
# General specifications and KPIs

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# General specifications and key performance indicators

# Table of contents

# General specifications and key performance indicators

## Executive summary

Environmental management is becoming an important part of every company's working methods, particularly in the ICT sector where there are negative environmental impacts like in any other sector, but whose products play an important role in enabling organizations of other industries improve their sustainability performance. The ICT industry needs excellent procedures and processes to deal with environmental data so that ICT organizations can improve their own sustainability tracking, management and performance.

This document, part of the ITU Toolkit for environmental sustainability for the ICT sector, focuses on environmental key performance indicators (KPIs) that can be of assistance to an ICT organization to quantify and evaluate performance in this area. Identifying and working with environmental KPIs is not new. Many organizations have already identified a number of common environmental KPIs between them. The objective here is to create a common set of environmental KPIs that together help an organization meet its regulatory, commercial and societal challenges.

There are five main groups of environmental KPIs that are tracked by ICT organizations: energy, GHG emissions, waste, water and others that are usually more specific to the operation of a company.

There are already a number of standards and methodologies in place that can provide a framework for environmental management. This document explores such standards from a number of these providers, including global standards organizations, and ICT industry networks and initiatives.

The starting point in the selection of an environmental KPI isn't picking and choosing a KPI from a global menu, but to define a target based on the organization's business strategy. First order priorities (lowering an organization's own impacts) usually provide economic and environmental benefits, but other priorities may be driven by business objectives, investor demand for information, better internal decision-making, etc.

The reason for building standardized processes with KPIs is to ensure that the metrics are as comprehensive, useful and insightful as possible. In choosing KPIs, this document suggests that issues such as relevance, measurability, and uniformity of data units/boundaries are important to ensure that time and resources are not wasted chasing after the wrong data.

Once the KPIs are chosen, there are good practices that need to be put in place to ensure that the data is collected, and once collected, is verified and validated.

While most of the KPIs covered in this analysis are focused on carbon and energy management, there are plenty of gaps that need to be explored in terms of other environmental KPIs, particularly relating to e-waste. Setting environmental targets supports effective environmental load reduction by the organization. In addition, it could help with compliance regarding environmental regulations whenever they emerge, even if they do not currently exist.

## The toolkit

This document on General specification and environmental KPIs is part of a set of documents that together form the Toolkit on environmental sustainability for the ICT sector. The toolkit is the result of an ITU-T initiative, carried out together with over fifty partners, which provides detailed support on how ICT companies can build sustainability into the operations and management of their organizations. The documents in the toolkit cover the following:

- *Introduction to the toolkit*
- *Sustainable ICT in corporate organizations*, focusing on the main sustainability issues that companies face in using ICT products and services in their own organizations across four main ICT areas: data centers, desktop infrastructure, broadcasting services and telecommunications networks.
- *Sustainable products*, where the aim is to build sustainable products through the use of environmentally-conscious design principles and practices, covering development and manufacture, through to end-of-life treatment.
- *Sustainable buildings*, which focuses on the application of sustainability management to buildings through the stages of construction, lifetime use and de-commissioning, as ICT companies build and operate facilities that can demand large amounts of energy and material use in all phases of the life cycle.
- *End-of-life management*, covering the various EOL stages (and their accompanying legislation) and provides support in creating a framework for environmentally-sound management of EOL ICT equipment.
- *General specifications and key performance indicators*, with a focus on the matching environmental KPIs to an organization's specific business strategy targets, and the construction of standardized processes to make sure the KPI data is as useful as possible to management.
- *Assessment framework for environmental impacts*, explores how the various standards and guidelines can be mapped so that an organization can create a sustainability framework that is relevant to their own business objectives and desired sustainability performance.

Each document features a discussion of the topic, including standards, guidelines and methodologies that are available, and a check list that assists the sustainability practitioner make sure they are not missing out anything important.

# 1 Introduction

This document establishes the necessary procedures that ICT companies should use to define environmental key performance indicators (KPIs) for decision making. KPIs are environmental tools used commonly for:

- environmental data management;
- eco-efficiency measurement (energy, water, waste and $CO_2$);
- environmental target setting and follow-up.

Environmental management is becoming an important part of every company and especially in the information and communication technology (ICT) companies, whose products and services are addressed to deal with tomorrow's needs of a more environmentally sustainable world. It is important to have standard procedures and processes to deal with environmental data management. This document draws from ICT's best practices and intends to help ICT organizations improve their environmental tracking, management and performance.

## *1.1 Target audience and scope*

This document is focused on information and communication technology (ICT) organizations and companies.[1] It is aimed at:

- The management of ICT organizations, from the business functions as well as the environment/sustainability functions.
- The management of non-ICT organizations who want to account for improvements in environmental impacts enabled through the use of ICT.

