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Methodology for energy consumption and greenhouse gas emissions impact assessment of information and communication technologies in organizations

Recommendation ITU-T L.1420

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Summary

Recommendation ITU-T L.1420 presents the methodology to be followed if an organization intends to claim compliance with this Recommendation when assessing its information and communication technology (ICT) related energy consumption and/or greenhouse gas (GHG) emissions.

This Recommendation can be used to assess energy consumption and GHG emissions generated over a defined period of time for the following purposes: for assessment of related impact from ICT organizations or for assessment of impact from ICT related activities within non-ICT organizations.

History

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FOREWORD

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Introduction

This Recommendation assists organizations in assessing the energy consumption and greenhouse gas (GHG) emissions related to their operations. It provides the necessary knowledge to prepare inventories and meet the societal demands emerging from a low-carbon economy and the challenge of higher energy prices.

The Recommendation focuses on the energy consumption and GHG emissions resulting from ICT activities and ICT organizations.

This Recommendation covers

- The assessment of the life cycle perspective environmental impact of ICT goods, networks and services used by a non-ICT organization ("ICT in organizations"), e.g., PCs, servers, data centers and networks within the organizations premises, based on the Recommendation ITU-T L.1410 and an aggregation to an organizational level for first and second order effects.
- The assessment of the environmental impact of an ICT organization ("ICT organizations") based on [ISO 14064-1] and [b-GHG Protocol].
- The interpretation of these impacts.
- The reporting of these impacts in a transparent manner.

Recommendation ITU-T L.1420

Methodology for energy consumption and greenhouse gas emissions impact assessment of information and communication technologies in organizations

1 Scope

The increasing proliferation of information and communications technology (ICT) has led to concerns regarding its environmental impact. Taking into consideration the ongoing efforts within the United Nations Framework Convention on Climate Change (UNFCCC) to combat climate change, ITU-T decided to develop an internationally agreed upon methodology to help the ICT Sector to make an inventory of the environmental impact, including greenhouse gas emissions and energy consumption, of ICTs in organizations.

This Recommendation can be used to assess the energy consumption and GHG emissions of ICT related to organizations for two different purposes.

- Firstly, it can be used to assess the life cycle GHG emissions (first and second order effects) emerging from the use of ICT in non-ICT organizations, based on the Recommendation ITU-T L.1410.
- Secondly, it can be used as a supplement to [ISO 14064-1] and to [b-GHG Protocol] for ICT organizations intending to assess their own organizational energy consumption and GHG related impact.

This Recommendation is intended to allow organizations to assess their direct GHG emissions (generally referred to as scope 1), their indirect GHG emissions (generally referred to as scope 2) and their other indirect GHG emissions (generally referred to as scope 3). It also allows organizations to assess their energy consumption by developing an energy inventory focusing on secondary energy used by the assessed organization itself.

However, it should be noted that this Recommendation will not address:

- GHG removal, which needs not be considered since ICT activities do not directly remove GHG,
- Other effects (apart from first or second order effects), such as rebound effects, since these effects are still under research to a large extent,
- Other environmental impacts like for example depletion of abiotic resources, acidification, eutrophication, stratospheric ozone depletion, photo-oxidant formation and human toxicity.

1.1 Assessment of impact from the use of ICT in non-ICT organizations

For the assessment of the first and second order effects when using ICT in non-ICT organizations, this Recommendation defines an assessment framework (principles, concepts, requirements and methods) to be used by any kind of organization (except for ICT organizations) when quantifying and reporting the energy consumption and the GHG emissions of ICT activities.

1.2 Assessment of impact from ICT organizations

For the assessment of an ICT organization, this Recommendation provides a methodology to assess both the energy consumption and the GHG emissions of its activities over a certain period of time for the following emissions:

- direct GHG emissions
- energy indirect GHG emissions and
- other indirect GHG emissions.

This Recommendation covers the following items:

- design and development of the inventory
- components of the inventory
- quality management requirements of the inventory
- reporting of the inventory results.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T L.1400] Recommendation ITU-T L.1400 (2011), *Overview and general principles of methodologies for assessing the environmental impact of information and communication technologies*.

[ITU-T L.1410] Recommendation ITU-T L.1410 (In-force), *Methodology for environmental impact assessment of information and communication technology goods, networks and services*.

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

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 activity data [b-GHG PI]: A quantitative measure of a level of activity that results in GHG emissions. Activity data is multiplied by an emission factor to derive the GHG emissions associated with a process or an operation. Examples of activity data include kilowatt-hours of electricity used, volume of fuel used, output of a process, hours a piece of equipment is operated, distance travelled and area of building.

3.1.2 emission factor [b-PAS 2050]: Amount of greenhouse gases emitted, expressed as carbon dioxide equivalent and relative to a unit of activity (or example, kgCO2e per unit input).

3.1.3 facility [ISO 14064-1]: Single installation, set of installations or production processes (stationary or mobile), which can be defined within a single geographical boundary, organizational unit or production process.

3.1.4 first order effect [ITU-T L.1410]: The impacts and opportunities created by the physical existence of ICT and the processes involved, e.g., GHG emissions, e-waste, use of hazardous substances and use of scarce, non-renewable resources.

3.1.5 greenhouse gas [ISO 14064-1]: 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. Greenhouse gas include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6).

3.1.6 greenhouse gas emission [ISO 14064-1]: Total mass of a Greenhouse gas released to the atmosphere over a specified period of time.

3.1.7 greenhouse gas removal [ISO 14064-1]: Total mass of a Greenhouse gas removed from the atmosphere over a specified period of time.

