide range of specific circumstances can lead to a wide range of variability in outcomes. Thus, the approach is intended to primarily establish a marker using a conservative approach which can be refined over time. If the operator has more specific comprehensive information about annual refrigerant purchase records that encompass all the operations within the calculation, using that approach (as outlined in above IPPC reference) is preferable, as it would lead to more accurate outcomes.

## I.4 Calculation time period

This methodology can be applied over a defined period during which multiple journeys occur, provided that all input values represent transportation operations that occur during the same time period. For journeys with multiple elements, GHG emissions for each element shall be calculated individually over the same time period according to the manner described for individual journey legs and chartered routes before aggregation.

In practice, for high frequency, regular, short duration transport, it is common to aggregate a year's worth of operational data for transportation operations that occur during that time period. This has the benefit of removing seasonal fluctuations from the reported results than can obscure more significant long-term trends. When estimating refrigerant leakage GHG emissions on an annual basis, results should be pro-rated by the number of days per year that the transport refrigeration units are in operation.

# Annex J
(normative)

# Additional requirements and guidance for GHG emission factors

## J.1 General

As stated in 5.2.2, the extent of GHG emissions to be calculated and reported for transport operations consists of the sum of the GHG emissions arising from vehicle and hub operation as well as the GHG emissions associated with the provision of the energy used. The total operational GHG emissions and total energy provision GHG emissions are reported separately as well as a total GHG emission value. In each case, the GHG emissions are quantified as mass of $CO_2$ equivalent, through the application of appropriate GHG emission factors which include the full energy carrier life cycle.

Comparability of calculation output relies on the use of robust and consistent GHG emission factors. For many traditional and new energy carriers, there is a wide range of possible feedstocks, production processes, regions of production and interdependencies (e.g. refinery efficiency, crude oil quality or feedstock production for biofuels). For this reason, Annex K provides GHG emission factors for the most relevant transport energy carriers which can only be seen as a starting point where sufficient information on the GHG emissions associated with the energy production and usage were available at time of writing.

Since the inclusion of all upstream processes (including plant infrastructure) can prove difficult in reality, the use of clearly stated cut-off criteria for GHG emission factors of energy provision in accordance with 5.2.3 is possible.

## J.2 Biofuels

GHG emission factors for biofuels shall include the following:

— GHG emissions from the extraction or cultivation of raw materials;

— annual GHG emissions from carbon stock changes caused by land-use change (20-year perspective);

— GHG emissions from processing;

— GHG emissions from transport and distribution;

— GHG emissions from the fuel in use.

Removal of atmospheric $CO_2$ during cultivation of raw materials shall be excluded based on the assumption that this removal matches the subsequent GHG emission due to combustion in the operational phase. Hence, $CO_2$ emissions of the fuel in the operational phase are zero for biofuels but all GHG emissions of other GHGs (e.g. $N_2O$ and $CH_4$) of the fuel in the operational phase shall be included in the GHG emission factor for biofuels.

Where a fuel production process produces, in combination, the fuel for which GHG emissions are being calculated and one or more other products (co-products), GHG emissions shall be divided between the fuel, or its intermediate product, and the co-products in proportion to their energy content (determined by lower heating value in cases of co-products other than electricity and heat). A co-product is any of two or more products coming from the same unit process or product system. The detailed application of these rules can vary in different certification schemes, particularly the way in which broader sustainability criteria are related to the individual co-products. For example, whether a certain process output is considered a co-product or a waste can be determined by the provisions of the certification scheme.

Waste wood, straw, husks, cobs and nutshells as well as residues from biomass processing, including crude glycerine and bagasse, may be considered to have zero life cycle GHG emissions up to the process of collection of those materials. According to local legislation, this can be subject to prior screening against wider sustainability criteria, e.g. requirements to meet sustainable land use criteria.

Indirect land use change (iLUC) can play a major role for crop-based biofuels, although iLUC GHG emission factors need further collaborative work and agreement. Separate reporting of iLUC GHG emissions is recommended along with clear, accompanying documentation of the sources and assumptions used. Further information about iLUC can be found in References [24] and [25].

Fuels derived from oil crops such as palm oil or certain other food or feed crops should be considered high risk due to the likelihood of there being a significant associated iLUC impact which can negate any GHG emission savings from the biofuel usage. This should be assessed on a case-by-case basis through an established, accredited fuel certification scheme.

For all renewable liquid and gaseous fuels of non-biological origin (commonly also referred to as "e-fuels"), the electricity used for the fuel production shall be included (in accordance with Clause J.3).

Energy and GHG emission factors for biofuel blends shall be calculated using the factors of the fuels blended, taking into account their relative share in the blend based on fuel volume or fuel energy content.

## J.3 Electricity

GHG emissions from electricity consumed by transport shall be quantified using the location-based approach by applying the GHG emission factor that best characterizes the pertinent grid, i.e. dedicated transmission line, or local, regional or national grid-average GHG emission factor.

Where national and sub-national GHG emission factors are not available, global or regional GHG emission factors can be applied.

NOTE 1 The location-based approach is a method to quantify GHG emissions from energy, based on average energy generation GHG emission factors for defined geographic locations, including local, subnational or national boundaries.

Grid-average GHG emission factors should be from the relevant reporting year, if available, or from the most recent year(s) if not. Grid-average GHG emission factors for imported consumed electricity should be based on the average consumption mix of the grid from which the electricity is consumed.

To ensure comparability of calculations carried out in accordance with this document:

— where national legislation mandates the use of a database that lists specific local, regional and grid average GHG emission factors, users should use the most current official GHG emission factors and sources available;

— the source of the GHG emission factor used shall be documented.

Energy provision GHG emission factors shall include all relevant GHG emissions associated with generation of electricity, such as:

— transmission and distribution losses;

— other life cycle processes used in generating the electricity such as extracting, transporting and processing the energy carrier, and the processes used in producing the capital equipment for generating the electricity.

The GHG emissions from energy generation infrastructure may be quantified, documented and reported separately.

If a TCE involves means of transport using electricity and crossing multiple regions, each electricity grid GHG emission factor shall be used. For means of transport using batteries, an apportioning of the electricity use associated with each recharge to the specific electricity grid region(s) should be conducted.

The GHG emission factors shall include all applicable covered GHGs.

NOTE 2 National electricity GHG emission factors can be purchased from the International Energy Agency[39] and can be available via life cycle databases or government publications/agencies.

In addition to using the location-based approach, a transport provider may report using their own electricity mix using the market-based approach, provided the contractual instruments conform to the following quality criteria:

— convey the information associated with the unit of electricity delivered together with the characteristics of the generator;

— are ensured with a unique claim;

— are tracked and redeemed, retired or cancelled by or on behalf of the reporting entity;

— are as close as possible to the period to which the contractual instrument is applied and comprises a corresponding timespan;

— are produced within the country, or within the market boundaries where consumption occurs if the grid is interconnected.

When the organization uses contractual instruments for GHG emission attributes, including renewable energy certificates, these transactions shall be documented and reported separately.

NOTE 3 Contractual instruments are any type of contract between two parties for the sale and purchase of energy bundled with attributes about the energy generation, or for unbundled attribute claims.

EXAMPLE Contractual instruments can include energy attribute certificates, renewable energy certificates, guarantees of origin, power purchase agreements, green energy certificates, supplier-specific GHG emission rates, etc.

NOTE 4 The market-based approach is a method to quantify the indirect GHG emissions from energy of a reporting organization based on GHG emissions emitted by the generators from which the reporting organization contractually purchases.

