IEC TR 62726

Edition 1.0 2014-08

TECHNICAL REPORT

Guidance on quantifying greenhouse gas emission reductions from the baseline for electrical and electronic products and systems

colour inside

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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GUIDANCE ON QUANTIFYING GREENHOUSE GAS EMISSION REDUCTIONS FROM THE BASELINE FOR ELECTRICAL AND ELECTRONIC PRODUCTS AND SYSTEMS

FOREWORD

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IEC TR 62726, which is a technical report, has been prepared by IEC technical committee 111: Environmental standardization for electrical and electronic products and systems.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
111/335/DTR	111/345/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

Electrical and electronic products and systems (hereinafter referred to as EE products) are widely used in our society, hence raising awareness of their environmental impacts. Consequently customers in the market and other stakeholders are requiring, or requesting that the electronics sector takes action to address the quantification and reduction of environmental impacts through environmental conscious design during the product development phase.

Among those environmental impacts, climate change is an important issue. A number of initiatives at local, national, regional, and international levels are being developed and implemented, aiming to curb the concentration of greenhouse gas (GHG) emissions which is understood to be a major causative factor.

All industry sectors are trying to reduce GHG emissions in order to meet the national, regional and global reduction targets for the future in order to stabilize atmospheric concentration below the level of triggering catastrophic climate change. For the EE sector, developing and supplying new products that achieve GHG reductions in society compared to other products offers significant opportunities for achieving large scale GHG reductions.

Among methodologies to quantify products' impacts on climate change is carbon footprint of products (CFP), which only covers GHG emissions that occur during the life cycle of the product. Although EE products consume energy, the EE industry is enabling other sectors to reduce large amounts of GHG emission. There are different opportunities for GHG reduction when the EE industry provides the same or similar function as existing products in the marketplace but with significantly less GHG emissions. For example, a manufacturer of renewable energy technologies can be interested not only in tracking the emissions and reductions that occur during the life cycle of its products, but also in assessing the reduction in society's GHG emissions as a result of using renewable energy technologies compared to generating electricity by combusting fossil fuels.

Examples of such products and solutions include:

- wind turbines or solar panels, compared to fossil fuel power plants;
- LED bulbs, compared to incandescent bulbs;
- online meeting (including software), compared to business travel.

For assessing this enabling effect, two scenarios are compared: the situation "with the technology" and "without or with old technology". Because the enabling effect is not included in CFP, quantification of such reductions requires a different methodology. Actually many companies are already quantifying or communicating future environmental contribution by this enabling effect through their businesses with numeric target values, such as "*help society to reduce XX million tons by 2025 through our high energy-efficient products*". Currently, various quantifications and claims for such GHG reduction are carried out mainly on a voluntary basis. However, there is no internationally recognized methodology to validate such numerical targets specifically for EE products. There is a business value in establishing an internationally recognized methodology at this time.

A basic generic and relevant methodology is provided by ISO 14064-2[1]. This ISO standard also incorporates the idea of "product-related GHG projects" and allows GHG projects to be performed as a result of product development.

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1 Numbers in square brackets refer to the Bibliography

The idea is related to EE products contributing to GHG emissions reduction such as high energy efficient EE equipment. The necessity of a sector-specific guidance applicable to the EE sector is recognized by considering specific characteristics of EE. These include their complex and dynamic supply chain, their varying lifespan, sometimes extending over many years, and associated energy consumption. Such characteristics underline the significance of the use stage of many EE products.

In accordance with ISO 14064-2, this report addresses “EE product-related GHG projects” as activity or activities performed as a result of the development and supply of EE products into the market alter the conditions identified in the baseline scenario which cause greenhouse gas emissions reduction, as well as the methodology associated with it.

In particular, the objectives of this report are as follows:

- enable organizations in the EE sector to quantify their contribution to society in reducing GHG emissions through their products and systems;
- allow EE product-related GHG projects to be evaluated in terms of their GHG emission reductions amount compared to a baseline.

In addition to the above purposes, the additional benefits below are also expected:

- facilitate incorporation of a GHG related target into design and development strategy of EE products;
- establish consistency and bridging between different product areas in the EE sector;
- help product-specific technical committees (TCs) with limited amount of expertise or resources to develop their own methodology.

The features of this report are as follows:

- This report contains the study and review of relevant standards, regional initiatives and practices to clarify and compare the differences and similarities in multiple existing methodologies for GHG reduction studies.
- This report is based on relevant International Standards, especially ISO 14064-2, and other forum/industry standards, and therefore gives a comprehensive guidance which enable readers to carry out GHG reduction study for EE products.

It should be also emphasized that GHG emission reduction addresses the single impact category of climate change and does not assess other potential social, economic or environmental impacts arising from the provision of products. Therefore GHG emission reductions do not provide an indicator of the overall environmental impact of products.

NOTE This report may be used as quantification guidance for GHG emission reductions as a part of the environmental impact categories in a multi-criteria environmental assessment.

The information in this report is entirely informative in nature, and does not establish or is intended to imply any normative requirements.

GUIDANCE ON QUANTIFYING GREENHOUSE GAS EMISSION REDUCTIONS FROM THE BASELINE FOR ELECTRICAL AND ELECTRONIC PRODUCTS AND SYSTEMS

1 Scope

IEC TR 62726, which is a technical report (hereinafter referred to as "report") describes principles and guidance on quantifying greenhouse gas emission (CO_2e) reductions compared to a baseline (which includes “business as usual”) for electrical and electronic products and systems (hereinafter referred as EE products).

This report addresses GHG reduction through an EE product-related GHG project, not just the difference between GHG emissions of two EE products.

This report is applicable to any type of EE product-related GHG projects which are introducing low-carbon technologies or highly energy-efficient products, etc., including both final products and intermediate products.

This report is based on the result of a comparative study on existing methodologies published or under discussion in international organizations.

This report is intended to be used by those involved in design, development and use of EE products, and their supply chains regardless of industry sectors, regions, types, activities and sizes of organizations.

Table 1 illustrates an example of an EE product-related GHG project and its relation with an EE product (also see Figure 2):

Table 1 – An example of EE product-related GHG projects

EE product-related GHG project	Target product	Baseline scenario
Introduction of 500 000 units of high-performance (energy-efficient) UPS in city A	High-performance (energy-efficient) UPS	1 million units of conventional UPS in city A

In this report, ISO 14064-2, ITU-T L.1410 [2] and GHG Protocol for Project Accounting, are studied and compared since these documents and initiatives are regarded as the most influential ones worldwide at the moment.

This report refers to requirements relevant to EE product-related GHG projects in the existing documents, e.g. ISO 14064-2 and GHG Protocol for Project Accounting and quotes them with boxes. The boxes are followed by guidance applicable to EE product-related GHG projects. It is to be noted that these boxes do not capture the full text of the referred standards therefore readers are encouraged to read the standards to fully understand their requirements.

This report is programme-neutral. If an organization applies for a specific programme (e.g. a greenhouse gas programme, such as certification and recognition of GHG reduction units under clean development mechanism (CDM) of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), or another climate change mitigation programme) some requirements of that programme may apply in addition to the descriptions given in this report.

NOTE 1 Under the Kyoto Protocol's CDM, a key provision is that CDM projects contribute to local sustainable development goals in addition to generating greenhouse gas emissions reduction. Sustainable development criteria may also be important to other climate change mitigation programmes. Because sustainability is not directly related to greenhouse gas emissions quantification, this report does not address such provisions or criteria.

2 Normative references

There are no normative references. Informative references are noted in the bibliography.

NOTE This clause is included so as to respect IEC clause numbering.

3 Terms and definitions

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

3.1
assessed product
product whose related GHG emissions are assessed for a product-related GHG project

3.2
baseline scenario
hypothetical reference case that best represents the conditions most likely to occur in the absence of a proposed greenhouse gas project

Note 1 to entry: The baseline scenario concurs with the GHG project timeline.

[SOURCE: ISO 14064-2:2006, 2.19]

3.3
carbon dioxide equivalent
CO_2 equivalent
CO_2e
unit for comparing the radiative forcing of a greenhouse gas to that of carbon dioxide

Note 1 to entry: The carbon dioxide equivalent is calculated by multiplying the mass of a given greenhouse gas by its global warming potential.

[SOURCE: ISO 14064-2:2006, 2.21]

3.4
EE product-related greenhouse gas project
EE product-related GHG project
activity or activities performed as a result of the development and supply of electrical and electronic products into the market that alter the conditions identified in the baseline scenario which cause greenhouse gas emissions reduction

Note 1 to entry: This definition was created in accordance with ISO 14064-2:2006, 2.12 and A.3.2.4.

[SOURCE: ISO 14064-2:2006, 2.12, modified]

3.5
functional unit
quantified performance of a product system for use as a reference unit

Note 1 to entry: As the CFP treats information on a product, the functional unit can be a product unit, sales unit or service unit.

[SOURCE: ISO TS 14067:2013, 3.1.4.8] [3]

3.6
global warming potential
GWP
characterization factor (ISO 14040:2006, 3.37) [4] describing the radiative forcing impact of one mass unit of a given greenhouse gas relative to that of carbon dioxide over a given period of time

[SOURCE: ISO TS 14067:2013, 3.1.3.4]

3.7
greenhouse gas
GHG
gaseous constituent of the atmosphere, both natural and anthropogenic, that absorbs and emits radiation at specific wavelengths within the spectrum of infrared radiation emitted by the earth's surface, the atmosphere, and clouds

Note 1 to entry: Greenhouse gases include, among others, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

[SOURCE: ISO 14064-1:2006, 2.1] [5]

3.8
greenhouse gas emission
GHG emission
total mass of a greenhouse gas released to the atmosphere over a specified period of time

[SOURCE: ISO 14064-1:2006, 2.5]

3.9
greenhouse gas project
GHG project
activity or activities that alter the conditions identified in the baseline scenario which cause greenhouse gas emissions reduction

[SOURCE: ISO 14064-2:2006, 2.12 , modified – omission of " .. or greenhouse gas removal enhancements"]

3.10
greenhouse gas reduction
GHG reduction
calculated decrease of GHG emissions between a baseline scenario and the project

[SOURCE: ISO 14064-2:2006, 2.7, modified – original term is "greenhouse gas emission reduction"]

3.11
greenhouse gas reduction study
GHG reduction study
study that quantifies the greenhouse gas reduction

3.12
greenhouse gas removal
GHG removal
total mass of a greenhouse gas removed from the atmosphere over a specified period of time

[SOURCE: ISO 14064-1:2006, 2.6]

3.13
greenhouse gas reservoir
physical unit or component of the biosphere, geosphere or hydrosphere with the capability to store or accumulate a GHG removed from the atmosphere by a greenhouse gas sink or a GHG captured from a greenhouse gas source

Note 1 to entry: The total mass of carbon contained in a GHG reservoir at a specified point in time could be referred to as the carbon stock of the reservoir.

Note 2 to entry: A GHG reservoir can transfer greenhouse gases to another GHG reservoir.

Note 3 to entry: The collection of a GHG from a GHG source before it enters the atmosphere and storage of the collected GHG in a GHG reservoir could be referred to as GHG capture and storage.

