INTERNATIONAL STANDARD

ISO 14083

First edition
2023-03

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

Reference number
ISO 14083:2023(E)

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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.

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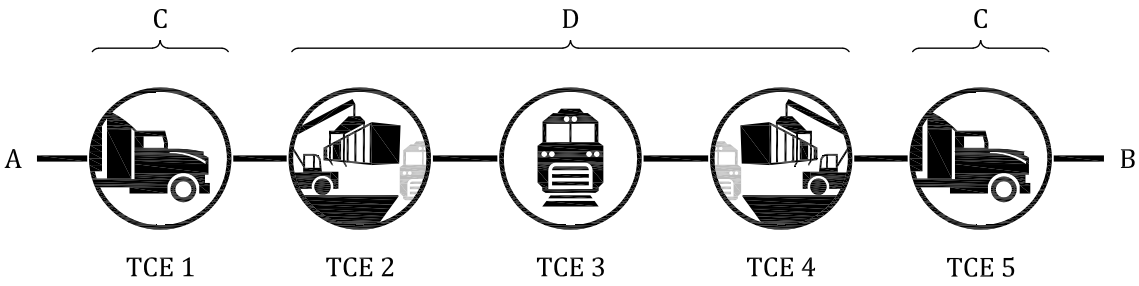
Introduction

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).

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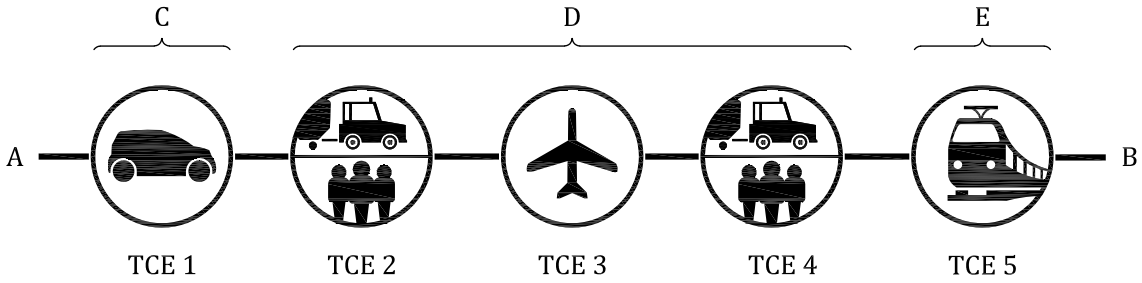

Key

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.