If the results are used for a product carbon footprint in accordance with ISO 14067, then the market-based electricity mix shall be reported in addition.

## J.4 General provision for GHG emission factors and sources

The user shall use GHG emission factors for fuels which conform with the provisions in this document. The GHG emission factors shall be listed and the following properties shall be given:

— fuel type;

— lower heating value (MJ/kg);

— density (kg/l) (for liquid fuels);

— operational GHG emissions (g $CO_2$e/MJ);

— total GHG emissions (g $CO_2$e/MJ);

— biofuel blend (in % energy content) (if applicable).

The user shall clearly state the source of all GHG emission factors for fuels.

The potential for leakage of methane, itself a potent GHG, shall be taken into account when calculating the GHG emissions resulting from the provision and use of methane-containing fuels such as compressed natural gas (CNG), LNG and their biogenic equivalents. Upstream venting of methane from the tank or at various points further up the supply chain shall be considered in the energy provision component of the overall GHG emission factor.

# Annex K
(informative)

# GHG emission factors and sources

To provide a starting point for suitable sources and GHG emission factors for fuels, the major fuels used in Europe are given in Tables K.1 and K.2 and in the United States (US) in Tables K.3 and K.4.

To ensure comparability of calculations carried out in accordance with this document, where national legislation mandates the use of specific GHG emission factors, users should use the most current official GHG emission factors and sources available. For locations outside Europe and the US where no nationally mandated values apply, users can identify an alternate source, including from Tables K.1 K.2, K.3 and K.4 or their own values, if in accordance with this document.

Users should also check whether official sources have updated their values, so the most current values for an official data source can be applied.

NOTE 1 The factors from the GREET®[1)] database[22] are recognized as an official source by the US government.

NOTE 2 In Tables K.1, K.2, K.3 and K.4, diesel and gasoline refers to 100 % mineral diesel and gasoline not bioblends, synthetic or other boutique fuels.

NOTE 3 All the GHG emission factors in Tables K.1, K.2, K.3 and K.4 were calculated using the GWP 100a (without climate-carbon feedback) in accordance with IPCC 2013[44].

The operational GHG emissions from gaseous fuels should be considered in a different way than for other fuels. The extent of the methane slip varies according to the engine technology, the way the engine is run and any GHG emission abatement technology that is fitted. The legislation that applies to engines used in different situations also varies, with different limits on methane emissions applying by location and mode.

1) GREET® is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

**Table K.1 — European GHG emission factors for liquid fuels and electricity**

| Energy carrier | Lower heating value<br>in MJ/ kg | Density<br>in kg/l | GHG emission (operational)<br>in g $CO_{2e}$/MJ | GHG emission (total)<br>in g $CO_2$e/MJ (total) | GHG emission (operational)<br>in kg $CO_2$e/kg | GHG emission (total)<br>in kg $CO_2$e/kg (total) | Source |
|---|---|---|---|---|---|---|---|
| Gasoline | 42,5 | 0,743 | 75,1 | 90,1 | 3,19 | 3,83 | [17] |
| Ethanol (40 % maize, 35 % sugar beet, 25 % wheat) | 27 | 0,78 | 0,3 | 48,2 | 0,01 | 1,30 | [21] |
| Diesel | 42,8 | 0,832 | 74,1 | 87,3 | 3,17 | 3,74 | [17] |
| Biodiesel (50 % rapeseed, 40 % used cooking oil, 10 % soybean) | 37 | 0,892 | 4,1 | 38,3 | 0,15 | 1,42 | [21] |
| LPG | 45,5 | 0,55 | 67,1 | 81,6 | 3,05 | 3,71 | [17] |
| Jet kerosene (Jet A1 and Jet A) | 43 | 0,8 | 73,5 | 84,7 | 3,16 | 3,64 | [17][20] |
| HFO (2,5 % sulfur) | 41,2 | 0,97 | 76,8 | 85,4 | 3,17 | 3,52 | [17] |
| Light fuel oil (LFO) (0,1 % sulfur) | 42,6 | 0,86 | 75,3 | 86,5 | 3,21 | 3,69 | [17] |
| Hydrogen from steam reforming of natural gas | 120 | not applicable | 0 | 114,4 | 0 | 13,73 | [18] |
| HVO[a]/HEFA (SAF) (50 % rapeseed, 50 % used cooking oil) | 44 | 0,77 | 0,1 | 28,6 | 0 | 1,26 | [21] |
| Electricity European average (EU 28, 2019, including average losses) | not applicable | not applicable | 0 | 97 | not applicable | not applicable | [21] |

[a] HVO (hydrotreated vegetable oil) may also be used as a marine biofuel.

**Table K.2 — European GHG emission factors for gaseous fuels including methane slip**

| Energy carrier | Example application | Lower heating value<br>in MJ/ kg | Density<br>in kg/l | GHG emission (operational)<br>in g $CO_2$e/MJ | GHG emission (total)<br>in g $CO_2$e/MJ (total) | GHG emission (operational)<br>in kg $CO_2$e/kg | GHG emission (total)<br>in kg $CO_2$e/kg (total) | Source |
|---|---|---|---|---|---|---|---|---|
| CNG | Europe spark ignition truck | 49,2 | not applicable | 56,6 | 72,7 | 2,79 | 3,58 | [18] |
| LNG | Europe spark ignition truck | 49,1 | not applicable | 57,9 | 75,5 | 2,84 | 3,71 | [18] |
| Bio-CNG (40 % maize, 40 % manure, 20 % biowaste) | | 50 | not applicable | 1,5 | 26,2 | 0,08 | 1,31 | [18][21] |
| Bio-LNG (40 % maize, 40 % manure, 20 % biowaste) | | 50 | not applicable | 1,5 | 30,4 | 0,08 | 1,52 | [18][21] |
| LNG | Otto dual fuel ship (medium speed) | 49,1 | not applicable | 73,6 | 91,2 | 3,61 | 4,48 | [18][19] |
| LNG | Otto dual fuel ship (slow speed) | 49,1 | not applicable | 66,0 | 83,6 | 3,24 | 4,10 | [18][19] |

NOTE 1 GHG emission factors can differ to the ones shown in this table when using other types of feedstock (e.g. waste) for producing the fuel.

NOTE 2 GHG emission factors from Reference [18] were updated to reflect the GWP 100a (without climate carbon feedback) in accordance with IPCC 2013.

NOTE 3 Operational non-$CO_2$ GHG emissions are taken from Reference [22]. Their actual values can vary between different vehicles/engine types and after treatment systems.

