International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

L.1430

(12/2013)

SERIES L: CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

Methodology for assessment of the environmental impact of information and communication technology greenhouse gas and energy projects

Recommendation ITU-T L.1430

ITU-T
ITU International Telecommunication Union

Recommendation ITU-T L.1430

Methodology for assessment of the environmental impact of information and communication technology greenhouse gas and energy projects

Summary

Recommendation ITU-T L.1430 is intended as a complement to ISO standard ISO 14064-2 and the Project Protocol of the Greenhouse Gas Protocol (GHG Protocol).

This Recommendation provides guidance for the application of a specific methodology to assess the environmental impact of information and communication technology (ICT) greenhouse gas (GHG) and energy projects. This assessment methodology is specifically directed at quantifying and reporting GHG emission reductions, GHG removal enhancements, energy consumption reductions, and enhancement of energy generation and storage in ICT GHG and energy projects.

An ICT GHG project uses mainly ICT goods, networks and services (GNS) and is designed to reduce GHG emissions or increase GHG removals that are quantified by comparison between the environmental impact of a project activity and a corresponding baseline scenario.

An ICT energy project uses mainly ICT goods, networks and services to reduce energy consumption and improve energy efficiency.

From the ICT perspective, this Recommendation takes into account considerations based on existing project quantification guidelines and aims at covering ICT GHG and energy project activities within both the ICT and the non-ICT sectors.

This Recommendation recognizes the importance of project validation and verification for the credibility of project results but does not enforce the validation and verification procedures to be applied. It is expected that such procedures will be determined by the selected GHG programme, national regulations, the project proponent's internal policy or the intended user's request.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T L.1430	2013-12-13	5	11.1002/1000/11904-en
1.1	ITU-T L.1430 Suppl. 1	2013-12-13	5	11.1002/1000/12118-en

Keywords

Clean development mechanism (CDM), climate change (CC), energy project, greenhouse gas (GHG) project, information and communication technology (ICT).

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

Table of Contents

Recommendation ITU-T L.1430

Methodology for assessment of the environmental impact of information and communication technology greenhouse gas and energy projects

1 Scope

This Recommendation describes principles, concepts, requirements and methods to provide specific guidance for assessment of the environmental impact of information and communication technology (ICT) greenhouse gas (GHG) projects and ICT energy projects. The methodology has been developed from the ICT perspective and is intended to assist in quantifying, monitoring and reporting GHG emission reductions or removal enhancements, energy consumption reductions, and enhancements of energy generation and storage in ICT GHG and ICT energy projects.

This Recommendation is a complement to [ISO 14064-2] and [b-Project Protocol] and provides additional requirements and guidance to complement [ITU-T L.1410] in:

- identifying GHG sources, sinks and storage systems relevant to ICT GHG projects
- identifying energy consumers, generators and storage systems relevant to ICT energy projects
- determining the baseline scenario
- identifying GHG sources, sinks and storage systems relevant to the baseline scenario
- identifying energy consumers, generators and storage systems relevant to the baseline scenario
- selecting relevant GHG sources, sinks and storage systems as well as relevant energy consumers, generators and storage systems for monitoring or estimating GHG and energy effects
- quantifying GHG emissions and removals as well as energy consumptions
- quantifying GHG emission reductions and removal enhancements as well as energy consumption reductions, and energy generation and energy storage enhancements
- managing data quality
- monitoring ICT GHG and energy projects
- documenting ICT GHG and energy projects
- validating and verifying ICT GHG and energy projects
- reporting on ICT GHG and energy projects.

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.1410] ITU-T L.1410 (2012), *Methodology for the assessment of the environmental impact of information and communication technology goods, networks and services*.

[ISO 14064-2] 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*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 carbon dioxide equivalent (CO2e) [ISO 14064-2]: A unit for comparing the radiative forcing of a GHG to carbon dioxide.

NOTE – The carbon dioxide equivalent is calculated using the mass of a given GHG multiplied by its global warming potential.

3.1.2 environmental load [ITU-T L.1410]: Environmental aspect which potentially causes interference with environmental conservation.

3.1.3 first order effects [ITU-T L.1410]: The impact created by the physical existence of ICTs and the processes involved, e.g., GHG emissions, e-waste, use of hazardous substances and use of scarce, non-renewable resources.

3.1.4 global warming potential (GWP) [ISO 14064-2]: Factor describing the radiative forcing impact of one mass-based unit of a given GHG relative to an equivalent unit of carbon dioxide over a given period of time.

3.1.5 greenhouse gas (GHG) [ISO 14064-2]: 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 – GHGs include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF6) and additionally Nitrogen Triflouride (NF3).

3.1.6 greenhouse gas (GHG) emission [ISO 14064-2]: Total mass of a GHG released to the atmosphere over a specified period of time.

3.1.7 greenhouse gas (GHG) emission reduction [ISO 14064-2]: A calculated decrease of GHG emissions between a baseline scenario and the project.

NOTE – The GHG emission reduction covers either decreases in relation to a hypothetical reference case or in relation to a real reference case as defined by the baseline scenario. Appendix IV includes more information.

3.1.8 greenhouse gas (GHG) removal [ISO 14064-2]: Total mass of a GHG removed from the atmosphere over a specified period of time.

3.1.9 greenhouse gas (GHG) sink [ISO 14064-2]: The physical unit or process that removes a GHG from the atmosphere.

3.1.10 greenhouse gas (GHG) source [ISO 14064-2]: The physical unit or process that releases a GHG into the atmosphere.

3.1.11 intended user [ISO 14064-2]: An individual or organization identified by those reporting GHG-related information as being the one who relies on that information to make decisions.

NOTE – The intended user can be the client, the responsible party, GHG programme administrators, regulators, the financial community or other affected stakeholders, such as local communities, government departments or non-governmental organizations.

3.1.12 monitoring [ISO 14064-2]: A continuous or periodic assessment of GHG emissions and removals or other GHG-related data.

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

3.1.14 stakeholder [ISO 14064-2]: An individual or organization that is affected by the development or implementation of a greenhouse gas project.

3.1.15 uncertainty [ISO 14064-2]: The parameter associated with the result of quantification which characterizes the dispersion of the values that could be reasonably attributed to the quantified amount.

NOTE – Uncertain information typically specifies quantitative estimates of the likely dispersion of values and a qualitative description of the likely causes of the dispersion.

3.1.16 validation [ISO 14064-2]: A systematic, independent and documented process for the evaluation of a greenhouse gas assertion in a GHG project plan against agreed validation criteria.

NOTE 1 – In some cases, such as in first-party validations, independence can be demonstrated by the freedom from responsibility for the development of GHG data and information.

NOTE 2 – The content of a GHG project plan is described in clause 7.1.

3.1.17 validator [ISO 14064-2]: Competent and independent person or persons with responsibility for performing and reporting on the results of a validation.

NOTE – This term can be used to refer to a validation body.

3.1.18 verification [ISO 14064-2]: A systematic, independent and documented process for the evaluation of a greenhouse gas assertion against agreed verification criteria.

NOTE – In some cases, such as in first-party verifications, independence can be demonstrated by the freedom from responsibility for the development of GHG data and information.

3.1.19 verifier [ISO 14064-2]: Competent and independent person, or persons, with responsibility for performing and reporting on the verification process.

NOTE – This term can be used to refer to a verification body.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 alternative baseline scenarios: Alternative technologies or practices within a specified geographic area and temporal range that could provide the same product or service as the project.

3.2.2 barrier: Any factor or consideration that would significantly discourage a decision to try to implement the project activity or its alternative baseline scenarios.

3.2.3 baseline impact: An estimated amount of GHG and energy effects associated with a baseline scenario or derived using a reference emission factor.

NOTE – A negative number for a baseline impact means that GHG removals are greater than GHG emissions; and energy consumption reductions, energy generation and energy storage enhancements are greater than energy consumptions.

3.2.4 baseline parameter: Any parameter whose value or status can be monitored in order to validate assumptions about baseline impact estimates or help to estimate baseline impacts.

3.2.5 baseline procedure: A method used to estimate baseline impacts.

3.2.6 baseline scenario: Either a hypothetical reference case that best represents the conditions most likely to occur in the absence of a proposed ICT GHG and/or energy project, or a real reference case where emissions are being generated and can be reduced by a proposed ICT GHG and/or ICT energy project (e.g., GHG emissions caused by an employee's business travel can be reduced by an ICT GHG and/or ICT energy project which includes video conference facilities).

NOTE 1 – The assessed time period of the baseline scenario concurs with that of the ICT GHG project/ or ICT energy project.

NOTE 2 – Appendix IV provides additional information.

3.2.7 emission factor: A factor linking GHG emissions to a level of activity or a certain quantity of inputs, products or services (e.g., tonnes of fuel consumed or units of a product).

NOTE – An electricity emission factor is commonly expressed as tonnes of CO2e per MWh. For example, an electricity emission factor of 1.3 means 1.3 t CO2e is emitted by consuming 1 MWh of electricity.

3.2.8 energy assertion: A declaration or factual and objective statement on the energy effects of project impacts, made by the responsible party.

NOTE 1 – The energy assertion may be presented in time scale or may cover a period of time.

NOTE 2 – The energy assertion provided by the responsible party should be clearly identifiable and allow consistent evaluation or measurement against suitable criteria by a validator or verifier.

NOTE 3 – The energy assertion could be provided in the form of an energy report or project plans of a GHG project, an ICT GHG project or an ICT energy project.

3.2.9 energy consumer: The physical unit or process that consumes energy.

3.2.10 energy consumption reduction: The decrease in energy consumption that is calculated between a baseline scenario and the project.

3.2.11 energy effect: The impact of energy consumption, energy consumption reductions and energy generation and energy storage enhancements on energy consumers, energy generators and energy storage.

3.2.12 energy generated: The calculated increase of the amount of energy generated by an energy generator between a baseline scenario and the project.

3.2.13 energy generator: The physical unit or process that generates energy.

3.2.14 energy storage system: The physical unit or component that has the capability to store or accumulate energy produced by an energy generator or energy captured from an energy consumer.

3.2.15 energy stored: The calculated increase of the amount of energy stored in an energy storage system between a baseline scenario and the project.

3.2.16 energy unit: The unit used for energy quantification. Energy units are expressed for electricity in MWh and for other energy types in tonne of oil equivalent (TOE).

NOTE – Energy units for an ICT GHG project or an ICT energy project may be converted to GHG units which may finally be represented by a certified emission reduction (CER), an emission reduction unit (ERU), credits or offsets, depending on the chosen GHG programme.

3.2.17 environmental load of an ICT [based on ITU-T L.1410]: The environmental load of an ICT over its life cycle. This includes the environmental load of ICT goods, networks and services (GNS) in the processes of a life cycle assessment (LCA), i.e., raw material acquisition, production, use and end-of-life treatment.

3.2.18 environmental load reduction effect from using ICTs [based on ITU-T L.1410]: The effect that noticeably reduces the environmental load of ICTs. The effects of improving energy efficiency, improving the efficiency of and reducing the production and consumption of goods, and reducing the movement of people and goods are brought about by using ICTs.

3.2.19 geographic area: A physical area that defines the analysis boundary of the baseline scenario, the alternative baseline scenarios and the project scenario. The area can be defined by a number of different elements including sociocultural, economic or legal factors, and the availability of the necessary physical infrastructure and biophysical characteristics.

3.2.20 greenhouse gas (GHG) assertion: A declaration or factual and objective statement on GHG effects of project impacts, made by the responsible party.

NOTE 1 – The GHG assertion may be presented in time scale or may cover a period of time.

NOTE 2 – The GHG assertion provided by the responsible party should be clearly identifiable and able to be consistently evaluated or measured against suitable criteria by a validator or verifier.