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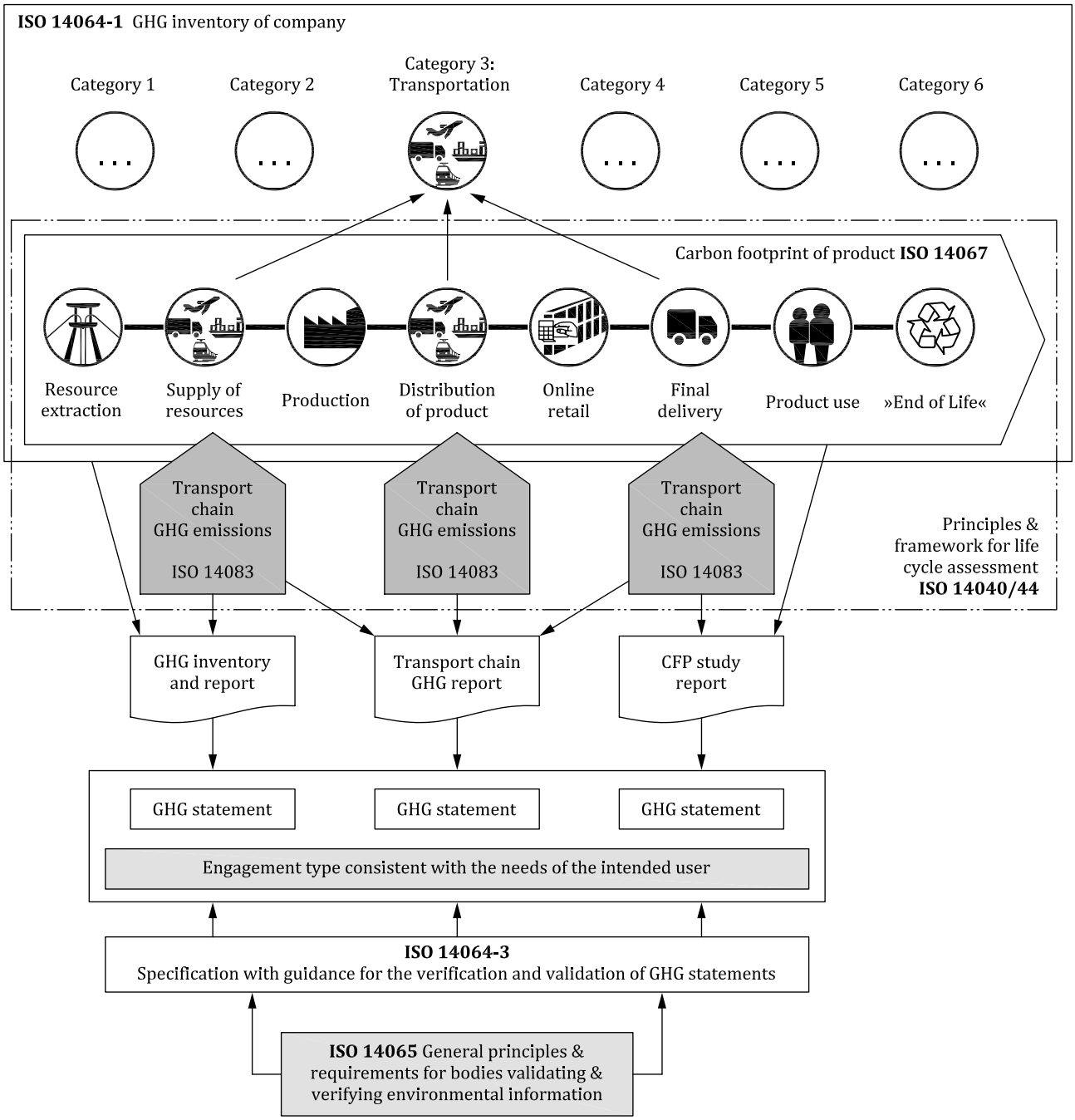

Figure 3 — Relationship between the ISO 14040 family of standards and the ISO 14060 family of standards, using the example of a freight transport chain

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].

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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.

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[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)

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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.]

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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

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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.

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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.]

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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).

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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_{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_{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_{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_{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_{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_{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_{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_{T}
sum of *GHG emissions* (3.2.8) from all *processes* (3.4.3) included in the system boundaries

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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_2e) per tonne kilometre, or equivalent units, for freight transportation;

— mass CO_2e per tonne for freight hub *throughput* (3.1.21);

— mass CO_2e per passenger kilometre, or equivalent units, for passenger transport;

— mass CO_2e 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).

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[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

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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.

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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;

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— 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.

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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);

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— (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.

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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.

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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.

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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.

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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.