**Table K.3 — North American GHG emission factors for liquid fuels and electricity**

| Energy carrier | Lower heating value<br>in MJ/ kg | Density<br>in kg/l | GHG emission (operational)<br>in g $CO_2$e/MJ | GHG emission (total)<br>in g $CO_2$e/MJ | GHG emission (operational)<br>in kg $CO_2$e/kg | GHG emission (total)<br>in kg $CO_2$e/kg | Source |
|---|---|---|---|---|---|---|---|
| Gasoline | 41,7 | 0,749 | 73,0 | 90,2 | 3,04 | 3,76 | [22] |
| Ethanol (corn) | 27,0 | 0,789 | 0,3 | 55,6 | 0,01 | 1,49 | [22] |
| Diesel | 42,6 | 0,847 | 75,0 | 90,5 | 3,20 | 3,86 | [22] |
| Biodiesel (soybean) | 37,7 | 0,881 | 4,1 | 20,6 | 0,15 | 0,78 | [22] |
| HVO (tallow) | 44,0 | 0,779 | 0,05 | 17,7 | 0,002 | 0,78 | [22] |
| LPG | 46,6 | 0,508 | 64,8 | 78,5 | 3,02 | 3,66 | [22] |
| Jet kerosene (Jet A1 and Jet A) | 43,2 | 0,802 | 73,2 | 84,6 | 3,16 | 3,65 | [22] |
| HFO (2,7 % sulfur) | 39,5 | 0,991 | 81,7 | 94,3 | 3,23 | 3,72 | [22] |
| Very low sulfur fuel oil (VLSFO) (0,5 % sulfur) | 39,5 | 0,991 | 81,7 | 95,6 | 3,23 | 3,78 | [22] |
| Ultra low sulfur fuel oil (ULSFO) (0,1 % sulfur) | 39,5 | 0,991 | 81,7 | 95,9 | 3,23 | 3,79 | [22] |
| MDO (0,5 % sulfur) | 41,0 | 0,914 | 78,6 | 92,1 | 3,22 | 3,78 | [22] |
| Marine gas oil (MGO) (1,0 % sulfur) | 42,8 | 0,837 | 75,2 | 87,8 | 3,22 | 3,76 | [22] |
| Electricity US (2019) (including average losses) | not applicable | not applicable | 0 | 118 | not applicable | not applicable | [23] |

**Table K.4 — North American GHG emission factors for gaseous fuels**

| Energy carrier | Example application | Lower heating value<br>in MJ/ kg | Density<br>in kg/l | GHG emission (operational)<br>in g $CO_2$e/MJ (operational) | GHG emission (total)<br>in g $CO_2$e/MJ (total) | GHG emission (operational)<br>in kg $CO_2$e/kg (operational) | GHG emission (total)<br>in kg $CO_2$e/kg (total) | Source |
|---|---|---|---|---|---|---|---|---|
| CNG | North America spark ignition truck | 47,1 | not applicable | 56,8 | 73,7 | 2,67 | 3,47 | [22] |
| LNG | North America spark ignition truck | 48,6 | not applicable | 57,0 | 76,7 | 2,77 | 3,72 | [22] |
| NOTE Operational non-$CO_2$ GHG emissions can vary between different vehicles/engine types and after treatment systems. | | | | | | | | |

# Annex L
(informative)

# Additional guidance for allocation to passenger according to passenger class of travel

## L.1 Guidance for the calculation of class factors based on area per seat and occupancy rate per class

### L.1.1 General case

The calculation of the class factor considering both the area per seat and the occupancy rate per class may be implemented using the following steps, within a given TOC:

— Step 1: The $f$ different classes $C_k$ ($k$ from 1 to $f$) should be identified and sorted in ascending order, from $C_1$ being the lowest to $C_f$ being the highest.

— Step 2: The $u$ different vehicle configurations $L_i$ ($i$ from 1 to $u$) should be identified, based on the different areas for each class for each vehicle configuration and data regarding these areas should be collected.

— Step 3: The average area per passenger for each class $C_k$ may be calculated, using Formula (L.1):

$$\Phi_{C_k} = \frac{\sum_1^u A_{C_k,L_i} \times s_{L_i}}{\sum_1^u T_{C_k,L_i}} \quad \text{(L.1)}$$

where

$\Phi_{C_k}$ is the average area per passenger for class $C_k$;

$A_{C_k,L_i}$ is the area for class $C_k$ within vehicle configuration $L_i$;

$s_{L_i}$ is the transport activity distance, in kilometres, of vehicle configuration $L_i$;

$T_{C_k,L_i}$ is the transport activity, in passenger kilometres, for class $C_k$ within vehicle configuration $L_i$;

$u$ is the number of vehicle configurations $L_i$.

— Step 4: a class factor for each class $z_{C_k}$ that characterizes the average area per passenger for each class $C_k$, compared to $C_1$, may be calculated, using Formula (L.2):

$$z_{C_k} = \frac{\Phi C_k}{\Phi C_1} \quad \text{(L.2)}$$

where

$z_{C_k}$ is the class factor for class $C_k$;

$\Phi C_k$ is the average area per passenger for class $C_k$.

NOTE By definition, $z_{C1} = 1$.

### L.1.2 Simplified calculation of average area per passenger for each class

Vehicle configurations within the TOC can be numerous and they can differ regarding, for example, area per seat or share of seats per class. This is why Formula (L.1) is given in L.1.1 for calculation of the average area per passenger. However, if they are identical, then the area per seat (for planes) or the number of seats per coach (for trains) and the occupancy rate can be used, and Formula (L.3) can be applied:

$$\Phi_{C_k} = \frac{\vartheta_{C_k}}{\chi_{C_k}} \quad \text{(L.3)}$$

where

| | |
|---|---|
| $\Phi_{C_k}$ | is the average area per passenger for class $C_k$; |
| $\vartheta_{C_k}$ | is the average area per seat for class $C_k$; |
| $\chi_{C_k}$ | is the occupancy rate for class $C_k$. |

## L.2 Use of plceq unit

As a consequence of Formula (L.2), the transport activity expressed in passenger of lowest class equivalent $C_1$ kilometres (plceqkm) for class $C_k$ equals the transport activity expressed in passenger kilometres (pkm) of class $C_k$ multiplied by the class factor $z_{C_k}$ of class $C_k$.

The examples in Clauses L.3 and L.4 illustrate utilization of this property.

## L.3 Air transport

### L.3.1 General

L.3.2 and L.3.3 present two examples of the calculation of class factors, illustrating the guidance of calculation of class factor based on both area per seat and occupancy rate per class, presented in Clause L.1.

Then, default class factor values provided by IATA are presented in L.3.4.

### L.3.2 Example of calculation of class factors and GHG emissions intensities for a TOC of flights with four classes

Up to four cabin classes are available sometimes, especially on long haul flights.

Tables L.1 and L.2 give examples of calculations for a TOC of flights performed by identical planes with four classes, based on guidance presented in Clause L.1.

**Table L.1 — Example of calculation of class factors $z_{C_k}$ for a TOC of flights with four classes**

| TOC of flights with four classes | | | | | |
|---|---|---|---|---|---|
| Class | | Area per seat<br>m² | Occupancy rate/ load factor<br>% | Area per passenger<br>m² | Class factor<br>$z_{C_k}$ |
| $C_1$ | Economy | 0,400 | 85 | 0,471 | 1,00 |
| $C_2$ | Premium economy | 0,600 | 80 | 0,750 | 1,59 |
| $C_3$ | Business | 1,200 | 75 | 1,600 | 3,40 |
| $C_4$ | First class | 1,800 | 70 | 2,571 | 5,46 |
| All classes | | 0,570 | 83 | 0,689 | 1,46 |
| NOTE Underlined values are assumptions for this example. Other values are calculated. | | | | | |

**Table L.2 — Example of calculation of GHG emission intensities $g_{TOC,C_k}$ for a TOC of flights with four classes**

| TOC of flights with four classes | | | | | | |
|---|---|---|---|---|---|---|
| Class | | Transport activity<br>pkm<br>$T_{TOC,C_k}$ | Class factor<br>$z_{C_k}$ | Transport activity<br>plceqkm<br>$T_{TOC,C_k}$ | GHG emission intensity per pkm<br>$kgCO_2e/pkm$<br>$g_{TOC,C_k}$ | GHG emission intensity per plceqkm<br>$kgCO_2e/plceqkm$<br>$g_{TOC,C_k}$ |
| $C_1$ | Economy | 1 540 785 | 1,00 | 1 540 785 | 0,068 | 0,068 |
| $C_2$ | Premium economy | 135 347 | 1,59 | 215 710 | 0,109 | |
| $C_3$ | Business | 290 030 | 3,40 | 986 103 | 0,232 | |
| $C_4$ | First class | 33 837 | 5,46 | 184 894 | 0,373 | |
| All classes | | 2 000 000 | 1,46 | 2 927 492 | 0,100 | |
| NOTE Underlined values are assumptions for this example. Other values are calculated. | | | | | | |

## L.3.3 Example for a TOC of flights with two classes

Two cabin classes are common in medium haul flights and some long-haul flights (charters). They are also available in some short-haul flights.