3.1.8 ICT goods [ITU-T L.1400]: The tangible products deriving from or making use of technologies devoted to or concerned with (a) the study and application of data and the processing thereof; *i.e.,* the automatic acquisition, storage, manipulation (including transformation), management, movement, control, display, switching, interchange, transmission or reception of a diversity of data; (b) the development and use of the hardware, software, and procedures associated with this delivery; and (c) the representation, transfer, interpretation, and processing of data among persons, places, and machines, noting that the meaning assigned to the data must be preserved during these operations.

3.1.9 ICT networks [ITU-T L.1400]: This includes a set of nodes and links that provide physical or over the air information and communication connections between two or more defined points.

3.1.10 ICT services [ITU-T L.1400]: This covers the combination of ICT goods and ICT networks. An ICT service is produced in one or more nodes of the network and provided to users or other ICT systems over the ICT network.

3.1.11 organization [ISO 14064-1]: Company, corporation, firm, enterprise, authority or institution, or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administration.

3.1.12 second order effect [ITU-T L.1410]: The impacts and opportunities created by the ongoing use and application of ICT. This includes environmental load reduction effects which can be either actual or potential.

3.1.13 validation [ISO 14064-1]: Systematic, independent and documented process for the assessment of a greenhouse gas assertion in a GHG project plan against agreed validation criteria.

3.1.14 verification criteria [ISO 14064-1]: Policy, procedure or requirement used as a reference against which evidence is compared. Validation or verification criteria may be established by governments, GHG programmes, voluntary reporting initiatives, standards or good practice guidance.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 direct GHG emissions [b-GHG PI]: GHG emissions from GHG sources owned or controlled by the organization.

NOTE – This term is referred to as "scope 1 emissions" in [b-GHG PI].

3.2.2 energy indirect GHG emissions [b-GHG Protocol Initiative]: Energy indirect GHG emissions cover GHG emissions from the generation of purchased energy, heat or steam consumed by the organization. Purchased electricity, heat or steam is defined as electricity, heat or steam that is purchased or otherwise brought into the organizational boundary of the company from external source.

NOTE – This term is referred to as "scope 2 emissions" in [b-GHG PI].

3.2.3 equity share: An equity share is defined as the percentage of economic interest in, or benefit derived from a facility.

3.2.4 ICT activities: ICT activities are defined as activities directly related to the design, production, promotion, sales or maintenance of ICT goods, networks or services, or related to the use of ICT goods, networks or services for the benefit of the organization.

3.2.5 ICT organization: An ICT organization is an organization, the core activity of which is directly related to the design, production, promotion, sales or maintenance of ICT goods, networks or services.

3.2.6 operational control: An organization has operational control if it has the full authority to introduce and implement its operating policies at the operation level.

3.2.7 other indirect GHG emissions [b-GHG PI]: Other indirect GHG emissions cover GHG emissions, other than energy indirect GHG emissions, which are a consequence of an organization's activities but arise from GHG sources that are controlled by other organization. This term is referred to as scope 3 in [b-GHG Protocol].

NOTE – This term is referred to as "scope 3 emissions" in [b-GHG PI].

3.2.8 primary energy: Primary energy is the energy embodied in natural resources prior to undergoing any human-made conversions or transformations.

3.2.9 secondary energy: Secondary energy is energy which has been refined from primary energy in an energy conversion process to a more convenient form of energy, such as electricity, refined or synthetic fuels (e.g., gasoline and hydrogen fuel).

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CO_2: Carbon Dioxide

CO_2e: CO_2 equivalent

EoLT: End-of-Life Treatment

GHG: Greenhouse Gas

GWP: Global Warming Potential

ICT: Information and Communication Technology

IPCC: Intergovernmental Panel on Climate Change

kWh: kiloWatt-hours

LCA: Life Cycle Assessment

PC: Personal Computer

5 Conventions

None.

6 Principles of organizational assessment

The following principles shall be taken into consideration when carrying out the assessment.

- Relevance

  Select energy or GHG sources, data and methods appropriate to the assessment of the energy consumption or GHG emissions of ICT activities and organizations.

- Completeness

  Include all specified energy sources or GHG emissions that provide a material contribution to the overall results.

- Consistency

  Enable meaningful comparisons of energy consumption or GHG emissions over time with respect to energy consumption, respectively GHG-related information of an organization.
- Accuracy

  Reduce bias and uncertainties as far as practicable.
- Transparency

  When communicating inventory results, the organization shall give sufficient information to support the interpretation of the results.

7 Evaluation of energy consumption and GHG impact of ICT activities in non-ICT organizations

The evaluation of the life cycle energy consumption and GHG impact of first and second order effects when using ICT in organizations should be based on [ITU-T L.1410] and aggregated to an organizational level according to the principles outlined in this Recommendation.

It should be noted that the assessment of the second order effects needs to be documented and reported separately from the first order GHG emission impact.

Clause 7 covers the use of ICT in any kind of organization, except for ICT organizations, including but not limited to organizations such as banks, insurance companies and public administrations.

7.1 Use of the Recommendation ITU-T L.1410 to assess the impact from the use of ICT in organizations

When assessing the impact of the use of ICT, the organization shall:

- Identify the concerned ICT goods, networks or services of which the organization would like to assess the impact.
- Define operational boundaries for all these selected ICT goods, networks and services.
- If results from life cycle assessments (LCAs) are not available, perform an assessment of these product systems of ICT goods, networks and services in accordance with Part I of [ITU-T L.1410] in order to calculate the life cycle impact of these product systems.

If the intention is also to capture the second order effects of the use of ICT goods, networks or services, a comparative assessment according to Part II of [ITU-T L.1410] needs also to be performed.

7.2 Aggregation of impacts from ICT goods, networks and services at an organizational level

When the selected product systems have been assessed as described above, the result needs to be aggregated to an organizational level.

A simplified example could be given as follows: if the annual impact of a single PC is *x* kg CO2e and the organization owns *n* PCs, then the organizational impact of the PCs is *n*x* kg CO_2e. This example is only applicable if the GHG emissions of the electricity mix (and other use conditions) are consistent for all the PCs within the scope of the assessment.