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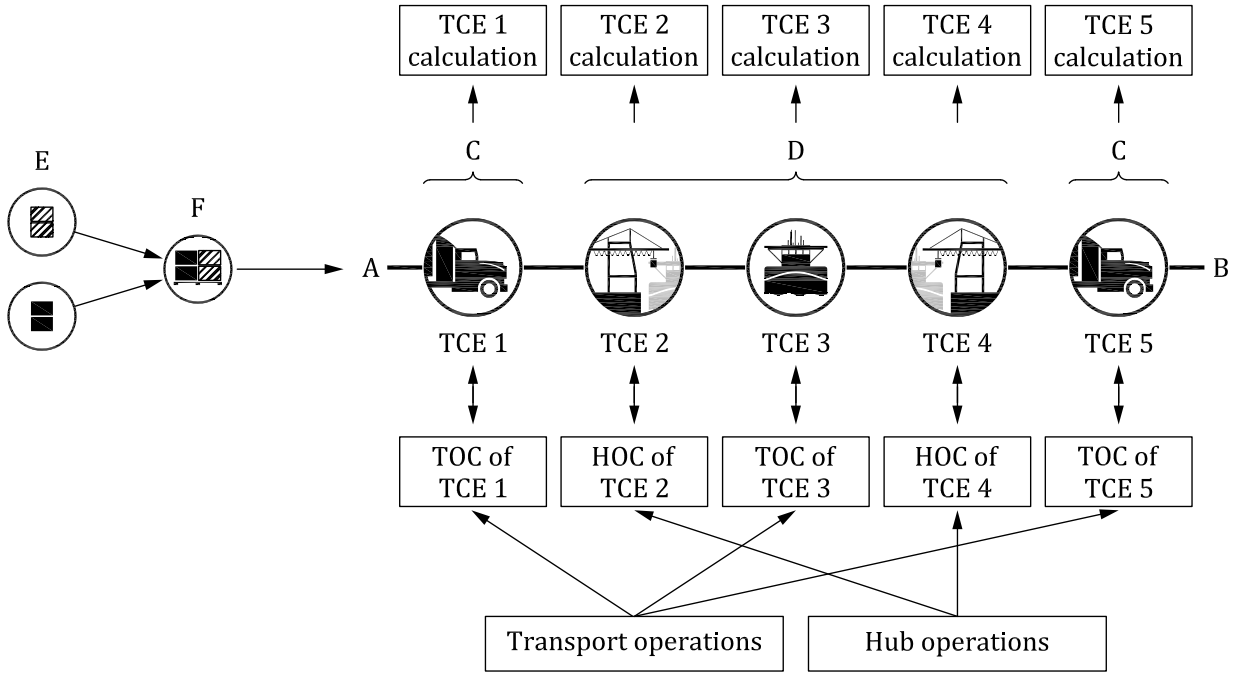

Key

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

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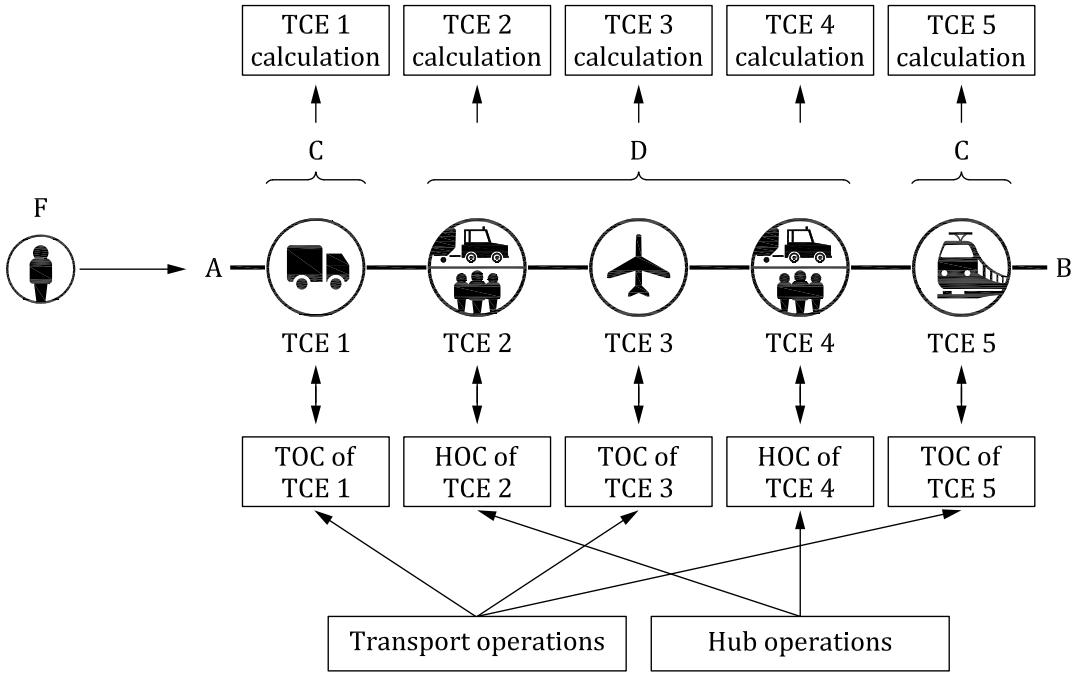

Key

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;

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— 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.