An ICT organization's core activity is directly related to the design, production, promotion, sales or maintenance of ICT goods, networks or services. ICT companies and organizations have several differentiated sub-sectors that must be considered in order to identify individual KPIs. Note that a company could orient its business to one or more of these sub-sectors:

- **ICT telecom operators**: Networks operation and provision of telecommunication services such as telephony or data communication accesses, e.g. Telefónica, Vodafone, AT&T, China Mobile, etc.
- **ICT manufacturers**: ICT technology and infrastructure developers and distributors, e.g. ALU, Nokia, Samsung, Sony, Ericsson, Nokia Siemens Networks, IBM, Huawei, Toshiba, etc.
- **ICT software developers**: Software programing for distribution and customer use from mobile or home devices, e.g. Google, Apple, Microsoft, etc.

The intensity of these different environmental indicators will differ regarding the ICT sub-sector, and the nature of the impact that can also vary from one sub-sector to another, e.g. network energy consumption is one of the most important impacts from telecom operators while production and material usage creates the largest impact for manufacturing companies. In this sense, it is not possible to make a specific, individual list of KPIs for ICT companies to follow. Instead, it is better to clarify terms and provide general guidance.

[1] ICTs are a combination of devices and services that capture, transmit and display data and information electronically. These include personal computers (PCs) and peripherals, broadband telecom networks and devices, and data centers. ITU-GeSI – Using ICTs to Tackle Climate Change (2010).

## 1.2 ICT environmental impacts

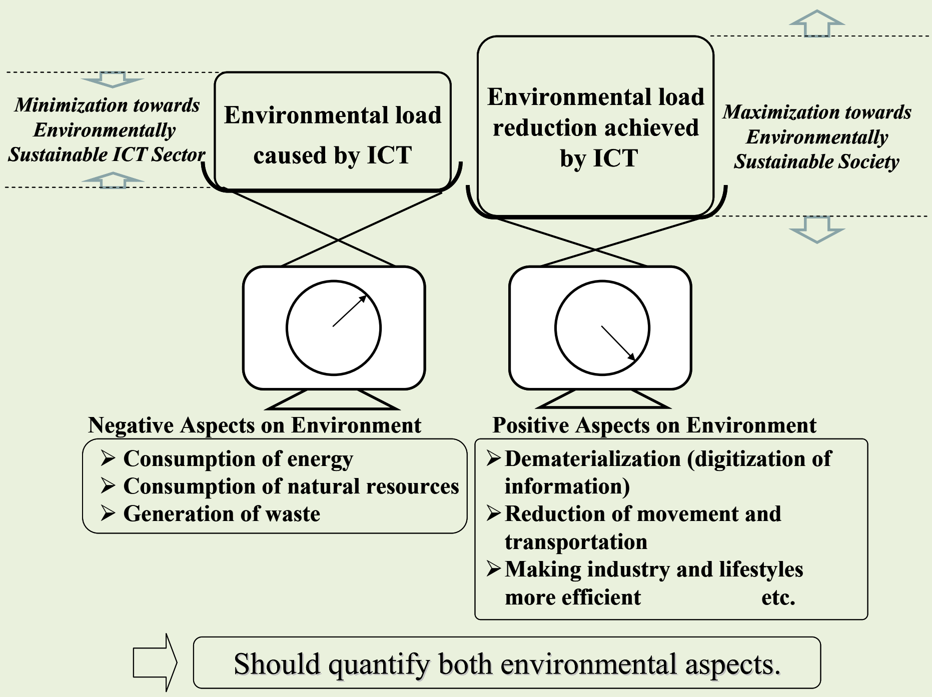
ICT organizations have a double-edged nature regarding environmental impacts. There are mainly two orders of effect regarding environmental impacts of ICTs[2]:

1. **First order effects** (or the environmental load of ICTs): the impacts created by the physical existence of ICT and the processes involved, e.g. GHG emissions, e-waste, use of hazardous substances and use of scarce, non-renewable resources, which together represent the environmental load related to ICT goods, networks and services over their life cycle.

2. **Second order effects** (or the environmental load reduction achieved by ICTs): the impacts and opportunities created by the use and application of ICTs. This includes environmental load reduction effects which can be either actual or potential, e.g. travel substitution, transportation optimization, working environment changes, use of environmental control systems, use of e-business, e-government, etc. In this sense, it is important to mention the "Enabling Effect" which represents the possible greenhouse gas (GHG) emissions reduction by five major opportunities: dematerialization, smart motor systems, smart logistics, smart buildings and smart grids[3].

Figure 1: Positive and negative impacts of ICTs describes a schematic approach of the environmental impacts of ICTs on the environment. First order effects are directly related to negative effects on the environment by ICTs, and second order effects are identified with the positive ones. It is important to calculate these positive impacts as well as the negative ones, if possible, to achieve an assessment with a fuller perspective. For both effects, environmental KPIs should be used to account for both impacts.