[SOURCE: ISO 14064-2:2006, 2.4]

3.14
greenhouse gas sink
physical unit or process that removes a GHG from the atmosphere

[SOURCE: ISO 14064-2:2006, 2.3]

3.15
greenhouse gas source
physical unit or process that releases a GHG into the atmosphere

[SOURCE: ISO 14064-2:2006, 2.2]

3.16
intermediate product
output from a unit process that is input to other unit processes that require further transformation within the system

[SOURCE: ISO 14040:2006, 3.23]

3.17
life cycle
consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to the final disposal

[SOURCE: ISO 14040:2006, 3.1]

3.18
monitoring
continuous or periodic assessment of GHG emissions and removals or other GHG-related data

[SOURCE: ISO 14064-2:2006, 2.25]

3.19
organization
group of people and facilities with an arrangement of responsibilities, authorities and relationships

[SOURCE: ISO 9000:2005, 3.3.1 [5], modified – omission of the EXAMPLE and the 3 Notes to entry]

3.20
primary effect
intended change caused by a project activity in GHG emissions, removals, or storage associated with a GHG source or sink

[SOURCE: The Greenhouse Gas Protocol for Project Accounting: 2005, subclause 2.4][6]

3.21
product
any goods or service

Note 1 to entry: This includes interconnected and/or interrelated goods or services.

[SOURCE: IEC 62430:2009, 3.14]

3.22
product category
group of technologically or functionally similar products where the environmental aspects can reasonably be expected to be similar

[SOURCE: IEC 62430:2009, 3.15] [7]

3.23
reference function
set of performance characteristics (including a combination of conventional products or human activities) having equivalent function with an assessed product

3.24
reference product
product whose related GHG emissions are assessed for a baseline scenario

3.25
secondary effect
unintended change caused by a project activity in GHG emissions, removals, or storage associated with a GHG source or sink

[SOURCE: The Greenhouse Gas Protocol for Project Accounting:2005, subclause 2.4]

3.26
target product
product which enables a GHG reduction

Note 1 to entry: The target product is different from the assessed product when the target product is an intermediate product (e.g. inverter driver circuit) to be integrated into the assessed product (e.g. an air conditioner) and enable the assessed product to reduce GHG emissions.

3.27
uncertainty
parameter associated with the result of quantification which characterizes the dispersion of the values that could be reasonably attributed to the quantified amount

Note 1 to entry: Uncertainty information typically specifies quantitative estimates of the likely dispersion of values and a qualitative description of the likely causes of the dispersion.

[SOURCE: ISO 14064-2:2006, 2.30]

3.28
validation
systematic, independent and documented process for the evaluation of a GHG assertion in a GHG project plan against agreed validation criteria

[SOURCE: ISO 14064-2:2006, 2.26, modified – omission of the two NOTES to entry]

3.29
verification
systematic, independent and documented process for the evaluation of a greenhouse gas assertion against agreed validation criteria

[SOURCE: ISO 14064-2:2006, 2.28, modified – Omission of the NOTE to entry]

4 Principles

4.1 Provisions in existing standards

Existing standards describe "principles" as follows:

> *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.*
>
> *3.2 Relevance*
>
> *Select the GHG sources, GHG sinks, GHG reservoirs, data and methodologies appropriate to the needs of the intended user.*
>
> *3.3 Completeness*
>
> *Include all relevant GHG emissions and removals. Include all relevant information to support criteria and procedures.*
>
> *3.4 Consistency*
>
> *Enable meaningful comparisons in GHG-related information.*
>
> *3.5 Accuracy*
>
> *Reduce bias and uncertainties as far as is practical.*
>
> *3.6 Transparency*
>
> *Disclose sufficient and appropriate GHG-related information to allow intended users to make decisions with reasonable confidence.*
>
> *3.7 Conservativeness*
>
> *Use conservative assumptions, values and procedures to ensure that GHG emission reductions or removal enhancements are not over-estimated.*
>
> [Source: ISO 14064-2:2006]

4.2 Electrotechnical industry guidance

Relevance, completeness, consistency, accuracy, transparency and conservativeness as required in ISO 14064-2 are all applicable to this report.

NOTE 1 Principles provided in ISO TS 14067 are also useful.

NOTE 2 The practicability of reaching certain accuracy depends on the intended audience of each GHG reduction study.

5 Comparative study on the existing relevant documents

Annex A summarizes the results of a comparative study on relevant documents which specify the methodologies for GHG reduction including this report.

Focusing on GHG projects or project-based activities, ISO 14064-2 addresses generic principles and requirements for quantifying and reporting project performance relative to a baseline scenario. It provides the basis for GHG projects to be validated and verified.

GHG protocol for project accounting (hereinafter referred as GHG project protocol) provides specific principles, concepts, and methods for quantifying and reporting GHG reductions through projects. It presents not only requirements for quantifying and reporting GHG reductions but also additional guidance for meeting those requirements.

Those two documents focus on GHG projects and are mainly intended to be applied to verified credit (e.g. the CDM) projects. Therefore they include requirements specific to verified credit which are not necessarily relevant to a GHG reduction study for internal decision making.

ITU-T L.1410 specifies methodologies and practical guidance specific to ICT goods, networks and services (GNS) for comparative analysis based on life cycle assessment (LCA) on a target product system and a reference product system. It is composed of a framework and guidance for LCA based methodology specified in ISO 14040 and ISO 14044 [8]. Although it also addresses GHG reduction, its methodology is different from the former two documents – it is more LCA oriented than project oriented.

This report provides guidance for quantifying GHG reduction through the development and supply of EE products. Its methodology takes into account both GHG projects and LCA. But in contrast with the former two documents, this report covers a generic guidance of quantification methodologies of GHG reduction which are widely applied not only to verified credits but also to estimation for internal decision making, etc.

NOTE This report also acknowledges the activity of ITU-T for development of recommendation L.1430 [9].

6 Quantification framework

6.1 General

This report provides guidance for quantifying GHG reduction through a “product-related GHG project” from a baseline.

NOTE ISO 14064-2:2006 describes “product-related GHG projects” as follows:

> *GHG projects may also be performed as a result of product development, where the GHG emission reductions or the GHG removal enhancements mainly occur in the use stage of the product life cycle (e.g. development of an air-conditioning system with lower energy requirements for a given cooling function than the baseline product). For product-related GHG projects, life cycle assessment (LCA) may be used to calculate GHG emission reductions or GHG removal enhancements.*
>
> [Source: ISO 14064-2:2006, A.3.2.4 Product-related GHG projects]

To identify specific GHGs to be calculated, this report recommends considering relevance and international framework/studies. For example, six gases are recognized in the international framework, i.e. The Kyoto Protocol: CO_2, CH_4, N_2O, HFCs, PFCs and SF_6. For gases other than CO_2, the CO_2 equivalent (CO_2e) is obtained by multiplying each GHG emissions by the global warming potential (GWP) of those gases.

It should be documented which version of the Intergovernmental Panel on Climate Change (IPCC) Assessment Report was used for the GHG reduction study. The GHGs to be taken into account should be reviewed periodically, with future international studies, etc. taken into due consideration. For example, all the gases (more than six, e.g. NF_3) specified in the latest IPCC Assessment Report may be selected for GHG reduction study.

6.2 Basic steps of GHG reduction study

6.2.1 Provisions in existing standards

Existing standards describe "the steps" as follows:

> *Steps for accounting and reporting GHG reductions from a GHG project*
>
> – *Define GHG assessment boundary*
>
> – *Select Baseline Procedure*
>
> – *Identify Baseline Candidates*
>
> – *Estimate Baseline Emissions*
>
> – *Monitor and Quantify GHG reductions*
>
> – *Report GHG reductions*
>
> *[...]*
>
> *Baseline candidates are alternative technologies or practices, within a specified geographic area and temporal range, that could provide the same product or service as a project activity.*
>
> [Source: Summary of GHG Protocol for Project Accounting:2005 (page 27)]

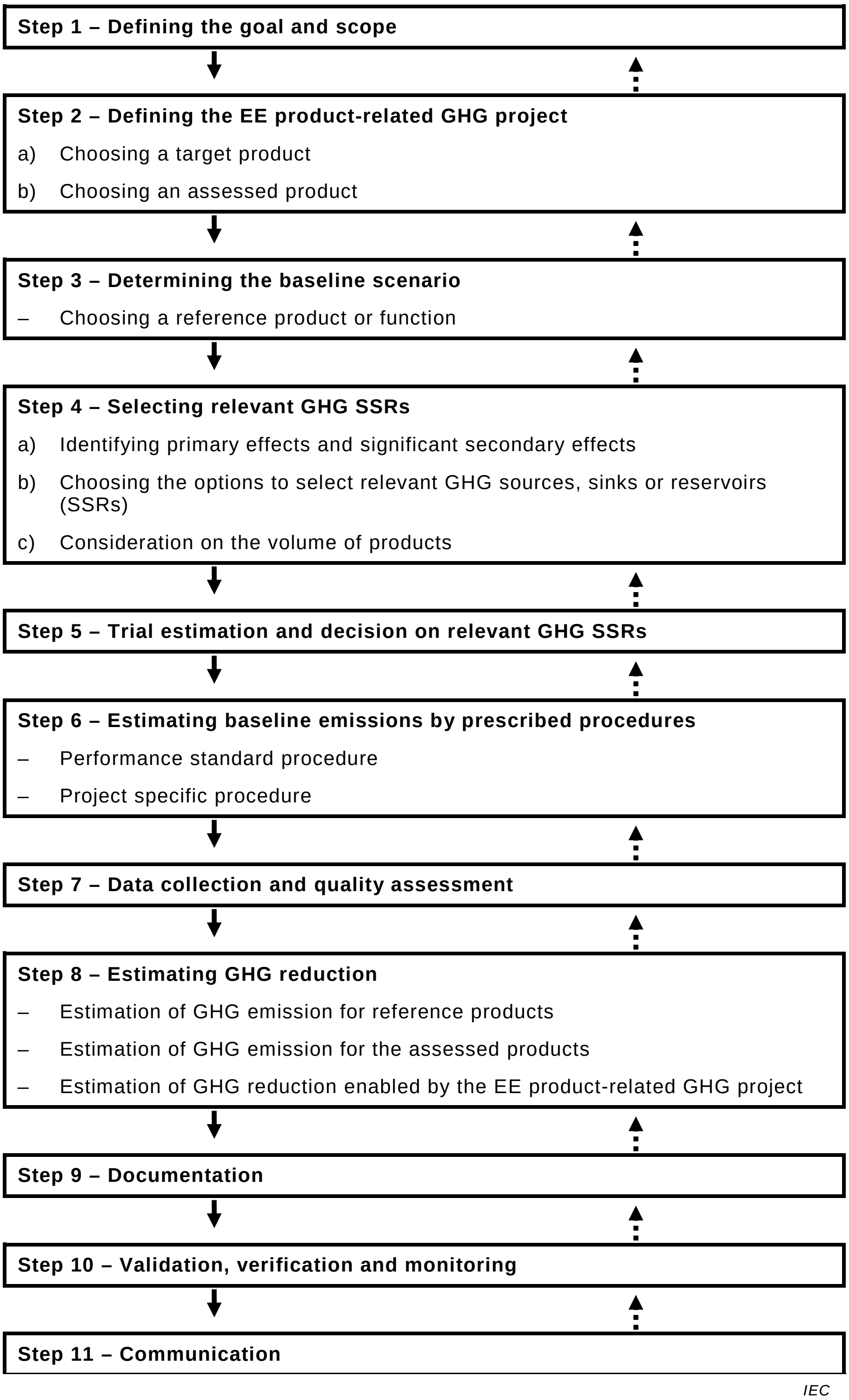
6.2.2 Electrotechnical industry guidance

The objective of carrying out a GHG reduction study is to quantify the amount of GHG reduction achieved by an EE product-related GHG project.