NOTE 3 – The energy assertion could be provided in the form of an energy report or project plans of a GHG project, an ICT GHG project or an ICT energy project.

3.2.21 greenhouse gas (GHG) effect: The consequence related to GHG emissions, removals, reductions and removal enhancements for GHG sources, sinks and storage devices.

3.2.22 greenhouse gas (GHG) programme: A generic term for: (1) any voluntary, mandatory, governmental or non-governmental initiative, system or programme that registers, certifies or regulates GHG emissions; or (2) any authorities responsible for developing or administering such initiatives, systems or programmes.

3.2.23 greenhouse gas (GHG) removal enhancement: A calculated increase in GHG removals between the baseline scenario and the project scenario.

NOTE – GHG removal enhancement corresponds to quantified GHG removal achieved by a project activity or set of project activities intended for the capture and storage of GHG. The use of ICT may enhance some GHG removals.

3.2.24 greenhouse gas (GHG) storage system: A 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 – The total mass of carbon contained in a GHG storage system at a specified point in time could be referred to as the carbon stock of the storage.

NOTE 2 – A GHG storage system can transfer greenhouse gases to another GHG storage system.

NOTE 3 – The capture of a GHG from a GHG source before it enters the atmosphere and its storage in a GHG storage system could be referred to as GHG capture and storage.

3.2.25 greenhouse gas (GHG) unit: A unit used for GHG quantification. GHG units are expressed in tonnes of CO2e.

NOTE – GHG units for GHG projects and ICT GHG projects may be represented by certified emission reduction (CER), emission reduction unit (ERU), credits and offsets according to the chosen GHG programme.

3.2.26 host participant: The participant on whose territory a project activity is physically located. A project activity located in several places may have several host participants.

3.2.27 ICT energy project plan: A document that describes the implementation plan of an ICT energy project.

3.2.28 ICT GHG project plan: A document that describes the implementation plan of an ICT GHG project.

3.2.29 ICT project activity: A project activity that incorporates mainly ICT goods, networks and services (GNS).

3.2.30 information and communication technology (ICT) project: A set of activities intended to implement a specific task that uses mainly ICT goods, networks and services. The task may consist of undertaking one or more ICT project activities with the ICT goods, networks and services.

3.2.31 information and communication technology (ICT) energy project: An ICT project that is designed to reduce energy consumption or enhance generation or storage of energy.

3.2.32 information and communication technology (ICT) greenhouse gas (GHG) project: An ICT project that is designed to reduce GHG emissions or increase GHG removals.

3.2.33 market response: A positive or negative reaction to a change in GHG emissions or energy consumptions as a result of project activity that affects market supply and demand.

3.2.34 off-grid electricity: Electricity not connected to the power grid.

3.2.35 one-time unintended changes: Unintended changes in GHG and energy effects related to the construction, installation and establishment of a project activity, or its decommissioning and termination.

3.2.36 other effects: [based on ITU-T L.1410] Effects that are not first or second order effects.

NOTE – Other effects may include the impacts and opportunities created by the aggregated effects on societal structural changes as a result of using ICTs. For some ICT services, such as teleworking or video conferencing, such effects may include the time gained by an end user using an ICT service which may then cause an additional impact e.g., a leisurely drive and economic activities, which are difficult to track. Such additional impacts are often defined as "rebound effects".

3.2.37 project activity: Any activity performed in a project which directly changes GHG emissions, removals or storage, energy consumptions, energy consumption reductions, energy generation or energy storage enhancements.

NOTE – The project activity may include modifications or alterations to an existing production, process, consumption, service, or management system, as well as the introduction of new systems. Activities related to management of the project are not considered as project activities in this Recommendation.

3.2.38 project activity impact: A quantified amount of GHG and energy effects produced by a project activity.

NOTE – The values of project activity impacts may be intermediate values issued by intermediate reports.

3.2.39 project impact: A quantified amount of GHG and energy effects produced by an ICT GHG or ICT energy project.

NOTE 1 – The values of project impacts may be intermediate values issued by intermediate reports.

NOTE 2 – A negative number for a project's impact means that GHG removals are greater than GHG emissions; and energy consumption reductions, energy generation and energy storage enhancements are greater than energy consumptions.

3.2.40 project participant: A participating organization that shares project benefits with other project participants and is either (a) an involved party that has indicated that it is a project participant, or (b) a private or public entity authorized by an involved party to participate in a project activity.

3.2.41 project plan documentation form: A documentation format to describe project activities of an ICT GHG project or an ICT energy project.

NOTE – The project plan documentation form for ICT GHG projects and ICT energy projects is specified in Appendix II.

3.2.42 project proponent: An organization that has overall control and responsibility for ICT GHG and energy projects.

3.2.43 project-specific procedure: A particular procedure to estimate baseline impacts that are based on the conditions specific to a project.

3.2.44 reference emission factor: A GHG emission factor used to determine baseline impacts for a particular type of project activity. A reference emission factor may be used to estimate baseline impacts for any number of similar project activities in the same geographic area.

3.2.45 reference emission factor procedure: A baseline procedure that estimates baseline impacts using a GHG emission factor derived from a numerical analysis of the GHG emission factors of all alternative baseline scenarios.

3.2.46 temporal range: A time period that defines the analysis boundary of the baseline scenario, the alternative baseline scenarios and the project scenario. The temporal range can be defined by a number of factors, such as the dominance of a single technology for an extended period of time, the diversity of options in a sector or region, or a discrete change in area or regional policy, technology, practice or resources.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AR	Assessment Report
CCX	Chicago Climate Exchange
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CO2	Carbon Dioxide
CO2e	Carbon Dioxide equivalent
CSR	Corporate Social Responsibility
EoLT	End-of-Life Treatment
ERU	Emission Reduction Unit
GHG	Greenhouse Gas
GNS	Goods, Networks and Services
GWP	Global Warming Potential
ICT	Information and Communication Technology
IPCC	Intergovernmental Panel on Climate Change
LCA	Life Cycle Assessment
QA/QC	Quality Assurance and Quality Control
tCO2e	Tonne of CO2 equivalent
TOE	Tonne of Oil Equivalent
UNFCCC	United Nations Framework Convention on Climate Change

5 Conventions

None.

6 Principles of assessment of ICT GHG and ICT energy projects

There are six principles that shall be applied to all aspects of the quantification and reporting of GHG and energy effects in order to ensure that the information on project results is a true and fair account.

6.1 Relevance

Relevant information on GHG sources, GHG sinks, GHG storage system, energy consumers, energy generators, energy storage system, and data and methodologies appropriate to the needs of intended users shall be selected. The quantification and reporting of GHG and energy effects shall thus include the information that intended users – both internal and external to an ICT GHG project or ICT energy project – need for their decision making and other purposes, such as internal and external communication. This information should fit the intended purpose of an ICT GHG project or ICT energy project and meet the expectations or requirements of intended users.

6.2 Completeness

All relevant GHG and energy effects shall be included, and all relevant information that may affect their quantification shall be considered and assessed. All relevant technologies or practices shall be considered as alternative baseline scenarios, and all relevant alternative baseline scenarios shall be considered when estimating baseline impacts.

6.3 Consistency

GHG and energy-related information, data, methodologies, criteria and assumptions shall allow meaningful and valid comparisons. To meet this objective:

- the same methodologies and procedures shall be applied to either an ICT GHG project or an ICT energy project and their components shall be applied in the same manner; and
- the same criteria and assumptions shall be used, and any data collected and reported shall be sufficiently compatible to allow meaningful and valid comparisons over time.

6.4 Accuracy

Bias and uncertainties with respect to GHG and energy measurements, estimates or calculations shall be reduced as much as possible. Acceptable levels of uncertainty will depend on the objectives of the ICT GHG project or ICT energy project in view of the needs of the intended user. If accuracy is sacrificed, data and estimates used to quantify GHG and energy effects shall be conservative.

6.5 Transparency

Sufficient and appropriate GHG- and energy-related information shall be provided to allow intended users to make decisions with reasonable confidence. For example, appropriate GHG- and energy-related information shall be compiled, analysed and documented in a clear, appropriate and coherent way that enables validators and verifiers to evaluate its credibility.

6.6 Conservativeness

The basic requirement is that GHG emission reductions, GHG removal enhancements, energy-consumption reductions, and enhancements of energy generation and energy storage related to the project shall not be overestimated. Conservative assumptions, values and procedures shall be used when data and factors are uncertain and measures to increase accuracy and reduce uncertainty are not cost-effective. Conservative quantification results will be underestimated rather than overestimated.

7 Introduction to ICT GHG and energy projects

7.1 ICT GHG and energy projects

The ICT GHG project is an ICT project which uses ICT goods, networks and services (GNS) to reduce GHG emissions, increase the capture and storage of GHG, or enhance GHG removals.

The ICT energy project is an ICT project which uses ICT goods, networks and services to reduce energy consumption and to enhance energy generation and storage.

An ICT GHG project or an ICT energy project may be implemented by any organization or company to reduce GHG emissions and energy consumptions. Both non-ICT and ICT activities may affect GHG emissions and energy consumption. For example, the establishment of a data centre may on the one hand incorporate activities for cooling and ventilation that are non-ICT activities and on the other hand include activities related to ICT goods, networks and services (GNS) systems that are ICT activities.

If an ICT GHG project or ICT energy project forms part of a general GHG project, the non-ICT-related activities of the GHG project are not addressed but are handled by existing GHG project methodologies; see [ISO 14064-2] and [b-Project Protocol].

An ICT network consists of a number of ICT goods that impact its GHG and energy effects. An ICT network incorporating various ICT goods may be used for ICT GHG and energy projects in any business or industrial sector. The ICT network itself may also be the target of such ICT GHG and energy projects.

An ICT service uses ICT goods and may also use ICT networks. Thus, the first order and second order effects of an ICT service may be analysed by assessing a combination of ICT goods and ICT networks. The ICT service itself may also be the target of ICT GHG and energy projects.

ICT GHG and energy projects may target the operational, industrial and commercial processes of ICT and other sectors where ICT goods, networks and services are installed to enhance their GHG and energy effects. Examples of ICT projects within the ICT sector are the establishment of energy-efficient networks, construction of energy-efficient base stations, establishment of a green and energy-efficient data centre, construction of optical fibre cables, installation of high performance and energy-efficient routers and switches, and installation of digital broadcasting systems. Appendix I lists other examples of ICT GHG and ICT energy projects.

Reduction of GHG emissions by ICT GHG and energy projects in non-ICT sectors may be achieved by ICT solutions which enable GHG and energy efficiency improvement in their industrial, commercial or operational processes. For example, projects related to ICT-based electricity networks (smart grids), ICT-based homes (smart homes), ICT-based buildings (smart buildings), ICT-based transportation and traffic flow, and ICT-based manufacturing processes where ICT has the potential to reduce GHG emissions and energy consumption in many different ways, including enhancements in the efficiency of the respective business process. Another example is optimized logistics for achieving better quality of service for receivers while reducing the overall driving distance and total fuel requirements. Appendix I provides more detailed information.

For quantification of first and second order effects of ICT GHG projects and ICT energy projects see clauses 11.2.3 and 11.2.4.

7.1.1 Project activities

ICT project activities are any activities which use mainly ICT GNS and are performed in an ICT project to change GHG emissions, removals or storage, energy consumptions, energy consumption reductions, energy generation or energy storage enhancements. Examples of such activities in the ICT sector are: replacement of existing ICT goods with energy-efficient ICT goods; reconfiguration of processing procedures and interconnection architectures of ICT goods, networks and services; rebuilding of software functions in ICT goods; recycling of ICT goods; virtualization of ICT goods and networks; and utilization of electric energy generated by renewable energy sources such as solar and wind power. ICT GHG and ICT energy projects may have diverse activities but their results will contribute to the improvement of the total GHG and energy effects compared to the baseline scenario.