Correspondingly, a simplified example for a service is as follows: if the actual or potential saving per meeting of utilizing a telepresence system instead of travelling is *y* kg CO_2e, and the company has saved *m* meetings a year between the same destinations with *z* travelling participants, the total savings at an organizational level becomes *y*m*z* kg CO_2e.

In many cases, different operating conditions (e.g., energy supply emissions, lifetime usage, etc.) apply within the scope of the assessment and within organizations and shall then be taken into account.

7.3 Organizational boundaries

The organizational boundaries shall be defined in accordance with clause 8.

7.4 Operational boundaries

When assessing the impact of ICT in organizations the following aspects of an organization's operations shall be assessed with respect to their GHG emissions, in accordance with the principles outlined in clause 8:

- ICT goods used by the organization. The ICT goods to be considered are further outlined in Annex A.
- Support equipment for ICT goods used by the organization (e.g., cooling and power supply equipment).
- ICT associated consumables used by the organization (e.g., ink cartridges, papers and DVDs).
- Software and ICT services used by the organization (e.g., purchased software, telecommunication services and consulting services).
- Staff responsible for purchase, operation and maintenance of ICT goods, networks and services.

For each of these categories, which are detailed in clause 7.4.1, the GHG inventory shall include scope 1 and scope 2 GHG emissions, and it should also include scope 3 GHG emissions.

Additionally, an energy inventory shall include direct energy consumption from sources described in clause 7.4.2.

7.4.1 GHG Emissions

Defining the operational boundaries means identifying the emission sources that shall be included in the assessment. In order to help to define these boundaries, the following sources of emissions shall be identified when applicable:

- Life cycle[1] GHG emissions related to ICT goods used by the organization. The ICT goods to be considered are further outlined in Annex A.
- Life cycle GHG emissions related to support equipment for ICT goods used by the organization (e.g., cooling and power supply equipment).
- Life cycle GHG emissions related to ICT associated consumables used by the organization. Examples of such consumables include DVDs, paper and ink cartridges used for printing.
- Life cycle GHG emissions related to software and ICT services used by the organization (e.g., purchased software, telecommunication services and consulting services). The following activities may be considered:
  - Software purchase and customization,
  - Telecommunication services,
  - ICT related consulting services.

For staff responsible for purchase, operation and maintenance of ICT goods, networks and services the following activities may also be considered:

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1 Raw material acquisition, production (including design), use and end-of-life treatment

- Daily commuting to work and business travel
- Freight of purchased ICT goods entering the organization, freight of ICT goods within the organization premises and freight of ICT goods leaving the organization's premises when decommissioned.

For each of the three scopes (direct emissions, indirect emissions and other indirect emissions), the selected emission sources shall be clearly described and documented.

7.4.2 Energy Consumption

Energy consumption from the following sources should be taken into account:

- Energy consumption of ICT goods used by the organization:
  - The ICT goods to be considered is further outlined in Annex A. Other ICT goods may also be considered as far as energy consumption is concerned.
- Energy consumption of support equipment for ICT goods used by the organization (e.g., cooling and power supply equipment):
  - Energy consumption for power supply and power supply back-up systems for ICT goods;
  - Energy consumption for power supply and power supply back-up systems dedicated to cooling of ICT goods;
  - Electricity consumption for cooling of ICT goods.
- Energy consumption for staff responsible for purchase, operation and maintenance of ICT goods, networks and services:
  - Energy consumption in the buildings hosting the ICT department's staff;
  - Energy consumption for cooling and heating of the buildings hosting the ICT department's staff.

The organization shall ensure that no double accounting occurs, for example between the energy consumed by cooling systems for ICT goods on one hand, and the energy consumed when cooling the building hosting the ICT department on the other hand.

Annex A further outlines the list of goods that should be considered when assessing the direct energy consumption of an organization. Other ICT goods may also be considered as far as energy consumption is concerned.

A list of selected goods shall be reported.

8 Evaluation of energy consumption and GHG impact of ICT organizations

8.1 General

This clause provides ICT organizations with a means to evaluate its energy consumption and/or its GHG emissions. This GHG impact assessment shall follow [ISO 14064-1] for GHG emissions, and shall include scope 1 GHG emissions, scope 2 GHG emissions and should also include scope 3 GHG emissions. The methodology described in the chapter below gives more details on aspects specific to the ICT industry.

8.2 Energy and GHG inventory design and development

In this Recommendation, the energy inventory is focusing on direct energy use by organizations in terms of secondary energy.

8.2.1 Organizational boundaries

The organizational boundaries define which parts of the organization to include in the energy consumption or emissions assessment (e.g., main units, subsidiaries, joint ventures, etc.).

The ICT organizations shall select a consolidation approach in accordance with [ISO 14064-1].

Irrespective of the approach chosen, ICT organizations should take into account all facilities used for the operation of the organization, whether owned or rented.

The same consolidation approach shall be applied throughout the organizational boundaries.

If the organization decides to exclude a particular facility or facilities, then this decision shall be justified.

8.2.2 Operational boundaries

To determine if an activity contributes to the energy consumption and to scopes 1, 2 and 3 GHG emissions, the organization shall refer to the chosen approach used when setting its organizational boundaries.

Within the organizational boundaries defined according to the approach chosen, emissions associated with all operational aspects shall be considered for scopes 1 and 2 GHG emissions and energy consumption. The operational impact generated by activities outside these boundaries is categorized as scope 3 and is further outlined in clause 8.3.5.1.3 and Appendix I.

All identified emission sources should be described and reported. In case of third party reporting, the reporting is not required to be detailed in a way that leads to conflicts with confidentiality obligations.