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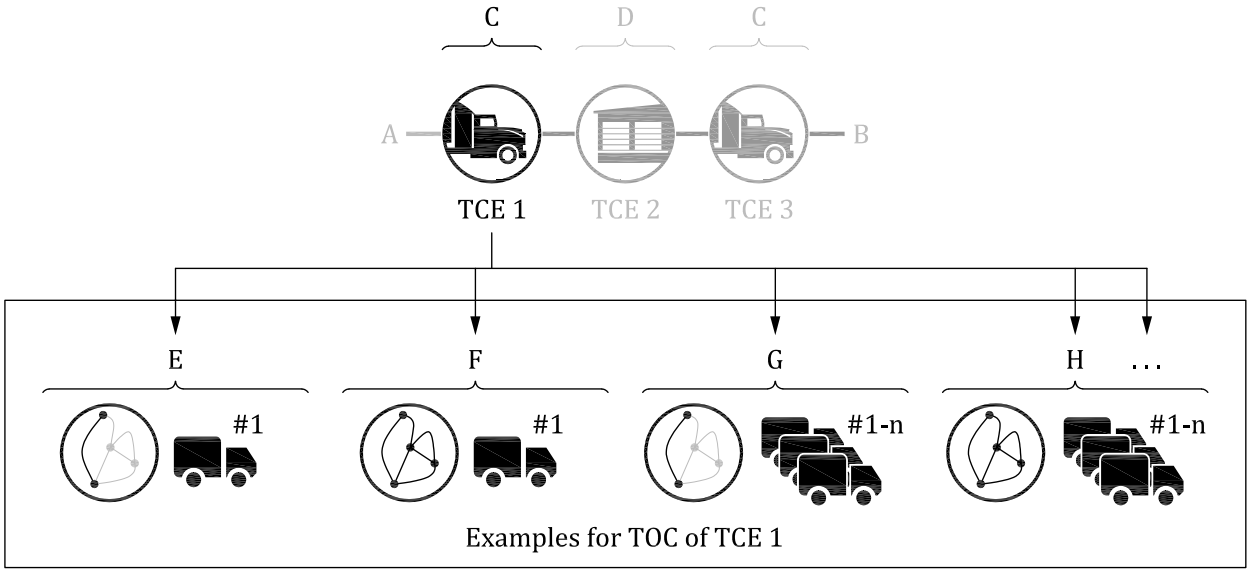

Key

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

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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);

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— 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;

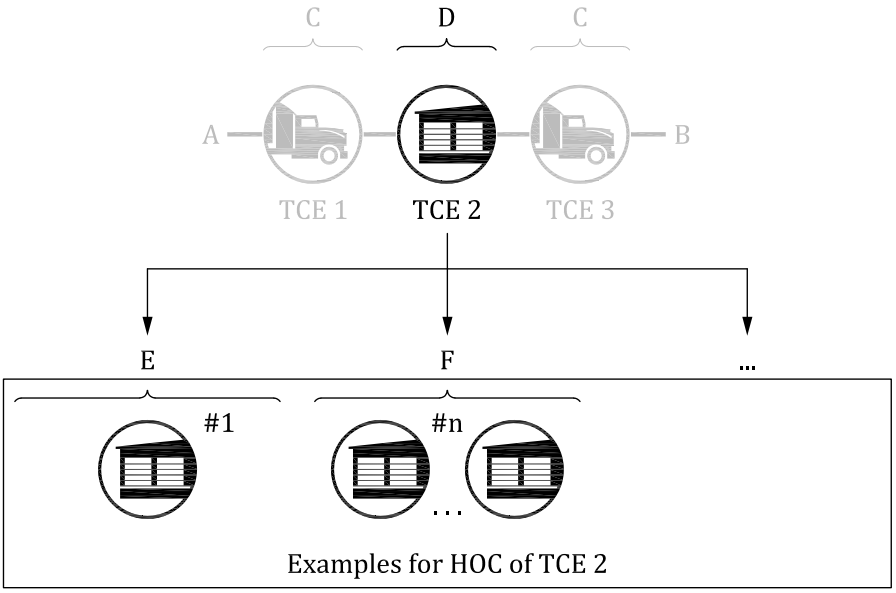
— HOC of a specific hub type.