An ICT project, or part of an ICT project, may target an ICT GNS product system. For quantification of first and second order effects of ICT GHG/energy projects, see clauses 11.2.3 and 11.2.4. If an ICT project activity involves multiple ICT GNS product systems, its second order GHG and energy effects could be quantified via summation of the second order effect of those ICT GNS product systems. Clause 11.2.4 describes how the quantification is made per ICT GNS product system and reference product system.

7.1.2 GHG sources and energy consumers

GHG sources are described in [b-Project Protocol]. GHG sources and energy consumers affected by an ICT project shall be identified to determine the GHG and energy effects of the ICT project. GHG sources and energy consumers are mitigated by the ICT project activities.

7.1.3 GHG sinks and energy generators

The energy generator is a physical unit or process that generates energy from energy sources such as wind, solar, tide, and fossil fuels, or that captures and generates energy from energy consumers. For example, reused waste heat from data centres is energy that is captured and generated from an energy consumer, e.g., the data centre.

ICT GHG and energy projects do not result directly in GHG removals; however, use of ICT goods, networks and services may improve the performance of GHG sinks. GHG sinks affected by an ICT project activity shall be identified to determine the GHG effects of the ICT project activity.

Energy generators affected by an ICT project activity shall be identified to determine the energy effects of the ICT GHG and/or ICT energy projects related to energy consumptions, energy consumption reductions, and enhancements of energy generation and energy storage. For example, an ICT GNS system may help to generate electric energy from renewable energy sources more efficiently.

7.1.4 GHG storage and energy storage

A GHG storage system may include ICT goods and may be maintained and managed over an ICT network by an ICT service; but the storage itself is not achieved by the use of ICT. Its performance, however, may be improved by the use of ICT goods, networks and services, which would contribute to the overall effects of the ICT GHG project and/or ICT energy project.

A typical example of an energy storage system is a battery which stores electric energy provided by the power grid or by renewable energy sources such as solar and wind power.

Different types of energy may be stored, such as electric energy, thermal energy and molten salt. Surplus electric energy may be stored in the form of ice or hot water for later use as thermal energy. Energy storage systems may be employed to balance energy demand between daytime and night-time to improve energy efficiency, since stored energy can reduce peak energy demand.

The amount of energy stored in energy storage systems may be affected by the self-discharge rate of energy storage. The self-discharge rate may depend on environmental conditions, e.g., temperature. This kind of self-discharge shall be considered while quantifying baseline and project impacts.

NOTE – An example of a self-discharge rate is that of electric batteries – disposable electric batteries typically lose from 8 to 20 per cent of their original charge every year at room temperature (20-30^{o}C).

7.2 Adoption of a GHG programme

A GHG programme is a system or scheme external to the organization or GHG project that registers, accounts or manages GHG emissions, GHG reductions, GHG removals, or GHG removal enhancements. The GHG programme may be voluntary or mandatory. The GHG programme may be international, national or sub-national.

GHG programmes may have different requirements. For example, the prerequisite conditions of the United Nations Framework Convention on Climate Change (UNFCCC) for Clean Development Mechanism (CDM) projects [b-Kyoto Protocol], such as prior consideration and additionality, may be optional or mandatory depending on the GHG programme. The validation and verification processes may be optional or mandatory depending on the GHG programme.

The project proponent may choose to adopt a certain GHG programme. If the project proponent adopts a GHG programme, the requirements of that GHG programme are additional to the requirements of this Recommendation. If a requirement of this Recommendation prohibits an organization or project proponent from complying with a requirement of the GHG programme, the requirements of the GHG programme shall take precedence.

7.3 Quantification units and emission factors

This Recommendation specifies the quantification units for GHG and energy effects of ICT GHG/energy projects. The quantification units are tonnes of carbon dioxide equivalent (CO2e) for GHG effects, MWh for energy effects related to electricity, and tonnes of oil equivalent (TOE) for energy effects related to other energy types. One GHG unit is generated by the reduction of one tonne of CO2e. The electricity unit is specified separately because electric energy is the major energy type involved in the ICT sector.

Electric power consumption, as well as other energy consumptions, may be converted into GHG emission values through various emission factors. Basically, the GHG effects shall be quantified in the GHG unit (i.e., tonnes of CO2e) and the energy effects shall be quantified in the energy unit (i.e., MWh for electric energy and TOE for other energy types). If it is required that energy project results be quantified and reported in the GHG unit only, then the energy project results can be converted from the energy unit (i.e., MWh or TOE) into the GHG unit. The decision about whether quantification and reporting are in both the energy unit and the GHG unit, or only in the GHG unit, depends on the GHG programme adopted, national regulations, requirement of intended users or internal policy, or any other conditions.

NOTE 1 – Relevant unit conversions are 1 W = 1 kg m^2 s^{-3}; 1 J = 1 Ws; 1 kWh= 3,600,000 J; and 1 TOE = 41.868 GJ, 11,630 kWh, or 11.63 MWh.

NOTE 2 – In this Recommendation, tonnes always refer to metric tonnes and the notation for a tonne of CO2e is tCO2e, which implies that 1 million tonnes CO2e is equivalent to 1 MtCO2e and 1 billion tonnes CO2e is equivalent to 1 GtCO2e.

7.4 Consideration of life cycle assessment

In alignment with Part II of [ITU-T L.1410], the second order effects of an ICT project should be assessed by comparing the emission levels when the project is applied with those of the reference scenario. Thus, a full assessment of the project's second order effects inherently includes the first order effects of the project and the reference scenario. The incorporation of the first order effects means that the environmental load of ICTs is assessed together with environmental load reductions from using ICTs. The total first order effects cover the full life cycle.

For ICT GHG and ICT energy projects, the GHG and energy effects of the projects should preferably be considered for the projects' full life cycle but may be quantified focusing only on the most significant stage, e.g., the use stage.

NOTE – For project assessments, other standards or guidelines do not require that a life cycle perspective be applied. However, this Recommendation specifies consideration of embodied emissions and includes the total first order effect assessment.

The principle of consistency in quantification described in clause 6.3 should apply to ICT GHG projects and ICT energy projects. Accordingly, if a life cycle assessment (LCA) analysis based on Part II of [ITU-T L.1410] applies to the project scenario of an ICT GHG/energy project, it should also apply to the corresponding baseline scenario and both results shall be compared on the basis of

Part II of [ITU-T L.1410]. If it is not possible to assess the baseline scenario from a life cycle perspective, the principle of conservativeness applies and a life cycle perspective should preferably be applied for the ICT GHG/energy project.

7.5 Project cycle of an ICT GHG/energy project

The project cycle is characterized by two phases: the planning phase and the implementation phase (refer to Appendix III for details). The planning phase may be certified by a third-party validation process and the implementation phase may be certified by a third-party verification process. The process depends on a selected GHG programme, national regulations, request of intended users, or internal policies.

If the validation process is required, only those ICT GHG and ICT energy projects that have been approved by the validation process are allowed to start. ICT GHG/energy projects may be certified by both the validation and the verification process when validation is an initial approval process for eligibility of the project plan, before project implementation. The verification process is then a post-approval process for affirmed project results on completion of ICT project activities.

It shall be noted that validation and verification may be mandatory or optional according to the chosen GHG programme, national regulations, requests of intended users, or internal policies. The level of validation and verification assures credibility of project results.

The project cycle steps of ICT GHG/energy projects may vary depending upon the scale and specific circumstances. Figure 2 of [ISO 14064-2] shows a typical GHG project cycle which illustrates some specific cycle steps and is also applicable to ICT GHG and ICT energy projects.

8 Planning of ICT GHG and ICT energy projects

8.1 General requirements

Since ICT GHG and ICT energy projects are basically GHG projects, the general requirements contained in clause 5.1 of [ISO 14064-2] shall apply to them.

The project proponent of an ICT GHG/energy project shall ensure that the project conforms to relevant requirements of the chosen GHG programme to which it subscribes (if any), including eligibility or approval criteria, relevant legislation or other requirements.

The project proponent shall identify, consider and use relevant and current good practice guidance. A national GHG registry may provide good practice guidance for various industrial sectors. Project proponents need to check whether relevant practice guidance is provided or not. UNFCCC may also have relevant information on methodologies and practice guidance.

NOTE – Since the ICT sector has a variety of ICT technology employment projects, the corresponding good practice guidance would be developed and may be utilized for other ICT GHG/energy projects. Through ITU-T Recommendations, ITU-T may maintain good practice guidance for various ICT GHG and ICT energy projects.

8.2 Defining the boundary for assessment of an ICT GHG/energy project

8.2.1 Defining the boundary for assessment of GHG and energy effects

The assessment boundary of GHG and energy effects shall be defined. The assessment boundary shall be defined by two aspects: first order effects and second order effects. If the assessment boundary covers the full life cycle, the LCA analysis shall apply to all applicable constituents of the ICT project according to the guideline of clause 7.4. If the assessment boundary covers only the most significant stage, this stage shall be assessed for all project activities as specified in clause 7.4.

An ICT GHG/energy project may consist of multiple project activities based on one or more ICT GNS product systems and these project activities cause first order effects and also produce second

order effects. Defining GHG and energy assessment boundaries corresponds to analysing all the first order effects and second order effects produced by all project activities of an ICT GHG/energy project. This work will involve:

a) identification of project activities of the ICT GHG/energy project; and

b) identification of first order and second order effects associated with each project activity.

8.2.2 Identifying project activities

An ICT project may involve only one ICT GNS product system or multiple ICT GNS product systems. Relevant project activities of an ICT GHG/energy project shall be identified and their employed ICT GNS product systems shall also be described. The assessed project activities should be limited to activities impacted by the ICT solutions. A base station rebuilding project may have two main project activities. For example, the first main project activity may be the replacement of old, energy-inefficient ICT GNS product systems with new, high energy-efficient ICT GNS product systems. The second main project activity may be a change from a non-renewable electricity supply to electricity produced from renewable energy sources such as solar and wind, where corresponding devices are installed together with base station systems.

8.2.3 Identifying GHG sources, sinks and storage, and energy consumers, generators and storage systems

The project proponent shall select or establish criteria and procedures for identifying and assessing GHG sources, sinks and storage, and energy consumers, generators and storage systems related to, or controlled or affected by the ICT GHG/energy project. Clause 7.1 describes a brief introduction to them.

Based on selected or established criteria and procedures, the project proponent shall identify GHG sources, sinks and storage, and energy consumers, generators and storage systems, as being:

a) related to the ICT GHG/energy project

b) controlled by the project proponent

c) affected by the ICT GHG/energy project.

In a base station rebuilding project, for example, a source of direct GHG emissions may exist if high voltage electric power using SF6 for insulation of a power system is used. The devices of a base station system are considered as energy consumers, electric energy generators from the solar and wind powers are energy generators, and batteries are energy storage systems.

8.2.4 Identifying second order effects

The GHG and energy effects of an ICT GHG/energy project are achieved by intervening actions against relevant GHG emission sources and energy consumers, as described in clause 7.1.2. The project proponent shall identify which type of second order effect can be achieved. Table 4 of [ITU-T L.1410] shows some examples of categories of second order effects.

A project activity may cause unintended changes in GHG and energy effects and they should be assessed according to the informative guidelines of Appendix V. Other effects as defined by [ITU-T L.1410] may be considered if possible.

8.3 Determining the baseline scenario of the ICT GHG project or ICT energy project

GHG emission reductions, removals and removal enhancements are quantified as the difference between the GHG emissions from GHG sources, sinks and storage relevant for the baseline scenario, and the project activity scenario relevant for the ICT GHG/energy project.