**Figure 1: Positive and negative impacts of ICTs[4]**




[2] Recommendation ITU-T L.1410 – Methodology for environmental impact assessment of information and communication technologies goods, networks and services (2012).

[3] SMART 2020 – Enabling the low carbon economy in the information age (2010).

[4] Recommendation ITU-T L.1410 (2012) – Methodology for environmental impact assessment of information and communication technologies goods, networks and services.

## 1.3 Definition of an environmental KPI

A key performance indicator, or KPI in terms of this document's usage, is a metric or measure used to quantify and evaluate organizational performance in relation to the meeting of targets and objectives. KPIs are also used to set measurable objectives, evaluate progress, monitor trends, make improvements, and support decision making.

The defined KPIs are quantitative and periodically measure values that concern the environment as a result of ICT business operations. They can be used to measure the level of eco-efficiency, a term based on the concept of creating more goods and services while using fewer resources and creating less waste and pollution.

Commonly used environmental KPIs are:

- energy consumption, from fuel use or electricity consumption, or use of renewable energy;
- GHG emissions depending on the scope, or by type of gas;
- waste generated;
- waste recycled;
- water used; and
- recycled, hazardous materials used, etc.

# 2 Environmental KPIs for ICT organizations

The intention of this section is to review existing environmental KPIs suggested or asked for by global environmental initiatives, or defined in ICT-specific guidelines or initiatives. The treatment and management of environmental KPIs is not new. Some organizations have already identified a number of common environmental KPIs between them. This document helps identify which KPIs might be relevant to a particular organization.

There are five main groups of environmental KPIs that are usually identified by different ICT and non-ICT institutions: energy, GHG emissions, waste, water, and others. The environmental KPIs in this document are organized in these same categories.

## 2.1 Environmental KPIs by global organizations or initiatives

The following organizations[5] are globally recognized as providing support to all sectors of the economy in defining comparable environmental KPIs. These KPIs are usually part of environmental reporting indices, investor indices, or environmental standards and methodologies.

Reporting or investor indices provide external bodies with an opportunity to make an evaluation regarding the sustainability and environmental performance of companies. KPIs on standards or methodologies provide a framework for environmental matters that help organizations measure their own performance and improve internal environmental management capabilities.

### 2.1.1 Carbon Disclosure Project (CDP)

The Carbon Disclosure Project is an organization that works with shareholders and corporations to foster, in particular, the disclosure of greenhouse gases emissions and climate change strategies of major

[5] This is a non-exclusive list in alphabetical order.

corporations.[6] CDP has developed a general questionnaire, and in 2012 included an ICT-specific questionnaire. Some of the KPIs required by the general CDP questionnaire are:

*Energy (usually denominated in megawatt hours or MWh):*

- fuel;
- electricity;
- heat;
- steam;
- cooling.

*GHG emissions (Tonnes $CO_2$eq):*

- total gross scope 1;
- total gross scope 2;
- total gross scope 3;
- scope 1 and 2 per type of gas;
- scope 1 and 2 per country;
- scope 1 and 2 per type of business;
- (scope 1 and 2)/revenues;
- (scope 1 and 2)/employee;
- (scope 1 and 2)/(normalized company intensity figure);
- kg $CO_2$-e per unit of good/service.

*Other:*

- Amount of emissions traded in carbon markets.

### Sector-specific question module (ICT)

The sector specific module is divided in sub-sectors. Here are some examples:

- Data centers
  - ◊ power usage effectiveness (PUE) value;
  - ◊ utilization rate.
- Scope 1 and 2 emissions in in metric tonnes $CO_2$eq/Terabyte of network traffic
- Electricity use/terabyte
- Hardware
  - ◊ % of products that meet energy-efficiency requirement.
- Business services
- Scope 1 and 2 emissions per square metre.

[6] Carbon Disclosure Project: www.cdproject.net (2012).

### 2.1.2 Dow Jones Sustainability Index (DJSI)

DJSI is an index that evaluates the performance of the world's leading companies in sustainability; it is the longest-running global sustainability benchmark worldwide.[7] The KPIs DJSI requires from ICT companies are:

*Energy (MWh):*

- Electricity purchased (MWh)
- Renewable energy: per type, number of units and MWh output.

*GHG emissions (Tonnes $CO_2$eq):*

- Metric Tonnes $CO_2$eq (scopes 1 and 2)
- Carbon intensity: relative indicator per unit of product or other KPI.

*Waste:*

- Total waste generated.

*Water (million $m^3$):*

- Total water withdrawal
- Total salt/brackish water withdrawn
- Total municipal water supplies (or from other water utilities)
- Total water from all other sources
- Water returned to the source of extraction at similar or higher quality as raw water extracted.

*Others:*

- Volume of oil lost
- Direct volatile organic compounds emissions.

