TECHNICAL REPORT

ISO/TR 14069

First edition
2013-05-01

Greenhouse gases — Quantification and reporting of greenhouse gas emissions for organizations — Guidance for the application of ISO 14064-1

Gaz à effet de serre — Quantification et rapport des émissions de gaz à effet de serre pour les organisations — Directives d'application de l'ISO 14064-1

Reference number
ISO/TR 14069:2013(E)

Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

ISO/TR 14069 was prepared by Technical Committee ISO/TC 207, *Environmental management*, Subcommittee SC 7, *Greenhouse gas management and related activities*.

Introduction

ISO 14064-1 enables organizations around the world to quantify greenhouse gas (GHG) emissions and removals. This Technical Report uses the principles and process from ISO 14064-1 to develop guidance on quantification and reporting of GHG for organizations.

This Technical Report is consistent with the objective of building on existing International Standards and protocols on corporate GHG inventories, and incorporates many of the key concepts and requirements stated in the GHG Protocol by the World Business Council for Sustainable Development/World Resources Institute in References [4] and [5]. Some of these concepts have been adapted to suit this Technical Report. Users of this Technical Report are encouraged to refer to References [4] and [5] for additional guidance on applying the relevant concepts and requirements.

ISO 14064-1 identifies three types of emissions:

a) direct emissions;

b) energy indirect emissions (associated with purchases of electricity and heat);

c) “other indirect emissions”.

Direct emissions correlate to “scope 1”, energy indirect emissions to “scope 2” and other indirect emissions to “scope 3” as defined by the GHG Protocol corporate standard (see Reference [4]).

In tackling climate change, there is a convergence of interests between organizations, national and regional regulators and international negotiators on the need to develop methods of quantifying GHG emissions and providing reliable tools to do so.

This Technical Report is intended to assist users in the application of ISO 14064-1, using guidelines and examples and to provide transparency in the quantification of emissions and their reporting.

This Technical Report enables an organization to do the following:

— enhance the transparency and consistency of reported GHG emissions (direct, energy indirect and other indirect), establish a classification of categories for all emissions, especially the indirect emissions, and recommend this classification for all ISO 14064-1 inventories;

— choose or develop the method of calculating emissions;

— differentiate, whenever necessary, the three main types of organization that are addressed in this Technical Report:

  — a facility or production site (spatially delimited) providing goods (industry) and/or services (tertiary), belonging to a private or public organization;

  — a private or public organization with several facilities/sites and/or subsidiaries, and needing consolidation procedures;

  — a local authority that produces both direct and indirect emissions, from both its own operations and services provided within a specific territory: the services provided to a community (roads, cleaning, transport, gardens, etc.) can be delivered directly by the public authority or under mixed forms (outsourced activities, delegations, concession, etc.);

— report GHG emissions and removals, using a simplified format to make the report easier to understand.

This Technical Report is intended to give guidance on the quantification of a GHG emissions inventory within the selected boundaries of an organization. It differs from the process of product carbon footprinting (see ISO 14067), whose primary focus are the emissions from the life cycle of a product.

The objective of this Technical Report is to offer organizations guidance on the quantification and reporting of their GHG inventory, using a process that incorporates the principles of relevance, completeness, consistency, accuracy and transparency. This kind of GHG inventory is expressed as net global warming potential in carbon dioxide equivalent (CO_2e).

Greenhouse gases — Quantification and reporting of greenhouse gas emissions for organizations — Guidance for the application of ISO 14064-1

1 Scope

This Technical Report describes the principles, concepts and methods relating to the quantification and reporting of direct and indirect greenhouse gas (GHG) emissions for an organization. It provides guidance for the application of ISO 14064-1 to greenhouse gas inventories at the organization level, for the quantification and reporting of direct emissions, energy indirect emissions and other indirect emissions.

This Technical Report describes for all organizations, including local authorities, the steps for:

— establishing organizational boundaries, in accordance with either a control approach (financial or operational) or an equity share approach;

— establishing operational boundaries, by identifying direct emissions and energy indirect emissions to be quantified and reported, as well as any other indirect emissions the organization chooses to quantify and report; for each category of emission, guidance is provided on specific boundaries and methodologies for the quantification of GHG emissions and removals;

— GHG reporting: guidance is provided to promote transparency regarding the boundaries, the methodologies used for the quantification of direct and indirect GHG emissions and removals, and the uncertainty of the results.

A table of correspondence between the numbering of ISO 14064-1:2006 and this Technical Report is provided in Annex A.

The examples and case studies presented in this Technical Report are not exclusive and non-exhaustive. The values of the emission or removal factors mentioned in the examples are given for illustrative purposes only. A non-exhaustive list of database references is provided in Annex B.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14064-1:2006, *Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14064-1 and the following apply.

3.1 Terms relating to greenhouse gases emission

3.1.1
direct greenhouse gas emission
GHG emission from greenhouse gas sources owned or controlled by the organization

Note 1 to entry: ISO 14064-1 uses the concepts of financial and operational control to establish an organization's operational boundaries.

[SOURCE: ISO 14064-1:2006, 2.8]

3.1.2
energy indirect greenhouse gas emission
GHG emission from the generation of imported electricity, heat or steam consumed by the organization

[SOURCE: ISO 14064-1:2006, 2.9]

3.1.3
other indirect greenhouse gas emission
GHG emission, other than energy indirect GHG emissions, which is a consequence of an organization's activities, but arises from greenhouse gas sources that are owned or controlled by other organizations

[SOURCE: ISO 14064-1:2006, 2.10]

3.1.4
greenhouse gas emission or removal factor
factor relating activity data to GHG emissions or removals

Note 1 to entry: A greenhouse gas emission or removal factor could include an oxidation component.

[SOURCE: ISO 14064-1:2006, 2.7]

3.1.5
avoided emission
GHG emission reduction that occurs outside the organizational boundaries of the reporting organization as a direct consequence of changes in the organization's activity, including but not necessarily limited to the emission reductions associated with increases in the generation and sale of electricity, steam, hot water or chilled water produced from energy sources that emit fewer greenhouse gases per unit than other competing sources of these forms of distributed energy

Note 1 to entry: Based on definition in Code of Federal Regulations — Title 10: Energy, Chapter II: Department of Energy, Subchapter B: Climate change, § 300.2.

3.1.6
downstream emission
other indirect GHG emission from goods and services subsequent to the sale and/or delivery by the organization and to the end of life of such goods and services

3.1.7
out of stream emission
other indirect GHG emission not included either in upstream or in downstream emission

Note 1 to entry: Out of stream emissions are limited to employee activities, e.g. commuting, which are neither purchased nor sold.

3.1.8
upstream emission
energy indirect GHG emission and other indirect GHG emission from goods and services acquired by the organization

3.1.9
double counting
accounting for GHG emissions or removals more than once

Note 1 to entry: Double counting can occur between organizations, i.e. two or more reporting organizations take ownership of the same GHG emissions or removals. Double counting can also occur inside an organization when GHG emissions or removals are taken into account in different categories (this type of double counting should not occur).

3.1.10
offsetting
mechanism for compensating for all or part of the GHG inventory of an organization that can occur directly through the prevention of the release of, reduction in, or removal of, an amount of greenhouse gas emissions in a process outside the operational boundaries of the organization or indirectly through the purchase of GHG reductions (in the form of carbon credits) generated by a third party

Note 1 to entry: A carbon credit is a generic term for any tradable certificate or permit representing the right to emit one tonne of carbon dioxide or the mass of another greenhouse gas with a carbon dioxide equivalent (tCO_2e) equivalent to one tonne of carbon dioxide.

3.2 Terms relating to biomass and land use

3.2.1
biomass
material of biological origin, excluding material embedded in geological formations and material transformed to fossilized material and excluding peat

Note 1 to entry: Biomass includes organic material (both living and dead), e.g. trees, crops, grasses, tree litter, algae, animals, and waste of biological origin, e.g. manure.

[SOURCE: ISO 14067:—[1], 3.1.8.1]

3.2.2
biogenic carbon
carbon derived from biomass

[SOURCE: ISO 14067:—, 3.1.8.2]

3.2.3
biogenic CO_2
CO_2 obtained by the oxidation of biogenic carbon

3.2.4
direct land use change
dLUC
change in human use or management of land within the organizational boundaries and as part of upstream or downstream activities

[SOURCE: ISO 14067:—, 3.1.8.4, modified]

3.2.5
indirect land use change
iLUC
change in the use or management of land which is a consequence of direct land use change not taking place within the operational boundaries of the GHG inventory

[SOURCE: ISO 14067:—, 3.1.8.5, modified]

3.3 Terms relating to data

3.3.1
greenhouse gas activity data
quantitative measure of activity that results in a GHG emission or removal

Note 1 to entry: Examples of GHG activity data include the amount of energy, fuels or electricity consumed, material produced, service provided or area of land affected.

[SOURCE: ISO 14064-1:2006, 2.11]

---

1) To be published.

3.3.2
site-specific data
data obtained from a direct measurement or a calculation based on direct measurement at its original source within the established operational boundaries of the GHG inventory

Note 1 to entry: All site-specific data are "primary data".

[SOURCE: ISO 14067:—, 3.1.7.2, modified]

3.3.3
secondary data
data obtained from sources other than a direct measurement or a calculation based on direct measurements at the original source

Note 1 to entry: Such sources can include databases, published literature, national inventories and other generic sources.

[SOURCE: ISO 14067:—, 3.1.7.3, modified]

3.3.4
disaggregation of activity data
subdivision of activity data into parts that are more closely related to the real emissions of the activity

EXAMPLE General activity data for goods transport is the number of tonnes per kilometre operated each year. A useful disaggregation of this activity data could be a distinction between the modes of transport (air, road, train, water, etc.) because of an important difference between related emission factors. More disaggregated activity data can be used consecutively, e.g. with a distinction between small and big trucks.

3.4 Other terms

3.4.1
local authority
public body given the authority by legislation or directives of a higher level of government to set general policies, plans or requirements

Note 1 to entry: Common names for a public body organization that operates within a nation-state include state, province, region, department, county, prefecture, district, city, township, town, borough, parish, shire, village.

4 Principles

The principles given in ISO 14064-1 apply.

4.1 General

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
3 Principles
3.1 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, requirements in this part of ISO 14064.

4.2 Relevance

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
3.2 Relevance
Select the GHG sources, GHG sinks, GHG reservoirs, data and methodologies appropriate to the needs of the intended user.

For the relevance of appropriate GHGs taken into account: the organization should determine, as appropriate to the needs of intended user, the greenhouse gases taken into account, by using the GHG definition (see ISO 14064-1:2006, 2.1) in the same way that is used for the selection of GHG sources, sinks and reservoirs.

This selection of GHGs should also be consistent with completeness principle (see 4.3). This GHG selection is notified, and possibly explained in the report (see Clause 8). Selection of GHG sources, sinks and reservoirs is independent from greenhouse gases taken into account. This selection of gases should also be consistent throughout all the emission categories considered inside operational boundaries (see 5.2).

Subclauses 5.3 and 5.4 provide guidance to the intended user on the relevance and selection of data and methodologies, category by category.

4.3 Completeness

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
3.3 Completeness
Include all relevant GHG emissions and removals.

Completeness refers to the need for the organization to have identified and understood all its emissions and removals and included them within its organizational and operational boundaries. This requires an organization to have the necessary competencies, capacity and processes in place to ensure the effective achievement of identification and understanding.

The principle of completeness is used with the principle of relevance to explain the choice of the GHGs taken into account in the GHG inventory.

4.4 Consistency

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
3.4 Consistency
Enable meaningful comparisons in GHG-related information.

Consistency is necessary both for organization internal and external comparisons.

Internal comparisons deal with period to period comparisons, in order to evaluate the potential results of decided and/or implemented directed actions. It also deals with internal comparisons between departments or subsidiaries within the organization.

For external comparisons, the GHG inventory should be presented in a manner that enables the users to analyse the changes in the organization's levels of emissions and removals over time.

4.5 Accuracy

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
3.5 Accuracy
Reduce bias and uncertainties as far as is practical.

Accuracy refers to the need for an organization to provide information regarding its emissions and removals that has a degree of accuracy, a low margin of uncertainty and is free of bias as far as is practicable in order for users to make decisions with a high degree of confidence. The accuracy of quantitative information may depend on specific sampling methods and qualitative information but is subject to a level of uncertainty.

4.6 Transparency

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
3.6 Transparency Disclose sufficient and appropriate GHG-related information to allow intended users to make decisions with reasonable confidence.

Transparency refers to the need for an organization to disclose sufficient and appropriate GHG related information relevant to the processes, procedures, and assumptions embodied in the reported information to allow users to make decisions with reasonable confidence.

5 GHG inventory design and development

5.1 Organizational boundaries

5.1.1 General

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
4 GHG inventory design and development **4.1 Organizational boundaries** The organization may comprise one or more facilities. Facility-level GHG emissions or removals may be produced from one or more GHG sources or sinks. (...) The organization shall consolidate its facility-level GHG emissions and removals by one of the following approaches: a) control: the organization accounts for all quantified GHG emissions and/or removals from facilities over which it has financial or operational control; or b) equity share: the organization accounts for its portion of GHG emissions and/or removals from respective facilities. The organization may use a different consolidation methodology where specific arrangements are defined by a GHG programme or legal contract. When a facility is controlled by several organizations, these organizations should adopt the same consolidation methodology. The organization shall document which consolidation method it applies. The organization shall explain any change to the selected consolidation method.

An organization engaged in setting its organizational boundaries first establishes the objective of the GHG inventory and then examines its mission, goals, operations and facilities to determine the GHG sources which it can control and those which it may influence. The objective of its inventory is used to determine the organizational boundaries.

If the objective is to calculate the GHG inventory of the whole organization, the organization should carefully analyse its current organizational boundaries and consolidation methods, already in place for their financial accounting. If these organizational boundaries are suitable for the GHG inventory objectives, and are explained and followed consistently, the organization should consider using these financial boundaries and consolidation methods.

— If the organization wholly owns and operates all its operations, its organizational boundaries are the same whichever consolidation method is used. In this case, the organization simply quantifies and reports all emissions from each of its wholly owned operations.

— For organizations with jointly owned operations, however, the organizational boundaries differ depending on the consolidation method used (control or equity share).

In relation to the inventory of GHG emissions from a local authority's own or delegated operations, ISO 14064-1 applies and further guidance can be found in this Technical Report (see 5.1.3). GHG inventory of emissions within the community, determined by the geopolitical boundaries of the administration (also known as "territorial approach") may need a specific methodology that is outside the scope of this Technical Report.

5.1.2 Selecting and applying the consolidation method

5.1.2.1 General

Each consolidation method (equity share or control) has advantages and disadvantages. The operational and financial control methods may best facilitate performance tracking of GHG management policies. However, these may not fully reflect the financial risks and opportunities associated with climate change, compromising financial risk management. On the other hand, the equity share method best facilitates financial risk management by reflecting the full financial risks and opportunities associated with climate change, and is less subject to interpretation, but may be less effective at tracking the operational performance of GHG management policies.

If both methods are equally applicable and meet the organization's objectives, preference should be given to the control method that follows the financial accounting rules already in place, in order to link GHG emissions reporting with actions to improve GHG management.

In some cases, the consolidation methods already in place for the organization's financial accounting may not be suitable for determining the GHG inventory of the organization. In these circumstances a specific definition of financial or operational control may be needed and reported in the GHG inventory.

The concepts described in 5.1.2.2 and 5.1.2.3 are issued from the International Financial Reporting Standards (IFRS) Guide "Presentation of Consolidated Financial Statements"[6].

5.1.2.2 Equity share consolidation method

Using equity share consolidation method leads to account emissions of consolidated entities up to the ownership percentage of the reporting organization.

Equity share reflects the extent of the rights an organization has to the risks and rewards from an operation based on its equity interest. Equity share is therefore the same as the ownership percentage.

NOTE In special cases, if the ownership percentage is below the economic interest, equity share is re-evaluated (see IFRS rules).

A subsidiary is identified by the share of equity held in it by its parent organization. The equity share communicates the stewardship of management in carrying out its responsibilities related to the subsidiary more clearly than if the investments were accounted for on the basis of direct equity interest.

A parent organization should determine the degree of equity investment (more than 1 %) it has in its subsidiaries to assist in defining its organizational boundaries.

The legal status of a subsidiary is independent of the control affiliation for the purposes of defining the organization's boundaries. Any change in equity share is a reason to reconsider the organizational boundaries. When a subsidiary is excluded from consolidation, its shares are recorded as "equity" in category 15 (Investments) of other indirect emissions (see 5.4.15).

Once the organizational boundaries are defined, the GHG inventory of the organization includes the equity share portion of GHG emissions of the consolidated subsidiaries. This includes in the GHG inventory of the parent organization and the emissions from its subsidiaries up to the representative portion of its interests.

EXAMPLE Parent organization A holds 30 % of the shares from organization B. The emissions from organizations A and B are shown in Table 1. The consolidated results are shown in Table 2.

Table 1 — Values of emissions from parent organization A and subsidiary B

Emissions	Parent organization A (emissions in t CO_2e)	Subsidiary B (emissions in t CO_2e)	30 %
Direct emissions	1 000	500	150
Energy indirect emissions	500	20	6
Other indirect emissions	8 000	7 000	2 100

Table 2 — Consolidated results for the GHG inventory of organization A (equity share consolidation method)

Consolidation	Emissions t CO_2e
Direct emissions	1 150
Energy indirect emissions	506
Other indirect emissions	10 100

5.1.2.3 Control consolidation method

Using control consolidation method leads to account 100 % of emissions of consolidated entities which are under the control of the reporting organization.

IFRS defines control as “the power to govern the financial and operating policies of an organization so as to obtain benefits from its activities”.

This definition of control encompasses both the notion of governance and the economic consequence of that governance (i.e. benefits and risks). “Power to govern” implies having the capacity or ability to govern the decision-making process through the selection of financial and operational policies.

As a general rule, control of an entity is presumed when the parent organization owns more than half of the voting power of the entity either directly or indirectly through subsidiaries.

When the parent organization owns half or less of the shares of an entity, control may occur in the following cases:

— extended voting rights over passing the majority by virtue of an agreement with other investors;

— power to govern the financial and operating policies of the entity under a statute or an agreement; (e.g. local authorities’ sharing entities or joint venture company);

— power to cast, appoint or remove the majority of the members of the board of directors (and other stewardship committees);

— control based on contracts: control means the right under contractual or statutory provisions, to exercise authority in an organization, whether the authority is a majority or minority shareholder of this organization; a parent organization has the ability to use or direct the use of assets in the same way it controls its own assets;

EXAMPLE 1 The parent organization can be a shareholder or a minority shareholder and be entrusted with the effective management of an entity.

— control *de facto*

In some cases, the organization can run sustainable financial and operating policies of another organization, although it does not hold majority voting rights or does not have a formal contract to exercise a dominant influence. The basis for the control should be explained.

An example of *de facto* control applies when the representatives of the parent organization are the top management leaders of an entity. In such a case, entity should be consolidated even if the parent organization has no majority voting rights.

Explanation and disclosure should be provided in determining whether an organization controls another. Once the organizational boundaries of the organization are defined, the parent organization should include 100 % of GHG emissions of the consolidated entities.

EXAMPLE 2 Parent organization A holds 70 % of voting rights from organization B (control explained). The emissions from organizations A and B are shown in Table 3. The consolidated results are shown in Table 4.

Table 3 — Values of emissions from parent organization A and subsidiary B

Emissions	Parent organization A (emissions in t CO_2e)	Subsidiary B (emissions in t CO_2e)
Direct emissions	1 000	500
Energy indirect emissions	500	20
Other indirect emissions	8 000	7 000

Table 4 — Consolidated results for the GHG inventory of organization A (control consolidation method)

Consolidation	Emissions t CO_2e
Direct emissions	1 500
Energy indirect emissions	520
Other indirect emissions	15 000

5.1.3 Case of a local authority

5.1.3.1 General

A local authority provides services to organizations and persons residing, transiting or working in an area under its jurisdiction. The scope of these services may differ from one local authority to another and, while normally restricted to a geographical area may, in certain circumstances, extend into another authority's area. Wherever they occur, these services are under the direct control of the local authority.

A local authority GHG inventory may also be established on the concept of "territoriality", namely the physical area or region over which it has control. In this case, all GHG emissions generated within the territory are taken into account, including those from private housing and transport, commercial and industrial organizations and any of the local authority's services' embedded emissions for products consumed by persons or activities in a territory may also be included.

Therefore, two different inventories may be established, one for the local authority's own operations (as for any other organization) and one for all the emissions within the community, determined by the geopolitical (territorial) boundaries of its jurisdiction. This territorial approach needs a specific methodology, which is outside the scope of this Technical Report.

The key differences between a local authority and other organizations are listed below. As described in 5.1.3.2, these differences should be considered when setting organizational boundaries and selecting consolidation methods.

— Aggregation of different social functions: a local authority has a broad spectrum of activities, from general administration to the maintenance of parks and gardens or the provision of public transport. All these activities (see 5.2.2.2) provided by a local authority may have very different operational boundaries.

— Legally provided services: many local authorities' activities and functions are defined in legislation. For example, in some countries, local authorities are responsible for traffic regulation and waste management. In these circumstances, actions for reducing GHG emissions cannot include ceasing to perform this function.

— Shared services: in order to perform services such as waste management or water treatment, a local authority often shares the means of providing these services with other local, regional or national authorities.

— Outsourced services: local authorities may have a legal responsibility to provide a service such as water supply and water treatment, but have outsourced the delivery of the service to an alternative provider through a concession or contract. These concessions or contracts may have many terms and conditions, which include arrangements for GHG emission reductions.

5.1.3.2 Setting organizational boundaries and selecting consolidation methods

Organizational boundaries of a local authority include the authority itself and, and as applicable, shared services, outsourced services and its concessions. The main objective chosen by a local authority to complete its GHG inventory is to identify the actions it can take to reduce its GHG emissions.

The potential to reduce GHG emissions should be taken into account in setting the organizational boundaries, along with any contractual conditions associated with outsourced or shared services.

Services provided or organized by a local authority may be free of charge (i.e. paid by local or national taxes), or be paid for at market or non-market prices, to the same or another local authority, or to any delegated public or private organization. This should not be a criterion to exclude services provided by organizations from the organizational boundaries. Consolidation methods used by companies such as equity share or control may be used or adapted by a local authority, paying special attention to any legal links between the local authority and the final service provider. Three main cases are described below: a) shared services, b) outsourced and c) equity share with another organization.

a) Example of shared services split between several local authorities includes waste or water management or school transportation. In most cases, those local authorities responsible for the service do not share capital, but provide human and/or financial resources to manage the burden equitably between them. Burden sharing should be used by a local authority if it selects equity share consolidation. Alternatively operational control consolidation may be selected where, for instance, one local authority provides the majority of the human and/or financial resources.

b) Outsourcing is another common way for a local authority to provide services. If services are provided on a shared basis, see a). If one single authority provides outsourced services to others, relevant GHG emissions should be incorporated into that local authority's organizational boundaries. In these circumstances, operational control should be selected as the consolidation method. Where for legal or contractual reasons, the local authority is unable to change its role as an outsourced provider, the relevant GHG emissions may be excluded from its organizational boundaries.

c) Local authorities may create or participate with a private organization in order to provide services. Where this occurs, one local authority may hold a majority equity share or the equities could be shared between several local authorities and private organizations. In either cases, the service provider may be considered as a subsidiary, and the consolidation method should be selected from equity share or control depending on the circumstances. The same rules as those described in 5.1.2 apply.

5.1.3.3 Case of special entities

Where contractual relationships exist between a local authority and a private organization, the organizational boundaries should be based on the control principle.

A Joint Powers Authority (JPA) is an institution authorized under the laws of some states, where two or more local authorities (e.g. utility districts or transport districts) can operate collectively. JPAs have separate operating boards of directors, and these boards can be given any of the powers inherent in all of the participating agencies. The joint authority can employ staff and establish policies independently of the constituent authorities.

As a JPA is considered a distinct organization from its member authorities, emissions from JPAs should not be reported as part of a local authority's inventory.

If the collection service and waste treatment has been entrusted to a cooperative structure (i.e. city association), it is necessary to define a rule for allocating emissions between the various members of the structure. This can be done in proportion to the billing, collected volumes, weight, etc.

5.2 Operational boundaries

5.2.1 General

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
4.2.1 Establishing operational boundaries The organization shall establish and document its operational boundaries. The establishment of operational boundaries includes identifying GHG emissions and removals associated with the organization's operations, categorizing GHG emissions and removals into direct emissions, energy indirect emissions and other indirect emissions. It includes choosing which of the other indirect emissions will be quantified and reported. The organization shall explain any changes to its operational boundaries.

Emissions can be divided into "upstream", "downstream" and "out of stream" in order to help the organization to understand better those emissions, to avoid double counting between organizations in a supply chain and to make reported GHG data more useful to interested parties (See also definitions 3.1.6, 3.1.7 and 3.1.8). Figure 1 shows the different emissions. Further details about upstream, downstream and out of stream categories are given in Table C.1.