A workable and simple way to conduct GHG reduction study for an EE product-related GHG project is summarized into the eleven steps described in Figure 1.

Although the steps follow a sequential order, GHG reduction study is not necessarily a strictly linear process. Some iteration between the steps will usually be necessary.

Additional guidance for intermediate products is provided in selected steps where necessary.



NOTE The dotted-line arrows indicate the possibility to come back from each step to a previous one.

Figure 1 – Basic steps of GHG reduction study

6.3 Defining the goal and scope

Existing documents provide no explicit clause dedicated to “goal and scope definition.”

This report recognizes the following typical goals and scopes of the GHG reduction study:

a) estimation of GHG reduction enabled by an EE product for internal decision making;

b) disclosure of GHG reduction study results to the public (e.g. a product claim on the web page or a corporate social responsibility (CSR) report);

c) official certification and recognition of GHG reduction units (e.g. credits) for e.g. use in meeting mandatory emission targets, voluntary programs;

d) others.

For goal and scope definition, this report recommends taking into account the items listed above.

NOTE This report provides quantification guidance generally applicable to the items above. However, for item c), quantification guidance provided by this report does not necessarily fully cover it. It might need special attention to meet additional requirements as provided by existing relevant standards such as ISO 14064-2 or the GHG protocol for project accounting on additionality, validation and/or verification, monitoring, etc.

The scope of the GHG reduction study should be determined taking the key relevant considerations into account, for example:

- progress in design or technology;
- function and the feature;
- user, using/service condition and site infrastructure;
- the utility duration (normal duration of using/service time, lifetime);
- consumables, other supportive products and opportunity of maintenance;
- end of life scheme;
- assumed primary effects, i.e. specific changes in GHG emissions that an EE product-related GHG project is designed to achieve.

6.4 Defining the EE product-related GHG project

6.4.1 Electrotechnical industry guidance

EE product-related projects may be defined for activities performed as a result of the development and supply of either single unit of product or multiple unit of functionally equivalent products introduced to the market.

To define the EE product-related GHG projects, this report recommends, in accordance with the goal and scope, defining at least the following items:

- project purpose(s) and objective(s);
- project activity or activities;
- project technology, product, service and the expected level of activity;
- project location, including geographic and physical information allowing the unique identification and delineation of the specific extent of the project;
- conditions prior to project initiation (e.g. historical conditions such as GHG emissions or activity level data and market conditions such as common technology used);
- how the project will achieve GHG emission reductions and/or removal enhancements.

Especially for products, this report recommends choosing a “target product” and “assessed product” provided by the project activity.

A target product is a product which enables a GHG emissions reduction. A target product is usually designed to achieve specific changes in GHG emissions by either used alone or by integrated into other products or systems (assessed products).

Where the target product can have a range of configurations with a highly varied number of components, the organization should attempt to select a target product configuration that is representative of the product configuration typically introduced into the market appropriate for the goal, scope and boundary conditions of the study.

If there is a range of variation in assessed product configurations, energy or material use, the organization should clearly identify the specific configuration for the study.

- An assessed product is a product with which the related GHG emissions are assessed in an EE product-related GHG project. If a target product is a final product or system, it may be chosen also as an assessed product.

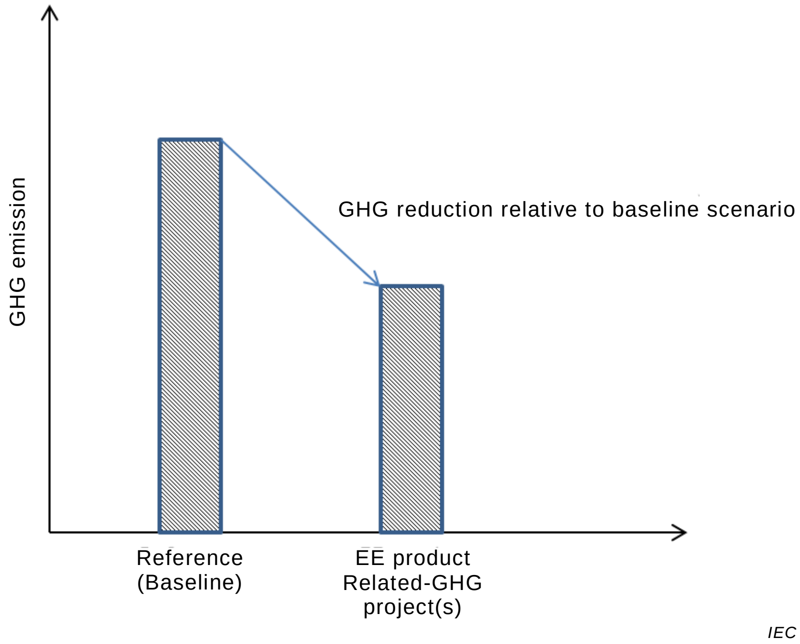


Figure 2 – Illustrated overview of GHG reductions relative to baseline scenario

Examples of criteria to choose an assessed product are including but not limited to:

- a product with high energy efficiency;
- a system with improved energy efficiency enabled by a high technology component;
- a system with low GHG emissions through a high level of efficiency utilizing advanced power grid technology (e.g. smart grid).

6.4.2 Additional guidance for intermediate products

If a target product is an intermediate product which can be included in a final product, the final product may be chosen as an assessed product, e.g. for an inverter as a target product, an air conditioner which includes it may be chosen as an assessed product.

It should be noted that there can be multiple types of final products including the intermediate products, e.g. a television (TV) set and a personal computer (PC) (two types of final products) including liquid crystal elements (intermediate products).

6.5 Determining the baseline scenario

6.5.1 Provisions in existing standards

Existing standards provide the following requirements regarding “baseline scenario”:

The project proponent shall select or establish criteria and procedures for identifying and assessing potential baseline scenarios considering the following:

a) the project description, including identified GHG sources, sinks and reservoirs (see 5.3);

b) existing and alternative project types, activities and technologies providing equivalent type and level of activity of products or services to the project;

c) data availability, reliability and limitations;

d) other relevant information concerning present or future conditions, such as legislative, technical, economic, sociocultural, environmental, geographic, site-specific and temporal assumptions or projections.

[…]

A.3.3 Identifying GHG sources, sinks and reservoirs for the project

A.3.3.1 General

[…]

To ensure an appropriate comparison of the project and baseline (to calculate GHG emission reductions and removal enhancements), the services, products or function generally include a quantitative measure, and demonstrate functional equivalence.

[Source: ISO 14064-2:2006]

The baseline scenario is a reference case for the project activity. It is a hypothetical description of what would have most likely occurred in the absence of any considerations about climate change mitigation. […] There are three generic possibilities for the baseline scenario:

- *implementation of the same technologies or practices used in the project activity;*
- *implementation of a baseline candidate; or*
- *the continuation of current activities, technologies, or practices that, where relevant, provide the same type, quality, and quantity of product or service as the project activity.*

[Source: Summary of GHG Protocol for Project Accounting:2005]

6.5.2 Electrotechnical industry guidance

GHG reductions are quantified relative to a reference level of GHG emissions. For EE product-related GHG projects, GHG reductions are quantified either based on a projected baseline scenario or on an actual project result.

Baseline candidates provide a product or function identical or similar to that of the project activity. The product or function can take many forms, depending on the type of project activity, and in some cases may not be obvious.

To ensure an appropriate comparison of the project and baseline, functional equivalence is a basic relevant idea to be taken into account and its compatibility with functional unit should be acknowledged. The functional unit characteristics should address the following questions: “What,” “how much,” “how well” and “for how long.”

NOTE 1 For example, a functional unit of paints could be “complete coverage of 1 m^2 primed outdoor wall for 10 years at 99,9 % opacity.”

However, for EE products, reconsiderations with regard to equivalence may be needed e.g. in the following cases:

- the market for the products provided by a project activity is poorly functioning or non-existent;
- a project activity is so large that the market response would not have been proportional (e.g. because the project activity is large enough to change market prices relative to the baseline scenario, causing a change in the total quantity produced).

An organization may use a product unit for defining a reference product, e.g. one unit of an old model of a specific product with justification on why functional unit is not applied in accordance with the goal and scope.

Special attention should be paid in such a case where one item of an assessed product possesses more advanced functions than the same unit of a reference product.

To determine a baseline scenario, this report recommends, in accordance with the goal and scope, the following:

- identifying the function of the assessed product;
- defining the conditions most likely to occur in the absence of a proposed EE product-related GHG project; and
- choosing a reference product or reference function which best represents the conditions

Baseline scenario should be continuously updated to reflect the natural evolution of technology and systems.

A baseline scenario should be modelled on the result of the supply and use of reference products. The duration of the study should be consistent with the typical time of technical advancement.

Consideration should be given to all feasible reference products over a range of the duration of the baseline application. However, since identifying an exhaustive list of reference products can be both costly and time consuming the balance of time and cost may be needed to identify reference products. While such trade-off is inevitable, any decisions relating to the reference products as a baseline should be transparent.

NOTE 2 Reference products may need to be reassessed from year to year to ensure that they represent the typical market.

For choosing reference products, this report recommends the following:

- define the temporal range;
- develop a list of candidates of reference products;
- adopt a reference product employed by a conservative baseline scenario.

Temporal range is an appropriate time period for the relevant baseline. The expected lifetime of the assessed product can be the temporal range. The reference product should be chosen from the products which are in the market or in use for a certain period after the introduction of the assessed products. Products which no longer exist at the timing of the introduction of the assessed products should not be chosen as the reference products.

A reference product should at least have functional compatibility with the assessed product. An organization may set further criteria to choose the reference product, in accordance with the goal and scope.

Examples of the criteria include but are not limited to:

- the exact specific system or product to be replaced by the assessed product;
- best available technology (such as the top of similar activities);
- common practices (such as common technology usage in the market), e.g. an existing product with the deepest market penetration (A product placed on the current market which is in competition with the assessed product or is expected to be replaced with the assessed product in the future);
- historical conditions (such as GHG emissions or activity level data).

Unless an EE product-related GHG project is to replace or retrofit a specific system or product (e.g. a specific fossil-fuel power station replaced with a renewable power station), a reference product may be selected as the one considered common practice or the best available technology.

NOTE 3 Common practice refers to the predominant technologies or practices in a given market, as determined by the degree to which those technologies or practices have penetrated the market. The level of penetration that represents common practice may differ between sectors and geographic areas. For example, in one area a certain technology may have a 60 % market share, while in another area it may only have a 15 % market share.