8.3 Quantification of energy consumption and GHG emissions

8.3.1 Quantification steps and exclusions

Within its organizational boundaries, according to [ISO 14064-1], the organization shall quantify and document energy consumption and GHG emissions by completing, as applicable, the following steps:

- identification of energy consumption and GHG sources (8.3.2)
- selection of quantification methodology (8.3.3)
- calculation of energy consumption and GHG emissions (8.3.4).

While keeping the five principles of organizational assessment (clause 6) in mind, the organization may exclude quantification of direct or indirect GHG sources or energy consumption if the assessment is not technically or economically feasible. The organization shall justify why certain GHG sources or energy consumption are excluded from quantification.

8.3.2 Identification of energy consumption and GHG sources

The organization shall identify and record sources of energy consumption such as:

- purchased electricity, heat or steam consumed by the organization
- fossil fuels consumed within the boundaries selected by the organization, by fixed or mobile equipment owned by the organization (e.g., a fuel-based power generator or a car owned by the organization)

The organization shall identify and should record separately, for its internal use, GHG sources contributing to its scope 1 GHG emissions.

The organization shall identify and should record separately, for its internal use, GHG sources contributing to its scope 2 GHG emissions.

The organization should identify and record separately, for its internal use, GHG sources contributing to its scope 3 GHG emissions.

The level of details for which energy consumption sources and GHG sources are identified and categorized should be consistent with the quantification methodology used.

8.3.3 Selection of quantification methodologies

The organization shall use quantification methodologies described in this Recommendation, which are intended to minimize uncertainty and yield accurate, consistent and reproducible results.

Estimation methods shall be documented.

8.3.4 Calculation of energy consumption and GHG emissions

The energy consumption and GHG emissions shall be calculated in accordance with the quantification methodology described below.

The detail of calculation procedures shall be documented.

8.3.4.1 Energy

The following requirements regarding energy consumption apply for the energy inventory:

- energy from renewable sources produced within the organization's boundaries
- energy imported by the organization for its own consumption
- heat or steam imported by the organization for its own consumption
- fossil fuel (e.g., coal, gas or oil) consumed by fixed equipment owned by the organization
- fossil fuel (e.g., coal, gas or oil) consumed by mobile equipment (e.g., automobiles) owned by the organization

The yearly energy consumption values shall be based on one of:

- actual energy consumption indicated in invoices from electricity suppliers
- actual energy consumption measurements
- estimates based on actual energy consumption measured in selected representative sites and scaled up to represent all sites. Estimation methods shall be documented
- estimated mean value of energy consumption over one year multiplied by the number of applicable goods. Estimation methods shall be documented.

For some categories of ICT goods, energy consumption over one year may be assessed using an estimated mean value of energy consumption over one year for a designated category of good, multiplied by the number of goods of the category.

The total energy consumption per type of energy shall be calculated by summing the energy consumption of each entity within the selected boundaries.

Energy consumption shall be assessed in kWh.

The calculation details should be recorded for internal reference or reviewing by authorized persons.

8.3.4.2 GHG emissions

Since direct measurements of GHG emissions are generally not applicable for ICT organizations, most emission data are based on (measured or estimated) activity data (such as amount of electricity and fuel used) which are recalculated into CO_2e (i.e. the equivalent quantity of CO_2 that would be needed to give the same greenhouse gas effect as the corresponding amount of CO_2).

The recalculation from activity data into CO_2e includes two steps:

- First the activity data is recalculated into GHG emissions using CO_2 and other GHG related emission factors for the applicable amounts of fuels, electricity or energy. Such emission factors can either be calculated by the organization or be collected externally from verified sources.
- Secondly the calculated amount of GHG emissions is recalculated into CO_2e using the most recent Global Warming Potential (GWP) factors for the different greenhouse gases, as defined by the IPCC (see [b-IPCC]), taking into account a timeframe of 100 years.

Note that for some fuels combined factors exist that combine both these recalculations into one step. For example an energy emission factor for a certain fuel can give the kg CO_2e per unit of fuel, comprising the combined effect of the CO_2, CH_4 and N_2O. In this case, the second step is not necessary. This is in contrast to the emission factor for global average electricity production with the unit of kg CO_2/kWh which only takes the CO_2-emissions and no other GHG emissions into account.

The organization shall select or develop emission factors that

- are derived from a recognized origin,
- are appropriate for the GHG source concerned,
- are valid at the time of quantification,
- take into account the quantification uncertainty and are calculated in a manner intended to yield accurate and reproducible results, and
- are consistent with the intended use of the GHG inventory.

The organization shall explain its selection or development of GHG emission factors, including the identification of their origin and appropriateness for the intended use for the GHG inventory.

The total organizational amount of CO_2e is then calculated as the total sum of applicable amounts of CO_2e relating to the considered year.

The electricity and energy mixes applied (e.g., specific; national; global) shall be described.

The calculation details should be recorded for internal reference and potential reviewing.

Additionally, for scope 3 GHG emissions, life cycle impact is applicable for several categories (e.g., for purchased goods and services and for capital goods). For such categories, it should be noted that all life cycle stages except the use stage should be divided by the operational life time to get the yearly impact. For further details on operational life time refer to [ITU-T L.1410].

The table below gives examples of activity data for scope 3 GHG emissions.

Activities causing scope 3 GHG emissions	**Example of activity data** (before multiplication by emission factors which take into account the physical properties of goods)
• ICT goods • Consumables • Disposal of ICT good	• Number of goods • Volume and type of paper, number and type of ink cartridges • Number and type of disposed ICT goods

8.3.5 GHG inventory components

8.3.5.1 Identifying GHG sources

8.3.5.1.1 Direct GHG emissions (scope 1 GHG emissions)

The organization shall quantify the direct GHG emissions generated by facilities within its organizational boundaries.