### 2.1.3 GHG Protocol corporate standard

The GHG Protocol is an accounting tool that gives standards and guidance regarding corporate greenhouse gas accounting and reporting to companies.[8] Note that the GHG Protocol provides numerous tools for GHG calculation, including several for specific sectors, but none specifically for ICTs. Due to the huge amount of possible KPIs, only a top-level selection has been made, with the intent of showing how GHG emissions are analysed in the GHG Protocol. The suggestions on how to organize KPIs for GHG emissions by this initiative are as follows:

- GHG emissions from stationary combustion (scope 1)
- GHG emissions from mobile combustion (scope 1)
- GHG emissions from air conditioning and cooling (scope 1)
- GHG indirect emissions from own consumption of purchased electricity (scope 2)
- Other indirect emissions (scope 3), e.g. extraction and production of purchased materials transportation of purchased fuels; and use of sold products and services.

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[7] Dow Jones Sustainability Index. www.sustainability-index.com/ (2012).

[8] Greenhouse Gas Protocol. www.ghgprotocol.org (2012).

### 2.1.4 Global Reporting Initiative (GRI)

GRI is a multi-stakeholder organization that produces a comprehensive sustainability reporting framework for the mainstreaming of disclosure on environmental, social and governance performance, producing standards for sustainability reporting.[9] General guidelines are to be used by companies of all types. A pilot version of a telecommunication sector supplement is also available. Some of the quantitative environmental KPIs suggested by GRI are:

*Energy:*

- Direct energy consumption by primary energy source
- Indirect energy consumption by primary source.

*GHG emissions:*

- Total direct and indirect greenhouse gas emissions by weight
- Other relevant indirect greenhouse gas emissions by weight.

*Waste:*

- Total weight of waste by type and disposal method
- Weight of transported, imported, exported, or treated waste deemed hazardous
- Percentage of transported waste shipped internationally.

*Water (million $m^3$):*

- Total water withdrawal by source
- Percentage and total volume of water recycled and reused
- Total water discharge by quality and destination.

*Materials and waste:*

- Materials used by weight or volume
- Percentage of materials used that are recycled
- Total weight of waste by type and disposal method.

*Others:*

- Emissions of ozone-depleting substances by weight
- NOx, SOx, and other significant air emissions by type and weight.

The sector supplement asks for the following environmental indicators:

- Volume/Weight of banned, restricted of scheduled waste for phase out in markets where the organization operates
- Volume/Weight of critical material.

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[9] Global Reporting Initiative – Telecommunication Sector Supplement. 2003. www.globalreporting.org/GRI Telecommunications Sector Supplement.

### 2.1.5 ISO 14031

ISO 14031 gives guidance on the design and use of environmental performance evaluation, and on identification and selection of environmental performance indicators, for use by all organizations, regardless of type, size, location and complexity.

*Energy:*

- Energy consumed per year or per unit of output
- Energy consumed or customer service
- Quantity of each type of energy consumed
- Energy generated by-products or process flows
- Number of units of energy saved through energy conservation programmes
- Area of land used to produce one unit of energy
- Average fuel consumption of vehicle fleet
- Total product lifetime energy consumption.

*Waste:*

- Waste per year or per unit of output
- Hazardous waste, recyclable and omnipresent produced per year
- Total waste for final disposal
- Amount of waste stored at the site
- Controlled amount of waste permits
- Waste converted into reusable materials per year
- Hazardous waste removed due to material substitution.

*Water:*

- Amount of water per unit of product
- Amount of reused water.

*Others:*

- Number of vehicles in the fleet that have the technology to reduce pollution
- Number of hours of preventive maintenance of equipment per year
- Number of products introduced to the market with reduced hazardous properties
- Number of products that can be reused or recycled
- Percentage of reusable or recyclable content of a product
- Proportion of defective products
- Number of units of products generated per unit of output
- Number of units of energy consumed during product use
- Product life
- Number of products with instructions for use and safe disposal to the environment.

### 2.1.6 ISO 14064-1

ISO 14064-1 provides governments, businesses, regions and other organizations with principles and requirements for the design, development and management of GHG inventories and their presentation. The norm establishes, in general terms, three main groups for GHG KPIs and each of these groups can be broken down individually by type of GHG gas ($CO_2$, $CH_4$, $N_2O$, HFC, PFC and $SF_6$), fuel, business area, etc.

*GHG emissions:*

- Direct GHG emissions, coming from fuel consumption for electricity, heat or steam generation.
- Indirect emissions from electricity, heat or steam generated externally and consumed by the company.
- Other indirect emissions: employee mobility, business travel, products transportation, GHG emissions coming from leasing companies, etc.

ISO 14064-1 covers the same approach for GHG accounting as the GHG Protocol. Other ISO 14064 family norms are ISO 14064-2 and ISO 14064-3 for GHG reduction projects and verification details, respectively.