Energy consumption reductions and enhancements of energy generation and/or energy storage are quantified as the difference between the energy consumptions from energy consumers, generators

and storage systems relevant for the baseline scenario, and the project activity scenario relevant for the ICT GHG/energy project.

A project scenario and its baseline scenario may be composed of one or more product systems which could be assessed and compared independently.

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

a) the technical project description, including identified GHG sources, sinks and storage, and/or energy consumers, generators and storage systems (see clause 8.2.3);

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

c) data availability, reliability and limitations; and

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

In developing the baseline scenario, the project proponent shall select the assumptions, values and procedures that help ensure that the GHG and energy effects brought by the ICT GHG/energy project are not over-estimated. For instance, a baseline scenario may be the continuation of ongoing activities without implementation of the ICT GHG/energy project.

There may be barriers associated with the implementation of an ICT GHG/energy project. For instance, barriers may be related to economic costs or lack of available resources, in which case the ICT GHG or ICT energy project may be qualified as "additional", relative to the baseline scenario as the ICT project would otherwise probably not have been implemented due to the barriers.

NOTE – Additionality is a criterion applied to ICT GHG and ICT energy projects, stipulating that GHG emission reductions and/or removal enhancements should be quantified only if the project activity (or the same technologies or practices it employs) would not have been implemented in its baseline scenario, and/or the project activity impacts are lower than baseline impacts. Thus, ICT GHG projects shall only be those intended for GHG emission reductions and/or removal enhancements, without regulatory enforcement and economic advantages. For example, if an ICT employment project is imposed by a regulation, its GHG effects do not have to be respected; if an ICT employment project incurs higher costs than benefits, it cannot be implemented due to economic reasons but shall be considered as additional. Consequently, its GHG effects can be rewarded with an economic incentive programme such as GHG emission allowances within GHG emission trading systems. The additionality is a prerequisite for UNFCCC CDM projects. However, national GHG programmes can selectively impose the additionality. For example, even though an ICT employment project has more economic advantages than cost burdens, it may be considered as additional and can be rewarded with an economic incentive.

Some GHG programmes have very strict additionality requirements, as part of strict eligibility criteria. If assessment of the GHG impact of the ICT GHG/energy project is done in view of participation in such a GHG programme, the determination of the baseline scenario shall strictly comply with the requirements of the GHG programme under consideration.

The additionality requirement may be mandatory or optional. This Recommendation does not enforce either way. GHG programmes, national regulations, requests of intended users, or internal policies may specify whether the additionality requirement is mandatory or optional.

If the additionality requirement is mandatory, the project proponent shall select or establish, justify and apply criteria and procedures to demonstrate that the project results in GHG effects and energy effects are additional to those that would occur in the baseline scenario.

8.3.1 Selecting a baseline procedure

This Recommendation defines two procedures for estimating baseline impacts associated with each second order effect of a project activity: project-specific procedure and reference emission factor procedure, as specified in clauses 8.3.3 and 8.3.4.

NOTE 1 – There may by similar project activities within a geographic area which will have very similar environmental conditions. For example, the installation of fibre optic cables and of coaxial cables may each be considered as a project activity. Construction of base stations may be another project activity. A GHG emission factor may be used to estimate the impact from this kind of project activities. For example, a GHG emission factor may be calculated per 100-metre installation of fibre optic cables. The reference emission factor procedure is very appropriate for this kind of project activity.

NOTE 2 – If project activities are unique and have different conditions and characteristics, they have to be analysed individually to develop their individual baseline scenarios. This is referred to as the project-specific procedure.

For each second order effect associated with a project, the project proponent shall select and justify the choice of procedure used to estimate baseline impacts.

Clause 6 of [b-Project Protocol] may be referred to for guidance on how to select and justify a baseline procedure. It is a general guidance and is also applicable to activities of ICT GHG and ICT energy projects.

A combination of baseline procedures is allowed. A project may consist of various project activities where one project activity may use a reference emission factor procedure and another project activity may use a project-specific procedure.

NOTE 3 – For example, a green data centre construction will involve many and varied ICT goods, networks and services as well as non-ICT equipment. A reference emission factor procedure cannot be developed for the whole data centre construction project but a project-specific procedure may be developed. The project, however, may incorporate a number of container-type data centre modules where a reference emission factor procedure may be developed for the data centre module, resulting in a case where the different procedures are combined.

8.3.2 Identifying the alternative baseline scenarios

For each project activity, the project proponent shall develop a complete list of alternative baseline scenarios that will be used in the project-specific and reference emission factor procedures to represent possible alternatives to the project activity. Alternative baseline scenarios are alternative technologies or practices within a specified geographic area and temporal range that could provide the same function or service as the project activity. They can involve both existing and potential technologies and practices.

The information contained in clause 7 of [b-Project Protocol] gives a general guidance and is also applicable to activities of ICT GHG and ICT energy projects.

8.3.3 Estimating baseline impacts – project-specific procedure

The project-specific procedure produces an estimate of baseline impacts for second order effects of a project through analysing a baseline scenario of the project.

The information of clause 8 of [b-Project Protocol] gives a general guidance and is also applicable to activities of ICT GHG and ICT energy projects.

8.3.4 Estimating baseline impacts – reference emission factor procedure

8.3.4.1 Type of reference emission factors

The reference emission factor procedure may be based on secondary data and analyses the existing GHG emission factors of all alternative baseline scenarios to construct a reference emission factor against which project activity impacts and consumption can be compared. The reference emission factor is used to determine baseline impacts for second order effects of a project which consists of similar project activities and can be quantified by a numerical aggregation of the GHG emission factors of representative project activities. Once the project proponent develops reference emission factors for a project activity, it may be used to compare similar project activities. The project proponent should update the reference emission factors periodically to reflect changing circumstances within the relevant geographic area and/or temporal range identified.

For all alternative baseline scenarios, the GHG emission factors of a reference emission factor procedure may be expressed as an amount of GHG emissions per produced unit of a product or service. This type of reference emission factor is referred to as a production-based reference emission factor. Many ICT GHG and ICT energy project activities may be assessed by production-based reference emission factors.

For project activities involving storage or removals of CO2e by biological processes, fugitive emissions, or waste emissions – where there is no easily measurable production of a product or service – the reference emission factor will usually be defined as a rate of GHG emissions (or removals) per unit of time and size or capacity of the alternative baseline scenarios. This type of reference emission factor is referred to as a time-based reference emission factor.

Table 9.1 of [b-Project Protocol] describes the two types of reference emission factors: production-based and time-based. For example, an ICT GHG/energy project activity may be the installation of optical fibre cables and its performance may be accounted per unit of installation distance (e.g., 100 m or 1 km). Such a distance-based reference emission factor is classified as a production-based reference emission factor. For the time-based reference emission factor, a typical example is a reference emission factor for one-hour teleconference which can also be applied to a 100-hour teleconference.

8.3.4.2 Guidance for the reference emission factor procedure

The information provided in clause 9 of [b-Project Protocol] gives a general guidance and is applicable to ICT GHG and ICT energy activities.

8.4 Designing data quality management

Data quality management corresponds to the monitoring plan of an ICT GHG/energy project, as specified in clause 10. Specifically the following points should be considered to design the data quality management plan:

a) There may be different emission factors for the same product provided within the same geographic area and/or temporal range due to non-harmonized, unorganized or unregulated market and business situations or an initiative competition. In this case, the chosen emission factor shall be justified.

b) If baseline impacts are estimated dynamically, baseline parameters may include emission factors or other variables that directly determine baseline impact over time. For example, a GHG emission factor for electricity may be updated annually and baseline impacts will be affected by this annual update.

The project proponent shall consider product-specific limitations. For example, the self-discharge problem for energy storage systems should be considered to cope with the problem (refer to clause 7.1.4).

8.5 Describing an ICT GHG project or ICT energy project

Proponents of an ICT GHG/energy project should incorporate a description of the project and its context in a project plan that includes the following:

a) The title of the ICT GHG/energy project: the title is recommended to focus on ICT-perspective activities for GHG and energy effects.

b) The purpose(s) and objective(s) of the ICT GHG/energy project: a general description of the project shall be summarized, including the purpose(s) and objective(s) (e.g., internal company strategy in such areas as corporate social responsibility (CSR), voluntary or mandatory commitment, economic incentives and national regulation).

c) The type of ICT GHG or ICT energy project: refer to Appendix I for details. Appendix I does not provide an exhaustive list of types of ICT GHG/energy projects. If the list given in Appendix I is not applicable, a new type of project by key characteristics may be specified, or this item may be ignored.

d) The project participants: the names, roles and responsibilities of the project proponent and other project participants shall be described, including their contact information.

e) The location of the ICT GHG/energy project, including host participant(s), and geographic and physical information allowing the unique identification and delineation of the specific extent of the GHG project. The project may consist of a set of project activities that may be hosted and undertaken by other project participants. The names and location information shall be described for each host participant.

f) The conditions prior to project initiation: any condition that affects the ICT GHG/energy project and its initiation shall be described.

g) A description of the ICT GHG/energy project: how the project will achieve GHG emission reductions, GHG removals and removal enhancements, energy consumption reductions, and enhancements of energy generation and storage shall be described. Its project activities also shall be described.

h) ICT GNS product systems to be employed by the ICT GHG/energy project: ICT GNS product systems incorporated in each project activity of the project shall be described.

i) An estimated amount of GHG and energy effects over the chosen period, stated in tonnes of CO2e, TOE or MWh.

j) An identification of risks that may substantially affect the project's GHG and energy effects.

k) Information about stakeholders: a description is provided of relevant regulator(s), practitioners or administrators of any GHG programme(s) to which the ICT GHG/energy project subscribes.

l) Any information relevant for the eligibility of an ICT GHG/energy project under a GHG programme, and quantification of emission reductions or removal enhancements, including legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and temporal information.

m) A summary environmental impact assessment when such an assessment is required by applicable legislation or regulation.

n) Relevant outcomes from stakeholder consultations and mechanisms for ongoing communication.

o) A chronological plan for the date of initiating project activities, date of terminating the project, frequency of monitoring and reporting and the project period, including relevant project activities at each step of the project cycle.

p) Public funding of the ICT GHG/energy project: if any public funding is incorporated for the project, it shall be described.

q) A sampling plan for validation and/or verification: there may be hundreds of thousands of check points for validation or verification. On-site validation and verification checks may in reality be impossible, in which case a reasonable sampling plan is required.

The above list is not exhaustive and the following clauses include additional items to be described in the ICT GHG/energy project plan. Any description requirement shall be satisfied in the ICT GHG/energy project plan, depending on the level of requirement.

Other items may be added and described to fit the intended purpose of an ICT GHG/energy project.

9 Validation of an ICT GHG or ICT energy project

Any assertion of GHG effects and energy effects produced by the ICT GHG/energy project may be required to be validated. Such validation may be mandatory or optional and may be performed according to [b-ISO 14064-3]. This Recommendation does not enforce either way. GHG programmes, national regulations, requests of intended users, or internal policies may specify whether the validation is mandatory or optional.

If validation is optional, the ICT GHG/energy project plan may be validated via a voluntary self-evaluation carried out by an internal company assessment team or any other assessment/verification entity. The voluntary self-evaluation process may follow the requirements and guidance provided in [b-ISO 14064-3].

If validation is mandatory, the ICT GHG/energy project plan shall be validated according to [b-ISO 14064-3]. Thus its validation shall be performed by a third-party validation body before the ICT GHG/energy project begins implementation. As a result, only validated ICT GHG and ICT energy projects are allowed to be implemented. The project proponent shall choose a validation body and submit the project plan for validation to it.