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

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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.

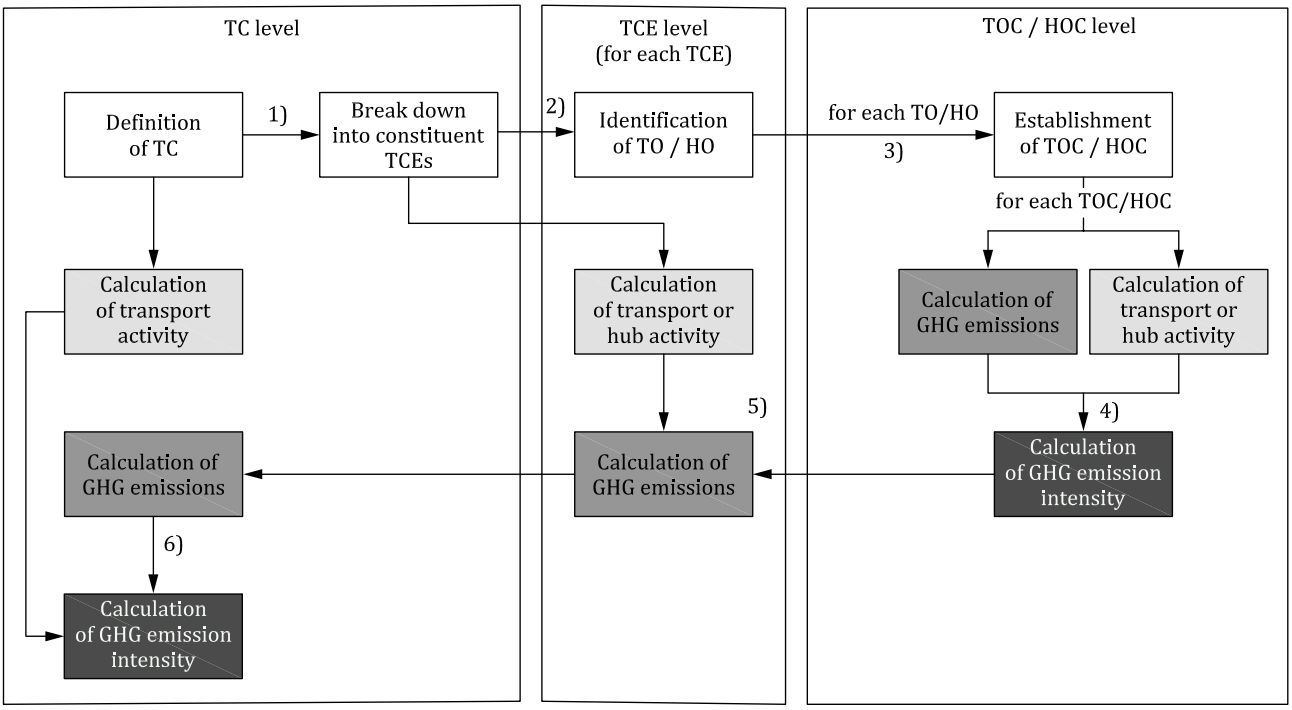

Figure 8 — GHG emission calculation steps for a transport chain

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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.

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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).

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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 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 A_i;

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

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