## 2.2 Environmental KPIs by ICT organizations or initiatives

In addition to the global initiatives, there are a number of organizations directly related to ICT which also provide environmental KPIs covering reporting guidelines, standards and methodologies.

### 2.2.1 European Telecommunications Network Operators' Association (ETNO)

ETNO is a policy group for European telecommunications network operators.[10] ETNO has defined a group of KPIs that are collected every year from its members for its Annual Report.[11] These KPIs are:

*Energy:*

- Total annual consumption of electricity from the grid
- Total annual consumption of electricity directly purchased from renewable sources
- Total annual consumption of electricity from CHP (combined heat and power)
- Total annual consumption from own production of electricity (e.g. fuel cells, own CHP, etc.)
- Diesel consumption
- Petrol leaded consumption
- Petrol unleaded consumption
- LPG (liquefied petroleum gas) consumption
- CNG (compressed natural gas) consumption
- Total annual automotive fuel savings (via energy efficiency actions) compared with previous year
- Total annual heating oil demand
- Total annual natural gas demand
- Other fuels/sources (e.g. coal, etc.)
- District heating
- Amount of energy.

[10] European Telecommunication Network Association. ETNO. www.etno.be (2012).

[11] ETNO: Sustainability reports questionnaire 2010.

*GHG emissions:*

- Total $CO_2$ emissions from electricity consumption
- Total $CO_2$ emissions from heating fuel consumption.

*Materials:*

- Paper demand by the employees
- Paper used for telephone directories
- Total paper demand (including demand by the employees but not directories)
- Percentage of paper recycled.

### 2.2.2 European Telecommunications Standards Institute (ETSI)

ETSI produces globally applicable standards for information and communication technologies including fixed, mobile, radio, broadcast, Internet, aeronautical and other areas. It provides technical specific standards for ICTs in the field of measurement methods for energy efficiency of wired and wireless[12] access. KPIs are defined as:

*Wired access:*

- The power consumption of broadband telecommunication network equipment:

  PBBline = PBBeq/Nsubscrib-lines

  The indicator needs to be evaluated in different conditions of traffic to take into account low power mode.

- Global network power performance is proposed as normalized power consumption

  NPC = 1 000 × PBBport/bitrate [mW/Mbit/s]

*Wireless access:*

- Network level efficiency is based on coverage (more indicative for rural cases):

$$EE_{coverage} = \frac{A_{coverage}}{P_{site}} : \text{km}^2/\text{W}$$

- Network level performance indicator based on data traffic (more indicative for urban cases). Two metrics are defined, one for GSMA and other for WCDMA/LTE/WIMAX technology.

GSMA $$EE_{capacity} = \frac{N_{busy\_hour}}{P_{site}}$$

*Nbusy_hour* is the number of subscribers based on average busy hour traffic demand by subscribers and average RBS busy hour traffic.

[12] European Telecom Standardization Institute. ETSI. ETSI TS 102 706 V1.2.1 (2011-10), Environmental Engineering (EE), Measurement Method for Energy Efficiency of Wireless Access Network Equipment.

WCDMA
LTE
WIMAX

$$EE_{equipment} = \sum_{ALx=1}^{l} \left( c_{ALx} \cdot EE_{equipment}^{ALx} \right)$$

$$EE_{equipment} = \sum_{ALx=1}^{l} \left( c_{ALx} \cdot EE_{equipment}^{ALx} \right)$$

(Kbit/J)

$EE_{equipment}^{ALx}$ takes into account data traffic and energy consumption during an activity of the cell. It is defined as average data traffic and distance between user equipment and radio network equipment. $C_{ALx}$ is a weighting factor that considers traffic distribution during a day.

In November 2011, ETSI published an LCA (Life Cycle Analysis) standard[13] containing detailed requirements beyond ISO 14040/ISO 14044 and EU ILCD Handbook for LCA of ICT Equipment, Networks, and Services.

Several useful KPIs can be derived through the use of LCA techniques, including *resource productivity,* where:

- Resource productivity = material input per unit service.

LCA provides a quantitative index with which to compare applications, e.g. similar ICT systems. As a result, it can be used to calculate resource productivity. ICT systems of higher resource productivity are those that deliver higher performance (e.g. lower $CO_2$ emissions) with lower resource consumption.

Another possible LCA based KPI applicable to ICT systems is carbon efficiency, defined as the "output of functionality/$CO_2$eq per ICT system providing the functionality". So the more functionality provided with less $CO_2$eq emissions, the higher the carbon efficiency of the ICT system. For example, the provision of services such as fibre to the home (FTTH) or fibre to the building (FTTB) differs, based on the results of this analysis.

FTTH 100 [Mb/s]/120 kg$CO_2$e = 0.83

FTTB 50 [Mb/s]/130 kg$CO_2$e = 0.38.