NOTE 4 An average value may be used as common practice such as a recent and regional electricity emission factor may be used as the common practice for the power consumption. Or, when reference products are similar everywhere, the latest world-average emission factors provided by the International Energy Agency (IEA) may be used.

A reference product can be based on the conservative baseline scenario if justification is provided such as the best available technology.

NOTE 5 A common practice may or may not correspond to what is legally required. However, where there is a relevant legal requirement that directly or indirectly affect GHG emissions which are enforced, an organization may use it to define a baseline candidate.

NOTE 6 The product which had once been prevalent in the market and has just been replaced with the assessed product may be chosen as a reference product. In such a case, the relationship of the assessed product and the chosen reference product should be justified.

Where there is no reference product, a reference function may be chosen. The reference function is defined in 3.23.

Examples of reference functions include but are not limited to

- “dry a pair of hands” which applies both a jet air dryer as an assessed product and wiping with paper;
- “1-terabyte storage” which applies to both a new storage device with 1-terabyte capacity as an assessed product and ten devices of 100-gigabyte storages.

6.5.3 Additional guidance for intermediate products

For an intermediate product, there can be multiple types of assessed products that are final products that include an intermediate product. Reference products should be chosen for each type of assessed product defined in accordance with the goal and scope.

6.6 Selecting relevant GHG sources, sinks and reservoirs (SSRs)

6.6.1 Identifying primary effects and significant secondary effects

6.6.1.1 Provisions in existing standards

Existing standards provide the following requirements regarding “selecting relevant GHG SSRs”:

> *The project proponent shall select or establish criteria and procedures for selecting relevant GHG sources, sinks and reservoirs for either regular monitoring or estimation.*
>
> *[Source: ISO 14064-2:2006]*

> *A project activity's total GHG reductions are quantified as the sum of its associated primary effect(s) and any significant secondary effects (which may involve decreases or countervailing increases in GHG emissions).*
>
> *[Source: Summary of GHG Protocol for Project Accounting:2005]*

6.6.1.2 Electrotechnical industry guidance

For quantification of GHG reduction of an EE product-related GHG project, it is necessary to select relevant GHG sources, sinks and reservoirs (GHG SSRs). Relevant GHG SSRs are GHG SSRs causing the primary effects and significant secondary effects of the project.

To identify GHG SSRs causing primary effects and significant secondary effects, this report recommends comparing GHG emissions from the life cycle stages of the assessed product and from the corresponding life cycle stages of the reference product. In many cases of EE product-related GHG projects, the primary effect occurs in the use stage. The life cycle stages related to an EE product can be: "material extraction and manufacturing", "distribution", "physical installation", "use" and "end of life." Some products may have a life cycle that does not include one (or more) of these stages (e.g. no physical installation phase for a mobile phone).

A primary effect is understood as a specific intended change in GHG emissions caused by the development and supply of EE products relative to a baseline scenario.

For EE product-related GHG projects, primary effects are typically related to the contribution of low-carbon or high energy-efficient technologies, or improved system operations.

Examples – EE products and primary effects contributed by them

- A product which contributes to energy saving in use stages, e.g.
  - an (energy-efficient) household refrigerator

    The primary effect is a reduction in combustion emissions from generating grid-connected electricity achieved by high energy efficiency of the refrigerator.
- A product which contributes to low carbon emission, e.g.
  - renewable energy generation (e.g. photovoltaic power generation, wind power generation)

    The primary effect is a reduction in combustion emissions from generating grid-connected electricity. (Alternative introduction of thermal power generation, operation margin)
  - electric vehicles

    The primary effect is switching from fossil fuel combustion to the charged energy through electric power grid which has lower GHG emission per mileage.

Examples – Primary effects which could be identified for an ICT service (reference to ITU-T L.1410)

- Transport and travel

- By reducing the movement of people and/or goods by using ICT service, energy consumption required for transportation can be reduced.

- Workspace environment
  - By improving office space efficiently by using ICT, energy consumption for lighting, air conditioning, etc. can be reduced.

A secondary effect is understood to be unintended changes in GHG emissions caused by the development and supply of EE products relative to a baseline scenario.

Secondary effects can be "positive" (e.g. involving a reduction in GHG emissions) or "negative" (e.g. involving an increase in GHG emissions). An example of secondary effects is unintended increases in GHG emissions associated with the acquisition of special raw materials (e.g. acquisition of rare metals) which may on the other hand enable suppression of GHG emissions at the use stage with its high energy efficiency.

Secondary effects are significant only when the unintended difference in GHG emissions between a baseline scenario and an EE product-related GHG project cannot be neglected in comparison with the primary effects in accordance with the goal and scope.

Secondary effects that are significant should be considered in the GHG reduction study.

NOTE As defined in this report, the terms "primary effects" and "secondary effects" denote intended and unintended effects, respectively. Similar terms, e.g. "first order effects," "second order effects," etc. in use in other standards denote different things and should not be confused.

To assess and quantify whether life cycle stages other than the use stage (e.g. materials, transportation, and manufacturing) are significant, this report recommends the methodology given in IEC TR 62725 [10].

6.6.2 Choosing the options to select relevant GHG SSRs

Project GHG emissions and baseline GHG emissions may be calculated based on GHG emissions from GHG SSRs in life cycle stages of the assessed product and in those of the reference product or function, respectively. This report recommends choosing one of the three options shown below to select relevant GHG SSRs and justify the appropriateness of the choice:

Option 1: GHG SSRs in the full life cycle stages of both the assessed product and the reference product or function

This option is applicable:

- For cases where the full life cycle emissions of both the reference product and assessed product can be calculated.

Option 2: GHG SSRs in the full life cycle stages of the assessed product and selected life cycle stages of the reference product or function

This option is conservative: If some life cycle stages of the reference products are excluded from the quantification, GHG emissions arising from the reference products are only partially quantified and therefore are usually underestimated. Then, the GHG emissions reduction achieved by the assessed products, which is relative to the GHG emissions of the reference products, is underestimated.

This option is applicable only if the non-selected life cycles of the reference product do not contain GHG removals. Typical cases fitted to this option are as follows:

- the emissions from some life cycle stages of the reference product are unknown or difficult to assess; or

- a reference function is chosen instead of a reference product.

Option 3: GHG SSRs in selected life cycle stages of both the assessed product which targets GHG reduction and the reference product or function

This option is applicable for cases such as

- emissions from not-selected life cycle stages of the assessed product are equal to those of the reference product and cancel out each other, or
- emissions only from not-selected life cycle stages of both of the products are deemed insignificant and justification is provided.

A unit process or a life cycle stage with only a minor contribution to the overall project may be excluded from the relevant GHG SSRs on condition that justification is provided. For example, it is often deemed that the amount of GHG emissions from production of an individual electronic component has only a minor contribution to the overall evaluation of the project, and therefore it can be ignored. For exclusion of a life cycle stage, consistent cut-off criteria should be defined with explanation, depending on the goal and scope. Cut-off criteria are usually composed of one or more elements. Any combination of the examples shown below may be used to define appropriate cut-off criteria:

Examples of cut-off criteria elements

- qualitative constraint, e.g.
  - printed circuit boards larger than 1 cm^2 shall be included.
- quantitative threshold
  - quantitative threshold for outputs, e.g.

    "less than 5 % of the total estimated emission can be excluded".
  - quantitative threshold for inputs, e.g.

    "less than 5 % of the total mass or amount input to the process map can be excluded".

NOTE 1 The examples above are adapted from IEC TR 62725.

Where an EE product-related GHG project employs multiple units of functionally equivalent assessed products, it is necessary to identify the number or the capacity of the assessed products introduced to or existing in the market.

GHG reduction can be estimated by multiplying the number or the capacity by the difference in GHG emissions between the introduced or existing assessed products and the corresponding units of the reference product or reference function.

To identify the number or the capacity of the introduced or existing products, this report recommends the following:

- number/capacity based on past actual sales

  The organization to conduct the GHG study may identify the historic data of the market size of the assessed product, e.g. the volume of shipments, the total capacity, etc. The organization may obtain such data either on its own or by processing data from public statistics.
- number/capacity based on a future forecast

  When the organization estimates GHG reduction in a certain point of time in the future, the organization may identify forecast data of the market size of the assessed product, e.g. forecast sales of the product. In this case, this report recommends keeping transparency and reliability of the data in such a way that referring to forecasts from multiple independent sources or from publicly authorized sources.

When a reference function is selected for a baseline scenario, the number of the product should be determined based on the equivalent function (e.g. a 1 Gb storage device vs. ten devices of 100 Mb storage).

NOTE 2 Volume of products needs to be used carefully. Conservative assumption and/or monitoring is useful to ensure that GHG reductions are not overestimated (For “monitoring”, see 8.2).

6.6.3 Additional guidance for intermediate products

If a target product is an intermediate product which is different from an assessed product, the volume of the target products is not always the same as that of the assessed products. For example, if the target product is a semiconductor and the assessed product is a PC, one unit of the assessed product can include multiple units of target products. Therefore, attention should be paid to see that the volume of assessed products is used for quantification.

6.7 Trial estimation and decision on relevant GHG SSRs

Trial estimation provides information for the selecting of relevant GHG SSRs (i.e. confirms the significance of assumed primary effects and selected secondary effects) as well as the workability and availability of the process data necessary to quantify those effects. For example, in order to check the appropriateness of the GHG SSRs selected, a rough estimate is needed of the life cycle emissions of both the reference product and assessed product.

This report highlights the importance of first estimating tangible, quantifiable energy and material reductions associated with the reduction project before assessing the GHG reductions.

This report recommends first estimating the reductions in energy use and material using quantifiable measurements before applying the more varied GHG emissions factors. This will enable an organization to clearly define the material's direct reductions of the particular project, before applying the GHG emissions factors which will be highly dependent on the geographic location, the material source and other variables. This concern is specific to EE product-related GHG projects where use and locations scenarios can result in ranges of GHG emissions of one or two orders of magnitude.

For approach of trial estimation, this report recommends the guidance provided by 6.5 of IEC TR 62725:2013.

6.8 Estimating baseline emissions

6.8.1 Baseline procedures

6.8.1.1 General

GHG reductions from a project activity are quantified relative to baseline emissions, which refer broadly to baseline GHG emissions, removals or storage. Baseline procedures are methods used to estimate baseline emissions.

6.8.1.2 Provisions in existing standards

Existing standards provide the following requirements regarding “baseline emissions” and “baseline procedures”:

The project proponent shall select or establish, explain and apply criteria and procedures for identifying and justifying the baseline scenario.

NOTE A baseline scenario determined using a project-specific approach represents what would occur in the absence of the project, whereas a GHG programme can prescribe another approach to determine the baseline scenario, such as a performance standard (e.g. benchmark or multi-project) baseline scenario.

[Source: ISO 14064-2:2006]

Baseline procedures are methods used to estimate baseline emissions. The Project Protocol describes two procedures:

– *Project specific procedures*
– *Performance Standard procedures*

[Source: Summary of GHG Protocol for Project Accounting:2005]

ISO 14064-2 does not prescribe criteria and procedures in themselves, but it does require the project proponent of selecting or establishing criteria and procedures for identifying and estimating potential baseline emissions.