Direct GHG emissions are principally the result of the following types of activities undertaken by the company:

- Physical or chemical processing. Most of these emissions result from manufacture or processing of chemicals. It should be noted that this is applicable to ICT to a limited extent.
- Transportation of materials, products, waste and employees. These emissions result from the combustion of fuels in company owned/controlled mobile combustion sources.
- Fugitive emissions. These emissions result from intentional or unintentional releases such as sulfur hexafluoride (SF6), equipment leaks from joints, seals, packing, and gaskets during the use of refrigeration and air conditioning equipment, e.g., air conditioning for data centers and making wafers.
- Combustion of fuels e.g., for power supply back-up of ICT goods and cooling of ICT goods.

8.3.5.1.2 Energy indirect GHG emissions (scope 2 GHG emissions)

The organization shall quantify indirect GHG emissions from the generation of purchased electricity, heat, or steam consumed by the organization, within the selected organizational boundaries. For many organizations, purchased electricity represents one of the largest sources of GHG emissions and one of the most significant opportunities to reduce these emissions.

Since ICT organizations in general are not energy producers, most emissions from internal operations will be reported in this category. Examples of operations using purchased energy thereby indirectly causing GHG emissions are heating and lighting of facilities, use of computers and use of other office goods.

8.3.5.1.3 Other indirect GHG emissions (scope 3 GHG emissions)

Scope 3 GHG emissions cover GHG emissions, additional to scope 2 GHG emissions, which are a consequence of an organization's activities but arise from GHG sources that are controlled by other organizations.

If an organization chooses to assess scope 3 GHG emissions, the categories listed in Appendix I should be taken into account by the organization when claiming compliance with this Recommendation.

Recognizing the complex and dynamic supply chain of ICT organizations, results from LCAs are seen as sufficiently accurate when assessing some scope 3 emissions (see Appendix I), and are recommended rather than an inventory based on input from all suppliers.

LCAs related to ICT goods, networks and services used as input for the inventory of scope 3 GHG emissions should fulfill the requirements of [ITU-T L.1410]. In particular, the inventory should be based on data from representative (ICT specific) sources where applicable.

The organization shall strive for the inventory to be relevant, complete, accurate, consistent and transparent, and shall apply these five principles in case of exclusion of activities. Any exclusion of activities made shall comply with the cut-off principles described in [ITU-T L.1410] which are applicable to all scope 3 categories.

Goods, networks and services, as defined in [ITU-T L.1410], can be included as examples of indirect GHG emission sources.

8.3.6 Organizational activities to reduce GHG emissions and energy consumption

Many organizations have initiatives to reduce GHG emissions, improve energy efficiency and/or increase GHG mitigation efforts. These activities may lead to a reduction in energy costs for an organization and/or lower the environmental impact and cost of GHG emissions.

Therefore**,** organizations may identify existing ICT activities where optimizations could be envisaged with the objectives to reduce the GHG emissions and/or energy consumption. This Recommendation does not impose on the organization any requirement to disclose these potential improvements in its energy and GHG Report.

Appendix II gives examples of actions that could be considered by the organization.

8.4 Annual assessment

Organizations should track energy consumptions and GHG emissions on an annual basis in response to a variety of business goals such as public reporting, establishing GHG and energy consumption targets, managing risks and opportunities and addressing the needs of investors and other stakeholders.

8.5 Establishment of base-year energy and GHG inventory

8.5.1 Selection and establishment of base year

As a principle, the publication date of this Recommendation (ITU base year) should be the base year for a GHG emission and energy consumption assessment.

However, a different base year could be chosen when:

- The organization estimates that the quantity and/or quality of available verifiable data for this particular different year would guarantee a more accurate evaluation of its GHG emissions and energy consumption. In this case, the organization should take all necessary measures in order to collect precise data and to apply this Recommendation not later than 2 years after the publication date.
- The organization has already put in place an assessment and reporting process based on a different base year, compliant with this Recommendation. In this case, the organization can continue to report from its initial base year.
- The activities carried out by the organization generate unusual fluctuations of GHG emissions and/or energy consumption in such a way that the base year might not be significant. In this case, the organization can choose an average of annual emissions and/or energy consumption over the 2 years prior the publication date.

Any choice of a different base year shall be documented.

8.5.2 Recalculation of energy or GHG inventory

Recalculation applies in two situations:

- Structural changes which include mergers, acquisitions and divestments and/or outsourcing or in-sourcing of GHG emitting activities.
- Discovery of significant errors contained within the base year emission calculations which can necessitate a change in the emissions inventory.

Structural changes shall be identified during the annual inventory reporting process via consultation with appropriate parts of the concerned organization.

To ensure that data are consistent and historically relevant, it is considered reasonable that the base year emissions will not be recalculated when the following structural changes occur:

- Acquisition of new facilities that did not exist in the base year.
- Organic growth or decline.

Arithmetic and data entry mistakes can also occur in the recording and reporting of emissions data (e.g., incorrect conversion factors, wrong data reported from facilities, incorrect data entry into spreadsheets, incorrect spreadsheet formula calculations, etc.). Should errors be identified, corrections to the base year emissions shall be made.

Similarly, should new data become available on source emissions that were not previously available (e.g., refrigerant loss records, etc.) or if a new methodology results in obtaining more accurate data on source emissions, an adjustment to the base year emissions may be required.

8.6 Assessing and reducing uncertainty

An uncertainty assessment for GHG emissions shall be performed in accordance with clause 5.4 of [ISO 14064-1] to the extent needed to correctly interpret the inventory results.

Uncertainty considerations for a GHG inventory which includes other indirect GHG emissions and value chain aspects is, to a large extent, the same as for an LCA and is further detailed in [ITU-T L.1410].

Consequently, the GHG inventory could be suitable for some purposes but less appropriate for others.