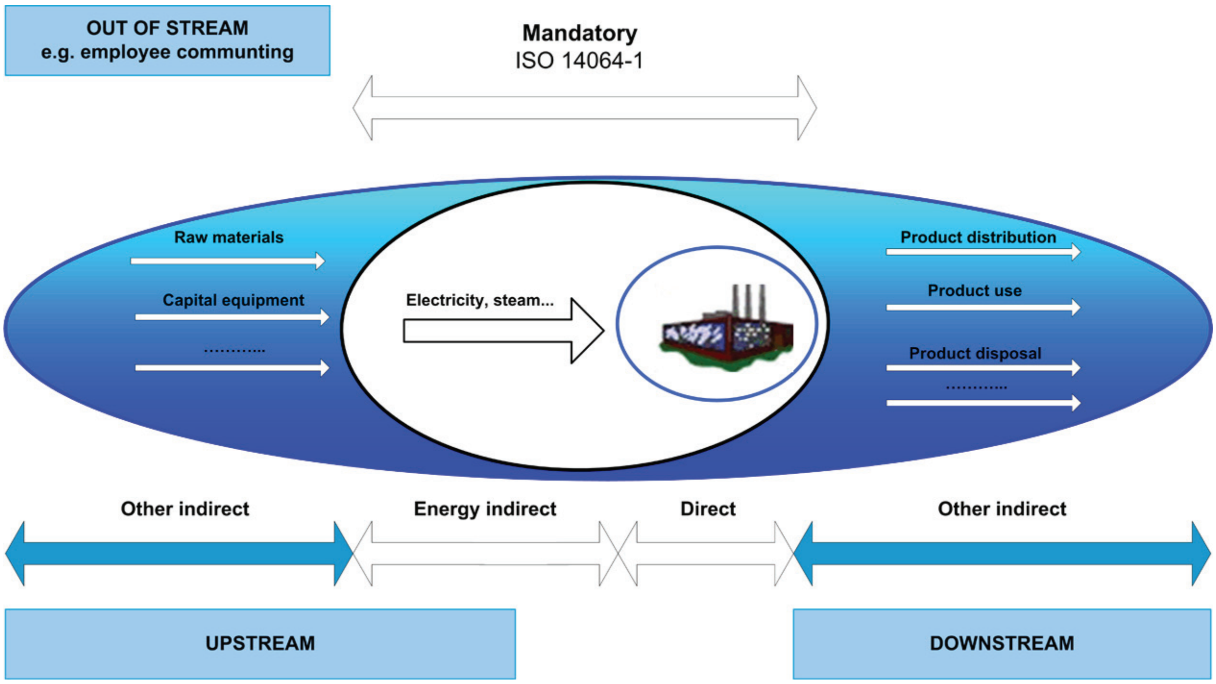


Figure 1 — Upstream emissions, downstream emissions and out of stream emissions

5.2.2 Categorization of emissions and removals

5.2.2.1 General

GHG emissions and removals are classified into the 23 categories listed below. Each emission can only belong to one category (see Table C.1, which presents the categories and examples of emission sources).

Additional information on sector specific requirements regarding monitoring and reporting of GHG emissions may be available from sector specific guidelines or standards and could help to achieve the principles of completeness, relevance and consistency.

— **Direct GHG emissions and removals** from facilities within its organizational boundaries related to:

1) direct emissions from stationary combustion;

2) direct emissions from mobile combustion;

3) direct process related emissions;

4) direct fugitive emissions;

5) direct emissions and removals from Land Use, Land Use Change and Forestry (LULUCF) (excluding combustion); according to ISO 14064-1, the quantification of direct removals is optional.

— **Energy indirect GHG emissions:**

6) indirect emissions from imported electricity consumed;

7) indirect emissions from consumed energy imported through a physical network (steam, heating, cooling, compressed air) excluding electricity.

— **Other indirect GHG emissions and removals:**

8) energy-related activities not included in direct emissions and energy indirect emissions;

9) purchased products;

10) capital equipment;

11) waste generated from organizational activities;

12) upstream transport and distribution;

13) business travel;

14) upstream leased assets;

15) investments;

16) client and visitor transport;

17) downstream transport and distribution;

18) use stage of the product;

19) end of life of the product;

20) downstream franchises;

21) downstream leased assets;

22) employee commuting;

23) other indirect emissions or removals not included in the other 22 categories.

NOTE 1 Some categories, mostly the upstream ones, might include emissions that occurred before the reporting year (e.g. emissions from previously made purchased products). With a view to account for all emissions related to the activities of the reporting organization, these emissions are also considered in the reporting year in which the activity is recorded.

NOTE 2 Some categories, mostly the downstream ones, might include emissions that will occur after the reporting year. With a view to account for all emissions related to the activities of the reporting organization, these emissions are also considered in the reporting year in which the activity is recorded.

5.2.2.2 Specific case of local authorities

A local authority provides services that generate emissions from sources which may be classified into the 23 categories listed in Table C.1. In order to establish the GHG inventory, local authorities may quantify emissions associated with the services they provide. A list of some potential generic services which could be provided by local authorities is presented below. The organization of services and the responsibility of local authorities depend on the context of each country:

— general administration: emissions from administrative activities and from buildings of the administration;

— education: emissions from teaching activities;

— housing: emissions from the housing provided by the local authority. this may include staff accommodation and social housing;

— transport: emissions from transport services and infrastructures (bus, motor vehicle, metro/light rail or train, port and airport).

— water sanitation: emissions for the management of water supply and sanitation services (network, collectors, water treatment plants, sludge treatment);

— waste: emissions for the collection, processing and disposal of household waste and waste treatment;

— sports facilities: emissions from sport service and infrastructures such as swimming pools, sports halls, sailing bases, climbing facilities, equestrian centres, driving circuits, etc.;

— cultural facilities: emissions from cultural services and infrastructures such as museums, theatres, infrastructures for festivals, historic sites, libraries, media centres, religious sites, etc.;

— health and social: emissions from activities and facilities to help senior citizens, facilities for persons with disabilities (physical, mental), nurseries and early childhood centres, etc.;

— green spaces: emissions from activities and facilities associated with public parks, forests, coastal sites, protected areas, roadside trees, including maintenance and management;

— streets and roads: emissions from roads construction and maintenance and from street lighting.

Table C.2 gives an example of the application of the 23 categories to the specific case of an education service.

Special attention should be paid to the risks of double counting throughout the consolidation of the GHG inventory of the local authority. Further guidance may be found in 5.3.2 and in several categories.

To avoid any double counting, the local authority should take care to instruct departments on the nature of the emissions to be considered and their allocation.

5.2.3 Prioritizing relevant emissions

5.2.3.1 General

According to ISO 14064-1, the organization:

— includes in its inventory 100 % of its direct and energy indirect emissions, however, absolute completeness in reporting may not be possible and exceptions may be made for trivial emission sources;

— chooses which of the other indirect emissions are quantified and reported.

Regarding "other indirect emissions", the organization may decide to concentrate its effort on quantification and reporting of a limited number of categories instead of spreading its efforts on all categories. In some organizations or sectors, the other indirect emissions may be more significant than the direct emissions. For this reason, it is important to approximate the magnitude of other indirect emissions, in order to be able to better decide which categories of these emissions should be considered.

In order to determine which other indirect emissions the organization includes in its inventory, as a minimum two factors should be taken in consideration:

a) to reduce the risk of overlooking/ignoring some significant sources of GHGs, a wide estimate of the potential sources of "other indirect emissions" is carried out defining, when possible, a quantitative threshold, in order to decide which sources should be defined and which can be excluded or estimated in the GHG inventory,

b) to ensure a transparent approach for the interested parties, the criteria and the consequent decision about which "other indirect emissions" and sources are taken into consideration or excluded should be explained and reported.

The assessment of the relevance and the prioritization of other indirect emissions are made by each reporting organization, in line with the objective for the GHG inventory, with a view to prioritizing those activities where the most significant GHG reduction opportunities lie. For example, a professional services company may determine business travel to be a significant "other indirect emissions" category, while an electric utility may not determine business travel to be significant compared to its other sources of emissions.

Relevant other indirect emissions may also be prioritized based on other factors such as the organization ability to influence/reduce the emissions, stakeholder concerns, and GHG program requirements.

If the organization chooses the criteria of relevance based on size, guidance for the prioritizing is provided in 5.2.3.2.

5.2.3.2 Prioritizing relevant other indirect emissions based on size

"Other indirect emissions" categories are considered relevant if they are large (or expected to be large) compared to the reporting organization's other sources of emissions.

The organization should estimate emissions from all sources to gain a basic understanding of the relative contributions of various "Other indirect emissions". Whether an individual "Other indirect emissions" is relevant in size is a function of:

a) total anticipated "other indirect emissions", and

b) the emissions from any single "other indirect emissions" category.

Initial estimates should be conducted for each individual "other indirect emissions" category and rolled up to obtain an estimate of total anticipated "Other indirect emissions".

Each category of "other indirect emissions" requires a separate screening method to estimate emissions.

To determine which "other indirect emissions" categories are most relevant in size, the organization should follow these steps.

— Use screening methods to individually estimate the emissions from all "other indirect emissions" categories. This estimate may be based on very rough hypotheses or expert judgment.

— Express each category of emissions of "other indirect emissions" as a fraction of total anticipated "other indirect emissions".

— Rank all "other indirect emissions" activities from largest to smallest to determine which activities are most relevant.

Then, the organization should select a significance threshold that defines the percentage of total anticipated "Other indirect emissions" to be included into the GHG inventory. The organization should disclose in the public report the percentage of total anticipated "other indirect emissions" that have been accounted for and reported. While the organization should strive for the GHG inventory to be as complete as possible, it is acknowledged that many small activities are likely to contribute only to a small portion of total "other indirect emissions".

5.3 Generalities on the quantification of emissions and removals

5.3.1 Selection of quantification methodologies

ISO 14064-1:2006, 4.3, identifies three GHG quantification methodologies that may be used for organizations:

a) calculation;

b) measurement;

c) combination of measurement and calculation.

In many cases, it is not practical to measure directly the GHG emissions resulting from an activity. Exceptions would include continuously collecting, recording and reporting the required emission data from factory stack or exhaust pipe. This subclause focuses mainly on the calculation methodology as it is most commonly used. An organization mainly assesses its GHG emissions resulting from its activities by calculation, using methodologies such as:

— GHG activity data multiplied by GHG emission or removal factors;

— the use of models.

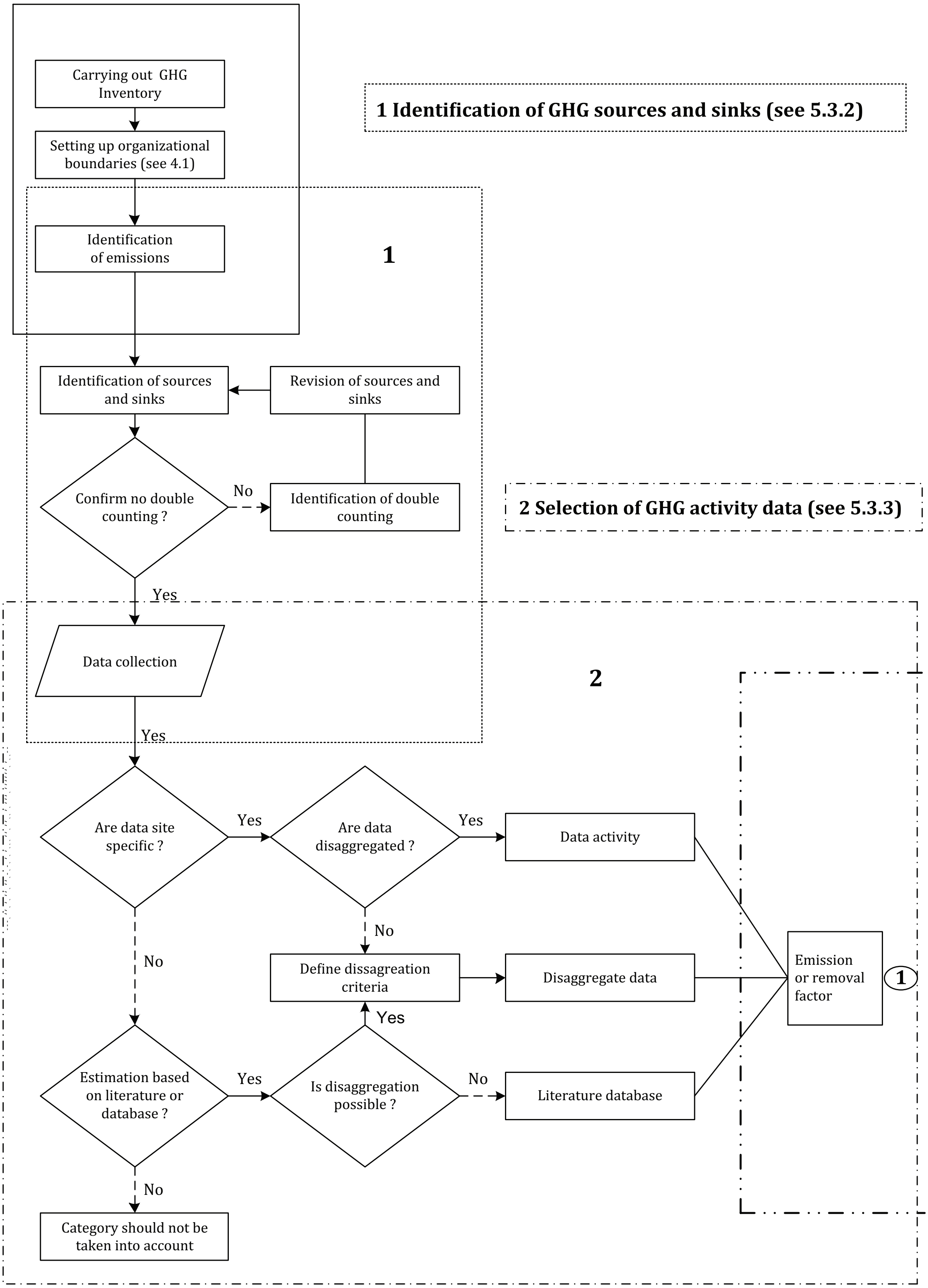
This Technical Report focuses mainly on the most commonly used calculation methodology. To calculate the GHG emissions of a category, the organization should follow these steps:

— identify the GHG sources and sinks for each category (see 5.3.2);

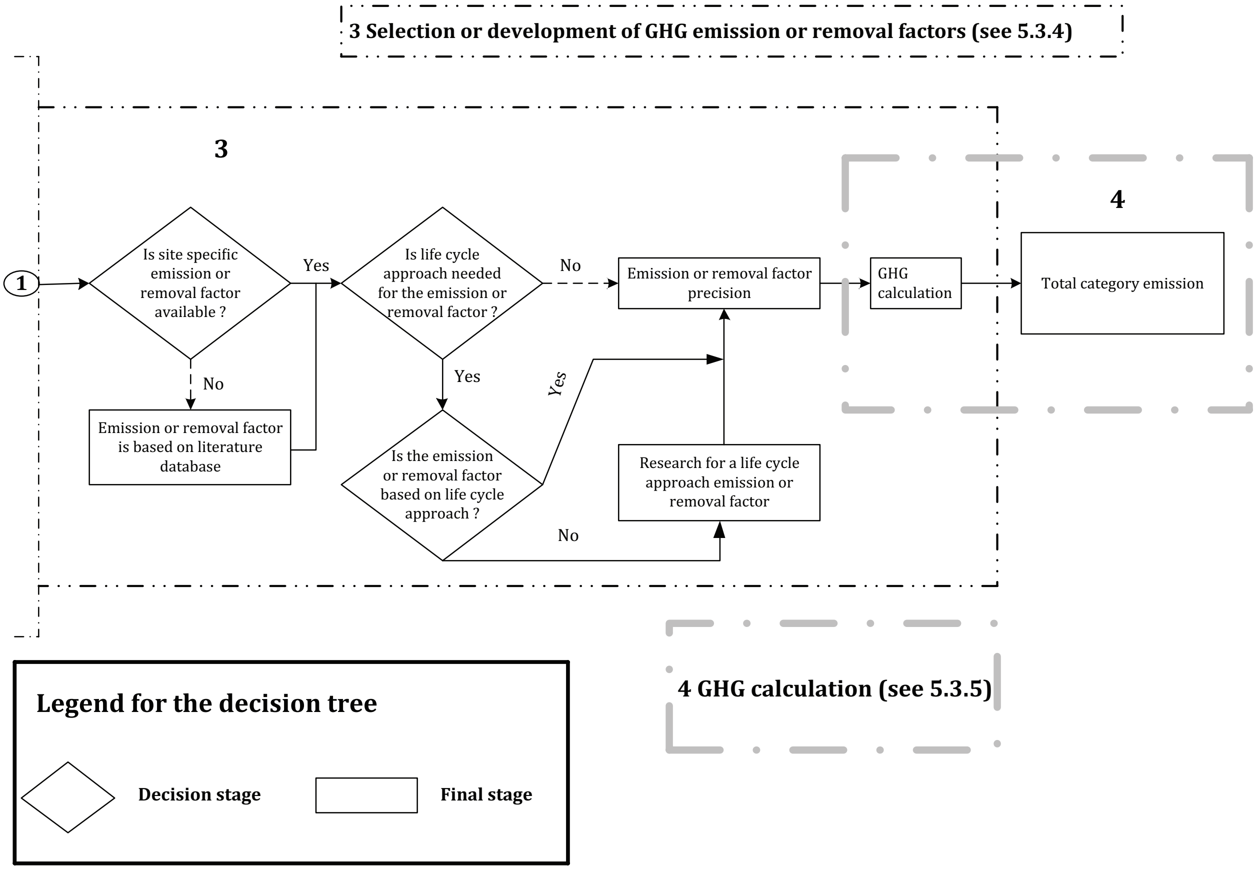
— for these sources and sinks, collect activity data at the appropriate disaggregation level (see 5.3.3);

— the activity data should be multiplied with appropriate emission or removal factors to obtain the GHG emissions or removals (see 5.3.4 and 5.3.5).

Those three steps are described as a flow chart in Figure 2. This general flow chart allows seeing the steps all together. The flow chart is divided into 5 boxes for which detailed explanation are given in 5.3.2 to 5.3.5.


1 Identification of GHG sources and sinks (see 5.3.2)
2 Selection of GHG activity data (see 5.3.3)
Carrying out GHG Inventory
Setting up organizational boundaries (see 4.1)
Identification of emissions
1
Identification of sources and sinks
Revision of sources and sinks
Confirm no double counting ?
No
Identification of double counting
Yes
Data collection
2
Yes
Are data site specific ?
Yes
Are data disaggregated ?
Yes
Data activity
No
No
Define dissagreation criteria
Disaggregate data
Emission or removal factor
1
Yes
Estimation based on literature or database ?
Yes
Is disaggregation possible ?
No
Literature database
No
Category should not be taken into account

a)



b)

Figure 2 — Flow chart

5.3.2 Identification of GHG sources and sinks

The organization clearly identifies all relevant sources and sinks for each emission category. The most relevant GHG sources and sinks for each emission category are described in the "paragraph a)" of each category (see 5.4.1 to 5.4.23).

The organization should pay attention to avoid double counting of emissions between different categories. When there is a risk for double counting, the organization should describe the sources and sinks of each category as well as a description of the boundaries of the different emission or removal factors.

For example, Figure 3 shows the risk of double counting between category 9 (Purchased products) and 12 (Upstream transport and distribution).

The two diagrams in Figure 3 deal with the GHG emissions related to category 9 (Purchased products) and category 12 (Upstream transport) for the same organization.

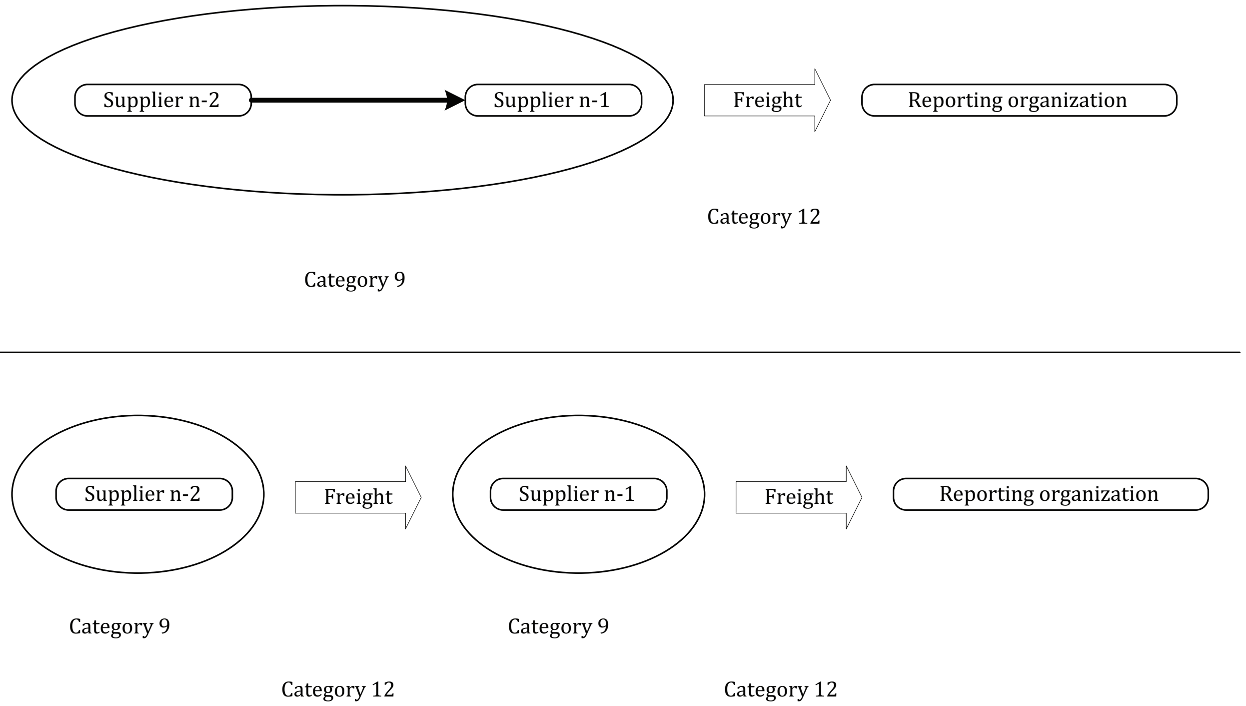


Figure 3 — Example of double counting issue between categories

In the first diagram, the organization takes into account the transport step between its last supplier and its site in category 12. For the calculation of the emissions of category 9, the organization takes into account very large boundaries for the emission factor. The emission factor is based on life cycle approach, taking into account upstream suppliers and all the upstream transport and distribution steps from the raw material to supplier *n*-1.

When there is not any emission factor based on life cycle approach available for the purchased products (category 9), then a second approach can be used as described in the second diagram. The organization takes into account all the transport steps (freight) from its supplier and upstream, in category 12. The products bought by its supplier are also taken into account as purchased products in category 9.

When both approaches are mixed, there is a risk of double counting.

5.3.3 Selection of GHG activity data

Once GHG sources and sinks are clearly identified, the organization collects or estimates activity data for each of the sources and sinks.

GHG activity data used to quantify GHG emissions or removals should be consistent with the requirements of the selected quantification methodology.

For the methodology using GHG activity data multiplied by GHG emission or removal factors, two types of GHG activity data are available:

— site-specific data (see 3.3.2), e.g. volume of fuel consumed, kWh of electricity bought, number of km travelled, units of purchased goods, weight of each type of waste produced by the organization, etc.;

— secondary data (see 3.3.3): whatever the origin of data, the organization should report the source of the secondary data, i.e. assumptions and key parameters used or a recognized study or national or sector inventory; secondary data are mainly used for other indirect emissions.

The type of activity data the organization chooses has a strong influence on the accuracy of the GHG inventory. The accuracy is linked with the site-specificity of the data and its disaggregation level.

Disaggregated site-specific data (see 3.3.4) provide the greatest accuracy. If there is no clear view on site-specific data, estimation should be done based on literature or recognized database. In this case, accuracy is lower. If it is not possible to collect or to estimate quality data, the category should not be taken into account. Such exclusion should be clearly stated in the report.

Non-exhaustive guidelines for the selection of activity data are given in subclauses relating to each emission category.

In those subclauses (5.4.1 to 5.4.23), a best scenario and a minimum scenario are defined for each emission category. The best scenario represents high quality data collection. By contrast, the minimum scenario represents the lowest acceptable level of accuracy of activity data. Between the best and minimum scenario, there is a range of possible intermediate scenarios that might be selected depending upon cost, time spent and other consideration. Guidelines are given on key parameters that should be considered for the disaggregation of activity data.