6.8.1.3 Electrotechnical industry guidance

For EE products, particularly complex products or systems with tens or hundreds of components and possible configurations, values for energy use, energy reduction and GHG reduction of the baseline and improved scenario will be heavily dependent on the product configuration chosen, the conditions of use and the emissions associated with a location specific energy source.

This report recommends the following actions:

- clearly define the chosen product configuration and assumptions regarding use phase conditions, and geographic location;
- identify the range of possible values for a "relevant consideration" to clearly detail the range of variation that is possible in the analysis for the given product type and the possible conditions and locations of use;
- for procedures to estimate baseline emissions, use one of two common types: a performance standard procedure or project-specific procedure.

6.8.2 Performance standard procedure

6.8.2.1 Provisions in existing standards

Existing standards specify "performance standard procedure" as follows:

Performance standard procedure—This procedure produces an estimate of baseline emissions using a GHG emission rate derived from a numerical analysis of the GHG emission rates of all baseline candidates. A performance standard is sometimes referred to as a multi-project baseline or benchmark, because it can be used to estimate baseline emissions for multiple project activities of the same type. It serves the same function as a baseline scenario, but avoids the need to identify an explicit baseline scenario for each project activity.

[Source: GHG Protocol for Project Accounting 2.10 Baseline Procedures]

The performance standard is used to determine baseline emissions for the project activity's primary effect. Once a performance standard is developed, any number of similar project activities may be compared to it. The GHG emission rate for a performance standard can be expressed in different ways, depending on the type of project activity involved. For energy efficiency, energy generation, and industrial process project activities, a GHG performance standard will generally be defined as a rate of GHG emissions per unit of a product or service produced by all the baseline candidates.

GHG protocol specifies the steps which shall be followed to derive a performance standard procedure:

– *Specify appropriate performance metrics for all baseline candidates;*
– *Calculate the GHG emission rate for each baseline candidate;*
– *Calculate GHG emission rates for different stringency levels;*
– *Select an appropriate stringency level for the performance standard;*
– *Estimate baseline emissions*

[Source: Summary of GHG Protocol for Project Accounting:2005]

6.8.2.2 Electrotechnical industry guidance

In the performance standard procedure, the performance metrics and the reference value are used to determine baseline emissions for the project activity's primary effect. This procedure is useful when the project introduces the same kind but improved technologies, e.g. a project like retrofit of an existing facility.

The GHG emission rate for a reference performance value can be expressed in different ways. For EE products, energy efficiency, energy generation and industrial process project activities are generally relevant. In such cases, a GHG performance reference value may be defined as a rate of GHG emission per unit of a product or unit of a service produced by the baseline.

The performance reference value can be determined from the average data of the product or given by a specific program for which the organization applies.

In general, options to determine the average energy efficiency include

- average efficiency of all the products existing in the market at a certain point of time, or
- average efficiency of the products introduced to the market within a certain period of time.

6.8.3 Project-specific procedure

6.8.3.1 Provisions in existing standards

Existing standards specify "project-specific procedure" as follows:

Project-specific procedure—This procedure produces an estimate of baseline emissions through the identification of a baseline scenario specific to the proposed project activity. The baseline scenario is identified through a structured analysis of the project activity and its alternatives. Baseline emissions are derived from the baseline scenario and are valid only for the project activity being examined.

[Source: GHG Protocol for Project Accounting 2.10 Baseline Procedures]

The project-specific procedure produces an estimate of baseline emissions for a project activity's primary effect through the identification of a baseline scenario linked to the specific circumstances surrounding the project activity.

GHG protocol specifies the steps which shall be followed to derive a project-specific procedure:

- *Perform a comparative assessment of barriers;*
- *Identify and justify the baseline scenario (Use assumptions, calculations, and emission factors specific to the identified baseline scenario);*
- *Estimate baseline emissions*

Broadly speaking, there are three types of possible alternatives for a baseline scenario:

- *The baseline scenario involves implementation of the same technologies or practices involved in the project activity;*
- *The baseline scenario involves the configuration, deployment, implementation, operation, and decommissioning of new technologies or practices;*
- *The baseline scenario involves the continuation of current activities that, where relevant, provide the same type, quality, and quantity of product(s) or service(s) as the project activity.*

The "continuation of current activities" can be thought of as the "do nothing" alternative. It will mean slightly different things depending on the type of project activity.

Examples include:

- *Provision of grid-connected electricity from existing power plants, where the project activity involves construction of new generation equipment that would displace grid-connected electricity.*

[Source: Summary of GHG Protocol for Project Accounting:2005]

6.8.3.2 Electrotechnical industry guidance

The project-specific procedure develops an estimate of baseline emissions for a project activity's primary effect through the identification of a baseline scenario associated with such circumstances where the project introduces alternative technologies which are totally different from the conventional ones and therefore there is no reference product with comparable performance.

In the EE sector, a project-specific procedure is applicable such as the introduction of renewable energy generation replacing fossil fuel combustion or information and communications technologies (ICT) services replacing human activities.

A baseline could be the conventional types of technologies or practices (e.g. a diffused technology or product in the market). They should be more carefully defined and explained than in the case of the performance standard procedure since largely different types of technologies are compared.

NOTE Carbon offsets may incentivise greater production, so baseline emissions are capped according to historical production levels. Baseline emissions correlate with production, but the emissions rate depends on a fuel mix of avoided grid generation.

6.8.4 Additionality

6.8.4.1 Provisions in existing standards

Existing standards describe “additionality” as follows:

This part of ISO 14064 deals with the concept of additionality by requiring that the GHG project has resulted in GHG emission reductions or removal enhancements in addition to what would have happened in the absence of that project. It does not use the term “additionality”, prescribe baseline procedures or specify additionality criteria. This part of ISO 14064 requires the project proponent to identify and select GHG sources, sinks and reservoirs relevant for the GHG project and for the baseline scenario. In order to be compatible with the broadest range of GHG programmes, it does not use the term “boundaries” to describe which GHG sources, sinks and/or reservoirs are considered for quantification, monitoring and reporting, but instead uses the concept of relevant GHG sources, sinks and/or reservoirs. Thus the project proponent may apply additionality criteria

and procedures, or define and use boundaries consistent with relevant legislation, policy, GHG programmes and good practice.

[Source: Summary of ISO 14064-2:2006]

3.1 Additionality:

Setting the stringency of additionality rules involves a balancing act. Additionality criteria that are too lenient and grant recognition for “non-additional” GHG reductions will undermine the GHG program’s effectiveness. On the other hand, making the criteria for additionality too stringent could unnecessarily limit the number of recognized GHG reductions, in some cases excluding project activities that are truly additional and highly desirable.
In practice, no approach to additionality can completely avoid these kinds of errors. Generally, reducing one type of error will result in an increase of the other. Ultimately, there is no technically correct level of stringency for additionality rules. GHG programs may decide based on their policy objectives that it is better to avoid one type of error than the other.

NOTE A determination of additionality is implicit in this procedure in the sense that if the identified baseline scenario is not the project activity, the project activity will be additional.

[Source: GHG Protocol for Project Accounting:2005]

ISO 14064-2 does not explicitly use the term “additionality.” GHG protocol does not require a demonstration of “additionality” *per se* but claims to incorporate "additionality" as an implicit part of the procedures used to estimate baseline emissions.

6.8.4.2 Electrotechnical industry guidance

The concept of “additionality” is often raised as a vital consideration for quantifying project-based GHG reductions. Additionality means that the claimed amount of GHG emission reduction is solely accounted for the project and would not have happened without it. While there is general understanding that additionality is important, its meaning and application remain open to interpretation. While the basic concept of additionality may be easy to understand, there is no common agreement about how to prove that a project activity and its baseline scenario are different. Distinguishing a project activity from its baseline scenario is often referred to as determining additionality.

Except for application to certification and recognition of GHG reduction units, a requirement specific to additionality is generally not necessarily applied to a GHG reduction study.

Additionality is explained e.g. by describing at least one of the following barriers:

- investment barrier;
- technological barrier;
- barrier due to prevailing practice (common practice);
- other barriers (e.g. institutional limitations, lack of information, lack of management resources, lack of organizational capacity)

6.9 Data collection and quality assessment

6.9.1 Data collection

Data collection is needed for the unit processes with primary and secondary effects identified during the definition of relevant GHG SSRs. GHG emissions per life cycle stage/unit process can be quantified by multiplying activity data by emission factors, or by direct measurement. Any of them may be used according to the goal and scope.

NOTE 1 This report basically follows the direction provided by the GHG Protocol, Product Life Cycle Accounting and Reporting Standard:2011 [12] to collect “primary data” and “secondary data”:

> *primary data*
>
> – *data collected from specific processes in the studied product’s life cycle*
>
> *secondary data*
>
> – *process data that are not from specific processes in the studied product’s life cycle*
>
> *[Source: GHG Protocol Product Life Cycle Accounting and Reporting Standard:2011]*

For all the processes under the ownership or control of the organization which performs GHG reduction study, primary data should be collected where economically and technically feasible.

NOTE 2 This process may be challenging for some small and medium enterprises (SMEs), or other organizations when there is a lack of dedicated research units and resources.

The organization may use secondary data from the process data that are not from specific processes in the product’s life cycle, for example:

- data from external sources (e.g. life cycle databases, industry associations, etc.);
- data from another and similar process or activity in the organization’s or supplier’s control.

Especially when the data are too difficult to obtain, the primary data may be replaced with available “conservative” data which tend to overestimate GHG emissions from the project or to underestimate GHG emissions from a baseline scenario. An example of conservative data is a relatively high energy efficiency indicator used for the reference product.

For further electrotechnical industry guidance on data collection, this report recommends the guidance provided in 6.6 of IEC TR 62725:2013.

6.9.2 Data quality

6.9.2.1 Provisions in existing standards

Existing standards provide the following requirements regarding “data management and data quality”:

The project proponent shall establish and apply quality management procedures to manage data and information, including the assessment of uncertainty, relevant to the project and baseline scenario.

The project proponent should reduce, as far as is practical, uncertainties related to the quantification of GHG emission reductions or removal enhancements.

[Source: ISO 14064-2:2006]

Project data quality can be improved by

- *establishing and maintaining a complete GHG information system,*
- *completing regular accuracy checks for technical errors,*
- *conducting periodic internal audits and technical reviews,*
- *appropriate training for project team members, and*
- *performing uncertainty assessments.*

An uncertainty assessment can involve either a qualitative (e.g. high, medium, low) or quantitative procedure and typically is less rigorous than an uncertainty analysis, which is a statistically detailed quantitative and systematic procedure to ascertain and quantify uncertainty. Generally, an uncertainty assessment is appropriate during the planning phase of a project, and an uncertainty analysis during the implementation phase. It is up to programme proponents to decide and stipulate whether an uncertainty analysis is appropriate for implemented projects. For those using this part of ISO 14064 outside of a programme, an uncertainty analysis is recommended for implemented quantifications.