Tables L.3 and L.4 give an example of calculation for a TOC of identical planes with two classes, based on guidance presented in Clause L.1.

**Table L.3 — Example of calculation of class factors $z_{C_k}$ for a TOC of flights with two classes**

| TOC of flights with two classes | | | | | |
|---|---|---|---|---|---|
| Class | | Area per seat<br>m² | Occupancy rate/ load factor<br>% | Area per passenger<br>m² | Class factor<br>$z_{C_k}$ |
| $C_1$ | Economy | 0,400 | 90 | 0,444 | 1,00 |
| $C_2$ | Premium | 0,600 | 70 | 0,857 | 1,93 |
| All classes | | 0,440 | 86 | 0,512 | 1,15 |
| NOTE Underlined values are assumptions for this example. Other values are calculated. | | | | | |

**Table L.4 — Example of calculation of GHG emission intensities $g_{TOC,C_k}$ for a TOC of flights with two classes**

| TOC of flights with two classes | | | | | | |
|---|---|---|---|---|---|---|
| Class | | Transport activity pkm $T_{TOC,C_k}$ | Class factor $z_{C_k}$ | Transport activity plceqkm $T_{TOC,C_k}$ | GHG emission intensity per pkm $kgCO_2e$/pkm $g_{TOC,C_k}$ | GHG emission intensity per plceqkm $kgCO_2e$/plceqkm $g_{TOC,C_k}$ |
| $C_1$ | Economy | 1 674 419 | 1,00 | 1 674 419 | 0,087 | 0,087 |
| $C_2$ | Premium | 325 581 | 1,93 | 627 907 | 0,168 | |
| All classes | | 2 000 000 | 1,15 | 2 302 326 | 0,100 | |
| NOTE Underlined values are assumptions for this example. Other values are calculated. | | | | | | |

### L.3.4 Class factors recommended by IATA

In April 2022 IATA published a Recommended Practice (RP 1726) titled "Passenger $CO_2$ Calculation Methodology"[54], which includes the principles of cabin class differentiation, and recommends the use of the class factors given in Table L.5.

These class factors may be used directly instead of calculating them. The latest version of these class factors published by IATA should be used.

**Table L.5 — Class factors $z_{C_k}$ recommended by IATA[54]**

| Aircraft type | Class $C_k$ | | | |
|---|---|---|---|---|
| | Economy $C_1$ | Premium economy $C_2$ | Business $C_3$ | First $C_4$ |
| Narrow-body aircraft | 1 | 1 | 1,5 | 1,5 |
| Wide-body aircraft | 1 | 1,5 | 4 | 5 |

## L.4 Rail transport

### L.4.1 General

Transport of passengers by rail often offers two different classes, available in separate coaches of the same dimension, which facilitates a comparison according to area per seat.

Depending on activities, detailed statistics on transport activity per class may not be available, even for rail companies themselves.

L.4.2, L.4.3 and L.4.4 present three examples of calculation of class factors, illustrating the guidance of calculation of class factor based on both area per seat and occupancy rate per class, presented in Clause L.1.

### L.4.2 Example of calculation of class factors and GHG emissions intensities for a TOC of double deck trains with two classes

Tables L.6 and L.7 give an example of calculation for a TOC of identical double-deck trains with two classes, based on guidance presented in Clause L.1.

**Table L.6 — Example of calculation of class factors $z_{C_k}$ for a TOC of double decker trains with two classes**

| TOC of double decker trains with two classes | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Class** | | **Number of seats per train** | **Number of coaches per train** | **Number of seats per coach** | **Occupancy rate/load factor** % | **Number of passengers per coach** | **Class factor** $z_{C_k}$ |
| $C_1$ | 2nd | 320 | 4 | 80 | 85 | 68,0 | 1,00 |
| $C_2$ | 1st | 180 | 3 | 60 | 80 | 48,0 | 1,42 |
| All classes | | 500 | 7 | 71,4 | 83 | 59,4 | 1,14 |
| NOTE Underlined values are assumptions for this example. Other values are calculated. | | | | | | | |

**Table L.7 — Example of calculation of GHG emission intensities $g_{\text{TOC},C_k}$ for a TOC of double decker trains with two classes**

| TOC of double deck trains with two classes | | | | | | |
|---|---|---|---|---|---|---|
| **Class** | | **Transport activity** pkm $T_{\text{TOC},C_k}$ | **Class factor** $z_{C_k}$ | **Transport activity** plceqkm $T_{\text{TOC},C_k}$ | **GHG emission intensity per pkm** $kgCO_2e/pkm$ $g_{\text{TOC},C_k}$ | **GHG emission intensity per plceqkm** $kgCO_2e/plceqkm$ $g_{\text{TOC},C_k}$ |
| $C_1$ | 2nd | 1 307 692 | 1,00 | 1 307 692 | 0,001 75 | 0,001 75 |
| $C_2$ | 1st | 692 308 | 1,42 | 980 769 | 0,002 48 | |
| All classes | | 2 000 000 | 1,14 | 2 288 462 | 0,002 00 | |
| NOTE Underlined values are assumptions for this example. Other values are calculated. | | | | | | |

### L.4.3 Example of calculation of class factors and GHG emissions intensities for a TOC of regional or commuter trains with two classes

Tables L.8 and L.9 give an example of calculation for a TOC of identical regional or commuter trains with two classes, based on guidance presented in Clause L.1.

**Table L.8 — Example of calculation of class factors $z_{C_k}$ for a TOC of regional or commuter trains with two classes**

| TOC of regional or commuter trains with two classes | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Class** | | **Number of seats per train** | **Number of coaches per train** | **Number of seats per coach** | **Occupancy rate/load factor** % | **Number of passengers per coach** | **Class factor** $z_{C_k}$ |
| $C_1$ | 2nd | 450 | 7 | 64,3 | 90 | 57,9 | 1,00 |
| $C_2$ | 1st | 150 | 4 | 37,5 | 50 | 18,8 | 3,09 |
| All classes | | 600 | 11 | 54,5 | 80 | 43,6 | 1,33 |
| NOTE Underlined values are assumptions for this example. Other values are calculated. | | | | | | | |

**Table L.9 — Example of calculation of GHG emission intensities $g_{TOC,C_k}$ for a TOC of regional or commuter trains with two classes**

| TOC of regional or commuter trains with two classes | | | | | | |
|---|---|---|---|---|---|---|
| Class | | Transport activity pkm<br>$T_{TOC,C_k}$ | Class factor<br>$z_{C_k}$ | Transport activity plceqkm<br>$T_{TOC,C_k}$ | GHG emission intensity per pkm $kgCO_2e/pkm$<br>$g_{TOC,C_k}$ | GHG emission intensity per plceqkm $kgCO_2e/plceqkm$<br>$g_{TOC,C_k}$ |
| $C_1$ | 2nd | 1 687 500 | 1,00 | 1 687 500 | 0,018 86 | 0,018 86 |
| $C_2$ | 1st | 312 500 | 3,09 | 964 286 | 0,058 18 | |
| All classes | | 2 000 000 | 1,33 | 2 651 786 | 0,025 00 | |
| NOTE Underlined values are assumptions for this example. Other values are calculated. | | | | | | |

### L.4.4 Example of calculation of class factors and GHG emissions intensities for a TOC of night trains with three classes

Tables L.10 and L.11 give an example of calculation for a TOC of identical night trains with three classes, based on guidance presented in Clause L.1.