The GHG inventory at an organizational level should primarily be used for the following purposes:

- Identifying opportunities to improve environmental performance of the organization
- Providing information to decisions-makers in industry, government or non-government organizations about typical environmental performances of an organization to assist their policy choices
- Selecting relevant indicators for monitoring of environmental performance
- Understanding improvements in GHG emissions over time
- Aggregating GHG emissions to a sector level based on scopes 1 and 2 reporting, given that the same consolidation approach is applied.

On the contrary the GHG inventory is not suitable for:

- Comparisons of the environmental load between different organizations
- High accuracy aggregation of GHG emissions to a sector level[2] based on scope 3 reporting.

8.7 Energy and GHG inventory quality management

8.7.1 Energy and GHG information management

To ensure accurate reporting a sufficient level of data quality is required. Over time, all organizations should develop systems to track the preferred reporting units for all key emissions and, as part of the qualitative criteria, the appropriateness of the level of data that will be assessed.

Data may be primary or secondary data. Primary data are process-specific data obtained by direct measurement of the energy or business activity. Secondary data are non-process specific data obtained from external sources other than direct measurement of the energy or business activity. For scopes 1 and 2 activity data, primary data applies.

Activity data sources shall be identified and documented for internal purposes.

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[2] The organizational GHG emission values may, however, be used for aggregations to a sector level if the intention is to get an indication of the magnitude of total GHG emissions. In case of aggregation, the double accounting effect needs to be avoided.

8.7.2 Document retention and record keeping

Organizations are responsible for ensuring that a documentation plan is defined in sufficient detail so that the organization can track and record results, statements and conclusions given in the energy and GHG report or in any publicly available documents.

A disclosure policy should be defined making a distinction between records used for internal purposes (e.g., organization staff or authorized persons) and records that could be reviewed by external parties.

The organization is responsible for ensuring that data used to complete the energy and GHG Report or to support any publicly available documents be secured and accessible according to the disclosure policy.

8.8 Reporting of energy and GHG inventory

8.8.1 General

This clause describes how the organization should prepare the GHG report to inform external and internal parties.

Recommended options (denoted "should") in this Recommendation that are not taken into account shall be documented and justified.

8.8.2 Planning the energy and GHG inventory report

The organization shall consider the following when planning and preparing its energy and GHG report:

- Purpose and objectives of the report
- Intended use and users of the report
- Overall and specific responsibilities for preparing the report
- Frequency of the report
- Period for which the report is valid
- Report format
- Data and information to be included in the report
- Policy on availability and methods for dissemination of the report

8.8.3 Energy and GHG report content

The energy and GHG report content should contain:

- a description of the reporting organization and the person responsible
- the reporting period or periods covered
- documentation of organizational boundaries
- documentation of operational boundaries
- a description of the quantification methodologies used within the framework of the study
- the principles for collection of energy data, GHG activity data and emission factors
- the outcome of the uncertainty assessment for energy consumption and GHG emissions Uncertainty assessment of for GHG emissions is further detailed in [ISO 14064-1].
- the results of energy consumption assessment and GHG emissions assessment
- any recalculations including corrections of the corresponding clauses of the previous report(s)

- a statement that the energy report and the GHG inventory report has been prepared in accordance with the principles outlined in the Recommendation.

For the above items, at a minimum, guidance presented in Annex B shall be followed.

Moreover, the following information shall be recorded by the organization for its internal use or to demonstrate compliance to the Recommendation to a reviewer:

- Facilities taken into account. Any omission of facilities falling within the organizational boundaries shall be documented and justified.
- Number of people working in each facility
- Geographical location
- A general description of the use of the building
- Activity data per facility

It should be noted that no reporting obligation applies for the above organizational details.

8.8.4 Other indirect GHG emissions (Scope 3 GHG emissions)

For scope 3 GHG emissions the following reporting structure applies (references given below refer to the table in Appendix I):

- Supply chain which consists of
  - Purchased goods and services (S3A)
  - Capital Goods (S3B)
  - Upstream leased assets (S3H)
  - Fuel- and energy-related activities not included in scope 1 or 2 (S3C)
  - Upstream transportation and distribution (S3D) – all inbound
- Own activities which consists of
  - Downstream transportation and distribution (S3J) – all outbound
  - Business travel (S3F)
  - Employee commuting (S3G)
  - Downstream leased assets (S3N) – others
  - Franchises (S3O)
- Operation of products which consists of
  - Processing of sold products (including goods, networks and services) (S3K)
  - Use of sold products (including goods, networks and services) (S3L)
  - Downstream leased assets (S3N) – products
- End-of-Life Treatment (EoLT) which consists of
  - Waste generated in operation (S3E)
  - EoLT of sold products (including goods, networks and services) (S3M)

Investments (S3I) including partly owned organizations are not considered but should be reported by the legal unit itself. (If such investments were included in the reporting they should be allocated to "Own activities").

The categories (S3A-S3O) should be transparently described with respect to the emissions considered. However, it is not required to report the emissions values per category.

If any GHG reporting program needs additional detail (e.g., to avoid double accounting), such requirements would be additional to those of this Recommendation. To prevent unnecessary

additional administrative burdens, it is however recommended that designers of such programs consider the detail of this Recommendation as being sufficient.

8.8.5 Aggregation of emissions between organizations

If reported emissions including scope 3 are intended to be used for aggregation purposes to indicate the total input at a sector level, it must be understood that such an aggregation cannot give an accurate estimate. Moreover, in the case of aggregation, precautions must be taken to avoid any double accounting effect within the sector, as scope 1 and 2 GHG emissions of one organization may be accounted for as scope 3 GHG emissions by another organization.

As an example, the energy needed for manufacturing a server is accounted for as scope 2 GHG emissions by the manufacturer, at the same time contributing to the scope 3 GHG emissions from a service provider operating the server.