5.3.4 Selection or development of GHG emission or removal factors

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
4.3.5 Selection or development of GHG emission or removal factors If GHG activity data are used to quantify GHG emissions and removals, the organization shall select or develop GHG emission and removal factors that a) are derived from a recognized origin, b) are appropriate for the GHG source or sink concerned, c) are current at the time of quantification, d) take account of quantification uncertainty and are calculated in a manner intended to yield accurate and reproducible results, and e) are consistent with the intended use of the GHG inventory The organization shall explain its selection or development of GHG emission or removal factors, including identification of their origin and appropriateness for the intended use for the GHG inventory. The organization shall explain any changes to GHG emission or removal factors previously used by the organization and, where appropriate, recalculate the base-year GHG inventory (...).

Once activity data have been clearly identified, the organization should collect or estimate emission and removal factors for each of the sources and sinks. Emission or removal factors should be selected according to the activity data and should be in line with the disaggregation level of the activity data.

The organization should first look for site-specific emission or removal factors or underlying data used to develop a site-specific emission factor. When no site-specific emission or removal factors (or the underlying data) are available, estimated emission or removal factors from literature or recognized databases should be used. System boundaries of the process(es) generating GHG emissions should be taken into account when selecting the emission or removal factor. For example, emission factor of motor vehicle transport may be restricted to the CO_2 emission of the combustion of the fuel or may include the GHG emissions associated with fuel extraction and refining, and/or amortized emissions of road and motor vehicle construction and maintenance.

For direct GHG emissions and energy GHG indirect emissions, the system boundary for the emission factor covers only one stage (for example, the combustion of fossil fuels in categories 1 and 2).

For other indirect emissions, emission or removal factors should be based on life cycle approach. For example, for purchased products category, the emission or removal factor should take into account the emissions from cradle to gate. When no emission or removal factor based on a life cycle assessment is available, the organization should try to set up an emission or removal factor which covers the most relevant stages of the life cycle. This is called the boundaries for the emission or removal factor and the description of the boundaries should be reported.

NOTE The concept of boundaries of the emission or removal factor is derived from the concept of the system boundary, as defined in ISO 14040:2006, 3.32.

The most important stages to include in the system boundary for the emission or removal factor are given in the descriptions of the different emission categories (5.4.1 to 5.4.23).

5.3.5 GHG calculation

There are two steps for calculation.

The first step is to convert activity data into GHG emissions:

GHG emissions or removals = activity data × emission or removal factor

The second step considers the Global Warming Potential (GWP) of each GHG and allows the conversion of GHG emissions or removals into climatic impact, identified in tonnes equivalent of CO_2 (tCO_2e):

$$\text{GHG emissions} = \sum_{gas}\left(emissions_{gas} \times GWP_{gas}\right)$$

where GHG emissions are expressed in CO2 equivalent units.

NOTE 1 It is advisable to use GWP values from the latest version of IPCC for conversion of emissions in CO_2-equivalents (see Annex D)

NOTE 2 Emission or removal factors can sometimes directly be given into CO_2 equivalent units, and then GWP is equal to 1.

The accuracy of the final calculation depends on the accuracy of the activity data and emission or removal factor. It is important to disclose considerations related to the accuracy level for data activity and emission or removal factors (see Clause 8 for the reporting).

5.3.6 Specific issues applicable to several categories

5.3.6.1 GHG emissions and removals from biomass

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
4.2.2 Direct GHG emissions and removals (...) The organization should quantify GHG removals from facilities within its organizational boundaries. (...) CO_2 emissions from the combustion of biomass shall be quantified separately.

Other anthropogenic biogenic CO_2 emissions (excluding biomass combustion) may occur from e.g. land use change, degradation process (e.g. fermentation), reversal of removals (for example, through deforestation).

Non anthropogenic biogenic CO_2 emissions caused by force majeure (e.g. wildfire, or infestation by insects) should be quantified and reported separately.

These other biogenic CO2 emissions should be quantified in the relevant direct categories: category 3 (Direct process related emissions), category 5 [Direct emissions and removals from Land Use, Land Use Change and Forestry (LULUCF)] and other indirect emissions within the relevant categories such as category 9 (Purchased products) or category 19 (End of life of the product). Additional guidance is provided in the relevant subclauses of 5.4.

Thus, biogenic CO_2 emissions from an organization should be reported separately as follows:

— CO_2 emissions from the combustion of biomass;

— other CO_2 emissions from biomass.

Other GHGs emissions from biomass (such as CH_4, N_2O) should be calculated in CO_2e. These quantities should be reported with that of similar GHG emissions from other sources e.g. combustion or industrial process, etc., thus differentiating the climatic impact between CO_2 and other GHG emissions.

5.3.6.2 Specific cases of emission factors

Some emission factors for processes or goods or services are still difficult to assess scientifically. In some cases, values may vary across a very large range, from one-to three-fold for instance. Two examples are listed below.

a) Aircraft emissions

According to IPCC (see Reference [10], Chapter 2), condensation trail and cirrus effects caused by global aircraft operations could influence significantly the radiative forcing due to emissions from aircraft. The organization could take into account this fact for its GHG quantification with a correction factor applied to the GHG direct emissions factor of fuel combustion. In this case, the organization indicates the correction factor applied to the emission factor to account for the higher radiative forcing (GWP) aircraft emissions associated with fuel combustion.

b) Nitrous oxide emissions from fertilizer use in agricultural practices

N_2O emissions are strongly dependent on regional and organizational specificities, such as fertilizer type and regime, temperature and humidity, and cultivation practices. In addition, understanding of nitrogen cycle through soil and atmosphere is still under scientific discussions.

As with the selection of all emission factors, the organization should indicate clearly the value of the emission factor used, explain this chosen value and document the used sources.

5.3.6.3 Avoided emissions

Avoided emissions (see 3.1.5) should be quantified only for energy generation or material recovery from waste treatment (see for example 5.4.9 and 5.4.11). Any other avoided emissions (e.g. from use stage of sold products) should not be taken into account. In this case, those emissions are quantified and reported separately.

NOTE When selecting emission factors for waste treatment, it is advisable that the organization identifies if avoided emissions are included or excluded.

5.4 Quantification of GHG emissions and removals for each category

5.4.1 Category 1 — Direct emissions from stationary combustion

a) Identification of GHG sources and sinks

Direct emissions from stationary combustion are due to on-site combustion of fuel burnt in stationary (fixed) equipment included within the organizational boundaries of the reporting organization (such as for example heaters, gas turbines, boilers, etc.) to generate heat, mechanical work and steam.

b) Selection of GHG activity data

1) Best scenario

The most accurate activity data are the total quantities of each fuel. The quantity of each fuel can be collected by reading out energy meters or by a follow-up of the amounts on the bills over the considered period.

2) Minimum scenario

The total energy consumed by the organization from stationary combustion per type of fuel is estimated. As a minimum, the organization could separate energy consumption from heating and from process as this could be useful for further energy efficiency.

3) Intermediate scenarios

All stationary combustion sources are identified and the quantity of fuel is normally available. Where the fuel used is not known, then an estimate of the consumption of fuel related to stationary combustion can be obtained by disaggregation using the following main key parameters:

For the heating of buildings, key parameters that should be considered are:

— floor area and age of building;

— type of energy used;

— climatic zone;

— operating hours and the use of the building.

For machinery, key parameters that should be considered are:

— type and size of machine;

— period of use per year;

— type of fuel;

— nominal input power and yield;

— efficiency and equipment rating.

c) Selection of emission factors

The emission factor takes into account only the direct emissions due to the stationary source.

GHG emission factors are expressed in GHG emissions per quantity of fuel used or per total energy consumed (kWh).

d) Examples

EXAMPLE 1: An organization has a central heating system using gas. There is an energy meter and the quantity (in kWh) each year on January 1 at noon is registered. Total quantity is 6 107 888 kWh. The quantity is expressed in higher heating value (HHV). Emission factor for natural gas (HHV) is 0,201 kg CO_2e/kWh. Total emissions = (6 107 888 × 0,201) = 1 227 685,488 kg CO_2e= 1 228 t CO_2e

EXAMPLE 2: An organization does not know its fuel consumption. The organization is composed of an office with 1 500 m^2 and uses heating oil. The organization has noted in recognized database that the average rate for offices is 248 kWh/m^2 heated. All 1 500 m^2 are heated. With this parameter of 248 kWh/m^2, the emission factor (kg CO_2/m^2) is 50 kg CO_2/m^2. Total emissions = (1 500 × 50) = 75 000 kg CO_2e = 75 t CO_2e

e) Other indirect emissions potentially linked to category 1 emissions

Other emissions of GHG are related to direct emissions from stationary combustion, without being direct emissions, and are classified in the corresponding other indirect emissions categories.

Considering a boiler belonging to and used by an organization, category 1 emissions are restricted to fuel combustion emissions. Other indirect emissions take into account, for example, GHG emissions due to fuel transport from refinery and/or due to boiler construction. These related processes are necessary to stationary combustion, but are not classified as direct emissions from stationary combustion.

Table 5 provides some potential other indirect emissions related to direct emissions from stationary combustion, and indicates in which category it should be classified. Depending on the process, the type of fuel and other potential characteristics of stationary combustion, other indirect emissions could be considered.

Table 5 — Non-exhaustive list of other indirect emissions potentially linked to category 1 (Direct emissions from stationary combustion)

Other indirect emissions potentially linked to direct emissions from stationary combustion	Category associated
Upstream emissions related to the production and transport of the fuel	8 Energy-related activities not included in direct emissions and energy indirect emissions (see 5.4.8)
Construction of the stationary combustion unit	10 Capital equipment (see 5.4.10)
End-of-life of the combustion unit	11 Waste generated from organizational activities (see 5.4.11)

These related emissions could be significant. For example, considering oil fuel, the production, refining and transport could emit from 5 % to 10 % of CO_2 combustion emissions.

Emissions due to construction, installation and maintenance of an industrial boiler should be amortized over the investment time-of-life (between 20 years and 50 years), or alternatively on fiscal depreciation period. Even if these emissions are not strictly proportional to consumed fuel (and so to combustion emissions), it could represent, each year, in some cases, 2 % or 3 % of these combustion emissions.

Including or neglecting one or several related other indirect emissions should follow the general recommendations "Prioritizing relevant emissions" described in 5.2.3.

5.4.2 Category 2 — Direct emissions from mobile combustion

a) Identification of GHG sources and sinks

Direct emissions from mobile combustion are due to fuel burnt in transport equipment, included within the organizational boundaries of the reporting organization (such as for example motor vehicles, trucks, ships, aircraft, locomotives, forklift trucks, etc.). Emissions from journeys in vehicles not included within the organizational boundaries of the organization are not considered as "direct GHG emissions" and should be reported as "other indirect emissions" arising from business travel, employee commuting, client or visitors transport, upstream leased assets, etc.

When vehicles are used for both occupational and personal travels, only the emissions due to distance travelled for occupational use, are taken into account. If it is not possible to separate occupational and personal travels, the organization should clearly mention it in the report.

b) Selection of GHG activity data

1) Best scenario

The most accurate activity data is the total quantity of each type of fuel consumed by each transport equipment.

The quantity of each fuel can be collected by collecting fuel meters readings or by totalling, the amounts on the bills over the analysed period.

2) Minimum scenario

If the total quantity of each fuel is not available, the reporting organization identifies each type of transport equipment with as a minimum a distinction between motor vehicles, trucks, ships and aircraft. For each transport equipment, the reporting organization then estimates the total distance travelled for each type. The activity data could be expressed either by total distance travelled or by fuel consumption.

3) Intermediate scenarios

The activity data can be more specific for each type of vehicle identified, depending on the following disaggregation.

The key parameters that should be considered are:

— Type of final energy used: gasoline, diesel fuel, gas, biofuel, etc.;

— Type of engine: small, medium, large, etc.;

— Type of travels: urban suburb, town centre, rural periphery, etc.

Other potential parameters that should be considered:

— type of use (eco driving, fast driving);

— weight of the vehicle with its load.

c) Selection of emission factors

GHG emission factors can be expressed in GHG emissions per quantity of fuel used or GHG emissions per distance travelled.

The emission factor should take into account only the direct emissions due to the transport equipment.

d) Examples

EXAMPLE 1: An organization owns a fleet of 25 identical trucks used for delivery of products. The trucks are parked at a central location and refuelled there from diesel storage tanks owned by the organization. The organization makes an inventory of fuel in the storage tanks on December 31 every year, and adds to this volume the amount of fuel delivered to the tanks during the calendar year. At the end of the year, the amount remaining in the tanks is again measured and deducted from the sum of the initial inventory plus deliveries. This method provides reasonably accurate “activity data” (litres of fuel used in trucks during the year). Look-up tables provide emission factors for emissions of CO_2, N_2O and CH_4 from the combustion of diesel fuel in mobile sources. Only one emission factor is needed for conversion of litres of fuel consumed to tonnes of CO_2.

In this example, the organization’s fleet of 25 trucks consumed 473 125 litres of diesel fuel in the year. For CO_2 emissions, the emission factor is independent of the distance travelled by the fleet of trucks.

Total emissions = (473 125 × 2,52)/1 000 = 1 192 t CO_2e where 2,52 kg CO_2/l is the emission factor from combustion of diesel fuel (all types of trucks).

EXAMPLE 2: An organization owns a fleet of different vehicles. Different GHG emission factors are needed for each type of vehicle. Those GHG emission factors should reflect the key parameters specified for each vehicle (type of energy used, type of engine, type of travels; see Table 6).

Table 6 — Example 2 for category 2

Number and type of vehicle	11 diesel light trucks (model years 1983-1995)		9 diesel light trucks (model years 1996-present)	5 electric heavy duty trucks (all model years)	Total
Travelling distance /year/ vehicle (in km)	30 000	urban area	100 000	100 000	
	70 000	rural area			
Average fuel consumption/ vehicle (in l/km)	0,15		0,11	non applicable	
Total fuel consumed (in l)	11 × 100 000 × 0,15 = 65 000		9 × 100 000 × 0,11 = 99 000	non applicable	264 000
Total CO_2 emissions (in kg CO_2e)	65 000 × 2,52[a] = 415 800		99 000 × 2,52[a] = 249 480		415 800 + 249 480 = 665 280 kg CO_2e = 665 t CO_2e

[a] The emission factor of fuel is 2,52 kg CO_2e/l

e) Other emissions potentially linked to category 2 emissions

Other emissions of GHG are related to direct emissions from mobile combustion, and are quantified in the corresponding other indirect emissions categories.

Table 7 provides some potential emissions related to direct emissions from mobile combustion, and indicates in which category these emissions should be classified. Depending of the process, the type of fuel and other potential characteristics of mobile combustion, other emissions could be considered.

Table 7 — Non exhaustive list of other emissions potentially linked to category 2 (Direct emissions from mobile combustion)

Other emissions potentially linked to direct emissions from mobile combustion	Category associated
Leaks of refrigerant from air cooling systems	Direct fugitive emissions (see 5.4.4)
Fossil fuels production and transport	Energy-related activities not included in direct emissions and energy indirect emissions (see 5.4.8)
Vehicles maintenance	Purchased products (see 5.4.9)
Vehicles construction	Capital equipment (see 5.4.10)
Vehicles end of life	Waste generated from organizational activities (see 5.4.11)

These related emissions could be significant. For example, considering oil fuel, the production, refining and transport could emit from 5 % to 10 % of CO_2 combustion emissions.

Including or neglecting one or several related other emissions should follow the general recommendations “Prioritizing relevant emissions” described in 5.2.3.

5.4.3 Category 3 — Direct process related emissions

a) Identification of GHG sources and sinks

Direct GHG processes related emissions are emissions from biological, mechanical or other activities that are not coming from the direct combustion of fossil fuels or from leaks from equipment and storage and transport systems or from leaks from reservoirs and injection wells. The emissions sources are within the organizational boundaries of the reporting organization.

This category covers a very wide range of emissions from different sectors such as:

— industrial process (decarbonation of limestone during the production of cement that generates CO2 emissions, venting, oil and gas refining, etc.);

— agricultural processes (putrefaction and fermentation, manure, livestock, application of nitrogen fertilizers, etc.);

— waste and wastewater treatment processes emissions;

— carbon capture and storage emissions processes.

The sources and the type of emissions can be very different from one sector to another and within the same sector. An exhaustive list is available in the emission factors database of IPCC [7].

b) Selection of GHG activity data

1) Best scenario

Exact quantification of direct GHG emissions is known for each process. Exact amount (weight, volume) for each gas is known and based on direct measurement or exact measurements of the activity data and related emission factor or based on the stoichiometric formula of a known chemical reaction that causes the process emissions.

2) Minimum scenario

When exact measurements are not possible and no stoichiometric formula can be specified, the organization estimates the direct GHG emissions by multiplying activity data for the processes identified with the relevant emission factor provided in the IPCC databases.

For example, if an organization produces carbon black, methane emissions occur during the production process. The facility of the organization is not equipped with a methane measurement system. The organization knows it has no abatement (thermal treatment of the methane emissions). Based on this information, the organization finds in the IPCC database that the emission factor is given by tonne of carbon black produced. Ideally, the organization knows how much carbon black it produced during the reporting period. This amount is in this case the activity data. If the organization does not know how much carbon black is produced, this activity data based on other site-specific activity data should be estimated. The emission factor is 28,7 kg CH_4/t of carbon black produced. The organization has all the necessary data to calculate the direct GHG process-related emissions of its activities.

3) Intermediate scenarios

The sources and types of emissions may differ from one sector to another but also within the same sector.

Given the large number of potential emissions covered by this position, this methodology does not identify key parameters for the calculation.

c) Selection of emission factors

Site-specific emission factors from measurements are preferred. If not available, emission factors can be obtained from recognized sources. A potential source of emission factors is the emission factor database from IPCC. This database is available on the website of IPCC. Scientific or professional publications may also contain emission factors related to these specific activities.

d) Examples

EXAMPLE 1: An organization uses nitrogen fertilizers. The total amount of nitrogen as N spread on the field is equivalent to 500 kg/year. The direct and indirect nitrogen volatilization factor given by the IPCC 2006 guidelines is 2,09 %. This factor is the emission factor making the link between the activity data and the GHG emissions. It means that the amount of N_2O emissions is equivalent to 10,45 kg (500 × 2,09 %). The GWP-value for N_2O is 298 kg CO_2e for 1 kg of N_2O. Total emissions = (10,45 × 298) = 3 114 kg CO_2e= 3 t CO_2e

EXAMPLE 2: The number of cows owned by an organization is 100. The estimated emission factor for one cow is 1892 kg CO_2e per year. Total emissions = (100 x1892) = 189 200 kg CO_2e =189 t CO_2e/year

5.4.4 Category 4 — Direct fugitive emissions

a) Identification of GHG sources and sinks

Fugitive emissions are direct uncontrolled emissions of greenhouse gases. Each process using GHG can potentially be a source of fugitive emissions.

Fugitive GHG emissions include leaks from equipment and storage and transport systems, and leaks from reservoirs and injection wells.

Fugitive emissions typically arise from activities that utilize or transport GHG such as methane transport and cooling systems containing refrigerants. Only the direct emissions should be taken into account in this category.

NOTE Direct measurements of direct fugitive emissions almost never happen.

b) Selection of activity data

1) Best scenario

For organizations transporting gases, the difference between the amount that is bought and the amount that is sold can be calculated. For cooling systems, it can be the quantity of refrigerants that is needed to refill the equipment. In many countries, it is mandatory to maintain a registry where these quantities are indicated.

2) Minimum scenario

If no data are available on the amount of GHG losses, the organization estimates the amount of leakage based on the information that is available about the system. Estimate may be based on formulae from published, peer-reviewed literature (see bibliography)

3) Intermediate scenarios

When some data are known, such data are used and the other data are estimated by disaggregation using such key parameters as:

- the type of GHG;
- the technical specificities of the system (cooling system, storage, transport, etc.);
- the age of the system;
- potential size of the source (transport distance, reservoir content, etc.);
- power of the equipment.

c) Selection of emission factors

Emission factors should only cover the direct emissions and not the emissions of the other stages of the life cycle. For example, direct emissions during the end-of-life stage of the technical equipment should be taken into account in the category 11 (Waste generated from organizational activities) (e.g. emissions of refrigerants during treatment of the end-of-life of an installation).

d) Examples

EXAMPLE 1: An organization buys methane in country A and transports it and sells it to country B. The distance between the two countries is 10 000 km. The organization knows that it buys 100 000 000 kg of methane in country A. It sells 99 500 000 kg of methane in country B. So, the organization knows that there is a leakage of 500 000 kg of methane. The GWP value for methane is 25. Total emissions = (500 000 000 × 25) = 12 500 t CO_2e

EXAMPLE 2: An organization has a cooling system on its administrative building. The organization needs to refill the system with 1 kg of R22 every year because of leakages. The amount of cooling liquids needed every year is found in the registry of cooling liquids which is filled in by the maintenance company, after every maintenance. The GWP value is 1 810 kg CO_2e for 1 kg of R 22. Total emissions = (1 × 1 810) = 1 810 kg CO_2e = 1,8 t CO_2e

EXAMPLE 3: An organization has a cooling system on its administrative building. The maintenance company has a global contract and cannot report how much refrigerant is refilled in the system every year. After a research, the organization obtains the following data on the system: the system has R22 as refrigerant. The system contains 26 kg of refrigerant. The cooling system is 10 years old. In the literature, the organization finds that for a system of that type and age, there is an average leakage of 4,5 %. Based on this data, the organization estimates that there is a loss of 1,17 kg of R22 every year. The GWP value is 1 810 kg CO_2e for 1 kg of R 22. Total emissions = (1,17 × 1 810) = 2 117 kg CO_2e = 2,1 t CO_2e. If the refill is not made every year, the average value between two refills should be reported every year.

5.4.5 Category 5 — Direct emissions and removals from Land Use, Land Use Change and Forestry (LULUCF)

a) Identification of GHG sources and sinks

GHG emissions and removals from LULUCF may come from anthropogenic land use activities (controlled biomass burning, restoration of wetlands, forest management, rice and other agriculture cultivation, animal husbandry generating enteric fermentation,) direct land use change (afforestation, reforestation, and deforestation), and managed forests, within the organizational boundary.

Direct GHG removals from atmosphere increases the carbon stock (see Note 1) of one of the following reservoirs: above-ground biomass, below-ground biomass, dead wood, litter, soil organic matter. These removals are due to the uptake of CO_2 during the growth of biomass.

Direct GHG emissions from one of the following reservoirs above-ground biomass, below-ground biomass, dead wood, litter, soil organic matter decreases the carbon stock. These emissions are caused by the degradation of the biomass to CO2 (e.g. deforestation), CH4 (e.g. enteric fermentation) and N2O (e.g. fertilizers).

Direct land use change (dLUC) occurs through anthropogenic intervention that creates a change in carbon stocks on that land. A change in carbon stock can occur when land use changes from one category to another (e.g. converting forest to crop land) or within a land use category (e.g. converting a natural forest to a managed forest, converting from till to no-till). Land use change does not include changes in crop cover or crop rotations that occur within the crop land category.

Land use categories include forest land, cropland, grassland, wetlands, settlements, and other lands (IPCC, 2006).

Indirect land use change (iLUC) should be considered in GHG inventory, once an internationally agreed procedure exists.

NOTE 1 Carbon stock refers to the total amount of carbon stored on a plot of land at any given time in one or more of the following carbon reservoirs: above-ground biomass, below-ground biomass, dead wood, litter, soil organic matter) (see IPCC, 2006, Volume 4 [7]).

NOTE 2 Direct GHG removals from growth of pasture and annual crops might be not quantified because they are soon released into the atmosphere through decay or digestion, and so are neutral on an annual cycle. If they are not excluded, biogenic CO2 emissions are accounted for in the other indirect emissions in category 9 (Purchased products), category 11 (Waste generated from organizational activities), category 18 (Use stage of the product) and category 19 (End of life of the product).

b) Selection of activity data

1) Best scenario (land area known, biomass per unit area known)

The most accurate activity data are the site-specific total area and type of land use within the organizational boundaries. The organization knows and uses data from the land use changes and practices associated with that land. The amount and type of biomass standing on this land can be considered, e.g. on the basis of a forest inventory.

2) Minimum scenario (area estimated, biomass estimated based on land use)

If the total area and type of land use is not precisely available, the reporting organization should as a minimum estimate the area for each type of land use: bare land, crops or forests, by using proxy data and explaining their choice.

3) Intermediate scenarios (area known, land use/land cover known, biomass per unit area estimated)

All biomass is identified and the area is estimated. The emissions due to biomass can be estimated by disaggregation using key parameters such as:

— type and quantity of biomass;

— climate in which the biomass is growing;

— harvested or natural growth.

c) Selection of emission or removal factors

An approved source of emission or removal factors is the database from IPCC or a recognized national source (see Annex B). Scientific or professional publications may also contain emission or removal factors related to these specific activities.