[Source: ISO 14064-2:2006, A.3.6 "Managing data quality"]

6.9.2.2 Electrotechnical industry guidance

This report provides guidance for assessing relevance of collected data associated with each process's primary and secondary effects, to fill data gaps and to continuously improve data quality.

During a GHG reduction study, an organization may identify data gaps. Data gaps exist when there are no primary or secondary data that are sufficiently representative of the given process in the product’s life cycle. Where necessary, data gaps can be filled with proxy or estimated data. How the proxy data was generated or estimated should be clearly explained and documented.

The data collection process may be improved by integrating it within existing management systems if available, e.g. environmental management system (EMS), quality management system (QMS), etc.

In general terms, uncertainties associated with GHG reductions can be categorized into “scientific uncertainty” and “estimation uncertainty”. Scientific uncertainty arises when the science of the actual emissions and/or removal processes is not completely understood. Estimation uncertainty arises any time GHG emissions are monitored and quantified and can be further divided into “model uncertainty” and “parameter uncertainty”.

For further electrotechnical industry guidance of uncertainty, this report recommends monitoring (see 8.2) or the guidance provided in 6.8 of IEC TR 62725:2013.

Where data and assumptions are uncertain, and where the cost of measures to reduce uncertainty is not worth the increase in accuracy, conservative values and assumptions should be used. Conservative values and assumptions are those that are more likely to underestimate than overestimate GHG reductions.

It is important to check the boundary and life cycle stages when using secondary data. For example, if secondary data cover recycled material GHG reduction and another does not, they are not used in the same manner.

NOTE For details for increase in accuracy, see 8.2 “Monitoring”.

6.10 Estimating GHG reduction

6.10.1 Provisions in existing standards

Existing standards provide the following requirements regarding “estimation of GHG reduction”:

The project proponent shall

- *Select or establish criteria, procedures and/or methodologies*
- *Quantify GHG emissions and/or removals separately for*
  - *a) each relevant GHG SSRs for the project, and*
  - *b) each relevant GHG SSRs for the baseline scenario.*
- *Estimate GHG emissions and/or removals by GHG SSRs relevant for the project and relevant for the baseline scenario.*

[Source: Summary of ISO 14064-2:2006]

The GHG protocol for project accounting does not provide a detailed description on estimation of GHG reduction.

6.10.2 Electrotechnical industry guidance

This report recommends estimating GHG reduction based on the relevant GHG SSRs chosen in step 4 in Figure 1“Selecting relevant GHG SSRs” (see 6.6) and on the procedure to estimate baseline emissions chosen in step 6 in Figure 1 (see 6.8). GHG reduction can be understood as a difference between the following two items:

- estimation of GHG emissions based on the baseline scenario,
- estimation of GHG emissions based on the EE product-related GHG project.

This report recommends estimating GHG reductions by year and then accumulating them into an overall GHG reduction by the project.

GHG reduction per unit in a specific year is quantified according to the formula given below:

$$R_i(y) = B_i(y) - P_i(y)$$

where

$R_i(y)$ is the GHG reduction per unit of an assessed product i in year y;

$B_i(y)$ is the baseline relevant GHG emissions per unit of the reference product/function corresponding to the assessed product i in year y;

$P_i(y)$ is the relevant GHG emissions per unit of the assessed product i in year y.

In general, GHG reduction per unit a year is accumulated to the overall emissions reduction of the project by the following formula:

Emission reduction of the project in year $y = n_1{*}R_1(y) + n_2{*}R_2(y) + \dots + n_t{*}R_t\,(y)$.

Where n_i refers to the number or the capacity of the assessed product introduced to or existing in the market in year y.

For complex EE products or systems, it is recommended identifying the savings in energy use and raw material reductions measured by mass prior to the application of any emission factors or GWP. This will prevent obfuscation of the benefits through biased selection of GHG factors.

6.10.3 Accumulation method

For accumulating GHG reduction per year, this report identifies two options:

- accumulation based on products' lifetime GHG emissions reduction:

  Under this option, GHG reduction by year is estimated by multiplying the number of assessed products sold in the year by the lifetime GHG emissions reduction per unit of the assessed product. The overall emissions reduction of the project is then estimated by applying the following values to the formula given in 6.10.2:

  $n_i(y)$ = the number/capacity of the assessed product i sold in year y;

  $R_i(y)$ = all lifetime GHG emissions reduction per unit of assessed product i sold in year y.

  The lifetime of the products should be based on the design specification prepared by the organization, published technical information as a legal standard, a PCR, a sector-specific standard, etc.

  NOTE Data from a customer or consumer questionnaire may also be useful.

- accumulation based on products' annual GHG emissions reduction:

  Under this option, GHG reduction by year is estimated by multiplying the number or capacity of assessed products existing in a year by the one-year GHG emissions reduction per unit of the assessed product. Then the overall emissions reduction of the project is estimated applying the following values to the formula given in 6.10.2:

  $n_i(y)$ = The number/capacity of the assessed product i operating in year y;

  $R_i(y)$ = One-year GHG emissions reduction per unit of assessed product i in year y.

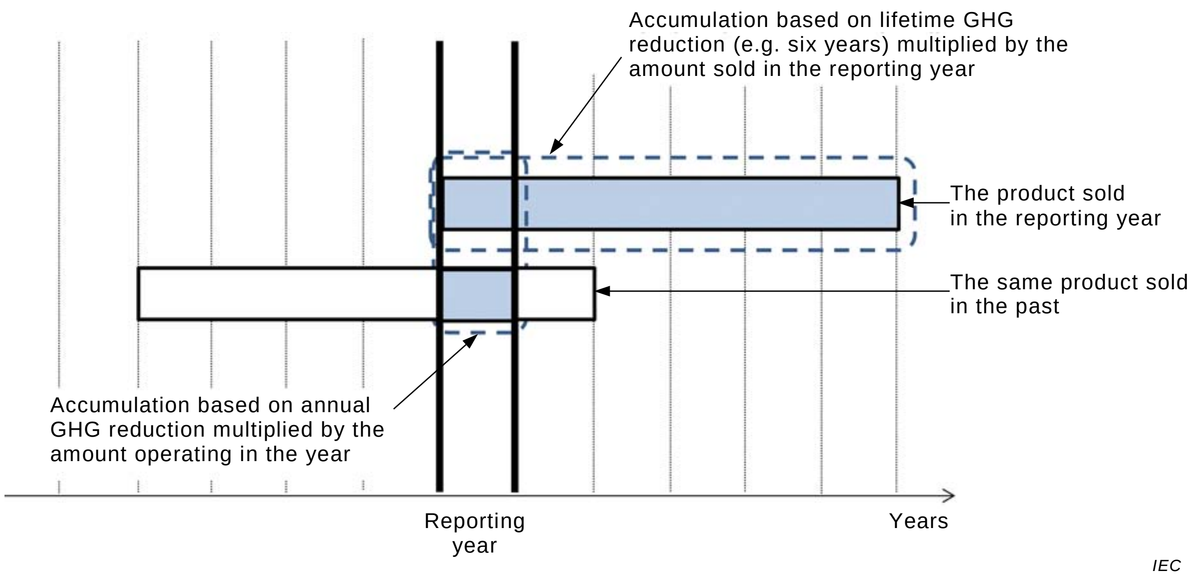


Figure 3 – Two options for accumulation

It is recommended using either of the options consistently within a GHG reduction study.

7 Documentation

7.1 Provisions in existing standards

Existing standards describe “documentation” as follows:

> *This part of ISO 14064 refers to documenting in the context of internal needs linked to auditing and validation and/or verification. It is a complement to reporting that should serve external purposes.*
>
> *Documentation is linked to the GHG information system and information system controls of the GHG projects, as well as to the GHG data and information of the GHG projects. Documentation should be complete and transparent.*
>
> *[Source: ISO 14064-2:2006, A.3.8 "Documenting the GHG projects"]*

GHG protocol for project accounting does not address documentation but prescribes minimum requirements for reporting the quantification of GHG reductions in a manner that is transparent and allows for evaluation by interested parties.

7.2 Electrotechnical industry guidance

In regards to documentation, attention should be given to recording and maintaining data from a GHG reduction study in a format that will support the analysis, validation and/or verification, monitoring, and communications of the results. For this, this report recommends the following:

- document procedures, methodologies, assumptions, evidences of all data, etc., for each step of GHG reduction study;
- compile the calculation results as a record, including at least the items required in the standards with which the calculation is intended to be compliant.

When a management system exists in an organization, the principles found in that management system may be used as guidance for addressing data traceability and evidence management, as long as those principles comply with international GHG management, GHG project, or CFP and LCA standards.

For further electrotechnical industry guidance of documentation, this report recommends the guidance provided in Clause 8 of IEC TR 62725:2013.

8 Validation, verification and monitoring

8.1 Validation and/or verification

8.1.1 Provisions in existing standards

Existing standards provide the following requirements regarding "validation and/or verification":

> *The project proponent should have the GHG project validated and/or verified.*
>
> *If the project proponent requests validation and/or verification of the GHG project, a GHG assertion shall be presented by the project proponent to the validator or verifier.*
>
> *The project proponent should ensure that the validation or verification conforms to the principles and requirements of ISO 14064-3: Specification with guidance for the validation and verification of GHG assertions.*
>
> *[Source: ISO 14064-2:2006]*

A GHG project protocol does not address verification, and prescribes minimum requirements for reporting the quantification of GHG reductions in a manner that is transparent and allows for evaluation by interested parties.

8.1.2 Electrotechnical industry guidance

This report recommends that the organization, at a minimum, performs an independent first party verification or assurance.

First-party verification can be more affordable than a third-party one for EE products because they usually have a long and complex supply chain and processes. For this, this report recommends the following:

- assign personnel in the organization, who are engaged in a business or a product other than the business or the product studied;
- have the personnel verify the logic of calculation, traceability of the data used for calculation, and, conformity to the standard(s) with which the calculation is intended to be compliant.

For further credibility of first-party verification, requirements in ISO 14064-3 [11] should be taken into account.

Third-party verification can increase credibility of a GHG reduction study and is usually required especially for certification and recognition of GHG reduction units.

8.2 Monitoring

8.2.1 Provisions in existing standards

Existing standards describe "monitoring procedures and monitoring plan" as follows:

Monitoring procedures may include schedules, roles and responsibilities, equipment, resources, and methodologies to obtain, estimate, measure, calculate, compile and record GHG data and information for the project and baseline scenario.

[Source: ISO 14064-2:2006]

A monitoring plan is a working document that describes procedures for collecting data on project activity emissions, for collecting data related to baseline emission estimates, and for ensuring and controlling the quality of the collected data.

Every time GHG reductions are quantified and reported, the project developer should check:

a) The accuracy, completeness, and consistency of all monitored data.

b) The validity of any assumptions made during the project development phase regarding baseline emissions and project activity emissions. This requires analyzing collected data to verify that:

- *each project activity has been implemented and is performing as expected; and*
- *any parameter values used to estimate the baseline emissions continue to be valid.*

Monitoring should always be conducted in a way that allows a complete and transparent quantification of GHG reductions. In general, project developers should follow the GHG Accounting Principles.