In conclusion, the most accurate basis for aggregation at a sector level would be to take into account scope 1 and 2 emissions from each organization, while including also scope 3 would lead to a more complete understanding of each organization but lead to less accuracy for aggregations.

In case of aggregation between sectors, the same situation applies to an even larger extent (e.g., transports of ICT goods from a manufacturer to a customer is seen as scope 3 GHG emission by the manufacturer, as part of scope 3 GHG emissions for purchased goods by the customer and as scope 2 GHG emissions by the transport company).

9 Organization's role in verification activities

For verification activities clause 8 of [ISO 14064-1] applies.

Annex A

List of goods to be considered when assessing the impact of ICT activities in organizations

(This annex forms an integral part of this Recommendation.)

When emissions due to goods used by the organization are concerned, the emissions from the following types of goods may be considered. The following list is not exhaustive and shows typical examples:

- Desktops;
- Laptops;
- Cathode Ray Tube (CRT) screens;
- Flat screens;
- Individual printers;
- Cables;
- Network printers and copiers;
- Servers, switches and routers;
- Fax machines;
- Scanners;
- Fixed phones;
- Mobile phones;
- Personal Digital Assistants (PDA) and tablets;
- Projectors;
- Videoconference installations;
- Televisions;
- Cooling systems for ICT goods;
- Other small ICT goods;
- Outsourced ICT goods, in particular outsourced datacenters;
- Power supply back-up generators.

It should be noted that these generators systems have to be dedicated to the ICT goods in this list. Otherwise an allocation approach would need to be used if the generators system is used for more than the ICT goods. The same remark applies for the cooling systems for ICT goods mentioned above.

Annex B

Information to be provided in the GHG emission and energy report on scope 1 and scope 2 GHG emissions and energy consumption

(This annex forms an integral part of this Recommendation.)

- **Organizational boundaries**

The organization should present a high-level description of facilities which have been taken into account and fall within the organizational reporting boundaries.

- **Operational boundaries**

The organization shall present for each reporting year, a description of the energy and/or GHG emission sources included.

The organization shall present in the Report, for each reporting year, any sources (e.g., facilities, activities, countries, etc.) of scope 1 and scope 2 GHG emissions which are not included in the Report and a justification for these exclusions.

The organization shall present for each reporting year, a qualitative uncertainty statement regarding the total global scopes 1 and 2 GHG emissions figures supplied by the organization with a description of the sources of uncertainties.

- **Base year**

The organization shall indicate in the report the base year chosen. If this is not the ITU base year, the organization shall provide justification for the different choice.

- **Reporting year**

The organization shall indicate the reporting year(s) chosen.

- **Quantification methodologies, principles to collect data and emission factors**

The organization shall provide for each reporting year, a list of the CO_2 and CO_2e emission factors used and their origin.

For GWP factors, the applicable version of [b-IPCC] shall be stated.

- **Results of the energy and GHG assessments**

The organization shall list for each reporting year, the countries where the organization operates and for which the organization is providing results of the energy and/or GHG assessments (main countries only, others can be grouped under "Rest of the World" (RoW)).

The organization shall present for each reporting year its global scope 1 and 2 GHG emissions figures.

The organization shall present for each reporting year its scope 1 and 2 GHG emissions breakdown per countries (main countries, RoW).

The organization shall provide for each reporting year, a high-level update of its structure and a list of calculation errors with an analysis of their effects on the previous reports.

- **Recalculation**

The organization shall indicate possible recalculations and include corrections of relevant sections of previous report(s).

- **Statement of compliance**

The organization shall mention in the report a statement indicating that the organization provides this report in accordance with the most up-to-date version of this ITU-T Recommendation.

Appendix I

Indirect GHG emissions categories

(This appendix does not form an integral part of this Recommendation.)

This table is based on [b-GHG PI] and [b- GHG PI3].

	Category	ICT application	Comments
S3A (Note 1)	Purchased goods and services	• Production-related procurement cradle-to-gate • Non-production related procurement: Paper usage cradle-to-gate Use of hotels • Related fuel and energy supply chain Optional • Other non-production related procurement of goods and services (Note 2) • Manufacturing of vehicles, facilities and infrastructure • Manufacturing of office equipment • Product take-back services for sold products (as a purchased service not handled by the organization itself)	Based on LCA (Note 3)
S3B	Capital Goods	• Computer-ware cradle-to-gate (Notes 4,5) • Related fuel and energy supply chain Optional: • Machinery (Note 6) production • Cradle-to-gate emissions from vehicles, facilities and infrastructure	Based on LCA
S3C	Fuel- and energy related activities not included in scope 1 or 2	• Fuel supply chain (Note 7) including transports. Infrastructure when data becomes available (Note 8) for fuel consumed by the reporting company • Energy supply chain including transports. Infrastructure when data becomes available (Note 9) for energy consumed by the reporting company	The whole supply chain has to be taken into account for electricity including infrastructure, land use; diffuse emissions of methane from oil and coal extraction; SF6 from transformer stations and handling of waste from electricity production Based on LCA. Electricity is of high importance for ICT industry. The fuel supply chain is also of great importance for other forms of energy (e.g., district heating) and for fuels consumed (incinerated) at sites.