As the emission or removal factors can be very different depending on the different parameters, it is important to report how the emissions or removals for this category were calculated/estimated and which sources were used.

d) Examples

EXAMPLE 1: An organization owns a forest of 100 ha. This pines forest is located in Norway. The CO_2 uptake is 4,5 t CO_2 per ha per year. The removal obtained from this managed forest is 4,5 × 100 = 450 t CO_2e per year. The removals will be accountable during the growth of the pine forests (rotation period).

EXAMPLE 2: Transformation of forest for long-term palm oil production (Source: IPCC 2007; as adapted in EC 2010: ILCD Handbook; General guide for Life Cycle Assessment – Detailed guidance, Annex B).

An organization wants to convert 1000 ha of primary forest into long-term palm oil production. It looks for the different information regarding that location such as:

— climate region: tropical

— moisture regime: wet

— soil type: volcanic

— land use 1: primary forest[

— land use 2: long-term cultivated

— land management and input level of land use 1: none

— land management and input level of land use 2: reduced tillage, low input

The GHG emissions due to land use change are obtained by calculating the original carbon stock SOC_{i} and the final carbon stock SOC_{f}. This does not take into account the loss of biomass in converting from native forest to oil palm; the organization checks the IPCC 2006 [7] and finds the following formulae:

$$SOC_i = SOC_n \times LUF_1 \times LMF_1 \times IL_1$$

$$SOC_f = SOC_n \times LUF_2 \times LMF_2 \times IL_2$$

SOC_i is the initial soil organic carbon stock of initial land use “1” expressed in t/ha

SOC_f is the final soil organic carbon stock of land use “2”, i.e. after transformation expressed in t/ha

SOC_n is the primary soil organic carbon stock (climate region, soil type) expressed in t/ha

LUF is the land use factor (dimensionless)

LMF is the land management factor (dimensionless)

IL is the input level factor (dimensionless)

The organization finds the following data in the IPCC guideline: SOC_n = 130 t/ha; LUF_1 = 1,00 ; LMF_1 = 1,00 ; IL_1 = 1,00 ; LUF_2 = 0,48 ; LMF_2 = 1,15 ; IL_2 = 0,92.

When applying the above equations,

SOC_i=130 × 1 × 1 × 1 = 130 t of C/ha

SOC_f = 130 × 0,48 × 1,15 × 0,92 = 66 t of C/ha

The loss in carbon stock = 130 – 66 = 64 t of C/ha.

The resulting total emissions to be attributed to that conversion to primary forest to oil palm production over the applicable productive period of use (e.g. 20 years) is 64 x44/12= 234,67 t CO2e/ha

NOTE 3 The conversion from carbon to CO_2 is calculated by multiplying the carbon quantity by 44/12.

The total annual emissions for the organization = 234,67 × 1000/20 = 11734 t CO_2e.

5.4.6 Category 6 — Indirect emissions from imported electricity consumed

a) Identification of GHG sources and sinks

This category includes only GHG emissions from electricity imported by the organization due to the fuel combustion. It excludes:

— all upstream (cradle to power plant gate) emissions associated with fuel;

— emissions due to the construction of the power plant;

— emissions allocated to transport and distribution losses (except when the reporting organization is an electricity generation company).

NOTE 1 If the producer owns the transmission and distribution system and provides an emission factor that incorporates the transmission and distribution losses, the reporting organization estimates the GHG associated with the transmission and distribution losses and reports them separately in category 8 (Energy-related activities not included in direct emissions and energy indirect emissions).

b) Selection of activity data

1) Best scenario

Exact amount of electricity bought by the organization is known.

MWh and GWh power consumption units are usually used to quantify electricity consumption. This amount of electricity is counted at organization power supply point(s).

The quantity of electricity can be collected from electricity meters or by collation of the electricity bills for the relevant period.

2) Minimum scenario

The amount of energy bought by the organization is estimated. The estimation is based on benchmarking with similar business sector and should be done separately for small (lighting, offices, etc.) and large (heating, air-conditioning) electricity consumers.

3) Intermediate scenarios

The organization knows accurately the amount of electricity bought for large electricity consumers and estimates its electricity consumption either by one of the following approaches:

— Estimation of the electricity consumption by a bottom-up approach: the power of each electricity consuming equipment is multiplied by the time the equipment is used and the percentage of the available power that is used. The estimates for all the different items of equipment are summed to give an estimate of the total electricity consumption for the organization.

— Estimate of electricity consumption by consumption ratios of organizations with similar activities.

c) Selection of emission factors

Each energy source (fuel, gas, wind, solar, etc.) and generation facility has its own GHG emission factor. The combination of the energy sources is called the electricity-mix.

The GHG emission factor associated with the purchased electricity can be based on the electricity mix from:

— a specific electricity generating company;

— an electricity supplier, i.e. one using an electricity-mix based on annual, hourly or other time related basis.

NOTE 2 Such emission factors are only permissible when the electricity supplier can guarantee the delivery of a kilo-Watt hour where the associated emissions are not double counted.

— the country where the facility is located;

— the relevant grid from which the power is obtained: a relevant grid should be understood as the grid to which the organization is connected and other grids possibly connected to this grid.

In addition, note carefully the different definitions of electricity-mix which may be based either on production or consumption.

In any case, the choice of the emission factor, its value, the origin of this value (database, provider information, etc.) and the validity of this value should be explained and documented.

d) Examples

EXAMPLE 1: An organization buys 5 123 588 kWh and has a binding contract with an electricity provider. The emission factor provided by this provider is 0,106 kg CO_2e/ kWh. Total emissions = (5 123 588 × 0,106) = 543 100,328 kg CO_2e = 543 t CO_2e

EXAMPLE 2: An organization knows that it consumes 14 254 988 kWh per year. The organization has no specific information concerning its electricity provider. The organization uses the country mix that is 0,726 kg CO_2e/kWh. Total emissions = (14 254 988 × 0,726) = 10 349 121,288 kg CO_2e= 10 349 t CO_2e.

EXAMPLE 3: An organization has no data about the electricity consumption in its building. The organization decides to estimate the electricity consumption based on a floor area which is 2 000 m^2. The organization finds a value of 240 kWh/m^2 for the electricity consumption of similar buildings. The emission factor for the electricity production in the country is 0,403 kg CO_2e/kWh. Total emissions = (2 000 × 240 × 0,403) = 193 440 kg CO_2e = 193 t CO_2e.

5.4.7 Category 7 — Indirect emissions from consumed energy imported through a physical network (steam, heating, cooling, compressed air) excluding electricity

a) Identification of GHG sources and sinks

Indirect emissions from steam, heating, cooling and compressed air used are due to GHG emissions from the generation of purchased steam, heating, cooling, compressed air consumed by the organization. These emissions have taken place in another organization where steam, heating, cooling or compressed air has been produced. It excludes:

— all upstream (cradle to gate) emissions associated with fuel;

— emissions due to the construction of the power plant,

— emissions allocated to transport and distribution losses (except when the reporting organization is an energy generation (steam, heating, cooling, compressed air) company.

b) Selection of activity data

1) Best scenario

The exact amount and type of energy (steam, heating or cooling) bought by the organization is known.

The organization also knows the exact amount of fuel (coal, gas, wood, etc.) consumed for the production of the purchased amount of steam, heating, cooling or compressed air.

The quantity of purchased steam, heating, cooling or compressed air can be collected from energy meters or by collation of the energy bills for the relevant period.

2) Minimum scenario

The exact amount of steam, heating, cooling or compressed air purchased by the organization is not known. The activity data are estimated separately for the need of heating or cooling for:

— building processes: cooling or heating;

— industrial processes.

The organization should also distinguish the heating, steam, cooling or compressed air purchased by type of fuel consumed based on an estimate of the yield of each generator.

3) Intermediate scenarios

The organization knows accurately the amount of heating, steam, cooling or compressed air bought for large consumers and calculates its consumption of heating, steam, cooling or compressed air using one of the following approaches:

— estimation by a bottom-up approach: the consumption of each energy item of equipment is obtained by multiplying the rated power by the time period for which the equipment is used; the estimates for the different items of equipment are summed to give an estimate of the total heating, steam or cooling consumption of the organization;

— estimates of the heating, steam, cooling or compressed air consumption by consumption ratios of organizations with similar activities; the choice of consumption ratios should be guided by the following parameters:

— type of organization (industry, offices, etc.);

— age of installations;

— activities that are covered by heating, steam, cooling or compressed air consumption and those that are providing energy by other energy sources (gas, electricity, etc.).

c) Selection of emission factors

The emission factor should only take into account the direct emissions related to the production of heating, steam, cooling or compressed air at the level of the organization which produces the heating, steam or cooling. The emission factor should take into account the following parameters:

— type of fuel source;

— type of combustion installation;

— age of the installation;

— the efficiency of the steam, heating, cooling, compressed air production, if also known.

The emission factor provided by the energy producer should be used when available. General country data for each type of fuel should be a second best option.

d) Examples

EXAMPLE 1: An organization buys cooling for its building. The organization does not know the consumption for the building but it has been told that the average for the type of building should be 250 kWh/m^2. The building area is 17 000 m^2. The supplier has calculated that for the geographic location, the emission factor is 0,018 kg CO_2e/kWh and presumes a loss of 10 %.Total emissions = (17 000 × 250 × 0,018) × (1 + 0,1) = 84 150 kg CO_2 = 84 t CO_2e.

EXAMPLE 2: An organization purchases steam for its process on a per tonne basis. The supplier has provided the emission factor and the losses during transport. The emission factor equals 88 kg CO_2e/t and the loss is 8 %. The total amount that is bought equals to 8 814,3 t. Total emissions = (8 814,3 × 88) × (1 + 0,08) = 837 711,072 kg CO_2e = 838 t CO_2e.

EXAMPLE 3: An organization buys 5 000 t of steam and has a binding contract with steam producer. The emission factor provided by this producer is 50 kg CO_2e/ t. Total emissions = (5 000 × 50) = 250 000 kg CO_2e = 250 t CO_2e.

5.4.8 Category 8 — Energy-related activities not included in direct emissions and energy indirect emissions

a) Identification of GHG sources and sinks

This category includes upstream emissions of energy sources that are associated with

— Fuels consumed by the reporting organization (see categories 1 and 2) and

— Imported electricity or steam consumed by the reporting organization (categories 6 and 7).

Upstream emissions of the energy sources are produced during all stages that occur before fuel combustion or energy consumption (extraction production, transport, distribution). The emissions can be due, for example, to the combustion of fuels during the transport stage or due to losses as fugitive emissions during the transport (due to leaks in the pipes), etc. Additional emissions may also be included due to those generated by the construction of energy producing, transport and distribution infrastructures.

b) Selection of activity data

1) Best scenario

The most accurate quantification is when an organization knows exactly the type and origin of the fuels consumed for the generation of electricity, steam, heating and cooling (either purchased or self-generated by the reporting organization). The different life stages of the product (e.g. fuel, electricity, steam) are also known exactly. The activity data for each life cycle stage can be multiplied by a site-specific emission or removal factor.

2) Minimum scenario

The organization does not know the origin of the fuels consumed for the generation of electricity, steam, heating and cooling (either purchased or generated by the reporting organization). The organization uses recognized database values.

3) Intermediate scenarios

When an organization is not able to verify the complete process for the generation of its imported energy, the organization disaggregates the data in order to obtain the most accurate estimates for its inventory using parameters such as:

— origin of fuel (extraction at off-shore wells or desert wells, etc.), distance from country of origin to place of consumption, type of transport mode;

— age of technologies, supplier energy consumption and associated mix within the different steps.

c) Selection of emission or removal factors

The organization reports which sources have been taken into account for the GHG emission or removal factors at each stage of fuel extraction, production and transport. Site-specific emission or removal factors are those that have been calculated by the suppliers of each specific stage. The calculation of the emission or removal factor should include all stages from the cradle to the reporting organization gate.

The organization explains which steps have been omitted and how this can affect its GHG emissions.

The organization reports which scope is covered by the emission or removal factors:

— stages of the upstream energy production process;

— losses of fuel during transport (losses of methane in transport pipes or in methane transporting boats, etc.);

— construction of infrastructure (power plant, gas network, super tanker, etc.).

NOTE Emission factors published by national or international energy agencies do not generally take into account the energy losses during transport and distribution. Where such emission factors are used for calculating GHG emission inventories, an allowance of 3 % of energy loss during high voltage transport and 7 % of energy loss during the transformation from very high voltage to low voltage can be used, unless more specific information is available.

d) Examples

EXAMPLE 1: An organization in Belgium buys 1 000 000 m^3 methane (gas) from a company in the Netherlands. To calculate the GHG emissions of its organization, the organization contacts the gas producing company and obtains the data given in Table 8.

Table 8 — Example 1 for category 8

Activity	Quantity	Emission factor
Energy consumption for extraction of 1000 m^3	25 kWh	400 g CO_2e/kWh
Energy used for transport of 1000 m^3 from the Netherlands to Belgium	100 kWh	400 g CO_2e/kWh

Total emissions = (25 × 1 000 × 400) + (100 × 1 000 × 400) = 50 000 000 g CO_2e = 50 t CO_2e.

EXAMPLE 2: An organization buys 1 000 MWh of electricity. To calculate the GHG emissions of this electricity consumption, the organization finds the following emission factor for the electricity: 348 g CO_2e kWh. This emission factor does not include the emissions due to the extraction, transport and production of fuel for the electricity production. This extra percentage is estimated to be 5 %. Total emissions = (1 000 000 × 348) × (1,05) = 365 400 000 g CO_2e = 365 t CO_2e.

5.4.9 Category 9 — Purchased products

a) Identification of GHG sources and sinks

Indirect emissions from purchased products are emissions from goods and services brought into the organization. The type of emissions can be very different from one product to another.

NOTE Purchased products include upstream franchises. A franchisee (i.e. an organization that operates franchises and pays fees to a franchisor) reports the franchisor's activity in this category, including all activities of the franchisor (i.e. an organization that grants licenses to other organizations to sell or distribute its goods or services, in return for payments, such as royalties for the use of trademarks and other services). The franchisor is asked to specify how it has allocated the GHG emissions of its services.

b) Selection of activity data

Organizations often have incomplete records, of purchased goods.

This is why the organization should clearly describe which purchased goods and services are taken into account and neglected and how this can affect the total GHG emissions. The possible ways to select a certain percentage of the purchased goods or services to be taken into account are the following:

— embedded GHG emissions of the purchased product;

— monetary value of purchased amount;

— weight of purchase amount.

The department or function responsible for buying goods and services should ensure that activity data are available.

1) Best scenario

The most accurate quantification is when an exact physical amount (weight, volume, number of units) is known for each of the goods and services.

Services contracted by the organization are also evaluated one by one in order to obtain specific activity data.

However, the quantification of each good and service purchased by the organization is in practice very difficult. Therefore a selection may be based on a first estimate of the embedded GHG emissions of the purchased product.

2) Minimum scenario

When no site-specific data are available, the organization uses aggregated estimated data. The organization should prioritize its purchased goods and services for emissions evaluation based on the monetary value of its contracts, given consideration of products and services emissions and/or intensity. While this may not provide the most accurate method of determining product carbon footprint, it may be considered as a suitable starting point. As a minimum, the organization should disaggregate the data at the level of the product families (e.g. plastics, metals, cleaning services, groundwork and garden services, etc.).

3) Intermediate scenarios

When no quantified data are available for purchases, an estimation is made. Due to the variety of key parameters, the intermediate scenario is, most of the time, a mix of different situations between those described in 1) and 2) above in the best and minimum scenario.

c) Selection of emission or removal factors

Ideally, the organization uses emission or removal factors for its purchased products that have been calculated with life cycle approach according to ISO 14067. The estimate of the emission or removal factor should include the emissions from cradle to gate. In this case, intermediate products are automatically taken into account.

Emission or removal factors based on ISO 14067 for purchased products can be obtained from the supplier. If the supplier has no such an emission or removal factor, it is possible for an organization to make it a requirement in its buying negotiation.

When no site-specific emission or removal factor is available for the purchased product, emission or removal factors from recognized (inter)national databases should be used. In this case, the organization clearly identifies if intermediate products are taken into account (see boundaries of the emission factor below).

When selecting an emission or removal factor from recognized Life Cycle Assessment (LCA) database, influential parameters to take into account are:

— energy mix in the country of production;

— geographical location;

— allocation rules;

— time-related coverage: age of data;

— technology used.

The organization reports which type (site-specific or estimated) of GHG emission factors has been taken into account for each good or service and which stages (extraction of raw materials, transport of raw materials, production of intermediate goods, transport of intermediate goods, production of bought goods/services) were taken into account: cradle-to-gate, gate-to-gate or cradle-to-grave.

d) Focus on double-counting

Site-specific emission factors are those that were calculated by the suppliers of the specific goods and services. The site-specific emission factors are calculated based on a life-cycle approach. ISO 14067 describes how to calculate such an emission factor. An organization that uses an emission factor based on ISO 14067, should not calculate the other indirect emissions that are related to its products. E.g. if an organization buys plastic bottles, it should not take all the freight between PET granulates producer and its own factory into account in other indirect emissions (category 12). These emissions are counted in the emission factor of the PET bottle (see 5.3.2 for more details on potential double counting).

Another risk of double-counting concerns the emission factor used for materials with recycled content. If an organization uses materials with recycled content, the GHG emission or removal factors of this product may take into account the avoided emissions due to the non-production of virgin materials. In this case, the emissions due to the recycling of this product (category 19) should not take into account the avoided emissions due to the non-production of virgin material. Only emissions for the collection and the recycling process should be considered in category 19.

There is a risk of double counting avoided emissions through recycling for the following categories:

— purchased products;

— waste generated from organizational activities;

— capital equipment.

e) Examples

EXAMPLE 1: An organization has two major types of purchases: PET granulates and management consultancy. The expenditure for the purchase of these good and service represents 95 % of the expenditures of the organization. It can be assumed that the impact of neglecting the other purchases is small. The organization asks the supplier of PET granulates and the supplier of consultancy to provide their GHG emissions for one bought unit. The organization has the following activity data: it purchases 25 t of PET granulates and it buys 1 000 man-days of consultancy. The suppliers provides the following emission factors: 1 t of PET granulates is responsible for the emission of 3 263 kg CO_2e from the manufacture to the distribution stage of the product to the organization and one man-day of consultancy is responsible for the emission of 29 kg CO_2e. Total emissions = (25 × 3,263) + (1 000 × 0,029) = 110,57 = 111 t CO_2e

EXAMPLE 2: An organization has two major types of purchases: services and small office equipment. The organization only knows that its expenditures for both are as follows: 8 000 € expenditures for services and 1 500 € for small office equipment (consumables and IT). Going through recognized database for expenditures, the emission factor should be 110 kg CO_2e/1 000 € and for the equipment it should be 915 kg CO_2e/1 000 €. Total emissions = (8 000 × 110/1 000) + (1 500 × 915/1 000) = 2 252, 5 kg CO_2e = 2 t CO_2e

EXAMPLE 3: An organization knows that its main amount of purchased products is packaging products (e.g. boxes). The organization does not know how much it buys every year. The organization finds in the literature that a similar company uses 5 € of packaging material per 1 000 € of activity. As the company has a yearly turnover of 1 000 000 €, it estimates that it uses 5 000 € of packaging material. In literature, the organization finds that an average emission factor for this type of product is 400 g CO_2e per €. Total emissions = (5 000 × 0,4) = 2000 kg CO_2e = 2 t CO_2e

EXAMPLE 4: The organization A (the franchisee) has 2 franchisors. The organization has no knowledge of the total GHG inventory of these franchisors. Franchisor A, a HR service is a big organization (100 employees). It works with 25 other franchisees. Franchisor B, a Payroll department is a smaller organization (42 employees). It only works with 9 other franchisees. The franchisor A finds in recognized database an average value for a company working in the service sector with 100 employees, of 21 000 ton CO_2e. The franchisor A estimates that the allocation should be 4 %. The franchisor B finds in recognized database an average value of a company working in the service sector with 45 employees, of 11 000 ton CO_2e. The franchisor B estimates that the allocation should be 10 %. Total emissions for organization A = (21 000 × 4 %) + (11 000 × 10 %) = 1 940 t CO_2e.

5.4.10 Category 10 — Capital equipment

a) Identification of GHG sources and sinks

This category includes all upstream emissions from the production of capital goods purchased or acquired by the reporting organization. Capital equipment consists of capital goods which are used by the organization to manufacture a product, provide a service, or sell, store, and deliver merchandise, has an extended lifetime and is not transformed nor sold to another organization or to consumers.

Examples of capital goods include equipment, machinery, buildings, facilities, and vehicles. In financial accounting, capital equipment is treated as fixed assets or plant, property and equipment.

GHG Emissions from the use or operation of capital goods by the reporting organization should be accounted for in either direct emissions (e.g., for fuel use) or energy indirect emissions (e.g., for electricity use), rather than in category 10.

The main difference between the categories "purchased products" and "capital equipment" is reflected in the differing duration in use. Purchased products often referred to as "consumable", are acquired for transformation or sale in a short period of time (sometimes a matter of days and usually less than 1 year) whereas capital equipment is used for much longer periods (perhaps from 5 years to 50 years). In some cases, there may be an ambiguity over whether a particular type of purchased product is a capital good. If so, the organization clearly describes and justifies its choice, and ensures there is no double counting between category 9 (Purchased products) and category 10 (Capital equipment).

This extended lifetime of capital goods, compared to time period of organization's GHG inventory (typically one year) leads to a choice of an amortization method in order to allocate upstream GHG emissions incurred for production of capital goods on a *pro rata* basis.

The recommended amortization method should be the one used in the organization's financial accounting and this ensures consistency with financial accounting rules. The organization may also amortize the emissions from the item of equipment based on the real life of that equipment. This approach makes it easier to communicate to internal and external stakeholders about the comparison of the GHG emissions inventory between years.

A third solution may be not to amortize. The organization takes into account the full emissions related to the capital equipment in the GHG emissions inventory of the year in which the equipment has been bought. For internal and external communication, this way of counting makes it difficult to have a consistent view on the comparison of GHG emissions inventory between years. In this case, there is no more difference between category 9 (Purchased products) and Category 10 (Capital equipment) GHG accounting.

The chosen amortization method should be described and reported by the organization.

b) Selection of activity data

1) Best scenario

The description and number of the different items of equipment is known and the data are site-specific.

2) Minimum scenario

Only an estimate of the capital equipment life is available. As a minimum, data are disaggregated between main categories of capital goods, e.g. buildings, machineries, mode of transport. The organization describes how the estimate is done and how the data have been disaggregated.

3) Intermediate scenarios

Capital goods are classified into categories and disaggregated using such key parameters as:

— all key parameters by categories: date of acquisition, assessed life time;

— specific key parameters by categories:

— buildings: (i) type of material used (concrete, steel, etc.), (ii) type of construction (classic, passive, ecological, etc.), (iii) total surface area or volume;

— machinery: (i) type of material used (steel, etc.), (ii) type of surface treatments, (iii) total weight or volume;

— vehicles: (i) engine and carrying capacity of the motor vehicle/truck, (ii) fuel type.

c) Selection of emission factors

Subclause 5.4.9, bullet c), applies without change.

d) Examples

EXAMPLE 1: The capital equipment of the organization is its building (500 m^2) and 50 computers. The organization supervised 10 years ago the construction process of its commercial building and therefore, knows the materials used. Accounting rules are used, and define a linear amortization with a 50 years period for buildings and 3 years for computers. See Table 9.

Table 9 — Example 1 for category 10

Material	Emission factor kg CO_2e/t	Quantity t	Total CO_2e kg CO_2e
PVC	1 778	0,548	974
Glazing	3 667	5,129	18 808
Wood	37	4,325	160
Reinforced concrete	366,7	32,488	11 913
Stone	11	1,026	11
Total embedded material emissions			31 866
Total incl. emissions from construction process (+20 %)			38 239

Considering computers, recognized data base gives a value of 1 280 kg CO_2e per computer. Emissions for computers are: (50 X1 280) = 64 t CO_2e.

One year amortized emissions = (64/3) + (38,24/50) = 22 t CO_2e

EXAMPLE 2: The organization owns for 5 years one building and 15 motor vehicles. The organization estimates the surface area of concrete structure and metal structure in the building. Regarding motor vehicles, the organization estimates that the average weight is 1 t. Amortization is linear and based on the average time life for the building (supposed to be 30 years) and for the motor vehicles (8 years).

Table 10 — Example 2 for category 10

Materials	m^2	Emission factor kg CO_2e/m^2	Total CO_2e t
Metal	6 000	158	948
Concrete	13 700	469	6 425
Total			7 373
Motor vehicles	**Number**	**Emission factor** kg CO_2e/m^2	**Total CO_2e** t
Total	15	5 500	82,5

One year amortized emissions = (7 373/30) + (82,5/8) = 256,07 = 256 t CO_2e

5.4.11 Category 11 — Waste generated from organizational activities

a) Identification of GHG sources and sinks

Emissions from the disposal of solid and liquid waste depend upon the characteristics of waste and its treatment. The typical type of treatment is landfill, incineration, biological treatment or recycling process. The principle emissions are CO_2 and CH_4 but an associated emission is N_2O, which occurs in incineration or biological treatment.