NOTE – In the case where it is inefficient to validate all the information described in an ICT GHG/energy project plan, a risk-based validation approach, i.e., sampling-based validation as described in section A.2.4.6 of [b-ISO 14064-3], may be used. The project proponent should provide a sampling plan with adequate evidence to support the expected level of assurance. If a sampling plan for validation and/or verification is provided with its justification, the validation body shall evaluate whether the sampling plan is justified or not under the quantification principles of the ICT GHG/energy project, as specified in clause 6. The sampling plan for validation checks by a validation body may be in conflict with the validation standard. The sampling plan shall be submitted for consultation and negotiation to the GHG programme authorities, relevant national authorities or other responsible entities.

10 Project monitoring of an ICT GHG or ICT energy project

The information contained in clause 10.1 of [b-Project Protocol] is a general guidance for monitoring project activity impacts and baseline parameters with quality assurance and quality control (QA/QC) measures. It is also applicable to ICT GHG/energy project activities.

Additional points for consideration are:

a) The project monitoring should accommodate the data quality management plan described in clause 8.4.

b) Monitoring GHG and energy effects for ICT GHG/energy project activities can be achieved through:
   - direct measurement of GHG emissions (e.g., measuring GHG emissions from a cooling device built in an ICT good),
   - direct measurement of electric energy consumption and generation,

– indirect measurement of GHG and other energy effects combined with calculations (e.g., calculating GHG effects from energy consumption data or calculating sequestered carbon from measured tree diameters).

NOTE – Clause 8.3.4.2 of [ITU-T L.1420] includes a detailed description on how to recalculate activity data into emission values for ICT organizations.

11 Quantification of an ICT GHG or ICT energy project

11.1 Requirements

11.1.1 General requirements

Section 5.7 of [ISO 14064-2] includes some general requirements and guidance for quantification of project results. They are also applicable to ICT GHG/energy projects.

Additional requirements for quantification of project results are specified as follows:

a) When the first order effects are quantified, the valid time length for the use stage in a life cycle shall be identified and justified for each ICT GNS product system.

b) The most recent global warming potential (GWP) values from IPCC for each kind of GHG emission should be used when baseline impacts and project impacts are quantified for each project activity of an ICT GHG/energy project.

NOTE – Clause 10 of [b-Project Protocol] contains additional information on what to be considered for project quantification. A future amendment or revision of this Recommendation may include additional requirements with normative reference to [b-Project Protocol].

11.2 Guidance for quantifying GHG and energy effects

11.2.1 General guidance

Quantification of an ICT GHG project or ICT energy project quantifies GHG reductions – i.e., GHG effects, and energy consumption reductions – i.e., energy effects. All GHG removals, reductions and removal enhancements are accumulated to GHG reductions. All energy consumption reductions and enhancements of energy generation and energy storage are accumulated to energy consumption reductions.

Quantification of GHG and energy effects for the baseline scenario and the project result may be performed using the same basic procedures. The quantification is calculated by the difference between baseline impacts and project activity impacts. Project activity impacts are quantified once the ICT GHG/energy project has been implemented.

Quantification of baseline impacts and project impacts shall be conducted through LCA results, based on Part II of [ITU-T L.1410], against ICT goods, networks and services if LCA considerations apply additionally to the ICT goods, networks and services adopted in the ICT GHG/energy project. Where the baseline impacts are quantified via calculation of reference product systems and the project impacts are quantified via calculation of ICT GNS product systems, the quantification shall be conducted in the same manner according to the consistency principle.

11.2.2 Identifying the time period for quantifications

The project proponent should select a time period for the use stage of an ICT GNS product system and corresponding reference product system in order to quantify the first order effects of those two systems.

The project proponent should select a valid time period for the project scenario and its corresponding baseline scenario to quantify GHG and energy effects produced by each scenario. The time period is selected per project activity and an ICT GHG/energy project may have multiple time periods for its project activities.

However, the time period is subject to uncertainty and shall be justified. The principle of conservativeness should be applied when selecting the time period. Alternatively, the project proponent may choose a standard valid time period prescribed by an existing GHG programme.

The following questions may help the project proponent to justify a selected time period:

- How quickly are economic conditions changing?
- How quickly are changes occurring in the technologies or practices providing the same ICT goods, networks or service as the project activity?
- At what point are the criteria and assumptions used to identify the geographic area or temporal range for alternative baseline scenarios likely to change?
- When might the barriers (or net benefits) faced by the project activity or alternative baseline scenarios change significantly?
- If the project activity involves a retrofit, when would the retrofitted equipment have otherwise reached the end of its useful lifetime?
- Are baseline impact estimates static or dynamic?

For example, the valid time period could be five years when the market penetration of an energy efficiency technology could reach 33 percent within five years, and then the improvement in energy efficiency would be considered as common. As another example, if switching from video tapes to digital storage systems takes ten years to become popular, the valid time period will be ten years. If a technology evolution for improvement in energy efficiency is made at three years, then its valid time period is three years. In the case of an ICT GHG/energy project greening a data centre, a variety of project activities may be incorporated and each project activity may have a selected time period with justification.

11.2.3 Quantifying first order effects

The following formulas should be used to quantify the first order effects for each ICT GNS product system and reference product system incorporated in each project activity. Their quantification is conducted via Part I of [ITU-T L.1410]. Quantification of the first order effects for a project is applicable when the reference system is also an ICT GNS system:

First order GHG effects = $\sum_a$ (Reference System GHG Emission$_{nta}$ – Project System GHG Emission$_{nta}$)

where:

Reference System GHG Emission: GHG emission during the life cycle of each reference product system, *n*, of each project activity, *a*, with the use time, *t*, in the unit, (t CO2e).

Project System GHG Emission: GHG emission during the life cycle of each ICT GNS product system, *n*, of each project activity, *a*, with the use time, *t*, in the unit, (t CO2e).

First order energy effects = $\sum_a$ (Reference System Energy Consumption$_{nta}$ – Project System Energy Consumption$_{nta}$)

where:

Reference System Energy Consumption: Energy consumption during the life cycle of each reference product system, *n*, of each project activity, *a*, with the use time, *t*, in the unit, (MWh or TOE).

Project System Energy Consumption: Energy consumption during the life cycle of each ICT GNS product system, *n*, of each project activity, *a*, with the use time, *t*, in the unit, (MWh or TOE).

11.2.4 Quantifying second order effects

The second order effects by each project activity are presented as GHG reductions and energy consumption reductions. The second order effects are quantified by summation of changes of emissions of each project activity for each year of the valid time length of the ICT GHG/energy project.

As shown in Figure 1, related to the second order effects, GHG and energy effects of each ICT GNS product system of each ICT project activity of an ICT GHG/energy project are quantified by comparison with those of each reference product system of each ICT project activity through Part II of [ITU-T L.1410].

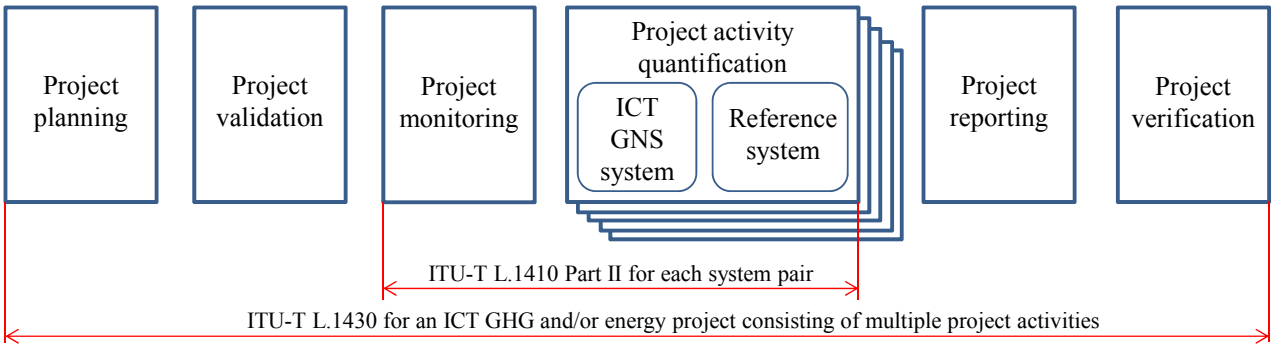

Figure 1 – Quantification boundary

11.2.4.1 Quantifying second order effects by GHG effects

The following formulas should be used to quantify the second order effects by GHG effects for each ICT GNS product system and reference product system incorporated in each project activity of an ICT GHG/energy project. Their quantification is conducted via Part II of [ITU-T L.1410]:

Second order effect by GHG Reduction$_y$ (t CO2eq) = $\sum_a$ Project Activity Reduction$_{ay}$;

where:

Project Activity Reduction$_{ay}$ = $\sum$[Baseline Impacts$_{ay}$ – Project Activity Impacts$_{ay}$]

Baseline Impacts$_{ay}$ = $\sum_r$ Reference Product System Emission$_{ayr}$

Baseline Impacts$_{ay}$: baseline GHG emissions for each project activity, *a*, in year *y* (in t CO2e for GHG); and

Reference Product System Emission$_{ayr}$: baseline GHG emissions for each reference product system, *r*, of each project activity, *a*, in year *y* (in t CO2e for GHG)

Project Activity Impacts$_{ay}$ = $\sum_i$ ICT GNS Product System Emission$_{ayi}$

Project Activity Impacts$_{pay}$: project activity impacts for each project activity, *a*, in year *y* (in t CO2e for GHG)

ICT GNS Product System Emission$_{ayi}$: project activity GHG emissions for each ICT GNS product system, *i*, of each project activity, *a*, in year *y* (in t CO2e for GHG)

The year in the formulas is not static. If the quantification time period is less than one year, the quantification time period shall not be normalized to one year and it shall apply as it is.

Since the time period is selected per project activity and an ICT GHG/energy project may have multiple time periods for project activities, a calculation result by the quantification time period of less than one year shall not be normalized to one year when a yearly quantification is performed. The calculation result shall be accumulated as it is to the one-year quantification result.

11.2.4.2 Quantifying second order effects by energy effects

The following formulas should be used to quantify the second order effects by energy effects for each ICT GNS product system and reference product system incorporated in each project activity. Their quantification is conducted via Part II of [ITU-T L.1410]:

Second order effect by Energy Consumption Reduction (MWh or TOE) = $\sum_a$ Project Activity Reduction$_{ay}$;

where:

Project Activity Reduction$_{ay}$ = $\sum$ [Baseline Consumptions$_{ay}$ – Project Activity Consumptions$_{ay}$]

Baseline Consumptions$_{ay}$ = $\sum_r$ Reference Product System Consumption$_{ayr}$

Baseline Consumptions$_{ay}$: baseline energy consumptions for each project activity, *a*, in year *y* (in MWh for electricity and TOE for other energy types)

Reference Product System Consumption$_{ayr}$: baseline energy consumptions for each reference product system, *r*, of each project activity, *a*, in year *y* (in MWh for electricity and TOE for other energy types)

Project Activity Impacts$_{ay}$ = $\sum_i$ ICT GNS Product System Consumption$_{ayi}$

Project Activity Consumptions$_{ay}$: project activity energy consumption for each project activity, *a*, in year *y* (in MWh for electricity and TOE for other energy types)

ICT GNS Product System Consumption$_{ayi}$: project activity energy consumptions for each ICT GNS product system, *i*, of each project activity, *a*, in year *y* (in MWh for electricity and TOE for other energy types)

The year in the formulas is not static. If the quantification time period is less than one year, the quantification time period shall not be normalized to one year and it shall apply as it is.

Since the time period is selected per project activity and an ICT GHG/energy project may have multiple time periods for its project activities, a calculation result by the quantification time period of less than one year shall not be normalized to one year when a yearly quantification is performed. The calculation result shall be accumulated as it is to the one-year quantification result.