	Category	ICT application	Comments
S3D	Upstream transportation and distribution	• Transports of products purchased by the organization (Note 10) (from supplier to the organization; between organization's facilities; to customer if paid by the organization) • Transports purchased by the organization • Related fuel supply chain Optional: • Manufacturing of vehicles, facilities and infrastructure • Storage during distribution • Consultants (Note 11) working outside facilities used by the organization	
S3E	Waste generated in operation	Optional: • Scope 1 and 2 emissions waste generated in operation that occur during disposal or treatment	Considered to be of low significance for ICT and does also have a high uncertainty
S3F	Business travel	• Air, road, rail and boat travel • Related Fuel supply chain Optional: • Manufacturing of vehicles, facilities and infrastructure	Over time the effects of teleworking are likely to affect these emissions and also results for employee commuting and other energy indirect GHG emissions (Note 12).
S3G	Employee commuting	• Air, road, rail and boat travel including public transports • Related fuel supply chain Optional: • Manufacturing of vehicles, facilities and infrastructure	Based on behavior statistics Over time the effects of teleworking are likely to affect these emissions and also results for employee commuting and other energy and/or indirect GHG emissions (Note 13).
S3H	Upstream leased assets	• Computer-ware cradle-to-gate (Notes 14,15) • Related fuel and energy supply chain Optional • Leased cars (Note 16) • Manufacturing of office equipment • Manufacturing of vehicles, facilities and infrastructure	
S3J	Downstream transportation and distribution	• Outbound transports ordered by the customer (Note 17) • Related fuel supply chain Optional: • Manufacturing of vehicles, facilities and infrastructure	
S3K	Processing of sold intermediate products	• Scope 1 and 2 during processing	

	Category	ICT application	Comments
S3L	Use of sold products	• Scopes 1 and 2 of use • Scopes 1 and 2 impact from use of support equipment necessary to operate the equipment (power supply and cooling) • Related fuel and energy supply chain Optional: • Support activities (indirect use phase emissions) including repair, servicing and maintenance of sold products	
S3M	EoLT of sold products	• Own disposal/treatment • Related fuel and energy supply chain Optional (due to uncertainty) • Scopes 1 and 2 during disposal/treatment	Based on LCA
S3N	Downstream leased assets	• Scopes 1 and 2 during operation • Related fuel and energy supply chain Optional • Manufacturing and construction	
S3O	Franchises	• Scopes 1 and 2 during operation • Related fuel and energy supply chain Optional: • Manufacturing and construction	
S3I	Investments	Optional: • Partially owned companies	Recommended that the legal unit reports its own emissions to avoid double accounting

NOTE 1 – Also, goods and networks, as defined in [ITU-T L.1410], are examples of indirect GHG emission sources

NOTE 2 – Services, e.g., finance, marketing, consultants and data traffic, could potentially be of interest for further studies in the future, but for the time being very little input data are available as a basis for inventories.

NOTE 3 – See 8.3.5.1.3

NOTE 4 – Use of PCs accounted for as "energy indirect GHG emissions"

NOTE 5 – Computerware includes PCs, servers, printers and copy machines etc. May in some organizations be part of leased assets

NOTE 6 – Machinery for production, development, test and repair

NOTE 7 – Lack of LCA data for district heating notified

NOTE 8 – Lack of data so far

NOTE 9 – Lack of data so far

NOTE 10 – It is assumed that other Scope 3 (e.g., S3A, S3B) emissions contain their own transports

NOTE 11 – Consultants located in the organization facilities should be accounted for as employees for practical reasons

NOTE 12 – Energy use in visited organization neglected due to methodological problems/ uncertainty in data

NOTE 13 – Energy use in visited organization neglected due to methodological problems/ uncertainty in data

NOTE 14 – Use of PCs accounted for as scope 2 GHG emissions

NOTE 15 – May in some organizations be part of Capital goods

NOTE 16 – Not recommended for inclusion because already included in commuting/business travels

NOTE 17 – It is assumed that other Scope 3 emissions contain their own transports

Appendix II

Examples of organizational activities to reduce GHG emissions and energy consumption

(This appendix does not form an integral part of this Recommendation.)

The following activities and initiatives are examples of energy consumption savings and GHG emissions reductions by enabling ICT solutions

- **Web-based service**

Many organizations use web sites for different kinds of services. People can download documents from the web sites at home using their PC or laptop at any time. Using web-based services, people can save the time taken to visit the organization. Hence, paper can be saved as well as GHG emissions can be avoided by not commuting to the organization.

- **Smart-Work including teleconferencing**

As a result of the distribution of high speed networks, many people choose to do smart-working using a smartphone, teleconferencing, etc. Especially, teleconferencing is beneficial to remotely located offices spread across the world.

- **Energy-efficient office machine**

Organizations use energy-efficient office machines such as fax machines, printers, etc. to reduce energy consumption and therefore GHG emissions. Moreover, organizations use energy-efficient lamps to reduce energy consumption. The energy-efficient lamp has a motion sensor and brightness sensor so that the lamp can be turned off, dimmed, brightened, etc. in response to human motion and the brightness required. Organizations can also turn off the lamp during lunch time and after work to reduce energy consumption and GHG emissions.

- **Green data centres**

Many organizations try to build green data centres to reduce GHG emissions and energy consumption. Data centres can consume large amounts of energy, so green technology is very important. [b-ITU-T L.1300] includes guidance on energy efficiency of data centres.

- **Building Energy Management System (BEMS)**

Organizations adapt BEMS by connecting electricity, gas, water supply, heating and cooling systems to a management system to save energy. The BEMS collects building information such as energy consumption.

Emerging Applications

- **Education**

Tele-education is an area that could grow rapidly, either as a substitute for traditional education or as a complement to it. It could improve the quality of learning in more specialized and advanced subjects. For equity as well as innovation, solutions could be provided that allow children living in rural areas to have the same quality of education as children in urban areas.

- **Health care**

One important area for an aging population is the use of different kinds of telemedicine and remote assistance services. Safety and health will always be the first priority in health care but by providing new ICT based infrastructures, new solutions will be possible once people get accustomed to the new technology.

By reducing the need to travel and overcoming the reluctance of many to go to the doctor, telemedicine could open up doors to preventive care that could reduce unnecessary suffering and waste of resources. This could also help to reduce the inequity in access to care between urban and rural areas.

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