NOTE Waste water is likely to produce greenhouse gases, typically methane, if it contains organic waste which is allowed to decompose.

In some cases, waste treatment may generate energy (heat and/or electricity) or recycled materials. This particularity introduces the concept of avoided emissions. Two types of avoided emissions can be taken into account in the GHG inventory:

— those due to the energy recovery for which an identified energy mix is substituted;

— those due to the material recovery with which virgin material has been substituted.

Avoided emissions are accounted for and reported separately.

b) Selection of activity data

1) Best scenario

Two types of activity data are needed. The first one is related to the quantity of waste and the second one is related to the type of treatment. The most accurate emission quantification is when the mass and the carbon content of each type of waste and the method of treatment and/or disposal can be used as site-specific data. The efficiency of the treatment process used should be known.

2) Minimum scenario

When the amount of waste and the method of treatment and/or disposal are not directly available, estimated data are used. For this estimate, the organization should explain its selection or development. The estimate can be based on expenditure for the waste treatment or linked to the amount of purchased goods and services. When the specific treatment per category of waste generated by the organization is unknown, national/sector average rate of end-of-life treatment (incineration, landfilling, recycling, composting, etc.) is used.

3) Intermediate scenarios

The relevant data disaggregation for each type of treatment is presented in Table 11.

Table 11 — Data disaggregation for category 11

Waste disposal or treatment process	Key parameters	Other potential parameters	Avoided emissions
Landfilling	— Waste composition (organic carbon content) — Degradation rate with the part of methane emissions and CO_2 emissions — Gas collection efficiency	— National electricity mix — Oxidation rate	— Type of energy recovery and efficiency of energy recovery/production process (electricity, heat or fuel). — Energy mix for the avoided emissions due to energy recovery
Incineration	— Waste composition : carbon and dry matter content	— National electricity mix — Slag recovery and recycling	— Waste composition (low heating value) — Type of energy recovery and efficiency of energy recovery/production process. — Energy mix for the avoided emissions due to energy recovery
Biological treatment of fermentable waste — Anaerobic digestion:	— Type of anaerobic process divided into wet or dry, thermophilic (55°C) or mesophilic (35°C) processes — Waste composition (organic carbon content and dry matter content) or directly biogas production factor (CH_4/kg waste)	— National electricity mix — Emissions from composting platform for the digestate	— Type of energy recovery and efficiency of energy recovery/production process (electricity, heat or fuel). — Energy mix for the avoided emissions due to energy recovery — Type of valorization of the compost
Biological treatment of fermentable waste – aerobic digestion (Composting)	— Type of composting process divided into open composting and closed plant — Waste composition (organic carbon content and dry matter content)	— National electricity mix	— Type of valorization (i.e. re-use or recovery of the material) — Soil carbon change in case of compost valorization — Production of artificial fertilizers in case of compost valorization — Soil carbon change in case of valorization of the residue waste — Production of artificial fertilizers in case of valorization of the residue waste
Recycling process	— Type of energy used and national electricity mix		— Type and amount of avoided virgin material — Rules for the allocation of the avoided emissions due to the recycling: to the product that is recycled or to the product that incorporates the recycled material. Indeed, in order to avoid double counting, the organization should specify, if the avoided emissions due to the material recovery are based on the recycled content of the consumed material or on the recycling rate of this material

c) Selection of emission or removal factors

The GHG emission or removal factors should include as a minimum emissions directly due to the waste treatment process.

The emission factors may also take into account, or not, other indirect emissions associated with the waste disposal/treatment process. These other indirect emissions could be, for example, waste disposal infrastructure construction emissions, or embedded emissions within maintenance products of waste disposal. For more information on boundaries of emission factor, see 5.3.4.

The reporting organization should pay attention to data accessibility in order to include or not these other emissions into the used emission factor.

Table 12 provides examples of other indirect emissions which could be included into the emission factor, depending on the type of waste disposal or treatment process.

Table 12 — Emission factors

Waste disposal or treatment process	Emission factors	
	Minimum to be included	Other indirect emissions that could be included
Incineration	Waste combustion	— Construction of equipment — On-site energy consumption — Energy recovery — Bottom ash recovery
Landfill	Waste degradation	— Final disposal of residual waste — Production of materials for pollutant abatement technology
Recycling	Energy consumption for recycling process	— Transport of recycled material — Landfill of ultimate waste — Production of avoided virgin material
Anaerobic/aerobic digestion	Biomass degradation	— Soil carbon change — Avoided emissions of chemical fertilizers
NOTE 1 In case of incineration, the estimation of emissions is based on the composition of the waste and the mass balance of carbon. The calculation is: kg CO_2e/year = kg of waste for incineration × oxidation factor of carbon in incinerator × conversion factor of C to CO_2 (44/12) · Σ [waste fraction (%) × dry matter content × carbon content (g/g dry weight)]. NOTE 2 When incinerating biomass, biogenic CO_2 can be generated, in which case it is quantified and reported separately.		

d) Examples

EXAMPLE 1: An organization produces 12 t of waste each year. For each type of waste, the organization asks for the type of treatment. At the end of the year, the organization has a table with information as shown in Table 13.

Table 13 — Example 1 for category 11

Type of waste	Amount t/year	Treatment
Household	10	Incineration
Organic	2	Composting

Different GHG emission factors are needed for each type of treatment. Those GHG emission factors should reflect the key parameters specified for each type of treatment. These methods of treatment avoid emissions due to energy recovery (incineration) and the production of industrial fertilizers (composting).

Avoided emissions and biogenic CO_2 emissions are accounted separately:

- Incineration (household waste)
  - CO_2 emissions = 1 227 kg CO_2e/t + 300 kg biogenic CO_2e/t
  - Avoided emissions due to energy recovery with average energy mix from France as key parameter = −146 kg CO_2e/t
- Composting (organic)
  - CO_2 emissions = 750 kg CO_2e/t + 450 kg biogenic CO_2/t
  - Avoided emissions due to the production of industrial fertilizers (compost) = −450 kg CO_2e/t −250 kg biogenic CO_2e/t

Emission or removal factors are then multiplied by the appropriate amount of waste generated each year by the organization with a clear distinction between biogenic and other GHG emissions and removals.

Total GHG emissions = (10 × 1 227) + (2 × 750) = 13 770 kg CO_2e = 13,8 t CO_2e

Total biogenic CO_2 emissions = (10 × 300) + (2 × 450) = 3 900kg CO_2e = 3,9 t CO_2e

Avoided emissions = (10 × −146) + (2 × −450) = −2 360 kg CO_2e = −2,4 t CO_2e

Avoided biogenic CO_2 emissions = (2 × −250) = −500kg CO_2e = −0,5 t CO_2e

EXAMPLE 2: An organization produces 10 t of cardboard each year all treated in landfill. Indirect GHG emissions from waste are calculated by multiplying the 10 t of cardboard by the emission factors of the landfilling of cardboard. Depending of the value of the key parameters, the GHG emission factor can vary significantly. Different GHG emission factors expressed in kg CO_2e/t of cardboard in a landfill are presented in Table 14 below. Regarding the large range of values shown in this table, the organization clearly reports which key parameters were considered for the selection of the estimated GHG emission factors. There are 4 possible calculations depending on the chosen parameters (see Table 14). The total emissions for each of the 4 cases are given in Table 14.

Table 14 — Example 2 category 11

Gas collection efficiency	Degradation rate after 100 years =100 %	Degradation rate after 100 years =34 %
0 %	5 088 CO_2e/t[a]	1 730 CO_2e/t[b]
50 %	3 063 CO_2e/t[c]	1 041 CO_2e/t[d]

[a] Total emissions = (5 088 × 10) = 50 880 kg CO_2e = 51 t CO_2e

[b] Total emissions = (1 730 × 10) = 17 300 kg CO_2e = 17 t CO_2e

[c] Total emissions = (3 063 × 10) = 30 630 kg CO_2e = 31 t CO_2e

[d] Total emissions = (1 041 × 10) = 10 410 kg CO_2e = 10 t CO_2e

5.4.12 Category 12 — Upstream transport and distribution

a) Identification of GHG sources and sinks

Indirect emissions due to transport are mainly due to fuels burnt in mobile sources of combustion neither owned or nor controlled by the reporting organization. Such sources could include but are not limited to motor vehicles, aircraft, trucks, railway locomotives and ships. Refrigerating gases should also be taken into account (in the case of transport with refrigerated trucks for example). If vehicles are owned or controlled by the organization, the emissions should be taken into account in category 2 within the direct emissions.

All types of transport are taken into account: road, rail, air and sea. Emissions from freight may be due to the first suppliers or other suppliers throughout the supply chain.

b) Selection of activity data

1) Best scenario

The most accurate quantification is when the distance travelled for each type of transport (rail, road, air, sea) and the type of fuel is known. For the distance travelled by each supplier, the organization should also know which part of the distance it should allocate to its activities. If a supplier makes a unique journey to the organization, these round-trip emissions should be allocated to its activities. If a supplier visits a number of clients/customers, the organization allocates only a part of the travelled distance to its activity based on mass, volume or economic allocation rules. The principle is that the total GHG emissions from freight transport are multiplied by the following ratio: mass, volume or economic valuation of the freight for the organization divided by the mass, volume or economic valuation of the global freight transported by the supplier. The allocation rule is reported.

For trucks, a corrective factor is also applied to the average consumption per km in order to take into account the load rate and the empty return rate.

The first step to model the truck emissions consists of determining the fuel consumption of trucks by kilometre which will be multiplied by the number of kilometres driven. The methodology is Copert 4, a calculation tool for polluting emissions due to road transport. It takes into account:

— the type of truck used (engine characteristics, etc.);

— the average speed;

— the average slope;

— the loading rate.

NOTE Copert 4 is used at the European level and financed by the European Environment Agency (EEA). This methodology is part of the ARTEMIS project, which has federated 36 organizations (firms, research institutes, universities) of 15 European countries in order to harmonize emission factors used in Europe.

With these data, Copert 4 enables the calculation of the truck consumption loaded at 100 %. To calculate the real consumption, it is considered that one part (2/3) is fixed and that the other part (1/3) is function of the weight effectively transported by the truck.

The real consumption per truck (in litres) is evaluated by:

$$\text{Consumption (l)} = \text{distance (km)} \times \frac{x}{100} \times \left[\frac{2}{3} + \left(\frac{1}{3} \times \frac{\text{load}}{\text{payload}} \right) + \left(\text{empty return rate} \right) \times \frac{2}{3} \right]$$

where x is the consumption of the truck at full load, expressed in l/100 km.

In order to obtain the data, surveys can be made, enabling the organization to collect the following data:

— number of vehicles coming from the suppliers and total distance allocated to the organization;

— type of vehicle (truck, train, aircraft, etc.);

— type of fuels burnt;

— load rate and empty return rate.

2) Minimum scenario

When the total distance per fuel and type of transport is not directly available, estimated data are used. These estimates should as a minimum differentiate the average distance by truck, aircraft, train and marine craft for the main purchased products. The total weight transported should also be known according to the transport type, truck, aircraft, train and marine craft, in order to be able to use emission factors expressed in t.km.

In order to obtain the data, surveys can be made. The number of vehicles entering the site by each type of transport mode can also be used as site-specific data and combined with an estimate of the distance driven out by each type of vehicle. The conversion between distance unit and number of vehicles entering the site could be made by a national/regional average distance by journey for each supplier.

For this estimation, the organization needs to explain its methodology.

3) Intermediate scenarios

Some key parameters can significantly modify the accuracy of the estimated GHG emission or removal factors. For each type of vehicle (road, rail, air and sea), the disaggregation of data could be done using such key parameters as:

— type of vehicle: e.g. small truck from to 3,5 t to 7 t; light medium trucks from 7 t to15 t, large truck from 15 t to 60 t;

— engine size in litres;

— type of travels: suburban, urban, rural periphery, etc.

Other potential parameters are for example: % of leakage at the cooling system, type of driving: eco driving, fast driving, pollution control devices installed on the vehicle.

c) Selection of emission factors

When the organization uses emission factors based on LCA approach for the calculation of the indirect GHG emissions from category 9 (Purchased products), GHG emissions of freight transport from suppliers throughout the supply chain are already taken into account. Therefore, only direct suppliers of the organization should be added (see 5.3.2).

If the emission factor chosen for category 9 (Purchased products) does not take into account the different transport steps between extraction of materials and the gate of the supplier, these transport steps should be taken into account in this category.

GHG emission factors are usually expressed in GHG emissions per distance unit (km or miles) or t.km. In the "best scenario", activity data are expressed in km per type of transport and type of fuels. Emission factors expressed in g CO_2e/km should then be used.

The organization reports the emissions sources that are covered by the emission factors: only combustion of fuels or also other emissions related to the transport (extraction of fuel, production of vehicles, etc.).

All the emissions that are not related to the combustion of fuels are taken into account. These are mainly the production of the vehicles, the end-of-life of the vehicle and the emissions throughout the production of the consumed fuels.

d) Examples

EXAMPLE 1: An organization receives goods from 10 suppliers. For each of them, the organization asks for the following information: amount of goods, total distance travelled, transport mode used. At the end of the year, the organization gets the information as shown in Table 15.

Table 15 — Example 1 for category 12

Transport mode	Total amount of goods t	Distance travelled per delivery km	Number of deliveries
Motor vehicle	3	15 00	50
Train	4 000	4 000	40
Aircraft (short distance <1 000 km)	300	20 000	2

GHG emission factors are needed for each transport mode. Those emission factors should reflect the key parameters specified for each transport mode:

— Motor vehicle: GHG emissions = 2 104 g CO_2e/t.km

— Train: GHG emissions = 7,5 g CO_2e/t.km

— Aircraft (short distance <1 000 km): GHG emissions = 3 132 g CO_2e/t.km

Total emissions = (2 104 × 3 × 1 500 × 50) + (7,5 × 4 000 × 4 000 × 40) + (3 132 × 30 × 20 000 × 2) = 9 031 800 000 g CO_2e = 9 031 t CO_2e.

EXAMPLE 2: An organization receives goods from its suppliers. Several modes of transport are used and the organization knows the distance travelled by the contracted suppliers (see Table 16).

Table 16 — Example 2 for category 12

Type	Distance km	Emission factor g CO_2e/km
8 m^3	751 088	555
Truck 3,5 t	18 547	547
Truck 12 t	54 698	830
Truck 40 t	1 258 621	1 194
35 t	9 874	1 320

Total emissions = (751 088 × 555) + (18 547 × 547) + (54 698 × 830) + (1 258 621 × 1 194) + (9 874 × 1 320) = 1 988 225 543 g CO_2e = 1 988 t CO_2e.

EXAMPLE 3: An organization has no data on the distance travelled by its suppliers. Only transport mode is known. The organization estimates the quantity of goods (see Table 17).

Table 17 — Example 3 for category 12

Transport mode	Amount of goods estimated t	Total distance estimated km	Number of deliveries	Emission factor g CO_2e/t.km	Emission factor g CO_2e/km
Cargo container	50 000	687 000	100	10,2	-
Aircraft	4 000	880 000	100	2 1157,5	-
Truck	-	248 069		-	645
Train	20 000	40 000	40	7,5	-

Total emissions = (10,2 × 50 000 × 687 000) + (2 157,5 × 4 000 × 880 000) + (248 069 × 645) + (7,5 × 20 000 × 40 000) = 7 950 930 t CO_2e.

EXAMPLE 4: An organization knows the amount of goods that are transported by trucks. The truck consumption, the payload, the payload max of the truck, the empty return rate and the distance travelled are also known (see Table 18).

The emission factor per litre of fuel is 3,17 kg CO_{2e}/l.

Table 18 — Data for example 4 for category 12

Truck	Consumption l/100km	Payload max t	Average payload t	Empty return rate %	Average distance km	Number of trips in a year
1	30	3,5	3,2	19	388	88
2	28	8	7,5	12	569	121
3	32	24	22,8	50	645	76

According to the equation given in 5.4.12 b), the consumption and the emissions for each truck may be calculated (see Table 19).

Table 19 — Results of example 4 category 12

Truck	Consumption l	Emissions
1	30/100 × (0,7 + 0,3 × (3,2/3,5) + 0,19 × 0,7) × 388 = 128,88	88 × 128,88 × 3,17 = 35 952,36 kg CO_{2e} = 36 t CO_2e
2	28/100 × (0,7 + 0,3 × (7,5/8) + 0,12 × 0,7) × 569 = 169,72	121 × 169,72 × 3,17 = 65 099,5 kg CO_{2e} = 65,1 t CO_2e
3	32/100 × (0,7 + 0,3 × (22,8/24) + 0,50 × 0,7) × 645 = 275,54	76 × 275,54 × 3,17 = 66 383,09 kg CO_2e = 66,4 t CO_2e
Total emissions		36 + 65,1 + 66,4 = 167,5 t CO_2e

5.4.13 Category 13 — Business travel

a) Identification of GHG sources and sinks

Indirect emissions from business travel are mainly due to fuels burnt in mobile sources of combustion neither owned nor controlled by the reporting organization, such as motor vehicles, aircraft and public transport.

Emissions are considered as indirect when vehicles are not controlled or not owned by the organization.

Hotel nights are included when linked to the business travel, i.e. a stay over for flight connections, when attending conference or for other business purposes. The indirect emissions generated during the journey should also be included, if such data are available and significant.

b) Selection of activity data

1) Best scenario

The most accurate quantification is when the distance travelled is known for each type of vehicle:

— classification, e.g. motor vehicle, train, aircraft, etc.;

— characterization of vehicles (size, type of technology);

— location (especially for electric train).

These distances can be used as site-specific data. Specification of the type of travel (first class, business class, etc.) should be used for the specific data as some database of emission factors propose different values due to allocation rules.

The number of hotel nights should also be known. Specification of the hotel category (1 star, 2 stars, etc.) could be used for the specific data as some databases of emission factors propose different values.

2) Minimum scenario

When the distance travelled is not directly available, estimated data based on the number of journeys multiplied with the average distance between the office and the destination is used. As a minimum, the estimate is disaggregated for motor vehicles, aircraft, trains. Travel expenses by type of transport can also be used and then converted to km.

For this estimate, the organization explains its selection or development. The estimate can be based on models or come from literature sources. Number of hotel nights is also taken into account.

3) Intermediate scenarios

Different intermediate scenarios for the estimate of the distance travelled and the number of hotel nights are possible. The organization should try to quantify the total distance travelled by aircraft and estimate the distance travelled by motor vehicle.

c) Selection of emission factors

GHG emission factors are usually expressed in GHG emissions per distance unit (km or miles). The GHG emission factor should take into account the emissions from combustion as well as from the production and the end-of-life of the vehicle, the production of the fuel, etc. as in the other emission categories linked to transport (see 5.4.12 or 5.4.17).

When information is gathered for the type of travel (first class, business class, etc.) specific GHG emission factor should be applied (see 5.3.6.2 aircraft emissions).

Hotel GHG emission factors can be expressed in GHG emissions per overnight stay. They should be a function of the hotel category.

The organization reports which sources have been taken into account for the GHG emission factors for each activity data.

For estimated emission factors, the organization reports which parameters has been taken into account.

The organization reports which emission sources are covered for the emission factors: from only the combustion of fuel or, also, fuel extraction and other emissions related to the transport (such as emissions due to production and disposal of cooling liquids, motor vehicle production, etc.):

- leaks of refrigerant from air cooling systems;
- fossil fuels production and transport;
- vehicle maintenance;
- vehicle construction;
- vehicle end of life;
- overnight stay in hotels:
  - construction of hotel;
  - energy consumption of hotel;
  - consumables in hotel;
  - meals in hotel.

d) Examples

EXAMPLE 1: An organization has a dedicated commercial employee. He travels for business 25 % of his time. The employee is responsible for a nearby client. He travels exclusively by motor vehicle. He owns the vehicle and enters travel expenses. He enters for a total amount of 1 361,12 €. The organization pays 0,301 €/km. He travelled in total 4 522 km. GHG emission for the motor vehicle is 253 g CO_2e/km. The total amount of emissions for this employee is: (4 522 × 253) = 1 144 066 g CO_2e = 1,14 t CO_2e.

EXAMPLE 2: An employee uses aircraft for an international conference on global warming issues. He travels by taxi a distance of 45 km from his house to the airport in country A. He takes a flight to country B and takes a business class ticket, he flies a total distance of 11 030 km one way. He takes another taxi to join the conference for a total of 79 km. He spends 4 nights in a standard hotel where the conference takes place and then returns by the same modes of transport to his starting destination.

The emission factors are:

- Motor vehicle country A: 204 g CO_2e/km
- Aircraft (business class): 222,7 g CO_2e/km
- Motor vehicle country B: 320 g CO_2e/km

— Hotel night: 42 kg CO_2e/night

Total emissions = (45 × 204 × 2) + (222,7 × 11 030 × 2) + (79 × 320 × 2) + (4 × 42 000) = 5 149 682 g CO_2e = 5,15 t CO_2e.

5.4.14 Category 14 — Upstream leased assets

a) Identification of GHG sources and sinks

This category includes emissions from the use of assets that are leased by the reporting organization in the reporting year. This category is only applicable to an organization that operates leased assets (i.e. lessees).

The word "lease" has a varied meaning, and it is useful to understand the different types of the leases. They depend on the nature of item leased, length of the lease, financial and contractual arrangements. The three main types of leasing are finance leasing, operating leasing and contract hire.

- Finance leasing (quite frequent for buildings):
  - a long-term lease over the expected life of the equipment, usually three years or more, after which the reporting organization pays a nominal rent or can sell or scrap the equipment: the leasing company does not want it any more;
  - the leasing company recovers the full cost of the equipment, plus charges, over the period of the lease;
  - although the reporting organization does not own the equipment, it is responsible for maintaining and insuring it;
  - the reporting organization should show the leased asset on its balance sheet as a capital item, or an item that has been bought by the company; therefore, GHG emissions from this type of leased equipment (for instance its manufacture, or the construction of the building) are recorded together with GHG emissions of category 10 (Capital equipment).
- Operating leasing:
  - it is usually the case when the reporting organization does not need the equipment for its entire working life;
  - the leasing company takes the asset back at the end of the lease, and is responsible for maintenance and insurance;
  - the reporting organization does not have to show the asset on the balance sheet.
- Contract hire:
  - it is usually the case for short-term hire, and is often used for company vehicles or short term rentals;
  - the leasing company takes some responsibility for management and maintenance, such as repairs and servicing;
  - the reporting organization does not have to show the asset on the balance sheet.

The organization should carefully avoid double counting with emissions already taken into account in direct emissions and energy-related indirect emissions (categories 1 and 8), in category 9 (Purchased products) that include purchased services, in category 11 (Waste generated from organizational activities), for category 19 (End of life of the product) for some consumables, and even in category 10 (Capital equipment).

b) Selection of activity data

1) Best scenario

First of all, the organization classifies all the leased assets into different categories in order to have a homogeneous type of emission. For example, these categories could be: buildings, motor vehicles, IT equipment trucks, machinery etc. Then, the organization identifies sources and sinks. Although emissions are usually due to energy consumption, all the other sources are calculated. To identify activity data, the organization could be helped by the description of the other categories of emissions (category 1 to 23).

2) Minimum scenario

The leasing organization should as a minimum differentiate its leased assets by the following categories:

— buildings;

— motor vehicles;

— it equipment;

— machinery.

For each group, the organization makes an estimate of some of the "use stage" emissions (especially emissions related to energy consumption) and the other emissions [see 4.4.14, bullet c)]. A clear distinction between usage emissions of the equipment and the remaining emissions tends to be very useful to be able to provide a summary of energy consumption of these equipment (whether they are owned or leased), and makes it easier, for the operational management, to launch actions to reduce emissions per category of equipment.

3) Intermediate scenarios

The organization can set up a survey, if practical, to collect the necessary data to calculate its GHG emissions related to its upstream leased assets:

— key parameters that should be considered: type of leased asset, age of leased asset, used technology, period it is used, geographical location;

— other potential parameters: maintenance and technical control, operational control, behaviour during utilization.

c) Selection of emission factors

The emission factor should take into account all emissions of GHG based on a life cycle approach as described in ISO 14067. The main stages that should be taken into account are: production of the leased assets, direct emissions from the leased assets, end of life of the leased assets.

The emission factor may come from the literature or a recognized database. The emission factor does not induce double counting with emissions already taken into account in other categories.

Guidelines are given below for the calculation of the emission factor:

— production stage;

— transport and distribution;

— use stage;

— maintenance;

— consumables;

— end of life.

d) Examples

EXAMPLE 1: Organization A leases a building as well as printing machines from another organization B. The reporting organization A does not know the exact energy consumption as it pays a unique fee to organization B which includes the right to use all leased assets (building + machine) as well as their energy consumption. The building is 1500 m^2 and 1000 m^2 are used for the workshop (printing zone). The office zone is 500m^2. The power of the printing machine is 75 kW used 10 h/day, 220 days/year (2 200 h/year). The heating system uses gas.