**Table L.10 — Example of calculation of class factors $z_{C_k}$ for a TOC of night trains with three classes**

| TOC of night trains with three classes | | | | | | | |
|---|---|---|---|---|---|---|---|
| Class | | Number of seats per train | Number of coaches per train | Number of seats per coach | Occupancy rate % | Number of passengers per coach | Class factor $z_{C_k}$ |
| $C_1$ | Reclining seat | 90 | 3 | 30 | 90 | 27,0 | 1,00 |
| $C_2$ | 6-berth compartment | 72 | 3 | 24 | 80 | 19,2 | 1,41 |
| $C_3$ | 4-berth compartment | 32 | 2 | 16 | 70 | 11,2 | 2,41 |
| All classes | | 194 | 8 | 24,3 | 83 % | 20,1 | 1,34 |
| NOTE Underlined values are assumptions for this example. Other values are calculated. | | | | | | | |

**Table L.11 — Example of calculation of GHG emission intensities $g_{TOC,C_k}$ for a TOC of night trains with three classes**

| TOC of night trains with three classes | | | | | | |
|---|---|---|---|---|---|---|
| Class | | Transport activity pkm<br>$T_{TOC,C_k}$ | Class factor<br>$z_{C_k}$ | Transport activity plceqkm<br>$T_{TOC,C_k}$ | GHG emission intensity per pkm $kgCO_2e/pkm$<br>$g_{TOC,C_k}$ | GHG emission intensity per plceqkm $kgCO_2e/plceqkm$<br>$g_{TOC,C_k}$ |
| $C_1$ | Reclining seat | 1 006 211 | 1,00 | 1 006 211 | 0,022 36 | 0,022 36 |
| $C_2$ | 6-berth compartment | 715 528 | 1,41 | 1 006 211 | 0,031 45 | |
| $C_3$ | 4-berth compartment | 278 261 | 2,41 | 670 807 | 0,053 91 | |
| All classes | | 2 000 000 | 1,34 | 2 683 230 | 0,030 00 | |
| NOTE Underlined values are assumptions for this example. Other values are calculated. | | | | | | |

# Annex M
(informative)

# General guidance on the approach to modelling of GHG emissions of transport chains

## M.1 General

The reason for including the option to use modelled data as an input to the calculation of GHG emissions within a transport chain is to allow for situations when a full set of primary data is not available and hence additional data are needed. The algorithm used by a model to perform the calculations uses the primary data that are available and fills gaps with secondary data that represent the best available approximation of the missing data given the type and nature of the transport operations being modelled. The intention is that the model outputs are the best possible representation of actual GHG emissions, related transport or hub activity and/or GHG emission intensity for a TOC or HOC. Hence, modelling is applicable if the outcome is expected to be a more accurate representation of actual GHG emissions or GHG emission intensity than estimations based on the best available default values. This can be achieved in situations where the model combines the parameters that influence fuel consumption and hence production of GHG emissions in a way that closely resembles actual values. Model outputs have the potential to be more representative than default values because modelling offers the flexibility to fill gaps in the primary data in a dynamic way according to the full range of parameter combinations available, in contrast to the specific assumptions associated with an individual default value.

The parameters that are relevant will vary according to the type of model used, the intended level of data disaggregation and the mode of transport, e.g. GHG emissions from waterborne transport are, among other factors, a function of currents for sea transport and direction of flow for inland waterways.

It is not the intention of this document to recommend certain models or even model types. In Clauses M.2 to M.5, two model types are introduced briefly, along with the main parameters that may be used in such models and the uses appropriate for that modelled data in order to add transparency in cases where modelled data are used.

## M.2 Model types

Determining GHG emissions of transport operations and relating this to the transport operations performed requires two sets of input information:

a) the energy use, which when combined with the appropriate GHG emission factor determines the corresponding GHG emissions;

b) the amount of transport activity carried out, which can be both an input to the calculation of the energy use and GHG emissions and the denominator in the formula for calculating the GHG emission intensity.

There are two main types of model that can be considered as being relevant for the intended use within this document, which use two alternative routes to reach a comparable end point as follows:

— Energy based:

  — Modelling of the transport operation system at vehicle level, to include vehicle type, routing, energy type, etc. The potential need to model the kilometres driven if the exact route is not known may be a component of energy-based modelling.

  - The level of detail can vary depending on the exact combination of parameters that are included. For example, modelling can be conducted based on vehicle dynamics based on the detailed powertrain, general equipment configuration and operating parameters of a specific vehicle type, potentially to model level (or even variation thereof), in combination with one or more drive-cycles (representing the operational profile required of the vehicle).
  - This type of model has the potential to be very specific and to compare the impact of changes to both vehicle and/or operating configuration and the journey characteristics. Hence, this type of model is well-suited to individual vehicle or trip analysis and for building bottom-up GHG emission calculations.
- Activity based:
  - Activity-based models tend to be empirical in nature, based on an agreed understanding of the transport activity as a given input to the model, and then taking into account a range of parameters that represent the general variation of a type of transport operation in response to variations in the vehicle, operation and journey characteristics, correlating with observed behaviour.
  - This type of model is more suited to top-down, fleet level analysis and is often applied by the users of transport operations who often lack the information necessary to perform energy-based calculations.
  - Such models can lack flexibility and the specificity associated with energy-based models as they relate to generic scenarios of transport system operation. Nonetheless, they can be useful to fill gaps between the isolated points that are represented by default GHG emission intensities providing continuous performance curves.
  - The accuracy of the model outputs will depend on the homogeneity of the TOC being modelled, the correlation between the observed and actual behaviour of the transport operation in question, the parameters that are included and the mathematical relationships that are used to represent their interaction.

Whichever model type is used, the parameters and their method of application shall be documented and applicable to the modelled system, ideally at consignment level.

## M.3 Model parameters

The subject of how to model GHG activity data is not within the scope of this document. However, by requiring the parameters that are taken into account within a modelling approach to be listed later in this clause, the intention is to improve transparency and hence provide the user to understand the coverage and potential shortcomings of reliance on a particular modelling approach. This requirement also serves the purpose of verifiability by third-party assurance providers in cases where the reliability and quality of computations need to be audited.

As per the note to the definition of modelling parameters such as vehicle size, load factor, fuel type and quality, topography and speed all have an impact on both operational GHG emissions and GHG emission intensity. The way in which these and other potentially relevant parameters interact to influence the GHG emission profile varies according to the mode of transport and the associated journey characteristics. For example, overall mass, which comprises the vehicle's unladen mass, and actual load (up to the legal maximum for the vehicle category in question) have a greater effect in hilly terrain and in stop-start driving conditions.