12 Reporting on an ICT GHG project or ICT energy project

12.1 Requirements

12.1.1 General requirements

The project proponent shall prepare an ICT GHG/energy project report for intended users. To this end, the ICT GHG/energy project report shall identify the intended use and intended users of the project report, and shall include the following information consistent with the needs of the intended users.

If the project proponent makes a GHG/energy assertion to the public claiming conformance to this Recommendation, the project proponent shall make the following available to the public:

a) an independent third-party validation and verification statement, if validation and verification are conducted by a mandatory requirement, a voluntary action, or any other reason; and

b) a project report that includes as a minimum the following description requirements specified in clauses 12.1.2, 12.1.3, 12.1.4, 12.1.5, 12.1.6, 12.1.7 and 12.1.8.

NOTE – Appendix VI provides a practical guidance to fulfil the reporting requirements specified in clause 12.1.

12.1.2 Description of general project information

The ICT GHG/energy project report shall include as a minimum the following information (refer to clause 8.5 for detailed information):

a) Title of the ICT GHG project or ICT energy project

b) Names and contact details of the project proponent, including any significant intermediaries

c) Information about stakeholders

d) GHG programme(s) to which the ICT GHG/energy project subscribes, if the project proponent has selected one

NOTE – Clause 7.2 includes detailed information on GHG programmes.

e) General market conditions, national regulations, requests of intended users, or internal policies, if anything has been enforced for the ICT goods, networks or services incorporated by each project activity

f) Additionality statement

NOTE – This item depends on the GHG programme adopted; intended use and request of intended users; national regulations and/or internal policies. The additionality statement may be mandatory or optional.

g) Purposes of the ICT GHG/energy project

NOTE – This item may be associated with item d) of clause 12.1.2.

h) Short description of the ICT GHG/energy project and of the ICT goods, networks and services that its project activities incorporate

i) Size of the ICT GHG/energy project

NOTE – The size information may be described per project activity if project activities have different geographic sizes for their implementation.

j) Geographic location of the ICT GHG/energy project, indicating whether the project involves activities or effects in more than one political jurisdiction

k) The type of ICT GHG project or ICT energy project

l) Start date of the ICT GHG project or ICT energy project

m) Time period covered by valid performance and expected as the operational life of the ICT GHG project

NOTE 1 – The chosen time period shall be justified.

NOTE 2 –Information on operational life may be described per project activity if project activities have different operational life for their implementation.

n) Date of the project report

o) Statement describing whether the GHG and energy assertions have been validated and/or verified, including the type of validation or verification and level of assurance achieved

p) An assessment of permanence, as applicable

q) A brief summary of the overall initiative if the ICT GHG or ICT energy project is part of a larger initiative, including any other GHG or ICT GHG/energy projects in this larger initiative.

12.1.3 Description of assessment boundaries

The ICT GHG/energy project report shall include the following information to describe the assessment boundary of each project activity of the ICT GHG/energy project:

a) Each project activity associated with the ICT GHG/energy project

b) First order, if it is required to assess the environmental loads of ICT goods, networks and services incorporated in ICT project activities of the ICT GHG project

c) Second order effects resulting from each project activity

d) Justifications for excluding any unintended changes and why they are not significant.

12.1.4 Description of baseline scenarios

The ICT GHG/energy project report shall include the following information to describe the baseline scenario of each project activity:

a) The type of chosen baseline procedure with justification of the choice (i.e., either project-specific procedure or reference emission factor procedure)

b) List of identified alternative baseline scenarios.

NOTE – Clause 11.3.1 of [b-Project Protocol] contains additional information on what to be considered. A future amendment or revision of this Recommendation may include additional requirements on that aspect with normative reference to [b-Project Protocol].

12.1.5 Description of estimated baseline impacts

The ICT GHG/energy project report shall include the following information assessed during the project planning phase:

a) Calculation methods used to estimate and quantify GHG and energy effects and any uncertainties associated with the estimated GHG and energy effects of each project activity

b) Statement of the aggregate and separate GHG effects by GHG sources, sinks and storage for the baseline scenario, stated in tonnes of CO2e for the relevant time period (e.g., annual, cumulative to date, or total) where the aggregation and separation shall be done per GHG effect

c) Statement of the aggregate and separate energy effects by energy consumers, energy generators and energy storage systems for the baseline scenario, stated in MWh for electricity and in TOE for other energy types for the relevant time period where the aggregation and separation shall be done per energy effect

NOTE – Clauses 11.3.2 and 11.3.3 of [b-Project Protocol] contain additional information on what to be considered. A future amendment or revision of this Recommendation may include additional requirements with normative reference to [b-Project Protocol].

12.1.6 Monitoring plan

The monitoring plan specified in clause 10 shall be reported. Also, intermediate monitoring and quantification reports shall be produced to confirm that the ICT GHG/energy project has been implemented as planned and to update or revise any assumptions. The time intervals of intermediate reporting may be defined by a quality assurance and quality control (QA/QC) policy, the chosen GHG programme or a national regulation/guidance.

12.1.7 Description of project impacts

The ICT GHG/energy project report shall include the following information to confirm that the project has been implemented as planned:

a) General description of the criteria, procedures or good practice guidance used as a basis for the calculation of GHG and energy effects of the ICT GHG/energy project.

b) Statement of the aggregate and separate GHG effects by GHG sources, sinks and storage systems over the ICT GHG/energy project, stated in tonnes of CO2e for the relevant time period (e.g., annual, cumulative to date, or total) where the aggregation and separation shall be done per GHG effect.

c) Statement of the aggregate and separate energy effects by energy consumers, energy generators and energy storage over the ICT GHG/energy project, stated in MWh for electricity and in TOE for other energy types for the relevant time period (e.g., annual, cumulative to date, or total) where the aggregation and separation shall be done per energy effect.

12.1.8 Description of GHG and energy assertions

The ICT GHG/energy project report shall include the following information to assert the final conclusions of the ICT GHG/energy project:

a) List of GHG assertions, including a statement of GHG emission reductions and removal enhancements in tonnes of CO2e

b) List of energy assertions, including a statement of energy consumption reductions and enhancements of energy generation and energy storage in MWh for electricity and in TOE for other energy types.

12.1.9 Description of validation and verification statement

This requirement depends on the GHG programme adopted, national regulation enforced, request by intended users or internal policy of the project proponent. For example, if the project proponent will use achievements of its ICT GHG/energy project internally within its organization, the ICT GHG/energy project does not have to be validated and verified.

The ICT GHG/energy project report shall describe whether the GHG and energy assertions have been validated or verified, including the level of assurance achieved and the sampling plan for validation and verification.

13 Verification of an ICT GHG project or ICT energy project

Any assertion of GHG effects and energy effects produced and reported by the ICT GHG/energy project result may be required to be verified. Such verification may be mandatory or optional and may be performed according to [b-ISO 14064-3]. This Recommendation does not enforce either way. GHG programmes, national regulations, requests of intended users, or internal policies may specify the verification is mandatory or optional.

If verification is optional, the ICT GHG/energy project report may be verified via a voluntary self-evaluation carried out by an internal company assessment team or any other assessment/verification entities. The voluntary self-evaluation process may follow the requirements and guidance provided in [b-ISO 14064-3].

If verification is required as mandatory, the ICT GHG/energy project report shall be verified according to [b-ISO 14064-3]. Thus its verification shall be performed by a third-party verification body during the project period, and after project activities are finished and GHG and energy effects are accounted. The project proponent shall choose a verification body to which it will submit the actual data and information monitored and collected, and quantified GHG and energy effects.

NOTE – If it is inefficient to verify all the information collected in an ICT GHG/energy project report, a risk-based verification approach, i.e., sampling-based verification as described in A.2.4.6 of [b-ISO 14064-3], may be used. The project proponent should provide a sampling plan with adequate evidence to support the expected level of assurance. If a sampling plan for verification is provided with its justification, the verification body shall evaluate whether the sampling plan is justified or not under the ICT GHG or ICT energy project quantification principles, specified in clause 6. The sampling plan for verification checks by a verification body may be in conflict with the verification standard. The sampling plan shall be submitted for consultation and negotiation to GHG programme authorities, relevant national authorities or other responsible entities.

Appendix I

Examples of information and communication technology (ICT) greenhouse gas and energy projects

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

The following examples of information and communication technology (ICT) greenhouse gas (GHG) and ICT energy projects may apply to both the ICT sector and the non-ICT sector. They are based on using ICT goods, networks and services that enhance GHG and energy effects in industrial, commercial or operational processes of other sectors of the economy where ICT is not the core business. Specific activities in each area of an ICT GHG/energy project correspond to activities belonging to the ICT GHG/energy project.

This Recommendation specifies several types of ICT GHG and ICT energy projects for an initial project launch: smart buildings, smart logistics and transport, smart grid, smart motors and manufacturing, dematerialization and carbon management. Also, there may be numerous and varied types of ICT GHG/energy projects in both the ICT sector and the non-ICT sector. This Recommendation does not list every project type but allows the project proponent to specify a project type by focusing on key characteristics.

1 Smart buildings	
Areas and themes	***Definition***
1.1 Applications for design and energy optimization	Computer-aided building design and simulation software reflecting energy efficiency considerations.
1.2 Alternating current (AC) management systems in buildings	Control software to optimize heating, cooling and ventilation in the use phase of building.
1.3 Automatic lighting control	Control software to turn down lighting when and where it is not needed.
1.4 Intelligent on/off-switching of devices	Control software to switch devices on/off according to the need to use them.
1.5 CO2 card	Personal CO2 quota system with interpersonal trade of pollution rights (scope is beyond the buildings category and includes activities like car refuelling). The energy consumed by people in buildings is classified as emissions in the building management sector. In this sense, the CO2 card refers directly to the energy consumed by people in a building and is assigned in a way that can be measured. It is allocated to the smart buildings group, without ignoring the fact that it also has touch points with other sectors, but it is in this group that it is more tangible.
1.6 Energy intelligence software	Management software that allow energy measuring and management in buildings or group of buildings to foster energy efficiency.
1.7 Other	N/A

2 Smart logistics and transport	
Areas and themes	***Definition***
2.1 Road-use charging	ICT-based city congestion charge: Access control to downtown city-area by video-aided license plate recognition and checking of access rights against vehicle database containing payment status for access right.
2.2 Fleet management	• Use on board CO2 emissions recording and computer-based training to improve driving style. • Use on board Co2 emission display to visualize effects of driving style.
2.3 Real-time traffic-flow optimization	• Use advanced on board navigation, including vehicle-to-vehicle communication, to prevent traffic jams. • Use sensor technology and control systems in the traffic infrastructure (not in vehicle) to prevent traffic jams.
2.4 Other	• Applications using GPS, RFID and mobile communication to increase utilization rates of capacity in moving vehicles and warehouses and to optimize cargo flow, including modal shift consideration. • Advanced ICT software which allows changes in users' driving behaviour.