The estimate of the consumption of energy is the following:

— Workshop

Heating is estimated to be: 75 kWh/m^2.year → 75 × 1 000 = 75 000 kWh

Electricity is estimated to be: 50 kWh/m^2.year + 75 kW × 2 200 → (50 × 1 000) + (75 × 2 200) = 215 000 kWh

— Office

Heating is estimated to be: 150 kWh/m^2.year → 150 × 500 = 75 000 kWh

Electricity is estimated to be: 100 kWh/m^2.year → 100 × 500 = 50 000 kWh

The emission factors are:

— for heating: 1,829 kg CO_2e/kWh

— for electricity : 0,403 kg CO_2e/kWh

— for electricity losses: 0,032 kg CO_2e/kWh

Total emissions = [(75 000 + 75 000) × 1,829] + [(215 000 + 50 000) × (0,403 + 0,032)] = 389 625 kg CO_2e = 390 t CO_2e.

The reporting organization A could report these 390 t CO_2e as GHG emissions related to energy used in leased asset. Organization A could also try to go further in this evaluation in reporting GHG emissions related to the construction and maintenance of the building and of the printing machine as well. In any case, organization A clearly states what has been evaluated and reported.

EXAMPLE 2: Organization A leases motor vehicles from Organization B. Organization A knows the motor vehicle specification, and its leasing contract is linked to the number of km or miles used by the organization.

4 motor vehicles are leased:

— For vehicle 1, it has been reported 15 069 km and has a CO_2 emissions = 201 g CO_2e/km

— For vehicle 2, it has been reported 18 588 km and has a CO_2 emissions = 154 g CO_2e/km

— For vehicle 3, it has been reported 7 521 km and has a CO_2 emissions = 88 g CO_2e/km

— For motor vehicle 4, it has been reported 21 548 km and has a CO_2 emissions = 195 g CO_2e/km

Emission factors for Vehicle 1 and 2 were found from manufacturers specifications, end of pipe and include an additional 10 g CO_2e/km to account for the production and end of life stage. Emission factors for Vehicle 3 and 4 were given by the vehicle manufacturer based on a LCA approach.

Total emissions = (15 069 × 201) + (18 588 × 154) + (7 521 × 88) + (21 548 × 195) = 755 129 g CO_2e = 10,8 t CO_2e

5.4.15 Category 15 — Investments

a) Identification of GHG sources and sinks

Indirect emissions from investments are emissions due to operation of equity investments.

An equity investment refers to the holding of shares of stock on a stock market in anticipation of income from dividends and capital gains, as the value of the stock rises. It may also refer to the acquisition of equity (ownership) participation in a private (unlisted) company or a start-up company.

Using its equity share and duration of ownership, the reporting organization should estimate the indirect emissions generated during the GHG inventory period.

In case of financial organizations, debt investments may be added to equity investments. A debt investment refers to an investment in the financing of property or of some endeavour, in which the investor loaning funds does not own the property or endeavour, nor share in its profits.

In other words, category 15 emissions consist in emissions related to a large part of the reporting organization's financial assets that can be found in the "intangible assets" section of its balance sheet.

Emissions due to operation of equity investments are defined hereinafter: a reporting organization A is holding 5 % shares from a company B (outside A's organizational boundaries). Reporting organization A include in category 15 emissions, 5 % of direct and energy indirect company B emissions. Organization A may also include other shared indirect GHG emissions of company B.

Confusion should not occur between category 15 and the following:

— emissions from capital equipment, the latter often being associated with the word "capital expenditures"/investments of the reporting organization, but these investments are those (plant, machinery etc.) physically needed and used by the reporting company for production purposes: these are reported in category 10;

— emissions due to operations of organizations that are already included in organizational boundaries and therefore are directly consolidated into all relevant emissions categories (direct emissions with categories 1 to 5 and energy indirect emissions as described in categories 6 and 7).

b) Selection of activity data

For the quantification of the indirect emissions from investments, activity data refer to the nature and amount of an organization's investments. This information is expressed in monetary value, and can be found on the balance sheet(s) of the reporting organization, in various financial assets sections.

1) Best scenario

Each investment is individualized. An exact amount (currency amounts, or even number of units of shares when applicable) for each investment is known. GHG emissions related to operation of each asset are known and documented.

2) Minimum scenario

Only most-significant investments and shares are known. The assets' operating economic sectors are known roughly (agricultural, commercial, cement, steel, chemistry, etc.) allowing the evaluation of the emission factors.

Details about specificities of financial or insurance companies are given in Annex E.

c) Selection of emission factors

Emission factors for operation of investments refer to GHG emissions related to fixed capital of the asset. It is then expressed by CO_2e per currency unit. The operation time period taken into account for investment should be identical to the organizations GHG inventory.

Various carbon intensities in g CO_2e per dollar (or any other currency) exist and are related to other monetary values, such as turnover, result or value-added, for instance. Carbon intensity used in 5.4.15 as an emission factor is related to fixed capital.

Direct and energy indirect emissions should be taken into account for any investment, other indirect emissions may be added.

If an asset's GHG emissions are not known directly, data emissions in CO_2e per fixed capital may be found in national and/or professional statistics.

d) Example

EXAMPLE: Equity investment

Reporting organization A holds shares of organization B, and organization A:

— knows precisely the book value of these shares (and the method chosen for calculating this value), as well as the number of shares of organization B that are held;

— knows as well the structure of liabilities of the balance sheet of organization B (total number of shares issued, total equity, that is including both shares and some categories such as convertible bonds, and amount of financial debt);

— has some information about direct GHG emissions, indirect GHG emissions and other indirect GHG emissions of organization B.

Organization A holds 10 000 shares of organization B. Organization B issued 1 000 000 shares, valued at 500 million Euros in organization B's financial statements.

Organization B's emissions are: direct GHG emissions, 2 000 t CO_2e, indirect GHG emissions, 3 000 t CO_2e, other indirect GHG emissions, 50 000 t CO_2e.

Total emissions = (10 000/1 000 000) × (2 000 + 3 000 + 50 000) = 550 t CO_2e

The two parts of the formula in brackets are (1) taking organization A's share in total shares and (2) summing emissions of organization B from direct GHG emissions up to other indirect GHG emissions.

5.4.16 Category 16 — Client and visitor transport

a) Identification of GHG sources and sinks

Indirect emissions from client and visitor transport are mainly due to fuel burnt in mobile sources of combustion neither owned nor controlled by the reporting organization, such as motor vehicles, aircraft and public transport.

b) Selection of activity data

Emissions are directly related to distance travelled and type of transport.

The organization should pay attention to allocation as the visit to it could be one part of the trip by the client or visitor (especially if the organization is a retailer). Therefore, the organization indicates which part of the round-trip is allocated to its activities. The best way to define an allocation method is to translate the information about the trip. This information should be collected in discussion with the clients or visitors (see also category 12).

1) Best scenario

The most accurate quantification is when the distance travelled by each type of transport mode can be used as site-specific data and multiplied by a GHG emission factor expressed in GHG emissions per distance unit (km or miles).

Relevant data for this calculation may be:

— mode of transport (bus, train, aircraft, etc.);

— distance travelled;

— size/specifications of the vehicle;

— number of person per unit of transport.

2) Minimum scenario

When the distance travelled is not directly available, estimated data based on number of journeys multiplied by an average distance should be used. The estimate should as a minimum be disaggregated for motor vehicles, aircraft, trains. For this estimate, the organization explains the methodology used. The estimate can be based on models or come from literature sources.

The organization can follow the number of journeys by another easier parameter. For example, for retailers, it is easier to follow the number of receipts.

3) Intermediate scenarios

The number of clients or visitors by transport mode is known but no data are available about the distance travelled. The conversion between number of journeys and distance unit should be made by an average distance by journey.

Surveys can be made to obtain these data. The survey should enable the organization to collect some of the following data: mode of transport (truck, train, aircraft, etc.), distance travelled to come, size/specifications of the vehicle, number of person per unit of transport, etc.

The organization can organize this survey at its reception desk. If clients are registered before entering the organization, the receptionist can ask questions. The more data available, the more accurate the calculation of the GHG emissions for this category.

c) Selection of emission factors

The organization reports which sources have been taken into account for the GHG emission factors of each of the fuels.

The organization reports which scope is covered for the emission factors: from only the combustion of fuel or also fuel extraction and other emissions related to the transport (such as emissions due to refrigerants, motor vehicle production, etc.):

— leaks of refrigerant from air cooling systems;

— fossil fuels production and transport;

— vehicles maintenance;

— vehicles construction;

— vehicles end of life;

— vehicles construction.

The accuracy of this approach depends on the precision of the site-specific or estimated GHG emission factors (see 5.3.2).

d) Examples

EXAMPLE 1: An organization receives 10 clients a week. For each of them, the organization asks the following information: distance travelled and mode of transport. At the end of the year, the organization has a table with information as shown in Table 20.

Table 20 — Example 1 for category 16

Transport mode	Distance travelled km
Motor vehicle	15 000
Train	40 000
Aircraft	10 000

Different GHG emission factors are needed for each type of transport mode. Those GHG emission factors should reflect the key parameters specified for each transport mode:

— Motor vehicle: CO_2 emissions = 253 g CO_2e/km

— Train: CO_2 emissions = 48,4 g CO_2e/km

— Aircraft: CO_2 emissions = 292,3 g CO_2e/km

Total emissions = (15 000 × 253) + (40 000 × 48,4) + (10 000 × 292,3) = 738 654 000 g CO_2e = 738,7 t CO_2e

EXAMPLE 2: An organization (supermarket) has 5000 customers every day. This organization makes a survey to know which transport mode and which distance is travelled to come to the organization and return. The information is available as shown in Table 21.

Table 21 — Data for example 2 for category 16

Transport mode	Percentage of the clients	Round-trip distance travelled km
Motor vehicle	50 %	25
Train	5 %	40
Bus	25 %	10
Metro/Light rail	20 %	15

Different GHG emission factors are needed for each type of transport mode. Those GHG emission factors should reflect the key parameters specified for each transport mode:

— motor vehicle :CO_2 emissions = 253 g CO_2e/km

— train :CO_2 emissions = 48,4 g CO_2e/km

— bus :CO_2 emissions = 154 g CO_2e/km

— metro : CO_2 emissions = 6,6 g CO_2e/km

The organization receives clients during 220 days a year. This means that the organization receives 1 100 000 clients a year. The calculation for the GHG emissions is given in Table 22.

Table 22 — Calculation for example 2 for category 16

Transport mode	Km travelled	GHG emissions g CO_2e	GHG emissions t CO_2e
Motor vehicle	1 100 000 × 50 % × 25 = 1 375 000	13 750 000 × 253 = 3 478 750 000	3 478,75
Train	1 100 000 × 5 % × 40 = 2 200 000	2 200 000 × 48,4 = 106 480 000	106,48
Bus	1 100 000 × 25 % × 10 = 2 750 000	2 750 000 × 154 = 423 500 000	423,5
Metro/Light rail	1 100 000 × 20 % × 15 = 3 300 000	3 300 000 × 6,6 = 21 780 000	21,78
Total			4 030,51

5.4.17 Category 17 — Downstream transport and distribution

This category uses the same methodology and concept as described in category 12 but deals with transport services for which the reporting organization does not pay.

This category is applicable when e.g. a client pays for the transport of products from the gate of the reporting organization to any different destination.

Refer to category 12 for further guidance.

5.4.18 Category 18 — Use stage of the product

a) Identification of GHG sources and sinks

This category includes emissions from “consumer use” of the product sold by the reporting organization in the reporting year, such as:

— the processing of the product sold which occurs after the organization and before the final consumer;

— the “end consumer” use of the product (e.g. motor vehicle fuel consumption, food cooking).

This category includes the total expected lifetime emissions from all relevant products sold.

In most cases, the organization does not know how the product is used and, thus, should define scenarios. Consequently, the emissions from this category are very linked to the scenarios elaborated. From a general point of view, the more the product is a “final product” the easier it is to define scenarios. For example, it is easier for motor vehicle manufacturer to define vehicle use scenarios (in order to evaluate motor vehicle energy consumption) than for a steel supplier who has less visibility.

The scenario should be clearly explained in the report.

b) Selection of activity data

1) Best scenario

The total quantity of sold products is known for the considered period of the GHG inventory of the organization.

Scenarios of use for processing are defined through a reliable traceability process for the sold products. Scenarios of “end consumer” use are based on detailed statistical and consumer behavioural studies.

2) Minimum scenario

The organization hasn’t any specific data and the scenarios of use are only defined by big product category. The estimate of the emissions associated with the scenarios should as a minimum incorporate an estimate of the energy use and the direct emissions of the product during its “final consumer” use stage.

3) Intermediate scenarios

The following key parameters could be used to elaborate scenarios:

— number of sold products (by category);

— power of the product (for electrical appliances);

— the time they are used during a year by an average consumer (based on behavioural surveys);

— the lifetime of the product (based on a survey or on internal technical information);

— used technologies;

— geographical location.

Other potential parameters are spare parts need, maintenance, etc.

c) Selection of emission or removal factors

The emission or removal factor may come from the literature or from a recognized database. The emission or removal factor does not induce double counting with emissions already taken into account in other categories.

Guidelines are given below for the calculation of the emission or removal factor:

— consumption during standby and during functioning;

— type of energy:

  — electricity (with electricity mix and all impacts of the life cycle);

  — steam (with production mix and all impacts of the life cycle);

  — heat (with production mix and all impacts of the life cycle);

  — cooling (with production mix and all impacts of the life cycle);

— technical maintenance (transport, spare parts and products needed);

— type of gas if any (risk of leakages).

d) Examples

EXAMPLE 1: An organization produces dishwashers. It sells a total amount of 1 000 dishwashers per year. It produces 2 type of dishwasher (A – 25 % and B – 75 %). The organization did a LCA of the dishwashers, modelling the typical use scenarios for each product. It calculated the use stage of these 2 products. Product A has an emission factor of 9,6kg CO_2e/year. Product B has an emission factor of 8,8 kg CO_2e/year. Total emissions = (1 000 × 0,25 × 9,6) + (1 000 × 0,75 × 8,8) = 9 000 kg CO_2e = 9 t CO_2e

EXAMPLE 2: An organization sells trees to customers. It is located in a moderate cold climate zone. It sells a total of 8 812 trees per year. The organization estimates that this is equivalent to 6 ha as the estimated density of plantation is around 1 500 trees/ha. The organization finds a value of 50tC/ha in an international database (FAO). This means that 183 t CO_2e/ha are removed. Total emissions = (6 × −183) = −1 100 t CO_2e

5.4.19 Category 19 — End of life of the product

a) Identification of GHG sources and sinks

This category includes the emissions associated with the end of life of all products sold by the reporting organization (in the reporting year).

Generally, the emissions sources and sinks are those described in category 11 (Waste generated from organizational activities). However, as for category 18 (Use stage of the product), the organization should define “end of life scenarios”. Consequently, the emissions from this category are very linked to the scenarios elaborated.

Furthermore, the organization should pay attention to the avoided emissions concept as for category 11.

b) Selection of activity data

1) Best scenario

The total quantity of sold products is known for the period under consideration for the GHG inventory of the organization.

"End of life scenarios" are defined through detailed statistical and consumer behavioural studies. The type and performance of waste treatment are known.

2) Minimum and intermediate scenarios

The organization hasn't any specific data. The organization has an estimate of the amount of the different sold products or has grouped them in big product families.

The "end-of-life scenario" takes into account the main components of the product and the geographical location of the waste treatment. The performance of waste treatment and the recycling rate per product are usually linked to geographical location.

c) Selection of emission or removal factors

Emission or removal factors which are used should be calculated on the basis of national/regional averages per type of waste treatment. Those averages are based on key parameters and emission or removal factor part of category 11.

d) Examples

EXAMPLE 1: An organization puts on the market 1 000 000 products containing mainly polypropylene (PP) (65 %) and iron (35 %). The organization does not know how consumers deal with the end-of-life of their products. The organization could then estimate that their products will end up for 30 % in landfill and for 70 % in a shredder installation. After the shredder it is reasonable to estimate that the iron will be recycled while the PP will be used in a co-incineration. The product weight is set to be 1 kg. Total weight: (1 000 000 × 1) = 1 000 t. Emissions for landfilling for PP and iron is 33 kg CO_2e/t. Emission factor for PP incineration is 2 106 kg CO_2e/t; as for iron recycling it is equal to 15 kg CO_2e/t as emissions and −2 090 kg CO_2e/t for the avoided emissions (no virgin iron has to be produced). Total emissions = (1 000 × 0,3 × 0,65 × 33) + (1 000 × 0,7 × 0,65 × 2 106) + (1 000 × 0,7 × 0,35 × 15) = 968 340 kg CO2e = 968 t CO2e. Avoided emissions = (1 000 × 0,7 × 0,35 × −2 090) = −512 050 kg CO2e = −512 t CO2e.

EXAMPLE 2: An organization produces chocolate candy bars. It sells a total amount of 1 000 000 bars a month. The organization looked to reduce its environment impact and to reduce its cost. It did a LCA of the candy bar. The final product is the packaged candy bar. Through the LCA, it has been calculated the different scenarios for the end of life of the product. The organization knows that 1 kg of packaging gives 3,2 kg of CO_2e. It knows that for 1 000 000 bars, the organization needs 5 t of packaging. In total, (5 × 12) = 60 t of packaging per year are needed. Total emissions = (60 000 × 3,2) = 192 000 kg CO_2e = 192 t CO_2e.

EXAMPLE 3: An organization produces wooden pallets for a total of 5 488 t/year. It estimates that 20 % of the production per year is not recovered or not reusable and therefore transformed into wood for heating. The organization has not made a LCA approach to calculate the emission factor. It found in a recognized database over the country that it allows a removal factor of 0,8 kg CO_2e per kg of wood. Total emissions = (5 488 000 × 0,2 × −0,8) = −878 080 kg CO_2e = −880 t CO_2e

5.4.20 Category 20 — Downstream franchises

a) Identification of GHG sources and sinks

This category includes emissions from the operation of franchises. A franchise is a business operating under a license to sell or distribute another organization's goods or services within a certain location. This category is applicable to franchisors (i.e. an organization that grants licenses to other entities to sell or distribute its goods or services, in return for payments, such as royalties for the use of trademarks and other services).

A total GHG inventory of the downstream franchises should be done. This may lead to double counting for the organization; transport of goods from the franchisor to the franchisee (see 5.4.12 and 5.4.17) should be only counted once. Waste management (see 5.4.11) of goods coming from the franchisor should only appear once, either in the franchisor GHG inventory or in that of the franchisee. Products delivered by the franchisor to the franchisee should only be accounted once.

NOTE It is advisable that franchisees report upstream franchises in 5.4.9.

b) Selection of activity data

1) Best scenario

The franchisor has detailed data about each one of the franchises. The GHG inventory is known for each downstream franchise. It should be integrated in the organization GHG calculation. If the franchisee is not owned 100 % by the organization, an allocation should be done by the franchisor.

2) Minimum scenario

The number of franchises is known. An estimated amount of GHG emissions is made in order to obtain an estimated emission value. Then it should be integrated in the organization GHG calculation. If the franchisee is not owned 100 % by the organization, an allocation should be calculated by the franchisor.

A literature calculation has been done in order to estimate the GHG emissions of the services offered by the franchisee.

3) Intermediate scenarios

The organization calculates GHG emissions of the franchisees. The organization allocates the emissions in this category. If the franchisee is not owned 100 % by the organization, an allocation should be calculated by the franchisor.

Disaggregation of data can be done using such key parameters as:

— size of the franchisee;

— geographical zone (for energy mix and climate);

— functionality and type of product;

— location (accessibility, rural, urban, semi urban, etc.).

Other potential parameter is management quality.

c) Selection of emission factors

The emission factor for each of the franchises covers the total GHG emissions (all direct and indirect) of the franchise.

Avoiding double counting should be noted, especially for the use stage of the product and for the purchased products.

An emission factor is estimated for one franchise. As a minimum, this emission factor should take into account the direct GHG emissions and the indirect energy-related GHG emissions. The emission factor should be expressed in amount of GHG per franchise. Ideally the size of the franchise should also be taken into account when making the up scaling for the total GHG emissions for all the franchises.

The following parameters may be taken into account for the calculation of the emission factor:

— energy consumption;

— employee commuting;

— capital equipment;

— client and visitor transport;

— waste;

— purchased goods.

d) Examples

EXAMPLE 1: Organization A (the franchisor) has 2 franchises. For each one of them, the franchisee is asked to make a GHG inventory of its direct and indirect emissions. The franchisee should not take into account the distribution from supplier neither the purchased products (delivered by the franchisor). Franchisee A is owned 100 % and Franchisee B is owned only at 51 %. Franchisee A calculated a total of 14 000 t CO_2e. Franchisee B calculated a total of 8 000 t CO_2e.Total emissions = (14 000 × 100 %) + (8 000 × 51 %) = 18 080 t CO_2e.

EXAMPLE 2: Organization A (the franchisor) has 3 franchisees (restaurant). The organization has no knowledge of the total GHG emissions of these franchisors. Franchisee A is a big restaurant with 30 employees. Franchisee B is a smaller restaurant with 9 employees. Franchisee C is an average restaurant with 15 employees. The organization does not know the GHG emissions but knows the average value for 15 employees as the organization has realized a benchmarking study for its own restaurant. The value is 19 500 t CO_2e. The organization estimates an average value per employee of 1 300 t CO_2e. Total emissions = [1 300 × (30 + 9 + 15)] = 70 200 t CO_2e

5.4.21 Category 21 — Downstream leased assets

a) Identification of GHG sources and sinks

This category includes emissions from the operation of assets that are owned by the reporting organization and leased to other entities during the reporting year. This category is applicable to the lessors (i.e. an organization that receives payments from lessees).

The main sources and sinks are:

— production stage of the leased asset;

— transport and distribution of the leased asset;

— use stage of the leased asset;

— end of life of the leased asset;

— maintenance of the leased asset;

— consumables.

Some of the sources and sinks in the list above may have been already counted by the lessee organization. There is any risk double counting except when lessees and lessors are within the same organizational boundaries.

When the whole life cycle of the goods is already taken into account in the purchased products or in the capital equipment, it should not be reported in this category. However in most cases, it is likely that GHG emissions of the purchased goods or capital equipment were assessed on a cradle-to-gate basis, and that “downstream” emissions from use stage and/or maintenance, end of life, would be missing. In such case, missing emissions of leased assets are reported in this category 21. As a lease is a way to generate income for the reporting organization, the logic here is quite similar to the one applied for categories 18 or 19 (use stage and end of life of the product).

b) Selection of activity data

1) Best scenario

The lessor collects the energy use data for the leased assets. If the leased assets are emitting other process emissions or fugitive emissions, those should also be taken into account. If the leased assets need maintenance or spare parts, they should be taken into account if this has not been taken into account in other emissions categories.

2) Minimum scenario

The lesser should group its leased assets by the following categories:

— buildings;

— motor vehicles;

— it equipment;

— lorries;

— machinery.

For each group, an estimate of the energy consumption and of the process and fugitive emissions is made.

3) Intermediate scenarios

GHG emissions are not known for each downstream leased asset. Downstream leased assets categories are set up based on the disaggregation of data presented below.

The organization can set up a survey to collect the necessary data to calculate its exact GHG emissions related to its downstream leased assets using such key parameters as:

— type of leased asset;

— age of leased asset;

— used technology;

— period it is used;

— geographical location.

Other potential parameters are: maintenance and technical control, operational control, behaviour during utilization.

c) Selection of emission factors

The emission factors should be those described in the different categories of the direct GHG emissions and the energy-related indirect GHG emissions.

A GHG inventory should be done to estimate the emission factors for these downstream leased assets.

The following parameters may be taken into account for the calculation of the emission factor:

— production stage;

— transport and distribution;

— use stage;

— end of life;

— maintenance;

— consumables.

d) Examples

EXAMPLE 1. An organization A leases motor vehicles to another organization B. Organization A knows the motor vehicle specification, and the leasing contract is linked to the number of kilometres or miles used by the organization B.

4 motor vehicles are leased:

— For motor vehicle 1, it has been reported 15 069 km and has a CO_2e emissions of 201 g CO_2e/km

— For motor vehicle 2, it has been reported 18 588 km and has a CO_2e emissions of 154 g CO_2e/km

— For motor vehicle 3, it has been reported 7 521 km and has a CO_2e emissions of 88 g CO_2e/km

— For motor vehicle 4, it has been reported 21 548 km and has a CO_2e emissions of 195 g CO_2e/km

Emission factors for motor vehicles 1 and 2 were found from motor vehicle specifications, end of pipe and include an additional 10 g CO_2e/km to account for the production and end of life stage. Emission factors for motor vehicles 3 and 4 were given by motor vehicle producer data based on a LCA approach.