The taxonomy for definition of TOCs in each of the modal annexes is based on those parameters considered most influential in determining the GHG emissions. The application of these influential parameters ensures a basic level of homogeneity within each category. The three broad groups of influencing parameters are as follows:

- Vehicle-related:
  - vehicle class/fleet profile:
    - energy consumption profile;
  - vehicle configuration:
    - body type/empty vehicle mass;
    - engine type;
    - engine emission class;
    - energy carrier(s) used in vehicle (electric, liquid fuel, etc.):
      - share of energy carrier.
- Operational:
  - freight type:
    - freight requirements (e.g. temperature control/hazardous);
    - use of specific container types;
  - load factor or average load expressed in tonnes;
  - service type (e.g. full truckload/less than truckload, full container load/less than container load);
  - extent of empty trips.
- Journey characteristics:
  - routing, including location of intermediate stops:
    - lane characteristics;
    - location parameters (e.g. origin, destination);
    - direct/via locations/multiple collection and delivery;
  - drive-cycle:
    - road type/channel type;
    - urban/mixed/long-haul:
      - frequency of stops;
      - speed profile;
    - topography;
  - geographic region of applicability;
  - currents/flow rate/head, cross or tail wind and windspeed.

The list is not considered exhaustive and the items mentioned are not prioritized over other items that can be possibly chosen by the user.

## M.4 Data categories

The most accurate calculation result should result from the use of primary data. In most cases, primary data should be available to the transport operator or carrier. Additional public data sources can be used to enable the availability of primary data (e.g. flight timetables or information linked to the registration plate or chassis number).

Modelling is required when a full set of primary data is unavailable, with the disadvantage of lower accuracy levels. Hence, modelling outputs can be considered as a form of secondary data.

The alternative form of secondary data in this context (default GHG emission intensities) is based on a static set of assumptions, and therefore provides a representative snapshot based on one specific combination of parameters that is broadly representative of a TOC. Default GHG emission intensities can be produced from either aggregated primary data or from modelling that has been reconciled with primary data.

Whichever data type is used, the data within it can vary significantly in quality:

— primary data can vary in quality depending on the method of collection and whether any data verification has taken place);

— models vary according to the parameters that are taken into account and the accuracy of the algorithm that combines them;

— defaults vary according to the basis upon which they are established and how closely they relate to the most common operating characteristics of actual transport operations.

Hence, transparency in all three cases, not just for modelled data, is important to put the calculation outputs in context.

## M.5 Uses

In many cases, it is likely that calculations will be based on a mix of data sources that combine primary data, modelled data and default values, sometimes making it difficult to clearly distinguish the categories.

In general, the use of primary energy or GHG emission data by operators is preferred, as the expectation is that transport operators should have access to such data for energy-related calculations. Hence, transport operators should aim to report GHG emissions to their users in accordance with 7.2 using primary data, or secondary data as a supplement, e.g. regarding the freight transported, only when necessary.

Use of modelled data is more likely by transport service users or organizers who, for whatever reason, do not have access to information that is based on primary data. Potential reasons are manifold, including information about GHG emission intensities not being provided by transport operators, but also the need to access supplementary information about the transport networks used to transport their freight, so filling gaps in knowledge about how freight is transported on multi-leg journeys between the ultimate origin and destination locations that are known to them.

With these caveats in mind, previous consultation with industry partners identified the following as generally accepted uses for modelled data:

— By purchasers of transport services:

  — ex-post calculation of total emissions per transport service and at company level;

  — ex-post calculation of emission intensity per transport service and at company level;

  — ex-ante estimation of emission impacts of modal switch;

  — ex-ante estimation of emission impacts of supply chain redesign;

  - ex-ante estimation of emission impacts of horizontal collaboration (e.g. load sharing).
- By transport operators, to be confirmed by primary data after implementation:
  - ex-ante and ex-post estimation of the amount of goods carried for specific accounts;
  - ex-ante estimation of emissions by different routes;
  - ex-ante estimation of emission impacts of load consolidation;
  - ex-ante estimation of emission impacts of vehicle sizing and purchase choices;
  - ex-ante estimation of emission impacts of different energy carriers.

# Annex N
(informative)

# Additional guidance for use of ICT equipment and data servers related to transport operations

## N.1 Background and motivation

More and more transport for passengers and, in particular, for freight is supported and enabled by ICT, for activities such as identification of transport options, booking of the transport, tracking and tracing of the transport, monitoring of the transport (e.g. temperature control), customs clearing, etc. Digitalization and encrypting technologies such as blockchain technology further increase this use of ICT. The related data needs to be generated, processed and stored, and is directly related to transport operations. It is estimated that emissions from ICT already in 2021 equalled 2,1 to 3,9 % of all human-made $CO_2$ emissions,[53] making them almost double as high as emissions resulting from aviation. This confirms the relevance of the inclusion of GHG emissions from ICT equipment for transport operations.

This annex gives guidelines on estimating the GHG emissions of ICT for transport operations arising from the exchange, storage, management and use of data in order to support the identification of GHG emissions of the entire transport chain.

## N.2 Data operations to be included in ICT GHG emission calculations

All GHG emissions related to ICT are indirect GHG emissions, arising during:

- preparation of a transport, including:
  - identification of transport options;
  - booking of the transport;
  - development of electronic transport documents;
  - customs-clearing-related processes;
- transport operation:
  - tracing and tracking of the transport;
  - monitoring of the transport (e.g. temperature control);
- logistics processes following the transport and related directly to it:
  - finalization of transport documentation;
  - customs-clearing-related processes.

Data operations to be excluded from the calculation of GHG emissions from ICT include:

- the capture of data for temperature-controlled operations because the GHG emission calculation of temperature-controlled operations are specified separately;
- any production or end-of-life processes relevant for the ICT infrastructure.

## N.3 Quantification of GHG emissions

### N.3.1 General

The user should quantify the number of data transfers relevant for the transport operation.

The approach suggested in this annex distinguishes two different applications of ICT for transport operations with resultant different approaches for the quantification of the number of data transfers.

### N.3.2 Continuously tracked and traced transport chains of freight and passengers

The user should apply Formula (N.1):

$$\psi_{data} = \psi_{data,prep} + (\psi_{data,av,km} \times s) + \psi_{data,fin} \quad (N.1)$$

where

$\psi_{data}$ is the total number of data transfers of preparation, carrying out and finalization of transport operation;

$\psi_{data,prep}$ is the organization's average number of data transfers per preparation of operation;

$\psi_{data,av,km}$ is the average number of data transfers per km of transport operation;

$s$ is the average SFD of the transport operations;

$\psi_{data,fin}$ is the organization's average number of data transfers per finalization of operation.

### N.3.3 Transport chains with set monitoring points

The user should apply Formula (N.2):

$$\psi_{data} = \psi_{data,prep} + \psi_{data,av} + \psi_{data,fin} \quad (N.2)$$

where

$\psi_{data}$ is the total number of data transfers of preparation, carrying out and finalization of transport operation;

$\psi_{data,prep}$ is the organization's average number of data transfers per preparation of operation;

$\psi_{data,av}$ is the average number of data transfers per transport operation;

$\psi_{data,fin}$ is the organization's average number of data transfers per finalization of operation.

The conversion of the number of data transfers into indirect GHG emissions shall be made using Formula (N.3):

$$G_{ICT} = \psi_{data} \times \varepsilon_{data} \quad (N.3)$$

where

$G_{ICT}$ is the total indirect GHG emissions of transport-operation-related ICT;

$\psi_{data}$ is the total number of data transfers of preparation, carrying out and finalization of transport operation;

$\varepsilon_{data}$ is the indirect GHG emission factor for data transfers.