So, in the case of this LCA study, the carbon efficiency KPI is 116% better for FTTH than FTTB.[14]

### 2.2.3 The Green Grid

The Green Grid is a non-profit, open industry consortium of end users, policy-makers, technology providers, facility architects, and utility companies collaborating to improve the resource efficiency of data centers and business computing ecosystems. They have developed two useful energy efficiency metrics for IT equipment:[15]

*Energy in data centers:*

- power usage effectiveness (PUE) = total facility power/IT equipment power;
- data center infrastructure efficiency (DCiE) = 1/PUE = IT equipment power/total facility power × 100%.

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13 European Telecom Standardization Institute. ETSI . ETSI TS 103 199. V1.1.1 (2011-11), Environmental Engineering (EE). Life Cycle Assessment (LCA) of ICT equipment, networks and services; General methodology and common requirements.

14 [G. Griffa, L. Radice, C. Bianco *et al.* (2010): Carbon footprint of next generation fixed networks. 32nd International Telecommunications Energy Conference, INTELEC 2010, June 6-10, Orlando, FL, US].

15 The Green Grid. www.thegreengrid.org – Green Grid Data Center Power Efficiency Metrics: PUE and DCiE (2008).

### 2.2.4 GSMA

The GSM Association (GSMA) is an association of mobile operators and related companies devoted to supporting the standardizing, deployment and promotion of the GSM mobile telephone system. The following KPIs are proposed in the GSMA Methodology for Assessing the Environmental Impact of Mobile Networks.[16]

*Energy:*

- energy consumption per mobile connection;
- energy consumption per unit mobile traffic;
- energy consumption per cell site;
- energy consumption per unit of mobile revenue;
- mobile network electrical energy usage and diesel energy usage.

*Others:*

- number of physical cell sites and number of technologies;
- percentage coverage (geographic, population);
- number of mobile connections, mobile revenues;
- minutes of mobile voice traffic, bytes of mobile data traffic.

### 2.2.5 International Electrotechnical Commission (IEC)

The International Electrotechnical Commission is a non-profit, non-governmental international standards organization that prepares and publishes International Standards for all electrical, electronic and related technologies. In its document on smart electrification[17], IEC suggests the following KPIs for efficient electricity generation:

*Energy (smart grids):*

- efficiency of generation = GE(generated energy)/IE (input energy);
- efficiency of transmission = TE (transmitted energy)/IE.

*GHG emissions:*

- $CO_2$ at generation = $CO_2$/IE

### 2.2.6 International Telecommunication Union – Study Group 5 (ITU-T SG 5)

ITU and its Telecommunication Standardization Bureau (ITU-T) have the mandate to lead and develop a set of methodologies to assess the environmental impact of ICTs. This objective is carried out by ITU-T Study Group (SG 5) which is responsible, inter alia, for studies on methodologies for evaluating ICT effects on climate change. Other efforts and activities of this study group are e-waste, electromagnetic fields, protection of telecommunication equipment from electromagnetic disturbances; supply chains aspects, conflict minerals, energy efficiency, etc.

Within the framework of SG 5, some KPIs for environmental management have been defined in several methodologies applicable to the whole ICT sector.

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16 GSMA Association. www.gsm.org A Methodology for Assessing the Environmental Impact of Mobile Networks (2011).

17 Coping with the Energy Challenge The IEC's role from 2010 to 2030: Smart electrification.

*Recommendation ITU-T L.1410 – Methodology for environmental impact assessment of information and communication technologies goods, networks and services*

This methodology provides assessment on the environmental impact coming from ICT goods, networks and services. The following KPIs have been extracted from different relevant parts of Recommendation ITU-T L.1410.

*Energy:*

The following KPIs are considered as inputs established in clause I.2: Methodological Framework, for handling of Life cycle Inventory (LCI) results for electricity and energy. Types of fuel extracted from Annex I: Elementary Flows.

- electricity;
- fuels: oil, diesel, petrol, jet fuel, LPG, LNG, coal, gas, other forms of delivered energies: district heating (water and steam), district cooling.

*GHG emissions:*

The KPIs considered in clause I.3 as a recommendation for reporting inventory are:

- total $CO_2$eq per ICT good, network and service;
- direct GHG emissions.

*Water:*

Annex H deals with the modelling of unit processes, where a unit process is a facility where a product is produced, an office or a store, an activity or a place where a service is produced and a vehicle or a "mobile facility" that transports products. Apart from considering energy inputs, this annex describes KPIs for water:

- water consumption [measured in litres];
- water discharge to municipal sewage or recipient.

*Waste:*

Waste fractions (residual waste fractions or waste fractions that needs further treatment, also including material recycling and energy recovery).