Total emissions of leased assets = (15 069 × 201) + (18 588 × 154) + (7 521 × 88) + (21 548 × 195) = 10 755 129 g CO_2e = 10,8 t CO_2e

EXAMPLE 2. An organization B leases a building as well as printing machines from another organization A (the lessor). The organization A does not know the exact energy consumption as organization A asks for the payment of a fee to the organization B which includes leased assets (building + machine) and their maintenance, but not the energy bill that is paid separately by organization B. If organization B is unable to or unwilling to provide organization A with some data related to energy consumption, a proxy could be calculated.

The building is 1500 m^2 and 1000 m^2 are used for the workshop (printing zone). The office zone is 500m^2. The power of the printing machine is 75 kW used 10 h/day, 220 days/year (2 200 h/year). The heating system uses gas.

The consumption of energy is estimated:

— Workshop

  Heating is estimated to be: 75 kWh/m^2.year → 75 × 1 000 = 75 000 kWh

  Electricity is estimated to be: 50 kWh/m^2.year + 75 kW × 2 200 → (50 X1 000) + (75 × 2 200) = 215 000 kWh

— Office

  Heating is estimated to be: 150 kWh/m^2.year → 150 × 500 = 75 000 kWh

  Electricity is estimated to be: 100 kWh/m^2.year → 100 × 500 = 50 000 kWh

Emission factors are:

— for heating: 1,829 kg CO_2e/kWh

— for this specific electricity source: 0,403 kg CO_2e/kWh

— for electricity losses: 0,032 kg CO_2e/kWh

Total emissions = [(75 000 + 75 000) × 1,829] + [(215 000 + 50 000) × (0,403 + 0,032)] = 389 625 kg CO_2e = 390 t CO_2e

If the reporting organization A already accounted for building and machine construction in other indirect GHG emissions upstream categories, as well as for general activities (commercial/office work) of A and maintenance related emissions in various categories, this figure of 390 t CO_2 could be used as a proxy for GHG emissions related to the use of the leased asset, and be reported in the category 21.

5.4.22 Category 22 — Employee commuting

a) Identification of GHG sources and sinks

Indirect emissions from employees commuting are mainly due to fuel burnt in transport equipment neither owned nor controlled by the reporting organization such as motor vehicles, and public transports.

Emissions are considered as indirect because vehicles are not controlled or not owned by the reporting organization.

Emissions related to telecommuting are also taken into account in this category. Telecommuting implies a greater use of energy for heating or cooling (when needed) from part of the employee and use of electricity at home.

These emissions belong to out of stream emissions (see 3.1.7).

b) Activity data choice

1) Best scenario

The organization knows the transport details for each of its employee. The distance and type of transport are known with its specifications:

— motor vehicle: type of motor vehicle, fuel type;

— train: country, train type (fast train, intercity metro, etc.);

— bus: bus type (inter-city, suburban, urban, rural, mini-bus, etc.).

The sum of total distance per type of transport is made.

The organization also knows how many days and how many times a day every employee comes to its workplace during the year. Surveys with specific questions can be made to obtain this information.

2) Minimum scenario

No specific data are available. The average distance and the estimation of type of transport are used to estimate the total distance and the type of transport.

This can be based on national or regional averages given by general surveys.

3) Intermediate scenarios

Some specific data are known by the organization such as: distance to work, number of days worked by employee and type of transport. Specific data are used along with national averages. Further information is easily achievable through internal data but not sorted out.

Disaggregation of data could be made using such key parameters as:

— total worked days per employee;

— telecommuting;

— type of travel (motor vehicle, bus, rail, air, etc.);

— type of final energy used: gasoline, fuel, gas, electricity, hydrogen, compressed air, fuel cell, etc.;

— type of engine: small, medium, big, etc.;

— type of travels: urban suburb, town centre, rural periphery, etc.

Other potential parameters are: type of driving: eco driving, fast driving, pollution control devices installed on the vehicle, etc.

c) Selection of emission factors

For transport, GHG emission factors are expressed in GHG emissions per distance unit (km or miles) and per type of travel.

Specific emission factor can be calculated for employee owned motor vehicle.

For telecommuting, the GHG emission factor should take into account the heating and electricity consumption for lighting and computer.

The organization reports which emission sources are covered for the emission factors: from only the combustion of fuel or also fuel extraction and other emissions related to the transport (such as emissions due to cooling liquids, motor vehicle production, etc.):

— leaks of refrigerant from air cooling systems;

— fossil fuels production and transport;

— vehicle maintenance;

— vehicle construction;

— vehicle end of life.

d) Examples

EXAMPLE 1: An organization has 88 employees: 23 employees take the metro/light rail for a total distance of 213 km/day; they all work 220 days/year. It makes a total of 213 × 220 = 46 860 km/year.50 employees take the train for a total distance of 5132 km/day; they all work 220 days/year. It makes a total of 5 132 × 220 = 1 127 060 km/year.15 employees use their own motor vehicle to come to work for a total distance of 2647 km/day; they all work 220 days/year. It makes a total of 2 647 × 220 = 582 340 km/year.

The emission factors are the following:

— Motor vehicle: CO_2 emissions = 253 g CO_2e/km

— Train: CO_2 emissions = 48,4 g CO_2e/km

— Metro/light rail: CO_2 emissions = 6,6 g CO_2e/km

Total emissions = (46 860 × 6,6) + (1 127 060 × 48,4) + (582 340 × 253) = 202 191 000 g CO_2e = 202,2 t CO_2e.

EXAMPLE 2: An organization knows that it has 2300 employees. No data are available within the organization about the employee commuting. The country administration made a survey two years ago and found following data about employee commuting:

— 72 % come by motor vehicle

— 18 % come by motorcycle

— 10 % come by public transport

Based on these figures, the organization calculates its GHG emissions of employee commuting. The organization knows that the average number of workdays for its employees is 215 days/year.

The average distances are the following:

— Motor vehicle : 150 km

— Motorcycle : 88 km

— Public transport :25 km (It has been assumed that the public transport is a bus)

The emission factors used are the following:

— Motor vehicle: CO_2 emissions = 253 g CO_2e/km

— Motorcycle: CO_2 emissions = 180 g CO_2e/km

— Bus: CO_2 emissions =154 g CO_2e/km

Total emissions = (2 300 × 0,72 × 215 × 150 × 253) + (2 300 × 0,18 × 215 × 88 × 180) + (2 300 × 0,1 × 215 × 25 × 154) = 14 981 489 938 g CO_2e = 15 000 t CO_2e.

5.4.23 Category 23 — Other indirect emissions or removals not included in Categories 1 to 22

If the organization has indirect emissions or removals of GHG that cannot be taken into account in one of the 22 categories described previously, the emissions are accounted for in this 23rd category. When this category is used, the organization clearly describes the sources and sinks as well as the methodology to calculate the emissions or removals.

6 GHG inventory components

ISO 14064-1:2006, 5.1, 5.2 and 5.3, and the following should be applied.

6.1 GHG emission reduction or removal enhancement projects (carbon offset projects)

The organization may report GHG emission reductions or removal enhancements purchased or developed from GHG projects, quantified using methodologies such as that given in ISO 14064-2, in order to meet GHG programme requirements, or other intended purposes of the GHG inventory.

If the organization reports GHG emission reductions or removal enhancements purchased or developed from GHG projects, the organization lists such GHG emission reductions or removal enhancements from GHG projects separately. And, also, the organization reports the following relevant information:

— descriptions of the programme (e.g. Kyoto mechanism, any carbon offset programme);

— type and location of project or activity;

— the approach used to quantify GHG emission reductions or removal enhancements;

— GHG emission reductions or removal enhancements purchased or developed from GHG projects quantified in tonnes of CO_2e;

— other relevant information.

6.2 Assessment of uncertainty

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
5.4 Assessing and reducing uncertainty The organization should complete and document an uncertainty assessment for GHG emissions and removals, including the uncertainty associated with emission and removal factors. The organization may apply the principles and methods of (ISO/IEC Guide 98-3:2008) in completing the uncertainty assessment.

Uncertainty associated with the quantification of GHG emissions is a key component of the GHG inventory. If possible, the organization could use a quantitative assessment or as an alternative may adopt a qualitative assessment including rounding rules or ranges. The main sources of uncertainty are as follows (non-exhaustive list).

— Methodology of quantification: the methodology for quantification could be either measurement or calculation or a combination of both. Measurement is preferable as it may provide greater accuracy). The calculation of the uncertainty in the organization inventory should takes into account uncertainty of the activity data as well as uncertainty of the emission factor.

— Physical and scientific uncertainty: when establishing the GHG inventory, the organization may face complex physical phenomena on which no scientific agreement exists for the GHG emissions modelling, then the uncertainty is large. For example, the complexity associated with biogenic carbon quantification (e.g. soil respiration) may be underlined.

— Scope of the inventory: In addition to direct and energy indirect emissions, the organization may include in its inventory, relevant other indirect emissions. As a general point, direct and energy indirect emissions would have a lower degree of uncertainty compared to other indirect emissions. Using primary or site-specific data reduces the degree of uncertainty. For quantification methodology, the following formula may be applied to quantify uncertainty:

$$\text{Aggregated uncertainty} = \sqrt{\left(EFu^2 + ADu^2\right)}$$

EFu is the uncertainty of the emission factor

ADu is the uncertainty of the activity data

The organization may apply the principles and methods of References [7] and [8] in completing the uncertainty assessment.

EXAMPLE 1 The data uncertainty of 1 kg CO_2e (e.g. emission factor) due to combustion of a litre of liquid fuel is estimated to be 8 %. The activity data uncertainty is estimated at 10 % (expressing the inaccuracy with which the amount of liquid fuel consumed by a company is quantified).

Consequently, if uncertainty for the emission factor is 8 % and data uncertainty is 10 %,

$$\text{Aggregated uncertainty} = \sqrt{\left(0,1^2 + 0,08^2\right)} = 0,128 = 12,8\%$$

In this case, uncertainty is interpreted as follows:

95 % of the real value would be included in the range of X ± 12,8 % (X is tCO_2e)

EXAMPLE 2 A graphic illustration of uncertainty for GHG inventory is shown in Figure 4. The histogram shows the mean estimate of emissions for categories 1 to 12; the thin red line shows the uncertainty within each category.

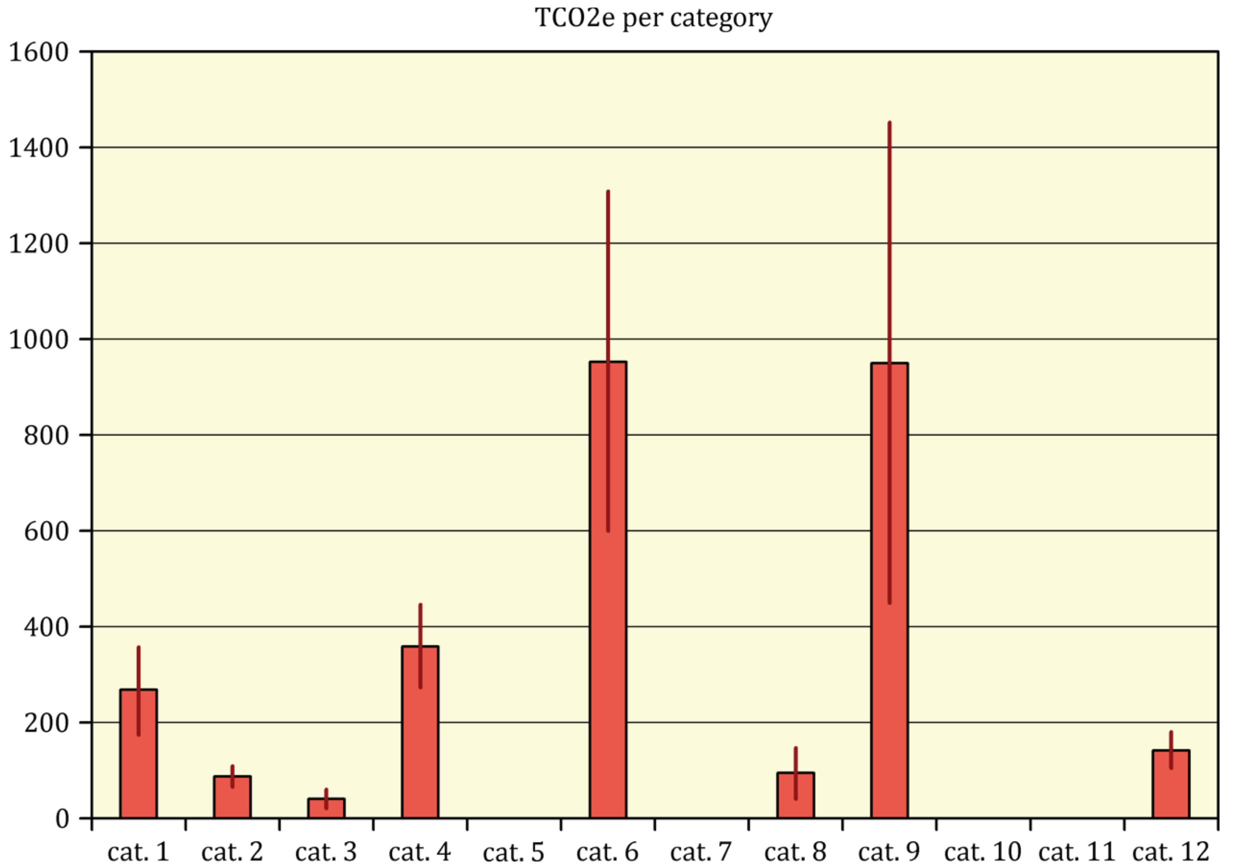


Figure 4 — Illustration of uncertainty for GHG inventory for categories 1 to 12

7 GHG inventory quality management

ISO 14064-1:2006, Clause 6, should be applied.

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
6 GHG inventory quality management
6.1 GHG information management
6.1.1 The organization shall establish and maintain GHG information management procedures that
a) ensure conformance with the principles of this part of ISO 14064,
b) ensure consistency with the intended use of the GHG inventory,
c) provide routine and consistent checks to ensure accuracy and completeness of the GHG inventory,
d) identify and address errors and omissions, and
e) document and archive relevant GHG inventory records, including information management activities.
6.1.2 The organization's GHG information management procedures should consider the following:
a) identification and review of the responsibility and authority of those responsible for GHG inventory development;
b) identification, implementation and review of appropriate training for members of the inventory development team;
c) identification and review of organizational boundaries;
d) identification and review of GHG sources and sinks;
e) selection and review of quantification methodologies, including GHG activity data and GHG emission and removal factors that are consistent with the intended use of the GHG inventory;
f) a review of the application of quantification methodologies to ensure consistency across multiple facilities;
g) use, maintenance and calibration of measurement equipment (if applicable);
h) development and maintenance of a robust data-collection system;
i) regular accuracy checks;
j) periodic internal audits and technical reviews;
k) a periodic review of opportunities to improve information management processes.
6.2 Document retention and record keeping
The organization shall establish and maintain procedures for document retention and record keeping.
The organization shall retain and maintain documentation supporting the design, development and maintenance of the GHG inventory to enable verification. The documentation, whether in paper, electronic or other format, shall be handled in accordance with the organization's GHG information management procedures for document retention and record keeping.

8 Reporting of GHG

8.1 General

ISO 14064-1, Clause 7, and the following should be applied.

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
7.1 General
The organization should prepare a GHG report to facilitate GHG inventory verification, participation in a GHG programme, or to inform external or internal users. GHG reports should be complete, consistent, accurate, relevant and transparent. The organization should determine the content, structure, public availability and methods of dissemination of GHG reports, based on requirements of the applicable GHG programme, internal reporting needs and the needs of intended users of the report.
If the organization makes a public GHG assertion claiming conformance to this part of ISO 14064, the organization shall make available to the public a GHG report prepared in accordance with this part of ISO 14064 or an independent third-party verification statement related to the GHG assertion. If the organization's GHG assertion has been independently verified, the verification statement shall be made available to intended users.

8.2 GHG inventory report format

In order to encourage completeness and readability, the organization should consider GHG report containing the following chapters.

— Chapter 1 : General description of the organization goals and inventory objectives

— This chapter includes the description of the reporting organization, persons responsible, purpose of the report, intended users, dissemination policy, reporting period and frequency of reporting, data and information included in the report (list of GHG taken into account and explained), statements by the organization about verification.

— Chapter 2 : Organizational boundaries

— This chapter includes explanation and documentation of boundaries and consolidation methods. See as an example Table F.1.

— Chapter 3 : Operational boundaries

— This chapter includes the explanation and documentation of emissions categories that are considered.

— Chapter 4 : Quantified GHG Inventory of emissions and removals

— This chapter includes the quantified data results by emission or removal category, description of methodologies and activity data used, references and/or explanation and/or documentation of emission and removal factors, uncertainties and accuracy impacts on results, disaggregated by category, tracks to reduce uncertainties. See as an example Table F.2, Table F.3 and Table F.4.

— Chapter 5 : Directed actions and internal performance tracking

— This chapter could be omitted from the public GHG assertion of the organization, either for confidentiality reasons or because internal performance tracking does not belong to the inventory scope.

— If the organization chooses another report format, this format should be indicated at the beginning of the report.

8.3 GHG inventory report content

8.3.1 Content of chapter 1: General description of the organization goals and inventory objectives

8.3.1.1 Required items according to ISO 14064-1

ISO 14064-1:2006, 7.3.1, defines items to be included in the report.

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
7.3 GHG report content **7.3.1** The organization's GHG report shall describe the organization's GHG inventory and shall include the following: a) description of the reporting organization; b) person responsible; c) reporting period covered; (...) j) The historical base year selected and the base-year GHG inventory (...); k) Explanation of any change to the base year or other historical GHG data, and any recalculation of the base year or other historical GHG inventory (...); (...) p) a statement that the GHG report has been prepared in accordance with this part of ISO 14064; q) a statement describing whether the GHG inventory, report or assertion has been verified, including the type of verification and level of assurance achieved.

The general description of the organization [ISO 14064-1:2006, 7.3.1, item a)] should be included in chapter 1. The detailed description, with consequences for organizational boundaries definition, could be included in chapter 2.

8.3.1.2 Recommended items according to ISO 14064-1

ISO 14064-1:2006, 7.2 and 7.3.2, defines the following recommended items.

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
7.2 Planning the GHG report
The organization should consider and document the following in planning its GHG report:
a) purpose and objectives of the report in the context of the organization's GHG policies, strategies or programmes and applicable GHG programmes;
b) intended use and intended users of the report;
c) overall and specific responsibilities for preparing and producing the report;
d) frequency of the report;
e) period for which the report is valid;
f) report format
g) data and information to be included in the report;
h) policy on availability and methods of dissemination of the report.

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
7.3 GHG report content
(...)
7.3.2 The organization should consider including in the GHG report:
a) a description of the organization's GHG policies, strategies or programmes;
(...)
e) as appropriate, a description of applicable GHG programme requirements;
(...)

8.3.2 Content of chapter 2: Organizational boundaries

ISO 14064-1:2006, 7.3.1, defines items to be included in the report.

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
7.3 GHG report content
7.3.1 The organization's GHG report shall describe the organization's GHG inventory and shall include the following:
(...)
d) documentation of organizational boundaries (...);
(...)
h) explanation for the exclusion of any GHG sources or sinks from the quantification (...);
(...)

The organizational boundaries are described and possibly explained, including consolidation methods. It is recommended to fill in Table F.1, but this table is indicative. Any organization may use another format to report organizational boundaries. This table should contain, for each entity, as a minimum the following items:

— denomination of entity;

— description (subsidiary, joint-venture, etc.);

— type of consolidation method (equity share, financial control, operational control, other control);

— percentage of GHG emissions and removals taken into account for consolidation in the organization GHG inventory;

— difference, if any, with financial accounting rules.

8.3.3 Content of chapter 3: Operational boundaries

The organization should report which other indirect emissions categories have been quantified, and explain if some categories are not quantified: inventory objective justification, unknown activity data and/or emission factor, negligible result assessment, or any other reason (see 5.2.3).

If some category, or part of a category, is identified as negligible, a rough estimate of the amount of neglected GHG emissions should be provided. Results should be summarized in Table F.2.

8.3.4 Content of chapter 4: Quantified GHG Inventory of emissions and removals

8.3.4.1 Required items according to ISO 14064-1

ISO 14064-1:2006, 7.3.1, defines items to be included in the report.

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
7.3 GHG report content
7.3.1 The organization's GHG report shall describe the organization's GHG inventory and shall include the following:
(...)
e) direct GHG emissions, quantified separately for each GHG, in tonnes of CO_2e (...);
f) a description of how CO_2 emissions from the combustion of biomass are treated in the GHG inventory (...);
g) if quantified, GHG removals, quantified in tonnes of CO_2e (...);
(...)
i) energy indirect GHG emissions associated with the generation of imported electricity, heat or steam, quantified separately in tonnes of CO_2e (...);
(...)
l) reference to, or description of, quantification methodologies including reasons for their selection (...);
m) Explanation of any change to quantification methodologies previously used (...);
n) reference to, or documentation of, GHG emission or removal factors used (...);
o) description of the impact of uncertainties on the accuracy of the GHG emissions/removals data (...);
(...)

According to ISO 14064-1, the following types of emissions are reported separately:

— emissions quantified separately for each GHG (excluding the emissions from the combustion of biomass);

— CO_2 emissions from combustion of biomass.

Direct and energy indirect emissions are reported separately by gas type, expressed in tonnes of CO_2e. The sums of direct emissions, and the sum of energy indirect emissions, are expressed as total CO_2e for their respective categories.

As recommended in ISO 14064-1, the removals of biogenic CO_2 should be separately reported.

This Technical Report recommends separating reporting for the other biogenic CO_2 emissions (not from combustion of biomass).

Table F.3 provides a reporting template for direct and energy indirect emissions categories. Similarly, Table F.4 provides a reporting template for other indirect emissions categories, adding a column to indicate if this category is quantified or not or only partially quantified. If needed and useful, emissions by category and GHG may be also disaggregated by source and sink, adding, for each category, several lines in Table F.3 or Table F.4.

The uncertainties for each category should be reported in Table F.3 or Table F.4 in order to fulfil ISO 14064-1:2006, 7.3.1, item o), concerning the accuracy of the organization GHG inventory. The description of the impact of uncertainties could be disaggregated in activity data uncertainties and emission factors uncertainties.

Concerning ISO 14064-1:2006, 7.3.1, items l), m) and n), for each category, the sources and sinks should be identified and the following information provided, and summarized in Table F.5:

— type of quantification methodology;

— activity data;

— emission factors: reference of the data base, or any other reference or from own calculation. If an emission factor has been specifically calculated or estimated by the organization, this emission factor is specified and its evaluation is documented in the report; if, for a given category or for a specific source or sink inside a category, used emission factor is different from a recognized reference, this should be specified and explained;

— methodology change occurred since the previous inventory, if relevant (yes or no).

8.3.4.2 Recommended items according to ISO 14064-1

ISO 14064-1:2006, 7.3.2, defines the following recommended items.

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
7.3 GHG report content
(...)
7.3.2 The organization should consider including in the GHG report:
(...)
b) if quantified, CO_2 emissions from the combustion of biomass, quantified separately in tonnes of CO_2e;
(...)
f) GHG emissions or removals disaggregated by the facility;
g) if quantified, other indirect GHG emissions, quantified in tonnes of CO_2e (...);
h) uncertainty assessment description and results, including measures to manage or reduce uncertainties (...);
(...)

8.3.5 Content of chapter 5: Directed actions and internal performance tracking

8.3.5.1 Recommended items according to ISO 14064-1

ISO 14064-1:2006, 7.3.2, defines the following recommended items.

ISO 14064-1:2006, **Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals**
7.3 GHG report content
(...)
7.3.2 The organization should consider including in the GHG report:
(...)
c) if appropriate, description of directed actions and attributable GHG emission or removal differences, including those occurring outside organizational boundaries, quantified in tonnes of CO_2e (...);
d) if appropriate, purchased or developed GHG emission reductions and removal enhancements from GHG emission reduction and removal enhancement projects, quantified in tonnes of CO_2e (...);
(...)
i) description and presentation of additional indicators, such as efficiency or GHG emission intensity (...);
j) assessment of performance against relevant internal and/or external benchmarks, as appropriate;
k) description of GHG information management and monitoring procedures (...).

This Technical Report recommends that the organization, when reporting its directed actions, should:

— describe these implemented directed actions, indicating the purpose and the action procedure;

— indicate the categories affected by these directed actions;

— provide any relevant information about implemented directed actions, particularly for other indirect emissions.

This Technical Report recommends that the organization should list GHG emission reductions or removals from GHG enhancement projects separately for each project, and the following relevant information should be provided:

— purpose;

— calculation method;

— amounts of purchased and sold (trading) GHG emission reductions or removal enhancements;

— any other relevant information.