[Source: Summary of GHG Protocol for Project Accounting:2005]

8.2.2 Electrotechnical industry guidance

Monitoring is the process of collecting the data used to quantify GHG reductions measured continuously or periodically, and to validate assumptions underlying the quantification.

Except for application for certification and recognition of GHG reduction units, an organization is usually not required to perform continuous or periodic monitoring, provided that conservative values and assumptions are used and clearly stated. However, to increase accuracy, monitoring is still useful.

For monitoring, this report recommends the following:

- select monitoring parameters and monitoring methods;
- develop a monitoring plan;
- implement monitoring.

Monitoring parameters to be selected are usually key ones used to estimate GHG reduction of an EE-product-related GHG project (see 6.8). For example, if the project is to introduce a high-efficiency home appliance, the energy efficiency rate can be a monitoring parameter.

Examples of monitoring methods include:

- method based on the actual measurement using metering instruments (data used: measured values);
- method based on the amount of transaction which is measured directly using metering instruments (data used: commercial evidence such as invoices);

- method based on public data which is measured by entities other than the organization (data used: publicly recognized data such as statistical data and specifications);
- method based on catalogue values (data used: values in design specification);
- other method.

A monitoring point shows the position where the activity data is collected. In selecting a monitoring point, an organization needs to select the most suitable position in order to collect the accurate data. Normally, the monitoring point corresponds to the position of the metering instrument. For example, when the amount of transaction is used to collect activity data, the receiving inlet of fuel at the factory or the place of business operations such as a fuel tank serves as monitoring point. In addition, it is not always necessary for the source to correspond to the monitoring point in a one-to-one manner. It is possible to monitor the activity data of two or more sources at a point. It is also possible to monitor the activity data of one source at two or more points.

If there are multiple sources (e.g. assessed products are mass-produced home appliances) and the measurements are expensive once a technician is on-site, monitoring methods may be implemented based on sampling approaches. The most common types of sampling approaches are

- simple random sampling,
- systematic sampling,
- stratified random sampling,
- multi-stage sampling,
- cluster sampling.

For example, multi-stage sampling is applicable to such a case: A study of efficient lighting might first draw a sample of buildings, and then take a sample of lighting fixtures in each selected building. If the characteristics of the fixtures in a given building are very similar and the costs of measuring them is relatively high, then taking a sample of fixtures may be sufficient to achieve a target level of precision at lower cost.

For sample size, in terms of statistics it is calculated based on standard deviation and standard errors, assuming that the population has normal distribution. For statistical estimation, a 90 % confidence interval and a 10 % allowable error are usually used.

For a monitoring plan, it should describe the following for each monitoring parameter:

- definition;
- unit;
- specific values used to estimate GHG reduction;
- monitoring method;
- recording frequency;
- recording means of data;
- storage life of data.

If monitoring is based on sampling, a monitoring plan should additionally include

- target population,
- sampling framework,
- sampling approach applied,
- samples size and the calculation formula,
- procedures to collect and manage data and to treat non-respondents,

- monitoring period; and
- estimation of population parameters.

An organization may implement monitoring in accordance with a monitoring plan and record its results along with the responsible person. If metering instruments are used, an organization should adopt ones properly calibrated and qualified according to corresponding common practices, national laws or regulations of the host country where the project is undertaken, or guaranteed by their manufacturers.

NOTE For an example of details of monitoring based on systematic sampling approach, see Annex C.

9 Communication

9.1 Provisions in existing standards

Existing standards describe "communication" as follows:

Reporting keeps intended users informed about the GHG project. The content and form of the information reported should be tailored to the needs and expectations of the intended user. […]

This part of ISO 14064 does not require the project proponent to make a GHG report available to the public unless a public GHG assertion or claim is made about the conformance of the GHG project to this part of ISO 14064. In such cases, minimum elements for GHG reports ensure completeness, accuracy and transparency in the public reporting of project information. The information released to the public should allow for fair comparison between various projects.

A high degree of transparency and opportunity for public comment can greatly increase the credibility of a project and is important for the market to assess the value of credits. Moreover, making project information public is necessary in order to obtain stakeholder comments for use in project development and management. Project proponents may also use public reports for publicity purposes.

5.13 Reporting the GHG project

The project proponent shall prepare and make available to intended users a GHG report. The GHG report

shall identify the intended use and intended user of the GHG report, and

shall use a format and include content consistent with the needs of the intended user.

If the project proponent makes a GHG assertion to the public claiming conformance to this part of ISO 14064, the project proponent shall make the following available to the public:

a) an independent third-party validation or verification statement, prepared in accordance with ISO 14064-3,

or

b) a GHG report that includes as a minimum:

   1) the name of the project proponent;

   2) the GHG programme(s) to which the GHG project subscribes;

   3) a list of GHG assertions, including a statement of GHG emission reductions and removal enhancements stated in tonnes of CO_2e;

   4) a statement describing whether the GHG assertion has been validated or verified, including the type of validation or verification and level of assurance achieved;

   5) a brief description of the GHG project, including size, location, duration and types of *activities;*

6) *a statement of the aggregate GHG emissions and/or removals by GHG sources, sinks and reservoirs for the GHG project that are controlled by the project proponent, stated in tonnes of CO_2e, for the relevant time period (e.g. annual, cumulative to date, total);*

7) *a statement of the aggregate GHG emissions and/or removals by GHG sources, sinks and reservoirs for the baseline scenario, stated in tonnes of CO_2e for the relevant time period;*

8) *a description of the baseline scenario and demonstration that the GHG emission reductions or removal enhancements are additional to what would have happened in the absence of the project;*

9) *as applicable, an assessment of permanence;*

10) *a general description of the criteria, procedures or good practice guidance used as a basis for the calculation of project GHG emission reductions and removal enhancements;*

11) *the date of the report and time period covered.*

[Source: ISO 14064-2:2006, A.3.10.1 "Reporting the GHG project – General"]

A GHG protocol for project accounting addresses minimum requirements for reporting the quantification of GHG reductions in a manner that is transparent and allows for evaluation by interested parties.

9.2 Electrotechnical industry guidance

To avoid misleading the audience, uncertainty needs to be clearly assessed and checked to ascertain whether it is smaller than the amount of the GHG reduction. Requirements given in 6.8 of IEC TR 62725:2013 and 5.13 of ISO 14064-2:2006 should be taken into account.

NOTE Allocation between the final products and the intermediate products is not covered by this report. The allocation determining the quota between the final products and the intermediate products can be performed based on the results of the GHG reduction study.

Annex A
(informative)

Study results of comparison analysis on selected existing relevant documents including International Standards

Methodological elements		ISO 14064-2	GHG Protocol for Project Accounting	ITU-T L.1410	IEC TR 62726
Relevant application		Verified credit (implicit)	Verified credit (implicit)	Comparative assertion/ Comparative analysis	– estimation of GHG reduction for internal decision making; – disclosing GHG reduction study results to the public (e.g. a product claim on the web page or a CSR report); – certification and recognition of GHG reduction units (e.g. credit); – others
Methodological foundation	Scope	Project level	Project level	Product (ICT goods, networks and services)	EE product-related GHG projects
	Basic idea to quantify reduction	Emissions reduction = [Baseline emissions] − [Project emissions]	Emissions reduction = [Baseline emissions] − [Project emissions]	Emissions reduction = [Reference product system's LCA results] − [Target ICT GNS's LCA results]	Emissions reduction = [Baseline emissions] − [Project emissions]
	Reference of existing standard/ methodology	ISO 14064-1 and ISO 14064-3 (and other initiative , e.g. Kyoto mechanism − CDM)	ISO 14064 series and GHG Protocol Corporate Standard	ISO 14040/ISO 14044	ISO 14064-2 and GHG Project Protocol
	Life cycle thinking	For product-related GHG projects, LCA may be used to calculate GHG emission reductions or GHG removal enhancements	No requirement for a complete LCA when considering secondary effects	Requirements for LCA against both ICT GNS systems and reference product system separately before comparison. Addressing full life cycle	For product-related GHG projects, LCA may be used to calculate GHG emission reductions or GHG removal enhancements

Methodological elements	ISO 14064-2	GHG Protocol for Project Accounting	ITU-T L.1410	IEC TR 62726
Implementing procedure	Steps for implementation (two-phases): planning phase – describes the project, – identifies and selects GHG sources, sinks and reservoirs (SSRs) relevant for the project, – determines the baseline scenario, and – develops procedures to quantify, monitor and report GHG emissions, removals, emission reductions and removal enhancements. implementation phase – specifies requirements for the selection and application of criteria and procedures for regular data quality management, monitoring, quantification and reporting of GHG emissions, removals, emission reductions and removal enhancements. user is encouraged to consider all requirements holistically and iteratively rather than a linear stepwise approach	Steps for accounting and reporting GHG reductions: – define GHG assessment boundary – select baseline procedure – identify baseline candidates – estimate baseline emissions – monitor and quantify GHG reductions – report GHG reductions	Comparisons between systems (comparative analysis) – the assessment procedure contains several steps: – definition of goal, functional unit and scenarios; – definition of system boundaries for each product system; – life cycle inventory including data collection for each product system; – life cycle impact assessment for each product system; – life cycle interpretation including comparison	Introduces basic eleven steps: – defining the goal and scope – determining the baseline scenario – selecting relevant GHG SSRs – trial estimation and decision on relevant GHG SSRs – estimating baseline emissions – data collection and quality assessment – estimating GHG reduction – documentation – validation, verification and monitoring – communication

Methodological elements		ISO 14064-2	GHG Protocol for Project Accounting	ITU-T L.1410	IEC TR 62726
Identify the relevant GHG SSRs		Requirement for including relevant GHG SSRs: – controlled GHG SSRs – related GHG SSRs – affected GHG SSRs	Requirement for including primary effects and significant secondary effects: – primary effects – secondary effects – secondary effects consists of – one-time effects – upstream and downstream effects – upstream and downstream effects includes “upstream and downstream effects involving market responses”	Requirement for: – being consistent the goal of the study; – considering 8 major activities for both boundaries of ● ICT GNS systems and ● reference product system. – ICT hardware – ICT software – consumables and other supportive products – site infrastructure – transports (movement of goods) – travel(movement of people) – storage of goods – working environment	Recommendation for including all the primary effects and all the significant secondary effects. Recommends choosing one of the three options shown below to select relevant GHG SSRs: – the full life cycle stages of both the assessed product and the reference product – the full life cycle stages of the assessed product and selected relevant life cycle stages of the reference product – selected relevant life cycle stages of both the assessed product which targets GHG reduction and the reference product
Baseline setting	Additionality	ISO 14064-2 deals with the concept of “additionality” by requiring that the GHG project has resulted in GHG emission reductions or removal enhancements in addition to what would have happened in the absence of that project. – does not use the term “additionality”, prescribes baseline procedures or specify additionality criteria	No requirement (implicit) – does not require a demonstration of “additionality” per se. – however, additionality is incorporated as an implicit part of the procedures used to estimate baseline emissions	Technical guidance and information only	Technical guidance and information only
	Estimating baseline – procedure for estimation	– project-specific approach – performance standard approach	– project-specific procedure – performance standard procedure	Examples of reference product system as the baseline scenario	– project-specific procedure – performance standard procedure

Annex B
(informative)

Examples of GHG reduction study

B.1 General

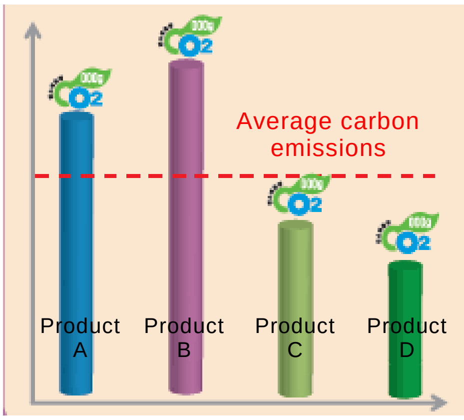
Annex B includes an example of GHG reduction studies for specific types of EE product-related GHG projects. It also includes extracted contents of main items for illustrative purposes. If organizations intend to use these examples for actual purposes, they should refer to the sources.