3 Smart grid	
Areas and themes	***Definition***
3.1 Virtual power plants	Combination of small-size renewable energy-generation units to larger scale generation unit.
3.2 Forecasting services for renewable energies	Short-term local weather forecasting to predict the availability of wind and solar power over the course of the day in order to align with demand and other energy sources.
3.3 Advanced smart meters	Metering device featuring remote meter reading, display of present and historical electricity consumption data, display of electricity cost based on utility-defined pricing scheme, and remote on/off switching of connected/controlled devices.
3.4 Demand-side-management	Incentivizing (by price differentiation) or forcing (by remote shut-off) electricity consumers to shift part of their demand from peak periods to off-peak periods.
3.5 Grid monitoring and availability	Sensor and control systems to monitor the transmission and distribution networks, detecting technical and non-technical loss and its sources.
3.6 Fleet optimization of large-scale power plants	Joint operation and control based on KPIs for groups of large scale power plants.
3.7 Other	N/A

4 Smart motors and manufacturing	ICT technologies that reduce energy consumption at the level of the motor, the factory or across the business.
Areas and themes	***Definition***
4.1 Frequency-modulated drives	ICT solution which drives an automatic control of an industry system formed of several processes.
4.2 Industrial system automation	ICT technologies that reduce energy consumption by the optimization of industrial systems, based on the reception of information at the factory level on actual output of all motor systems in real time.
4.3 Optimized power plant operation	Optimized operation of power plants based on the use of ICT solutions across the plant processes.
4.4 Other	N/A

5 Dematerialization	
Areas and themes	***Definition***
5.1 Teleworking	Working remotely via the use of ICT solutions. Includes telecommuting, teleconferencing and videoconferencing.
5.2 Virtual conferencing	Service that allows multiple participants to meet remotely, replacing or complementing face-to-face meetings.
5.3 e-media	Electronic media: media communication and activities based on ICT services, including most of the time web-based and electronic services.
5.4 e-documents	Virtual substitution of any physical or paper document into electronic version.
5.5 e-invoice	Invoice of any product of service delivered electronically to the customer in total or partial substitution of the physical paper invoice. Also known as e-billing or electronic invoicing.
5.6 e-paper	Electronic substitution of physical paper documents.
5.7 Telepresence	Telepresence is videoconferencing characterized by high definition video (1080 p,30 fps), life-sized images, spatial audio, imperceptible latency and easy operation. Required ICT equipment includes one or more display screens with microphones, speakers and cameras designed for the telepresence system.
5.8 Data centre energy efficiency	Service which promotes energy efficiency in customer data centres, including virtual hosting/cloud computing activities.
5.9 Others	N/A

6 Carbon management	IT software that allows carbon quantification on a cross sectoral level and allows forecasting of emissions and the establishment of GHG targets. This type of technology allows GHG quantification for better decision-making and enhances GHG reduction practices.

Areas and themes	*Definition*
6.1 Others	N/A

7 ICT GHG and ICT energy projects in the ICT sector	
Areas and themes	***Definition***
Smart metering in telecommunication networks sites	Metering devices for remote meter-reading, display of present and historical electricity consumption data, display of electricity cost based on utility-defined pricing scheme, remote on/off switching of connected/controlled devices in telecommunication network sites.
Green data centres	Integrated management of data centres for ICT service provision, with energy efficiency features, e.g., automatic monitoring, temperature control optimization, remote on/off switching of connected/controlled equipment, and others.
Selective switch-off of ICT equipment	Automatic control software to turn on or down network or other ICT equipment in order to optimize energy consumption.
Integrated management of off-grid telecommunication sites	Smart monitoring of energy supply and automatic control of ICT equipment in off-grid telecommunication sites such as base stations. Energy supply may be based on renewable energy and/or hybrid systems.
Other	N/A

Appendix II

Documentation form for the project plan of ICT GHG and energy projects

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

Documentation forms are out of scope of this Recommendation. The documentation forms are provided by the authorities of a selected GHG programme or national regulation, or by organizations designated by intended users or internal policy. For example, CDM project documentation forms are provided by the United Nations Framework Convention on Climate Change (UNFCCC). This Recommendation does not specify any documentation form but depicts an example documentation form to describe a project plan for an ICT GHG/energy project, in which documentation items are not exhaustively listed but which aims at providing a documentation structure. A project validation body may evaluate this project plan if a validation process is required.

Project title

A	General description of project
A.1	Purpose(s) and objective(s)
A.2	Brief summary of ICT GHG project or ICT energy project
A.3	ICT GNS product systems deployed in project
A.4	Description of ICT project activities
A.5	Project type
A.6	Project participants
A.7	Stakeholders
A.8	Location of project
A.9	Information of risks
A.10	Project eligibility
A.11	GHG effects
A.11.1	Estimated baseline impacts
A.11.2	Estimated project activity impacts
A.12	Energy effects
A.12.1	Estimated baseline consumptions
A.12.2	Estimated project activity consumptions
A.13	Milestones for chronological project plan
A.14	Selected GHG programme
A.15	Regulatory requirements by nations, intended users, or internal policies
A.16	Conditions prior to project initiation

B	Assessment boundary
B.1	Coverage of first order effects and second order effects
B.2	Coverage of life cycle assessment
B.3	Description of ICT GHG and energy project
B.4	Identification of ICT project activities
B.4.1	Identification of first order effects per project activity
B.4.2	Identification of second order effects per project activity
B.4.3	Identification of unintended changes in GHG and energy effects per project activity
B.4.4	Identification of ICT GNS product systems per project activity
B.4.5	Identification of reference product systems per project activity
B.5	Identification of GHG sources, sinks and storages
B.6	Identification of energy consumers, generators and storages
B.7	Estimation of project activity impacts

C	Baseline information
C.1	Selection of baseline procedure
C.2	Identification of alternative baseline scenarios
C.3	Justification of selected baseline scenario
C.4	Identification of GHG sources, sinks and storages
C.5	Identification of energy consumers, generators and storages
C.6	Estimation of baseline impacts

D	Monitoring plan
D.1	Description of data quality management
D.2	Update plan for monitoring plan
D.3	Monitoring criteria
D.4	Monitoring procedure
D.4.1	Monitoring plan for baseline parameters
D.4.2	Monitoring plan for data related to GHG and energy effects
D.5	Uncertainties management plan

E	Validation and verification plan
E.1	Level of project evaluation
E.2	Sampling plan for validation and verification

F	Quantification plan
F.1	Time period for quantification
F.2	Specific quantification logics or formulas

G	Description of environmental impacts

H	Other information
H.1	Outcomes from communication with stakeholders
H.2	Information about public funding

Appendix III

Description of project cycle and steps

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

Appendix III describes specific information for a typical project cycle and execution steps. The project cycle shown in Figure 2 of [ISO 14064-2] consists of two phases: the planning phase and the implementation phase.

III.1 Planning phase steps

A project proponent of an ICT GHG project or an ICT energy project is an organization willing to undertake an ICT GHG project or an ICT energy project. First the proponent needs to justify whether its ICT GHG/energy project idea is worth carrying out. The project proponent may obtain approval of the ICT GHG/energy project from the relevant authority, depending on the selected GHG programme. If a chosen GHG programme indicates voluntary validation and verification, such an approval process is optional.

The justification procedure consists of identifying the project concept, designing the ICT GHG or ICT energy project, and evaluating the project feasibility by assessing GHG programme eligibility requirements. The proponent shall then develop its project plan specifically for a validation process if required, and other purposes which may be raised by intended users. The project proponent may consult stakeholders to seek guidance, such as outside consulting firms, verifiers, verification bodies, validators, validation bodies, GHG-relevant finance firms, and government. It also assigns its resources internally for the planning work.

While developing its ICT GHG/energy project plan, the project proponent describes the ICT GHG/energy project, identifies and selects GHG sources, sinks and storage, energy consumers, generators and storage systems relevant to the project, determines the baseline scenario, and develops procedures to quantify, monitor and report GHG effects and energy effects.

If a validation process is required, a third-party validation body shall validate the ICT GHG/energy project plan to provide assurance to intended users that the project's GHG/energy assertions are complete, accurate, consistent, transparent, and without material discrepancies, and that the project is eligible. A validated ICT GHG/energy project plan shall be registered in a registry for which the registration procedure is defined by a GHG programme the project proponent has selected while assessing GHG programme eligibility requirements.

NOTE – The UNFCCC is the only registry of UNFCCC CDM projects. There are many voluntary or mandatory, international, national or sub-national GHG programmes that define registration, quantification, management, validation, and/or public distribution of GHG emissions, removals, GHG emission reductions or GHG removal enhancements. For example, the Chicago Climate Exchange (CCX) has specified the CCX offset project programme of which CCX offset projects mean GHG projects, and it also works as a registry for its offset projects.

III.2 Implementation phase steps

Implementation of an ICT GHG/energy project may be initiated by a specific project activity (e.g., an action to install, implement, engage or otherwise begin operations) and may end with a specific termination activity (e.g., an action to complete, close, decommission or otherwise formally end the project) specified in the relevant project plan.

While carrying out project activities during the project implementation period, the project proponent may initiate periodic verification, certification and recognition of GHG/ICT energy units achieved by the executed project activities according to the selected GHG programme or other guidelines (e.g., national regulations, etc.). This intermediate reporting process and frequency is

optional and may vary based on the specific requirements of the ICT GHG/energy project and the GHG programme. Based on actual data and information monitored and collected, quantified GHG and energy effects resulting in GHG and energy units may be verified by a verification body.

After all the project activities have been finished, all GHG and energy quantification results shall be aggregated per GHG effect and energy effect into the project report and this project report shall be submitted to a verification body if requested by the GHG programme. The project proponent might submit verified GHG emission reductions, removal enhancements, energy consumption reductions, and enhancement of energy generation/energy storage to a GHG registry in order to generate recognized GHG and energy effects within the GHG programme. The verification body might submit these verified project results to the GHG registry to request their endorsement. This certification process depends on the GHG programme. The project results are represented by the certification as recognized GHG and energy effects. The ICT GHG/energy project will then be terminated.

Appendix IV

Consideration of emission avoidance

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

Within the context of international GHG programmes and taking into account that the ICT sector may apply for several national and/or international GHG programmes (e.g., CDM) in the future, this appendix captures current understanding on GHG emission avoidance in the ICT sector.

This Recommendation does not specify "GHG emission avoidance" or "avoided emission" because, although GHG emission reduction has a clear definition, GHG emission avoidance has no clear shared definition yet. This Recommendation does however support the same concept of emission avoidance" under the GHG emission reduction category and does not conflict with the same concept of CDM methodologies (see [b-CDM Booklet]).

Currently there are no clear definitions on emission avoidance in [ISO TC 207], [b-Project Protocol] or [b-Kyoto Protocol]. However, a view covering the concept of emission avoidance is proposed below.

This appendix describes a harmonized view for GHG emission reduction and GHG emission avoidance/avoided emission. It is to be noted that this view does not provide any definition but describes current understanding following a review and harmonization.

GHG emission reduction can be described as the GHG emissions that are actually reduced by the implementation of ICT GHG/energy project activities, considering a baseline scenario built on a real reference case. The real reference case means that there is a real GHG emission source, and that GHG emissions into the atmosphere are really occurring.

The GHG emissions avoidance can be described as the GHG emissions that will not be generated, or that will be avoided, by the implementation of ICT GHG/energy project activities, considering a baseline scenario built on a hypothetical reference case. The hypothetical reference case means that there is a hypothetical GHG emission source which does not exist in the real world and some GHG emissions may or may not happen in the future. This concept has been reflected in the definition of a baseline scenario in clause 3.2.6.

Hereafter is some background information on these terms: clause 1.2 of [b-CDM Booklet] describes categorization of GHG mitigation activities and some CDM methodologies have been categorized for examples. The following types of mitigation activities are given:

- displacement of a more GHG-intensive output
- renewable energy
- low carbon electricity
- energy efficiency
- fuel or feedstock switch
- GHG destruction
- GHG emission avoidance
- GHG removal by sinks.

The GHG emission avoidance category is described as the category for various activities where the release of GHG emissions into the atmosphere is reduced or avoided (e.g., avoidance of anaerobic decay of biomass and reduction of fertiliser use). The case of avoidance of anaerobic decay of biomass is definitely an avoidance activity. Any anaerobic decay of biomass may emit methane or carbon dioxide. If such decay does not occur or is delayed, corresponding GHG emissions may be

avoided. In [b-CDM Booklet], GHG emission reductions and avoidances belong to the same category, "GHG emission avoidance."