Annex A
(informative)

Correspondence between ISO 14064-1:2006 and this Technical Report

Table A.1 — Correspondence between ISO 14064-1:2006 and this Technical Report

Clause of ISO 14064-1:2006	**Clause of this Technical Report**
Introduction	Introduction
1 Scope	**1 Scope**
	2 Normative references
2 Terms and definitions	**3 Terms and definitions**
3 Principles	**4 Principles**
3.1 General	4.1 General
3.2 Relevance	4.2 Relevance
3.3 Completeness	4.3 Completeness
3.4 Consistency	4.4 Consistency
3.5 Accuracy	4.5 Accuracy
3.6 Transparency	4.6 Transparency
4 GHG inventory design and development	**5 GHG inventory design and development**
4.1 Organizational boundaries	5.1 Organizational boundaries
4.2 Operational boundaries	5.2 Operational boundaries
4.3 Quantification of GHG emissions and removals	5.3 Generalities on the quantification of emissions and removals
	5.4 Quantification of GHG emissions and removals for each category
5 GHG inventory components	**6 GHG inventory components**
5.1 GHG emissions and removals	
5.2 Organizational activities to reduce GHG emissions or increase GHG removals	6.1 GHG emission reduction or removal enhancement projects (carbon offset projects)
5.3 Base-year GHG inventory	
5.4 Assessing and reducing uncertainty	6.2 Assessment of uncertainty
6 GHG inventory quality management	**7 GHG inventory quality management**
6.1 GHG information management	
6.2 Document retention and record keeping	
7 Reporting of GHG	**8 Reporting of GHG**
7.1 General	8.1 General
	8.2 GHG inventory report format
7.2 Planning the GHG report	
7.3 GHG report content	8.3 GHG inventory report content
8 Organization's role in verification activities	
8.1 General	
8.2 Preparing for verification	
8.3 Verification management	

Annex B
(informative)

Examples of emission or removal factors data bases

a) 2006 IPCC Guidelines for National Greenhouse Gas Inventories/EFDB http://www.ipcc-nggip.iges.or.jp/EFDB/main.php

b) The ELCD (European reference Life Cycle Database) database, version II currently online: http://lca.jrc.ec.europa.eu/lcainfohub/datasetArea.vm

c) France National Database, Base Carbone® (ADEME), www.basecarbone.fr

d) UK National Atmospheric Emissions Inventory, http://naei.defra.gov.uk

e) Cement Sustainability Initiative (CSI), World Business Council for Sustainable Development (WBCSD) (2012): “Getting the Numbers Right” (GNR). Global Cement Database on CO2 and Energy Information; http://www.wbcsdcement.org/index.php/key-issues/climate-protection/global-cement-database (verified 15 Oct 2012

f) The Plastics portal, plastics and sustainability, http://www.plasticseurope.org/plastics-sustainability/eco-profiles.aspx

g) CO2 emission factor of each electric power supplier in Japan http://ghg-santeikohyo.env.go.jp/files/calc/list_ef_eps.pdf

h) Quantification methods and emission factor, Japan http://ghg-santeikohyo.env.go.jp/files/calc/itiran.pdf

Annex C
(informative)

List of categories

Table C.1 — Categories and examples of emission sources

	Type of emissions[a]	N°	Category	Example of emission sources
Direct GHG emissions and removals		1	Direct emissions from stationary combustion	Combustion of fuels, including combustion of biomass (to be quantified separately)
		2	Direct emissions from mobile combustion	Combustion of fuels from mobile sources including combustion of biomass (to be quantified separately)
		3	Direct process related emissions	Process related emissions may produce CO_2, CH_4 and N_2O (decarbonization, waste treatment, livestock, fertilizer use, etc.)
		4	Direct fugitive emissions	Fugitive GHG emissions include leaks from equipment and storage and transport systems, and leaks from reservoirs and injection wells.
		5	Direct emissions and removals from Land Use, Land Use Change and Forestry (LULUCF)	Soils, forests, grasslands, lakes.
Energy GHG indirect emissions	U	6	Indirect emissions from imported electricity consumed	Emissions resulting from the generation of imported electricity. In case of a GHG inventory of an energy supplier that owns or controls the transmission and distribution system, the GHG emissions from the transmission and distribution system should be accounted in energy indirect emissions.
	U	7	Indirect emissions from consumed energy imported through a physical network (Heating, steam, cooling, compressed air) excluding electricity	Emissions resulting from the generation of imported steam, heating, cooling, compressed air. In case of a GHG inventory of an energy supplier that owns or controls the transmission and distribution system, the GHG emissions from the transmission and distribution system should be accounted in energy indirect emissions.

[a] U are upstream emissions, D are downstream emissions and O are out of stream emissions

Table C.1 *(continued)*

	Type of emissions[a]	N°	Category	Example of emission sources
Other indirect GHG emissions	U	8	Energy-related activities not included in direct emissions and energy indirect emissions	Extraction, production, and transport (leaks included) of fuels that are consumed by the organization (upstream emissions linked to categories 1 and 2). Extraction, production, and transport (leaks included) of fuels in the generation of electricity, steam, heating cooling and compressed air imported by the reporting organization (upstream emissions linked to categories 6 and 7) Electricity, steam, heating, cooling and compressed air consumed in transmission and distribution of network energies. When the reporting organization is an utility company that sold energy to an end users, emissions from the extraction, production and transport of purchased electricity, steam, heating, cooling and compressed air.
	U	9	Purchased products	Extraction and production of inputs (i.e. purchased or acquired goods, services, materials,) Outsourced activities, including contract manufacturing, data centres, outsourced services, etc. associated with direct (tier 1) suppliers. It includes upstream franchises (partial allocation of the franchisor's emissions to be reported by franchisee). Disposal/treatment of waste generated in the production of inputs (i.e. purchased or acquired goods, services, materials or fuels).
	U	10	Capital equipment	Manufacturing/construction of capital equipment owned or controlled by the reporting organization
	U	11	Waste generated from organizational activities	Disposal/treatment of waste generated in operations Transport of waste generated in operations
	U	12	Upstream transport and distribution	Transport and distribution of inputs (i.e. purchased or acquired goods, services, materials or fuels), including intermediate (inter-facility) transport and distribution, warehousing and storage, associated with direct suppliers
	U	13	Business travel	Employee business travel
	U	14	Upstream leased assets	Manufacturing/construction and operation of leased assets not included in lessees "direct emissions" (reported by lessee)
	U	15	Investments	GHG emissions associated with investments, including fixed asset investments and equity investments not included in organizational boundaries
	U	16	Client and visitor transport	Transport to and from the client/visitor location to the organization
	D	17	Downstream transport and distribution	Transport and distribution of sold products, including warehousing and retail
	D	18	Use stage of the product	Use of sold goods and services
		19	End of life of the product	Disposal of sold products at the end of their life
	D	20	Downstream franchises	Emissions from all franchisees (to be reported by the franchisor).
	D	21	Downstream leased assets	Downstream GHG Emissions of lessors assets
	O	22	Employee commuting	Employees commuting to and from work Employee telecommuting
	U/O/D	23	Other indirect emissions not included in the other 22 categories	If emissions are not covered by the 22 other categories, this extra category should be used. The organization should clearly describe what is taken into account in this category.

[a] U are upstream emissions, D are downstream emissions and O are out of stream emissions

Table C.2 — Example of GHG emissions for an education service

	Type of emissions	N°	Category	Examples of emission sources
Direct GHG emissions and removals		1	Direct emissions from stationary combustion	School building heating
		2	Direct emissions from mobile combustion	Car or bus emissions when vehicles used for school purpose within the operational boundaries of the local authority.
		3	Direct process related emissions	Non applicable
		4	Direct fugitive emissions	Cooling liquid leaks from air conditioning system
		5	Direct emissions and removals from Land Use, Land Use Change and Forestry (LULUCF)	Non applicable
Energy GHG indirect emissions	U	6	Indirect emissions from imported electricity consumed	Electricity consumption of the school
	U	7	Indirect emissions from consumed energy imported through a physical network (Heating, steam, cooling, compressed air)	Non applicable
Other indirect GHG emissions	U	8	Energy-related activities not included in direct emissions and energy indirect emissions	Extraction, production, and transport (leaks included) of fuels consumed by the local authority Extraction, production, and transport (leaks included) of fuels in the generation of electricity, steam, heating, cooling and compressed air, purchased by the local authority)
	U	9	Purchased products	School stationery production (books, pen); food for school meals system
	U	10	Capital equipment	Computer and copying machine construction
	U	11	Waste generated from organizational activities	Used paper treatment
	U	12	Upstream transport and distribution	Non applicable
	U	13	Business travel	Study trip
	U	14	Upstream leased assets	Non applicable
	U	15	Investments	Non applicable
	D	16	Client and visitor transport	Children trip from home to school
	D	17	Downstream transport and distribution	Non applicable
	D	18	Use stage of the product	Non applicable
	D	19	End of life of the product	Non applicable
	D	20	Downstream franchises	Non applicable
	D	21	Downstream leased assets	Non applicable
	O	22	Employee commuting	Teacher trip from home to school
	U/O/D	23	Other indirect emissions not included in the other 22 categories	Non applicable

[a] U are upstream emissions, D are downstream emissions and O are out of stream emissions

Annex D
(informative)

100-year global warming potential (GWP)

The global warming potential according to IPCC 4th assessment report is an index, based upon radiative properties of well mixed GHGs, measuring the radiative forcing of a unit mass of a given well-mixed GHG in the present day atmosphere over a chosen time horizon, relative to that of carbon dioxide. Table D.1 shows the 100-year GWP of GHGs.

NOTE 1 When new data is published by the IPCC, the new data supersedes that in Table D.1.

NOTE 2 Table D.1 is based on Reference [10], Table 2.14.

Table D.1 — Global warming potentials (GWP) relative to CO2 for the 100-year time horizon

Industrial designation or common name	Chemical formula	GWP for 100-year time horizon (at date of publication)
Carbon dioxide	CO_2	1
Methane	CH_4	25
Nitrous oxide	N_2O	298
Substances controlled by the Montreal Protocol		
CFC-11	CCI_3F	4 750
CFC-12	CCI_2F_2	10 900
CFC-13	$CCIF_3$	14 400
CFC-113	CCI_2FCCIF_2	6 130
CFC-114	$CCIF_2CCIF_2$	10 000
CFC-115	$CCIF_2CF_3$	7 370
Halon-1301	$CBrF_3$	7 140
Halon-1211	$CBrCIF_2$	1 890
Halon-2402	$CBrF_2CBrF_2$	1 640
Carbon tetrachloride	CCI_4	1 400
Methyl bromide	CH_3Br	5
Methyl chloroform	CH_3CCI_3	146
HCFC-21	$CHCl_2F$	151
HCFC-22	$CHCIF_2$	1 810
HCFC-123	$CHCI_2CF_3$	77
HCFC-124	$CHCIFCF_3$	609
HCFC-141b	CH_3CCI_2F	725
HCFC-142b	CH_3CCIF_2	2 310
HCFC-225ca	$CHCI_2CF_2CF_3$	122
HCFC-225cb	$CHCIFCF_2CCIF_2$	595
Hydrofluorocarbons		
HFC-23	CHF_3	14 800
HFC-32	CH_2F_2	675
HFC-41	CH_3F	92
HFC-125	CHF_2CF_3	3 500
HFC-134	CHF_2CHF_2	1 100
HFC-134a	CH_2FCF_3	1 430

Table D.1 *(continued)*

Industrial designation or common name	Chemical formula	GWP for 100-year time horizon (at date of publication)
HFC-143	CH_2FCHF_2	353
HFC-143a	CH_3CF_3	4 470
HFC-152	CH_2FCH_2F	53
HFC-152a	CH_3CHF_2	124
HFC-161	CH_3CH_2F	12
HFC-227ea	CF_3CHFCF_3	3 220
HFC-236cb	$CH_2FCF_2CF_3$	1 340
HFC-236ea	CHF_2CHFCF_3	1 370
HFC-236fa	$CF_3CH_2CF_3$	9 810
HFC-245ca	$CH_2FCF_2CHF_2$	693
HFC-245fa	$CHF_2CH_2CF_3$	1 030
HFC-365mfc	$CH_3CF_2CH_2CF_3$	794
HFC-43-10mee	$CF_3CHFCHFCF_2CF_3$	1 640
Perfluorinated compounds		
Sulphur hexafluoride	SF_6	22 800
Nitrogen trifluoride	NF_3	17 200
PFC-14	CF_4	7 390
PFC-116	C_2F_6	12 200
PFC-218	C_3F_8	8 830
PFC-318	c-C_4F_8	10 300
PFC-3-1-10	C_4F_{10}	8 860
PFC-4-1-12	C_5F_{12}	9 160
PFC-5-1-14	C_6F_{14}	9 300
PFC-9-1-18	$C_{10}F_{18}$	> 7 500
trifluoromethyl sulphur pentafluoride	SF_5CF_3	17 700
Perfluorocyclopropane	c-C_3F_6	> 17 340
Fluorinated ethers		
HFE-125	CHF_2OCF_3	14 900
HFE-134	CHF_2OCHF_2	6 320
HFE-143a	CH_3OCF_3	756
HCFE-235da2	$CHF_2OCHClCF_3$	350
HFE-245cb2	$CH_3OCF_2CF_3$	708
HFE-245fa2	$CHF_2OCH_2CF_3$	659
HFE-254cb2	$CH_3OCF_2CHF_2$	359
HFE-347mcc3	$CH_3OCF_2CF_2CF_3$	575
HFE-347pcf2	$CHF_2CF_2OCH_2CF_3$	580
HFE-356pcc3	$CH_3OCF_2CF_2CHF_2$	110
HFE-449sl (HFE-7100)	$C_4F_9OCH_3$	297
HFE-569sf2 (HFE-7200)	$C_4F_9OC_2H_5$	59
HFE-43-10pccc124 (H-Galden1040x)	$CHF_2OCF_2OC_2F_4OCHF_2$	1 870
HFE-236ca12 (HG-10)	$CHF_2OCF_2OCHF_2$	2 800
HFE-338pcc13 (HG-01)	$CHF_2OCF_2CF_2OCHF_2$	1 500
	$(CF_3)_2CFOCH_3$	343
	$CF_3CF_2CH_2OH$	42
HFE-338pcc13 (HG-01)	$(CF_3)_2CHOH$	195

Table D.1 *(continued)*

Industrial designation or common name	Chemical formula	GWP for 100-year time horizon (at date of publication)
HFE-227ea	$CF_3CHFOCF_3$	1 540
HFE-236ea2	$CHF_2OCHFCF_3$	989
HFE-236fa	$CF_3CH_2OCF_3$	487
HFE-245fa1	$CHF_2CH_2OCF_3$	286
HFE-263fb2	$CF_3CH_2OCH_3$	11
HFE-329mcc2	$CHF_2CF_2OCF_2CF_3$	919
HFE-338mcf2	$CF_3CH_2OCF_2CF_3$	552
HFE-347mcf2	$CHF_2CH_2OCF_2CF_3$	374
HFE-356mec3	$CH_3OCF_2CHFCF_3$	101
HFE-356pcf2	$CHF_2CH_2OCF_2CHF_2$	265
HFE-356pcf3	$CHF_2OCH_2CF_2CHF_2$	502
HFE-365mcf3	$CF_3CF_2CH_2OCH_3$	11
HFE-374pc2	$CHF_2CF_2OCH_2CH_3$	557
	- $(CF_2)_4CH(OH)$ -	73
	$(CF_3)_2CHOCHF_2$	380
	$(CF_3)_2CHOCH_3$	27
Perfluoropolyethers		
PFPMIE	$CF_3OCF(CF_3)CF_2OCF_2OCF_3$	10 300
Hydrocarbons and other compounds – Direct effects		
Dimethylether	CH_3OCH_3	1
Chloroform	$CHCl_3$	31
Methylene chloride	CH_2Cl_2	8,7
Methyl chloride	CH_3Cl	13
	CH_2Br_2	1,54
Halon-1201	$CHBrF_2$	404
Trifluoroiodomethane	CF_3l	0,4

Annex E
(informative)

Specificities of financial or insurance companies for category 15 (investments)

For organizations operating within the financial or insurance business category, financial assets are the core of their business and therefore should be considered carefully.

For the finance sector, the distinction between “products” and “investments” is not always clear. As GHG reporting sector standards for the finance industry develop, rules and recommendations will emerge and lead to a better understanding of both categories of emissions and their evaluation.

For example, it is accepted that “other indirect GHG emissions” of a bank widely outweigh its direct emissions and is key to assessing the impact of this bank GHG emissions at the global level.

When looking at the assets section of the balance sheet of a bank, the following should be considered.

— A large part of it consists of “bank products”, bank products being, for instance, loans and credits to individuals (to purchase motor vehicles, houses etc.), to states or institutions, to other banks or to corporations. This encompasses a great diversity of credit types: mortgage loans, consumer credits, asset-backed or not, in the field of project finance or for short-term financing, etc.

— In such circumstances, these assets cannot be defined as “investments”, but more as products of the banking activity. Therefore, other indirect GHG emissions of the bank (related to the operation of the activities of individuals or corporations/institutions financed by the bank) would logically fall under the category 18 (use stage of the product), and not under category 15.

— Other financial assets may not be the result of the ordinary “production” of the bank, but are other types of fixed or variable income assets. Their role would be, for instance, to keep a robust balance sheet (by balancing asset and liabilities) or to represent other activities of the bank than retail or corporate banking. Such assets are, for instance, bonds issued by companies, bonds issued by corporations and other types of commercial papers, shares in companies, investment fund units, etc. All of them would have to be reported in category 15.

— There may be other items such as impairment for overdue securities, and trading derivatives, which so far are not included in category 15.

The definition of category 15 mentions emissions due to operation of investments. As the range of investments is very wide, it is rather difficult to specify what “operation” would mean in any situation.

To understand what “operation” means: for equity investment, a reporting organization A holding shares from organization B. This investment enables B to operate, so most GHG reporting methodologies or initiatives suggest that the reporting organization A reports a share of organization B’s GHG emissions, and to do so takes into account as a minimum a share of direct emissions (direct GHG emissions) and energy indirect GHG emissions of organization B, and optionally also a share of its other indirect GHG emissions. Issues regarding calculations rules are addressed further in this Technical Report.

In most cases, the book value of investments does not include fees paid to the financial intermediary organization/financial service provider (e.g. fees from a bank that manages the portfolio of titles from B, C and D, portfolio held by reporting organization A). These fees would usually be found in purchases and are, therefore, “translated” into category 9 (Purchased products). In other words, in category 15 only emissions due to operations of B, C or D, are accounted in category 15 but emissions due to operations of the financial service provider are not accounted.

Annex F
(informative)

Tables for reporting

Table F.1 — Organizational boundaries

Denomination of entities inside the organizational boundaries	Description of the entity (subsidiary, joint-venture, etc.)	Consolidation method used for the entity	% of GHG emissions and removals consolidated for the entity	Difference, if any, with financial accounting rules
Parent organization				
entity # 1				
………………				
entity # n				

Table F.2 — Operational boundaries

GHG Emission or removal categories	Emissions quantified	Reasons for categories not quantified or partially quantified. If emissions for the category are negligible, indicate a rough estimate of the value
1 Direct emissions from stationary combustion	Yes	
……………	Yes	
7 Indirect emissions from consumed energy imported through a physical network	Yes	
8 Energy related	Yes/no/partial	
9 Purchased products	Yes/no/partial	
……………	Yes/no/partial	
………	Yes/no/partial	
13 Business travel	Yes/no/partial	
………….	Yes/no/partial	
23 Other indirect emissions not included in the other 22 categories	Yes/no/partial	

Table F.3 — Direct and energy indirect GHG emissions results

GHG emission or removal categories	CO_2 tonnes (excluding biogenic CO_2)[e]	CH_4 tCO_2e	N_2O tCO_2e	Fluorinated gases tCO_2e	Other GHG tCO_2e	Total emissions in tCO_2e (excluding biogenic CO_2)	CO_2 from combustion of biomass tCO_2e	Other biogenic CO_2 emissions tCO_2e	Removals of biogenic CO_2 tCO_2e	Result uncertainty % if quantified
1 Stationary	a	a	a	a	a	a	c	b	b	
2 Mobile	a	a	a	a	a	a	c	b	b	
3 Process	a	a	a	a	a	a	b	a	b	
4 Fugitive	a	a	a	a	a	a	b		b	
5 Biomass	b	a	a	b	a	a	b	a	d	
Total direct GHG emissions	c	c	c	c	c	c	c	a	a	
6 Indirect from imported electricity						a	c		b	
7 Indirect from steam, heating, cooling, etc.						a	c		b	
Total indirect energy GHG emissions	c	c	c	c	c	c	c		b	

[a] Recommended according to this Technical Report.

[b] Recommended according to ISO 14064-1.

[c] Required according to ISO 14064-1.

[d] Not applicable.

[e] CO_2 emissions are mostly generated from the combustion of fossil fuels but less so from industrial chemical reactions.

NOTE An empty box indicates that the reporting of data is optional according to this Technical Report and ISO 14064-1.

Table F.4 — Other indirect GHG emissions results

GHG Emission or removal categories	Category of emissions quantified	CO_2 tonnes	CH_4 tCO_2e	N_2O tCO_2e	Fluorinated gases tCO_2e	Other GHG gases tCO_2e	Total emissions tCO_2e	CO_2 from combustion of biomass tCO_2e	Other biogenic Co2 emissions tCO_2e	Removal of biogenic CO_2 tCO_2e	Avoided emissions tCO_2e	Result uncertainty %
8 Energy related	Yes/no/ partial						a					
9 Purchased products	Yes/no/ partial						a	a		a		
10 Capital equipment	Yes/no/ partial						a					
11 Waste generated from organizational activities	Yes/no/ partial						a	a	a	a		

[a] Recommended according to this Technical Report.

[b] Recommended according to ISO 14064-1.

NOTE An empty box indicates that the reporting of data is optional according to this Technical Report and ISO 14064-1.

Table F.4 *(continued)*

GHG Emission or removal categories	**Category of emissions quantified**	**CO_2** tonnes	**CH_4** tCO_2e	**N_2O** tCO_2e	**Fluorinated gases** tCO_2e	**Other GHG gases** tCO_2e	**Total emissions** tCO_2e	**CO_2 from combustion of biomass** tCO_2e	**Other biogenic Co2 emissions** tCO_2e	**Removal of biogenic CO_2** tCO_2e	**Avoided emissions** tCO_2e	**Result uncertainty** %
12 Upstream transport and distribution	Yes/no/ partial						a	a				
13 Business travel	Yes/no/ partial						a	a				
14 Upstream leased assets	Yes/no/ partial						a					
15 Investments	Yes/no/ partial						a					
16 Client and visitors transport	Yes/no/ partial						a	a				
17 Downstream transport and distribution	Yes/no/ partial						a	a				
18 Use stage of the product	Yes/no/ partial						a	a				
19 End of life of the product	Yes/no/ partial						a	a	a	a		
20 Downstream franchises	Yes/no/ partial						a					
21 Downstream leased assets	Yes/no/ partial						a					
22 Employee commuting	Yes/no/ partial						a	a				
23 Other indirect	Yes/no/ partial						a					
TOTAL							b	a	a	a		

[a] Recommended according to this Technical Report.

[b] Recommended according to ISO 14064-1.

NOTE An empty box indicates that the reporting of data is optional according to this Technical Report and ISO 14064-1.

Table F.5 — Quantification methodologies and emission factors used for each category of emission and source

GHG emission/ removal categories	Sources and/or sinks denomination	Quantification methodology	Activity data	Emission or removal factors	Change of methodology since the previous inventory (if relevant)
1 Direct emissions from stationary combustion	[a] *Source # 1*	*Calculation or measurement or both*	*Tonnes of m³ of gas*		*Yes, cf. report*
	Source # 2			*On-site measurement*	*No*
	Sink # 1				*No*
…………	……………………	……………………			
9 Purchased products	*Product type 1*			*Ref. UNFCCC*	
	Product type 2			*Ref. GIEC 2007*	
	………				
10 ………					
23 Other indirect emissions or removals					
TOTAL					

[a] Cells in italics contain examples.

Bibliography

[1] ISO 14064-2:2006, *Greenhouse gases — Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements*

[2] ISO 14067:—, Carbon footprint of products — Requirements and guidelines for quantification and communication[2)]

[3] ISO/IEC Guide 98-3:2008, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

[4] GHG Protocol Corporate Accounting and Reporting standards (2004), WRI/WBCSD

[5] Greenhouse Gas Protocol, Corporate Value Chain (scope 3) Accounting and reporting Standard (2011)

[6] International Financial Reporting Standards (IFRS) http://www.ifrs.org/Home.htm

[7] IPCC Guidelines for National Greenhouse Gas Inventories. 2006, http://www.ipcc-nggip.iges.or.jp/public/gp/english/gpgaum_en.html

[8] The Climate registry, http://www.theclimateregistry.org/

[9] Ashrae journal http://www.ashrae.org/resources--publications/periodicals/ashrae-journal

[10] IPCC Fourth Assessment Report: Climate Change 2007 (AR4), Working Group I Report “The Physical Science Basis”

[11] Code of Federal Regulations — Title 10: Energy

2) To be published.

ICS 13.020.40

Price based on 88 pages