The user should use the value of 10,0 g $CO_2$e per data transfer.

This value is based on the following consideration: depending upon the complexity of the TCE and the use of mobile versus desktop usage, information exchange causes 5 g to 25 g.[35][36][51][52] A value representing the geometric mean between 5 g and 25 g is 10 g $CO_2$e per TCE.

# Annex O
(informative)

# Quantification of GHG emissions arising from (re)packaging processes at logistics hubs

## O.1 General

The normative part of this document covers the GHG emissions caused by the additional mass of the transport packaging that is needed in the course of the transport chain, e.g. related fuel consumption of vehicles. At logistics hubs, the consolidation of shipments, as well as changing their physical character by order picking, customizing or (re)packing process, is a relevant task. Hub operators are responsible for preparation of onward transport and can be interested in quantifying the GHG emissions related to this responsibility and their selection and use of transport packaging.

(Re)packing processes refer to freight transport chains. No passenger transport chains are considered in this annex.

This annex refers to those GHG emissions that arise during the packaging life cycle, i.e.:

— provision processes (e.g. upstream processes such as production of transport packaging or transport for supply to the point of use at the logistics hub);

— (re)packing processes requiring energy use;

— end-of-life processes (e.g. downstream processes such as collection of waste from transport packaging, reuse or recycling and end of life treatment).

GHG emissions that arise from returning multi-use transport packaging (e.g. reverse logistics, empty container handling, balancing transport in pooling-systems) should be calculated as described in Clauses 7 to 12, because in those cases the multi-use transport packaging is freight to be transported/handled.

## O.2 (Re)packaging process specific boundary

Those hub operations needed for (re)packing freight that consume transport packaging material, energy or cause transport packaging waste are included.

Energy consumption for (re)packing processes is often of low impact on GHG emissions at logistics sites. The user may balance the effort of collecting detailed energy consumption of equipment used in (re)packing processes and the overall impact on the GHG emission result. It can also occur that this energy consumption is already covered in the general hub GHG emissions quantification due to simplification.

## O.3 Calculation parameter

The allocation parameter “tonnes throughput” should be used.

In addition to the mass, other relevant units (e.g. $m^2$, $m^3$, number of items, number of vehicles) may be used for transport activity.

## O.4 Transport packaging specific issues — GHG emission factors for transport packaging

GHG emission factors for the same type of transport packaging can vary in different geographical settings.

EXAMPLE The production of plastic foil includes varying shares of recycled plastics. The end-of-life management of waste fractions varies in different geographical regions.

GHG emission factors cover the following provision and end-of-life processes:

— extraction, processing and transport of primary resources, and production of transport packaging;

— transport to the point of use;

— collection transport of waste fractions, and end-of-life processes of related waste fractions, including credits for possible reuse of material.

References [45] to [49] are examples of databases covering GHG emission factors for different types of transport packaging, some of which focus on specific types or regions, partly with licensed access. It is recommended to use the newest data sets.

# Annex P
(informative)

# Quantification of black carbon emissions from transport operations

## P.1 Background and motivation

This annex gives guidelines on estimating black carbon emissions for transport operations.

Black carbon is not currently considered to be included within the definition of GHG emissions. It is a carbonaceous component of particulate matter, especially of fine and ultrafine particles. More specifically, black carbon comprises the carbonaceous solid form of light-absorbing carbon also known as “soot.” black carbon strongly absorbs solar radiation (light) at all wavelengths throughout the ultraviolet (UV) visible spectrum from short waves to UV.

Black carbon can be emitted along with brown carbon. Brown carbon is another carbonaceous component of particulate matter, especially of fine and ultrafine particles, and is the carbonaceous aerosol form of light-absorbing organic matter. Brown carbon also absorbs solar radiation (light); however, it absorbs it preferentially, at near-UV wavelengths and, to a lesser extent, visible light.

Black carbon is distinguishable from carbon compounds contained in atmospheric aerosol and from other forms of carbon because it has a unique combination of the following physical properties[26]:

a) it strongly absorbs visible light with a mass absorption cross-section of at least 5 $m^2g^{-1}$ at a wavelength of 550 nm;

b) it is refractory, i.e. it retains its basic form at very high temperatures, with vaporization temperature typically near 4 000 K (although it can be lower under certain conditions);

c) it is typically insoluble in water, in common organic solvents including methanol and acetone, and in other components of atmospheric aerosol;

d) it exists as an aggregate of small carbon spherules.

Black carbon can be of interest for users of this document because it has the second biggest impact on climate forcing in the atmosphere, following carbon dioxide.[50] The impact of black carbon emissions varies in different areas: their impact is considered strongest in areas of permafrost and areas covered by snow and ice due to the resulting reduced reflection of sunlight, as well as in areas with high population density due to the impact of black carbon on human health.

The approach suggested in this annex was published by the Smart Freight Centre (see Reference [29]). This approach builds on previously developed methodologies and is aligned with the GHG Protocol[16] and the IPCC Guidance[34].

## P.2 Approach

The approach for the calculation of black carbon considers black carbon emissions related to fuel combustion that can be controlled using tailpipe exhaust emissions standards. Non-exhaust black carbon emissions and black carbon emissions linked to co-pollutants are currently not included in the methodology outlined in this annex but should be included with advanced access and ease-of use of measuring technologies in future approaches.

The rationale for this approach lies within the genesis of black carbon. Black carbon is formed in flames during combustion of carbon-based energy carriers (and, under certain conditions, through pyrolysis processes). Therefore, the suggested methodology for black carbon shares a common basis with the calculation methodology for other climate pollutants in this document.

The approach covers the transport modes of air, inland waterways, rail, road and sea.

## P.3 Quantification of black carbon emissions

The approach is carried out in five steps:

a) definition of the transport chain(s) subject of the analysis and determination of calculation tier based on data and identification of constituting TCEs;

b) gathering of fuel and shipment information (fuel use data, vehicle type, shipment mass and distance travelled), per TCE based on measured or default fuel consumption;

c) identification of black carbon emission factors per TCE;

d) calculate black carbon emissions of the transport chain by conversion of fuel use into black carbon emissions per each TCE, followed by summing up of all TCE-related black carbon emissions established;

e) report and reduce.

The black carbon emissions are the product of the fuel used and the relevant black carbon emission factor.

NOTE Black carbon emission factor depends on the fuel type, engine type and aftertreatment technology.

Black carbon from freight transport can be calculated using calculation approaches that draw from specific, known sources (always the most representative of actual emissions) to using default data. The factors are similar to assessments for other climate pollutants; transported mass, distance, vehicle information, energy carrier and fuel consumption or energy intensity value. Table P.1 illustrates this range of approaches, from the most generic using default values on the left, to the most representative using actual known values on the right.

**Table P.1 — Quality levels for black carbon emission calculation and related data sources**

| Quality level "low" | Quality level "medium" | Quality level "excellent" |
|---|---|---|
| Air, rail, inland waterway, sea: Default black carbon emission factor for each mode is in Appendix 1 of Reference [29]. | Air, rail, inland waterway, sea: Data sources for silver tier black carbon emission factors are in Appendix 3 of Reference [29]. | Data sources are listed in Appendix 3 of Reference [29]. |
| Road: Default black carbon emission factors for various vehicle size categories and regions are in Appendix 1 of Reference [29]. | Road: Black carbon emission factors are listed by vehicle size categories and engine standards are in Appendix 2 of Reference [29]. | |
| NOTE Source: Reference [29]. | | |

## P.4 Additional resources related to black carbon emissions

Other published references related to black carbon emissions include, but are not limited to, sources found in References [27] and [28].