*Others:*

The following KPIs are considered as "additional impact categories" in clause I.2.4: Life cycle impact assessment (LCIA):

- human toxicity [kg 1,4-DB eq.];
- resource depletion [kg Sb-eq.];
- acidification [kg S02-eq.];
- eutrophication [kg PO4-eq.]; and
- ozone layer depletion [kg CFC 11-eq.].

*Recommendation ITU-T L.1420 – Methodology for energy consumption and greenhouse gas emissions impact assessment of information and communication technologies in organizations*

This methodology presents the requirements and recommendations which an organization needs to comply with when assessing the ICT-related energy consumption and greenhouse gas (GHG) emissions.

*Energy:*

In clause 8.3.4.2, "Evaluation of energy consumption and GHG impact of ICT organizations", the methodology addresses several sources of energy that can be considered for environmental KPIs:

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

*GHG emissions:*

The approach is the same as the GHG Protocol and ISO 14064. It also addresses metrics for the emission factors , which complement the metrics in the other two standards:

- Scope 1: GHG emissions in kg $CO_2$eq per litre of fuel used for ICT power supply backup systems
- Scope 2: GHG emissions, in kg $CO_2$eq per kWh consumed, mentioning the country and/or the energy provider considered.

And for indirect emissions, clause 8.7.1 reviews in detail different indirect GHG emission sources, which can be used as well as KPIs:

GHG emissions from supply chain: Purchased goods and services, capital goods, leased assets (upstream), fuel- and energy-related activities not included in scope 1 or 2, transportation and distribution (upstream).

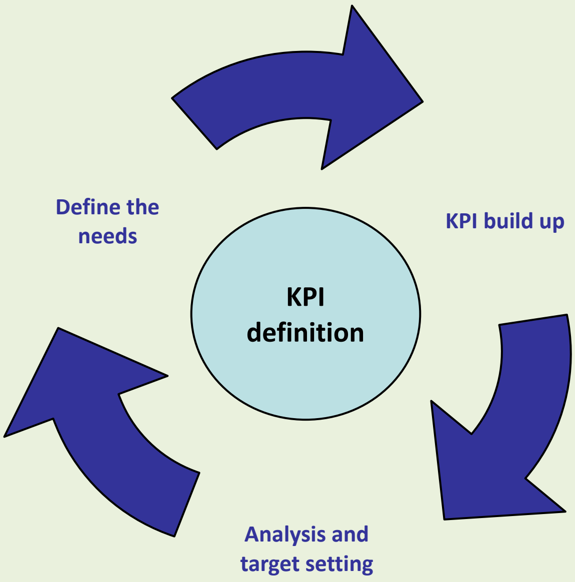
GHG emissions from own activities: Transportation and distribution (downstream) business travel, employee commuting, leased assets (downstream) and others, franchises.

- GHG emissions from operation of products: Processing of sold products, use of sold products, leased assets (downstream)
- GHG emissions from end-of-life treatment (EoLT): Waste generated in operation, EoLT of sold products.

# 3 A suggested process for KPI definition

Before selecting any environmental KPI, it is important that ICT companies have clear business strategies and target definition. After this, a process of KPI definition should be established. Figure 2 represents a schematic way of a KPI definition process.

**Figure 2: Environmental KPI process scheme**




## 3.1 Defining the needs

First of all, the needs of the organization must be clear, in order to identify KPIs to satisfy those needs and drive the process in the right path. First order priorities are of an economic and environmental nature, but other specific needs can be based on business objectives and priorities, investor demands, control of processes, efficiency, better decision making, investment indices, etc.

## 3.2 Listing relevant KPIs

In order to build up KPIs based on organizational needs, it is important to consider three things. The first issue is being clear about the types of KPIs desirable for the organization. The second issue is identifying the process for collecting the inputs needed for the KPIs. Finally, the third issue is putting in place verification to ensure that the KPIs meet quality expectations in terms of decision-making, In addition, is important to establish adequate internal processes to guarantee the availability and reliability of the primary data required to build them.

### 3.2.1 Types of KPIs

Prior to data collection, it is necessary to define the KPIs that are going to be managed. Several suggestions and examples have been made thus far, but it is important to know the characteristics that an environmental KPI must have in order to make the right choice.

These are important **characteristics** that apply when choosing KPIs:

**Relevance:** This is an important characteristic not only to the environment but also to company priorities, objectives or data management. If the company is going to spend time and money on managing data, that data needs to be relevant; otherwise, it would be a waste, or at least not efficient. It is appropriate at this point to consider the needs of other stakeholders as well. For example, KPIs for reporting under the GRI scheme could be different from those needed for internal environmental management or communication to executive committees.

**Measurability**: Not every KPI is easily quantifiable. As a result, it helps to be precise in the definition of the ones which are not, to avoid confusion.

**Uniformity:** Standard processes require standard KPIs: all data collected should have the same units and boundaries; this will save time in normalization processing. Being clear about data boundaries is important – this accounts for which data have been taken into account, or not, to build specific KPIs. At the same time, it must be very clear where assumptions and/or estimations have been made. If part of the data is missing, it is necessary sometimes to carry out an estimation to cover the data gap.