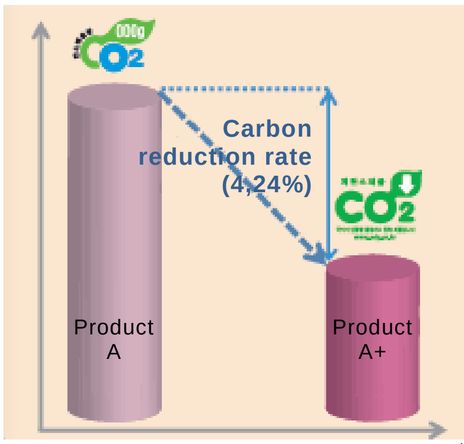
B.2 Example – GHG reduction of EE products calculated based on carbon footprint (Korea low carbon footprint labelling)

Where appropriate, GHG emissions reduction of EE products calculated based on carbon footprint may be used as GHG emissions reduction per unit of assessed product.

The following example, as shown in Table B.1, is a case in point:

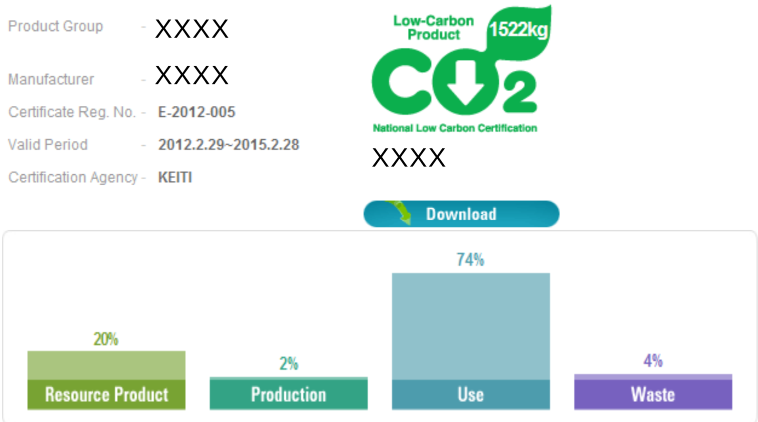
Table B.1 – Korea low carbon footprint labelling

<table>
<tr><th colspan="2">Title</th><th>Korea low carbon footprint labelling (example: application to a refrigerator)</th></tr>
<tr><td colspan="2">URL</td><td>http://www.edp.or.kr/carbon and http://www.keiti.re.kr</td></tr>
<tr><td rowspan="3">Low carbon footprint product category rule (PCR)</td><td>Assessed products</td><td>– Assessed products of low carbon footprint labelling are products which are certificated CFP labelling
– the assessed product has the same function and product name of the reference product
– if a new product which has improved functions and different name compared with reference product is released the same time of reference product in market, the product is not the target product of low carbon footprint product</td></tr>
<tr><td>Certification criteria</td><td>– The product should satisfy two criteria to get low carbon footprint
– criteria of average carbon emission: the product has lower than average carbon emission in the same category product
– criteria of carbon reduction ratio: Based on “XX %” per “YY years” drawn from “National Reduction Target for energy and GHG emissions”


IEC
Figure B.1 – Criteria of average carbon emission


IEC
Figure B.2 – Criteria of carbon reduction ratio
(In this case, based on 4,24 % per 3 years drawn from Korea’s national reduction target.)</td></tr>
<tr><td>Reference product</td><td>Reference product is a certificated product of carbon footprint labelling and the same function of assessed product of low carbon product</td></tr>
<tr><td colspan="2">Definitions and scope of product</td><td>– Scope of application: this measurement/calculation method is applicable for all ranges of home and commercial electric freezer, refrigerator.
– function: refrigeration and freezing of food for prolonged storage of food</td></tr>
</table>

<table>
<tr><th colspan="2">Title</th><th>Korea low carbon footprint labelling (example: application to a refrigerator)</th></tr>
<tr><td colspan="2">Calculation unit</td><td>– Sales unit (per unit)
– Two door refrigerator
(weight of refrigerator: 146 kg, weight of packing material: 9,82 kg, Capacity: 751L)</td></tr>
<tr><td colspan="2">GHG emission calculation method</td><td>– GHG emission calculation is flowed Korea CFP PCR II and III</td></tr>
<tr><td rowspan="4">Calculation scope of GHG reduction

(This case is calculated based on CFP)</td><td>Life cycle stage</td><td>– Same of reference product</td></tr>
<tr><td>Date collection and period</td><td>– Data collection of XXXX refrigerator for certificating low carbon footprint labelling: system boundary is the same of reference product.
– Time boundary
– product production: 2010.10.01 ~ 2011.10.31
– distribution: 2010.11.01 ~F 2010.11.31
– XXXX refrigerator is certificated at Feb, 2011
(The verification of product is spend time about 90 days)
– Geographical boundary
– product production: On-site in Korea
– distribution: Republic of Korea</td></tr>
<tr><td>Allocation</td><td>– Basically, carbon emission of XXXX refrigerator was calculated by general allocation rule in PCR II
– Allocation is the same of reference product.</td></tr>
<tr><td>Cut-off criteria</td><td>– First, collect data on the “consumption of raw materials and auxiliary materials that are accountable for cumulative mass contribution of up 95 % at each assembly stage or of total parts used” versus the “total raw materials and auxiliary materials used”
– Second, in relation to the assemblies and parts that is included pursuant to the foregoing first step, collect data on the consumption of each material that are accountable for cumulative mass contribution of up to 95 % at each assembly stage or of parts used</td></tr>
<tr><td colspan="2">Verification of GHG reduction</td><td>– GHG reduction amount or ratio is only accepted when improved technologies are applied to process for improvement of process efficiency.
– XXXX refrigerator is reduced about 12,7 % of carbon emission by applying high efficiency compressor and vacuum-insulator to the product
<table>
<tr><th></th><th>Raw material acquisition</th><th>Product production (assembly)</th><th>Using stage</th><th>End of life</th><th>Total</th></tr>
<tr><td>Reference product</td><td>323 kg CO_2e/unit</td><td>30,1 kg CO_2e/unit</td><td>1 330 kg CO_2e/unit</td><td>60,2 kg CO_2e/unit</td><td>1 743,3 kg CO_2e/unit</td></tr>
<tr><td>Low carbon footprint product</td><td>309,4 kg CO_2e/unit</td><td>32,4 kg CO_2e/unit</td><td>1 121,4 kg CO_2e/unit</td><td>58,8 kg CO_2e/unit</td><td>1 ,522 kg CO_2e/unit</td></tr>
</table></td></tr>
<tr><td colspan="2">Communication</td><td>– Low carbon footprint labelling is put on the XXXX refrigerator for communicating to costumer (Figure B.3). More detail information of the XXXX refrigerator’s carbon footprint is on the web-site


IEC
Figure B.3 – Low carbon footprint labelling</td></tr>
</table>

Table B.2 – Relationship of a low carbon footprint product and an EE product-related GHG project

EE product-related GHG project	Assessed product	Baseline scenario
Introduction of a unit of a low carbon footprint refrigerator in Korea	A low carbon footprint refrigerator	Use of a functionally equivalent conventional refrigerator in Korea

NOTE “Korean low carbon footprint labelling” is understood as being a study to calculate GHG reduction by an EE product-related GHG project to introduce one single unit of a low carbon product as an assessed product which replaces one single unit of a conventional refrigerator as a reference product.

Annex C
(informative)

Example of monitoring based on systematic sampling approach

Systematic sampling is a statistical method involving the selection of elements from an ordered sampling frame and is applicable in a number of situations, e.g. monitoring of electricity consumptions of refrigerators developed and supplied under an EE product-related GHG project. In this approach, sample size may be calculated by the following formula:

$$n \geq \frac{N}{\left(\frac{CI}{2k}\right)^2 \frac{N-1}{s^2} + 1},$$

where

n is the sample size;

N is the population size;

k is the rejection limit of normal distribution;

CI is the sampling error;

s^2 is the estimate of variance of the population (normalized for the average of 1).

For a monitoring method, actual measurements using metering instruments may be applied at each sample monitoring point.

For a monitoring period, it is appropriate to cover a season with frequent use (e.g. summer for a refrigerator).

Estimation of population parameter, i.e. energy consumption, can be calculated as follows:

- ratio of daily energy consumption of refrigerator to total yearly electricity consumption for each sample household:

$$R_i = \frac{EC_i}{TEC_i \cdot MP},$$

where

Ri is the ratio of daily energy consumption of refrigerator to total yearly electricity consumption for household I (kWh/(kWh*D));

ECi is the electricity consumption of refrigerator in monitoring point during the monitoring period (kWh);

$TECi$ is the total yearly electricity consumption of each sample monitoring point (kWh);

MP is the monitoring period (days).

- sample average of the ratio:

$$SA = \frac{1}{n}\sum_{i=1}^{n} R_i,$$

where

SA is the sample average of the ratio.

- energy consumption of population under the project:

$$\sum_{j=1}^{N} SA \times D_j \times TEC_j \ ,$$

where

R_i is the ratio of daily energy consumption of refrigerator to total yearly electricity consumption for household I (kWh/(kWh*D));

D_j is the duration of use at household j (days);

TEC_j is the electricity consumption of refrigerator in household j during the monitoring period (kWh).

NOTE For a specific programme of certification and recognition of GHG reduction units, an organization to apply for the programme may be required to fulfil more strict specifications given in existing relevant standards e.g. ISO 14064-2, ISO 14064-3, GHG Protocol for Project Accounting:2005 and/or a specific program itself.

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[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*

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[4] ISO 14040:2006, *Environmental management – Life cycle assessment – Principles and framework*

[5] 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] *The GHG Protocol for Project Accounting:2005, World Resources Institute, World Business Council for Sustainable Development*

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[8] ISO 14044:2006, *Environmental management – Life cycle assessment – Requirements and guidelines*

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[12] WBCSD/WRI, *The Greenhouse Gas Protocol, Product Life Cycle Accounting and Reporting Standard*, 2011

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
Fax: + 41 22 919 03 00
info@iec.ch
www.iec.ch