# Annex Q
(informative)

# Selection of sources of default GHG emission intensities

Transport and hub operators and individuals should use their own primary data, in accordance with 7.2.2, as the basis for the quantification of total GHG emissions and GHG emission intensities.

Transport service organizers and transport service users should request the necessary information from their transport provider, in accordance with 7.2.1 and 7.2.6, in order to quantify the GHG emissions for the operations provided on their behalf.

Due to variations in passenger transport equipment in different parts of the world, differing expectations in terms of comfort, loading levels and a wide range of operating conditions and practices, the resulting range of transport options and GHG emission performance means that data for passenger transportation is subject to greater regional variability than for freight transport. Hence, the use of passenger transport GHG emission intensities in a different location to the one where they were derived should be treated cautiously, e.g. as an indication of the type of data that a user reliant upon default data should look for in their national context or to check locally sourced values make sense in terms of order of magnitude.

It is also anticipated that the International Civil Aviation Organization will provide default GHG emission intensities for passenger and freight transport that can be used by users where applicable.

In all cases, users are encouraged to ensure that they use the latest version of whatever data source they rely upon.

Default GHG emission intensities will, by definition, be associated with a specific set of characteristics that specify a transport or hub operating category. When choosing a set of default GHG emission intensities, users should endeavour to align the defining characteristics as closely as possible to the characteristics of the TOC. Refer to the individual referenced source for information regarding the context of each GHG emission intensity value to decide whether or not a value meets the need.

It is anticipated that the use of the values taken from the sources referred to in this annex will, primarily, be by organizations or individuals that are largely unfamiliar with the process of quantifying and reporting GHG emissions from transport chains as a starting point for their GHG emission calculations. As an organization or individual becomes more familiar with the topic, it is expected that they will feel more comfortable with working with input data that relates more directly to their actual transport activity and will, in turn, benefit from the extra accuracy from such calculations.

The sources for default values below are listed without order of preference. An organization or individual user of this document shall select default values based on their own assessment to meet the gaps related to primary data.

The GLEC Framework[15] has become established as the global industry reference point for GHG accounting and reporting for freight transport. Module 2 of the GLEC Framework[15] contains a broad set of default GHG emission intensities that is updated on a regular basis. Because modern freight transportation networks are interconnected and operated at a global level, with a relatively consistent set of equipment and operating practices, the authors of the GLEC Framework[15] have been able to provide a reasonably consistent, broadly applicable data set. The defining characteristics and resulting GHG emission intensities within the GLEC Framework[15] are designed to provide a conservative approach to GHG emission calculation results. This will help to ensure that calculations do not underestimate total GHG emissions. It should also incentivize users to seek out primary data, not only for the benefits of accuracy and gaining a better insight into GHG emission reduction actions/progress but also because the outputs from the use of primary data should, typically, be lower.

An associated reference site for logistics hubs is the REff Tool®2)[40].

Several countries have used the transport data they collect to compile national databases that they expect or recommend to be used for emission calculations within their jurisdiction. These can include freight and or passenger transport information. Examples include:

— France: the Base Carbone®2) database[41];

— Japan[42];

— the United Kingdom[43].

2) The REff Tool® and Base Carbone® are examples of suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of these products.

# Annex R
(informative)

# Comparison of GHG emission categorization used in the GHG Protocol and this document

The overview in this annex, particularly Table R.1, compares GHG emission groups within the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard[16] and this document, with the aim to contribute to a better understanding of how these concepts are related.

Regarding well-to-tank (WTT), tank-to-wheel (TTW) and well-to-wheel (WTW) GHG emissions, these are included within the GHG Protocol[16]:

— within scope 1: TTW GHG emissions of fuels used by own fleet (fuels bought/burned directly by the reporting company);

— within scope 2: WTT GHG emissions for electricity, but only scope 1 emissions of the electricity provider;

— within scope 3 (category 3): WTT GHG emissions for fuels, including emissions for fuel production and transmission losses for electricity;

— within scope 3 (category 4): minimum TTW GHG emissions of fuels used by transport carried out by third parties for the reporting company;

— within scope 3 (category 4): optional WTT GHG emissions of fuels used by transport carried out by third parties for the reporting company.

**Table R.1 — Comparison of GHG emission categorization used in the GHG Protocol and this document**

| GHG Protocol | | | | This document |
|---|---|---|---|---|
| **GHG scope** | **GHG Protocol category** | **Transport-related content** | **Site-related content** | **GHG emissions categories** |
| Scope 1 | GHG emissions from operations that are owned or controlled by the reporting company (direct emissions). | Direct GHG emissions from burned fuels (TTW). Direct process emissions, e.g. leakage. | Direct GHG emissions from burned fuels (e.g. handling equipment, yard logistics, heating equipment) and leakage of refrigerants. | $G_{VO}$, $G_{HEO}$ |
| Scope 2 | GHG emissions from the generation of purchased or acquired electricity, steam, heating or cooling consumed by the reporting company (indirect emissions). | Indirect GHG emissions from bought electricity and other energy. | Indirect GHG emissions from bought electricity and other energy. | $G_{VEP}$, $G_{HEEP}$ |
| Scope 3 | All indirect GHG emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream GHG emissions. | 1. Purchased goods and services (production/delivery of bought packaging). | Production and supply of transport packaging (used at the selected hub) (see Annex N) | $G_{PL}$ |
| | | 2. Capital goods (construction of owned infrastructure). | | not included |
| | | 3. Fuel and energy related activities (production/delivery of fuels (WTT) and electricity distribution). | Production and supply of fuels and electricity distribution. | $G_{VEP}$, $G_{HEEP}$ |
| | | 4. Upstream transport and distribution (transportation done by third parties (subcontractors)). | Upstream hub processes done by third parties (subcontractors). | $G_{VO}$, $G_{HOC}$, $G_{VEP}$, $G_{HEEP}$ |
| | | 5. Waste generated in operations (disposal of used packaging, by reporting company). | | not included |
| | | 6. Business travel (transportation of employees carried out not by the company itself, but, for example, by transport operators or employees themselves). | | not included |
| | | 7. Employee commuting (any form of commute of employees not carried out by the company itself). | | not included |
| | | 8. Upstream leased assets. | | not included |

**Table R.1** *(continued)*

| GHG Protocol | | | | This document |
|---|---|---|---|---|
| **GHG scope** | **GHG Protocol category** | **Transport-related content** | **Site-related content** | **GHG emissions categories** |
| | | 9. Downstream transport and distribution (fuel/energy consumption already accounted in scope 1/2; can be extended to life cycle assessment (LCA) of leased assets). | Collection (transport) of waste from transport packaging (used at the selected hub) (see Annex N). | $G_{PL}$ |
| | | 10. Processing of sold products (transportation done by third parties, after product was sold, i.e. subcontracted by the reporting companies' customers). | | not included |
| | | 11. Use of sold products. | | not included |
| | | 12. End-of-life treatment of sold products (disposal of used packaging, by customer). | Disposal/recycling of transport packaging (used at the selected hub) (see Annex N). | $G_{PL}$ |
| | | 13. Downstream leased assets. | | not included |
| | | 14. Franchises. | | not included |
| | | 15. Investments. | | not included |

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