An existing guideline, "GHG Protocol Scope 3 Accounting and Reporting Standard" (see [b-Corporate Protocol] describes two cases of "avoided emission": avoidance by recycling and avoidance by sold products. Recovered materials via recycling during the end-of-life treatment stage can avoid GHG emissions which would have been generated from the same materials manufactured from raw materials. The emissions avoided by sold products correspond to a company's contribution to reducing GHG emissions in society, beyond the boundary of the company.

Appendix V

Consideration of unintended changes in GHG effects and energy effects

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

A project activity may cause unintended changes in GHG and energy effects. The project proponent may refer to clause 5.3 of [b-Project Protocol] for general understanding of unintended changes. Only significant unintended changes need to be considered in the GHG and energy assessment boundary.

Unintended changes are classified into one-time unintended changes and upstream and downstream unintended changes.

V.1 One-time unintended changes

One-time unintended changes are those related to GHG emissions or energy consumptions produced by the project activity during the implementation phase of an ICT GHG/energy project cycle. Clause 5.3.1 of [b-Project Protocol] may be referred to for general understanding of the one-time unintended changes.

One-time unintended changes during the implementation phase may be large for some ICT GHG/energy projects. For example, an ICT GHG project or ICT energy project for a smart electricity grid may require installing wide-area electrical transmission towers and communication facilities in mountainous regions where the clearing of vegetation and forest is required to enable the construction of access roads and sites.. This contributes to GHG emissions from the machinery used to clear the sites and build the roads, as well as the release of stored carbon from the cleared vegetation and disturbed soils.

Some other examples of one-time unintended changes are described:

- underground installation of optical fibre cables requires relevant machinery to be used
- transitioning to digital media storage from analogue media storage may cause off-site waste disposal against discarded analogue media storage systems
- replacement of low-performance equipment with high-performance equipment may cause dismantling discarded equipment.

V.2 Unintended upstream and downstream changes

The unintended upstream changes are those associated with the inputs used by a project activity and the unintended downstream changes are those associated with the products produced by a project activity. Unintended upstream and downstream changes incur unintended repercussions during the implementation phase of a project activity. Unintended upstream and downstream changes are identified by considering whether there are any inputs consumed or products/by-products produced by the project activity that will cause a change in GHG emissions or energy consumptions during the implementation phase of project activity.

Some examples of where unintended upstream changes may arise, include:

- Project activities that use fossil or biomass fuels to generate electricity, heat or steam. Unintended upstream changes may result from changes in the extraction of fossil fuels, the harvest of biomass, and the transportation of either type of fuel – e.g., changes in the release of methane (CH4) during coal mining, the release of CO2 from fuel combustion during harvesting, and the release of CO2 from transporting coal or biomass. A project activity of an ICT GHG/energy project may be involved with this unintended upstream change because it may use an air compressor which may consume fossil or biomass fuels.

- Project activities that cause a change in the use of materials or products that give rise to GHG emissions or energy consumptions as a result of physical or chemical processing and ICT hardware and software processing during their manufacture, use, or disposal. For example, a project activity of a green data centre establishment project may be to bind several network or electronic cables together with cable ties where a number of cable ties are consumed.
- Project activities that cause a change in the use of materials or products, whose application gives rise to GHG emissions or energy consumptions. For example, changes in HFC leakage from refrigeration equipment or changes in SF6 leakage from high-voltage electric power insulation equipment.
- Project activities that involve the transportation of materials and employees. Changes in GHG emissions and energy consumptions for the inputs consumed may arise from changes in the combustion of fuels in vehicles, trains, ships, and aircraft. For example, installation of wide-area electric transmission towers and communication facilities at mountains and fields causes a lot of movements of employees who have to go to installation sites and consume energy for their trip. Transportation of steel towers to mountains and transportation of wood waste produced during construction of an access road will cause energy consumption. The former is an unintended upstream change and the latter is an unintended downstream change.

Some examples of where unintended downstream changes may arise include:

- project activities that involve the transportation of employees, products, and waste.
- changes in GHG emissions and energy consumptions for the products/by-products produced may arise from changes in the combustion of fuels in vehicles, trains, ships, and aircraft.

V.3 Analysis of market responses to upstream and downstream effects

Nearly all upstream and downstream unintended changes will involve, or be associated with, some kind of market response. Market responses occur when alternative providers or users of an input or product react to a change in market supply or demand caused by the project activity. In other words, the market response means a positive or negative reaction to a change in GHG emissions or energy consumptions on market supply and demand.

For example, a positive downstream market response occurs when establishment of a green data centre that reduces its energy consumption gives other companies the opportunity of leasing computing resources from the green data centre instead of installing their own computer systems. An example of a negative upstream market response is where deployment of LED lights increases production of relevant cooling devices, which in turn increase energy consumption.

The ICT GHG/energy project proponent should refer to clause 5.3.2 of [b-Project Protocol] for further understanding on analysis of market responses incurred by unintended upstream and downstream changes.

V.4 Assessment of significance of unintended changes

V.4.1 Use of conservativeness principle

Any method used to estimate unintended changes is prone to uncertainty. Because of this, the conservativeness principle should guide any effort to estimate magnitude and significance. For instance, it is advisable to use upper-bound estimates for GHG emissions or energy consumptions of project activities, and lower-bound or zero estimates for baseline impacts. Use of a conservative estimate for baseline impacts is appropriate whenever it is difficult to determine the baseline scenario conditions related to an unintended change. This is particularly relevant when the reference emission factor procedure is used to estimate baseline impacts for a project activity. In this case, it

may be simplest to assume that the baseline impacts for unintended changes are zero, as the baseline scenario conditions may be ambiguous.

V.4.2 Assessment of the relative magnitude and significance of unintended changes

Only significant unintended changes are included in the GHG and energy assessment boundary. Therefore, project proponents should attempt to estimate the magnitude of unintended changes as a prelude to determining whether they are significant. Project proponents should refer to clause 5.4 of [b-Project Protocol] for specific guidance for the estimation.

The significance of an unintended change may be subjective and may depend on the context of the project's activity. Some criteria may be used to help determine whether an unintended change is significant or not. Project proponents should refer to clause 5.5 of [b-Project Protocol].

V.4.3 Exclusion of significant unintended changes

In some instances, two significant unintended changes – one positive and one negative – associated with related GHG sources or sinks, or energy consumers and generators, may effectively counterbalance each other. For example, a project activity that switches data storage from analogue tapes to digital disks may give rise to two unintended changes: (1) a reduction in transportation GHG emissions associated with transporting analogue tapes (positive), and (2) an increase in transportation GHG emissions associated with transporting digital disks (negative). If these two unintended changes were of the same magnitude, they would cancel each other out. If it can be demonstrated that two related significant unintended changes will counterbalance each other, their net effect could be considered insignificant and they could be excluded from the GHG and energy assessment boundary. However, the expected magnitude of both unintended changes should be clearly substantiated.

Appendix VI

Guidance for reporting on ICT GHG projects and ICT energy projects

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

This appendix provides guidance to meeting the reporting requirements specified in clause 12.1.

VI.1 General guidance

The report on an ICT GHG/energy project is basically based on, and should be consistent with, the project plan as specified in clause 8.5. All items in the project plan should be reported in the related project report together with project activity results.

VI.2 Guidance for describing assessment boundary

In accordance with clause 8.2, the information that shall be documented and justified shall be included in the ICT GHG/energy project report. The items to be described as mandatory or optional depend on the level of requirement. Guidance for defining the assessment boundary is also described in clause 8.2.

VI.3 Guidance for describing baseline scenarios

The ICT GHG/energy project report shall include information on what shall be documented and justified in order to meet requirements outlined in clauses 8.3.1 and 8.3.2. The items to be described as mandatory or optional depend on the level of requirement.

VI.4 Guidance for describing estimated baseline impact

The ICT GHG/energy project report shall include the information that shall be documented and justified in order to meet requirements outlined in clauses 8.3.3 and 8.3.4. The items to be described as mandatory or optional depend on the level of requirement. Aggregation of GHG and energy effects applies to each project activity and the baseline impact is a total amount of baseline impacts per project activity.

NOTE – Energy consumptions, GHG emissions and GHG removals do not consider a comparison but a total amount of their results over a time period. GHG reductions and removal enhancements, energy consumption reductions and enhancements of energy generation and energy storage do consider a comparison between a baseline and a project activity result.

VI.5 Guidance for describing the monitoring plan

All GHG sources, sinks and storage, energy consumers, generators and storage systems within the project assessment boundary will be monitored once the ICT GHG and ICT energy projects have been implemented. Actual monitored data will contribute to quantification of GHG and energy effects.

In accordance with clause 10, information on what requires to be documented and justified shall be included in the ICT GHG and ICT energy project report. The items to be described as mandatory or optional depend on the level of requirement. Any changes to the monitoring plan shall also be reported.

The project proponent should refer to clause 11.5 of [b-Project Protocol] for additional guidance.

The intermediate report specified in clause 12.1.6 shall contain a quantification result of GHG and energy effects until then based on actual monitored data.

VI.6 Guidance for describing project impact

The information on what clause 11 requires to be documented and justified shall be included in the ICT GHG/energy project report. The items to be described as mandatory or optional depend on the level of requirement.

Aggregation of GHG and energy effects applies to each project activity and the project impact is a total amount of project activity impacts.

The project impact for GHG effects is calculated by subtraction of GHG emission reductions and removal enhancements from GHG emissions by a project activity result.

The project impact for energy effects is calculated by subtraction of energy consumption reductions and enhancements of energy generation and energy storage from energy consumptions by a project activity result.

VI.7 Guidance for describing GHG and energy assertions

The GHG assertion is a total amount of GHG assertions produced by each project activity. Each GHG assertion is a declaration or a factual and objective statement in CO2e by subtraction of the project impact from the baseline impact per project activity.

The energy assertion is a total amount of energy assertions produced by each project activity. Each energy assertion is a declaration or factual and objective statement in MWh for electricity and TOE for other energy types by subtraction of the project impact from the baseline impact per project activity.

VI.8 Guidance for describing validation and verification statement

ICT GHG/energy project reports shall include information on what needs to be documented and justified in order to meet requirements outlined in clause 12.1.7. The items to be described as mandatory or optional depend on the level of requirement.

If the validation and verification have been conducted by a third-party organization, the contact information for the validation and verification bodies shall be included.

The level of assurance for the ICT GHG/energy project reports may depend on validation and verification standards selected for project evaluation. The achieved level of assurance shall be stated.

Bibliography

[b-CDM Booklet] CDM Methodologies Booklet (2012), *United Nations Framework Convention on Climate Change (UNFCCC) secretariat.* http://cdm.unfccc.int/methodologies/documentation/index.html

[b-Corporate Protocol] The Greenhouse Gas Protocol (GHG Protocol) (2011), *Corporate Value Chain (Scope 3) Accounting and Reporting Standard,* World Resources Institute and World Business Council for Sustainable Development. http://www.ghgprotocol.org/standards/scope-3-standard

[b-ISO 14064-3] ISO 14064-3:2006, *Greenhouse gases – Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions*.

[b-Kyoto Protocol] Kyoto Protocol to the United Nations Framework Convention on Climate Change (1998), *Article 12. A clean development mechanism is hereby defined.* http://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.php

[b-Project Protocol] The Greenhouse Gas Protocol (GHG Protocol) (2005), *The GHG Protocol for Project Accounting*, World Resources Institute and World Business Council for Sustainable Development. http://pdf.wri.org/ghg_project_accounting.pdf

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	**Construction, installation and protection of cables and other elements of outside plant**
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Terminals and subjective and objective assessment methods
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	Global information infrastructure, Internet protocol aspects and next-generation networks
Series Z	Languages and general software aspects for telecommunication systems

Printed in Switzerland
Geneva, 2014