KPIs can be **constructed** in different ways, including the following:

**Absolute/relative:** A KPI can be defined in absolute terms (e.g. total electricity consumed during a year) or in relative terms (e.g. electricity consumed per employee). The latter forms of KPIs are intensity values, and these are necessary when comparing data from different companies. Absolute data is usually not comparable, because it depends too much on the size of the company, company growth, or changes in boundaries. Intensity KPIs can be more equitably compared between different companies or different divisions of the same company. They can also better reflect changes in the organization's size and performance. Usual intensity denominators are: employees, revenues, and products manufactured.

Since the main objective of using relative KPIs is homogenization, the key is to homogenize the intensity denominators, e.g. if a company decides to use the KPI "Volume of $CO_2$ per unit of product manufactured" during a certain period, it should take into consideration the fact that different products need different amounts of energy. To manage a KPI like this, an algorithm needs to be put in place so that all products are denominated in terms of energy, which is directly related to $CO_2$ spent.

Here's an example.

> *Product A costs 1 energy unit to be produced, and Product B costs 2 energy units. If the company produces 100 A and 100 B, it spends 300 energy units in both products, so the resulting KPI is 300 energy units/200 products = 1.5 energy units/product. If the company has a target in reducing the energy per product manufactured, an increase of demand of product A to 200 units (and no increase in the production of B) requires 400 energy units to produce both, and the resultant KPI = 400 energy units/300 products = 1.33 energy units/product. While the company is reducing its KPI (energy units per units of product) in absolute terms, but managing this value as an internal target can be confusing, because the KPI target was met without recourse to any energy efficiency measures. However, a change in demand favouring Product B next year could result in the KPI target being completely missed, again with no change in energy efficiency measures.*

**Direct/indirect:** Especially in carbon accounting and reporting, the difference between indirect or direct KPIs has its importance, in order to meet the requirements of standards such as ISO or GHG Protocol. Investment indices also require reporting in these terms. A direct KPI would relate to resources spent directly by company-owned buildings or their employees. Indirect KPIs would represent third parties such as leasing companies.

**Positive/negative:** The positive and negative effects of different KPIs have been explained and are related to first and second order effects.

**Local/global:** KPIs can be managed locally or globally according to company needs. Note that some indicators can be global by nature: $CO_2$ emissions affect climate change globally, no matter the department, zone or country where they are generated, while water pollution, for example, is locally focused.

### 3.2.2 Data collection process

The establishment of an internal standard process to gather all the relevant information relative to environmental performance is essential to manage the data and build KPIs. Data gathering is periodical, and without a standard process the data could well be incomplete, wrong or late. Having a data collection process reduces uncertainty risk when the data has to be published in an external report or index.

1. **Identify a responsible group and/or dashboard:** This group will be responsible for the management of the KPI data, and the boundaries applicable to the data. It will also make the internal decisions to ensure that the data is correct, internally verified and, where relevant, verified externally as well.
2. **Identifying the organizational and geographical boundaries:** The data will be collected from different departments or subsidiaries inside the company. The first step is to identify them, so there can be an effective communication between the KPI data group and the rest of the organization. Documents and databases need to be accessible to all the subsidiaries and companies.
3. **Identifying key actors:** The data gathering group will need to identify and have contact with the data providers, and ensure that they are aware of and understand the mechanism of the data gathering process and its importance. The units of the data collected and sent must be the same for each category.
4. **Having a reliable database or data storing software to store and/or manage the data:** There needs to be an internal database to store the relevant information, and provide management of access permissions. There a growing number of software solutions available to manage such tasks.
5. **Establishment of a period of data gathering:** In order to meet company objectives and compare the data across time periods, it is essential to define time boundaries and compile the information in blocks. This can be done monthly, quarterly, or annually. Theoretically, the shorter the time period is, the better, but sometimes the only effective way is to gather it annually. The reporting bodies and indices too ask for environmental information based on specified time periods.
6. **Identify data/KPIs and their boundaries:** Some of the KPIs coincide with the stored data, but most of them are a combination of different units, or a result of a calculation or conversion. It is important to differentiate and identify them. Estimating the degree of confidence in the measures helps in estimating and verifying future numbers.

Note: Do not expect the data to be perfect the first year!

## *3.3 Third-party verification of data collected for all environmental indicators*

Data verification is essential in the process to reduce data uncertainty and minimize errors in data gathering, which leads to a more accurate control of the processes, better decision making and control. Ultimately, this also helps meet investor expectations. Verification can be done internally and/or externally. Third-party verification is important in order to have data accounting certified for environmental reporting and compliance with possible local environmental regulations and policies.

### 3.3.1 Common verification process

It is recommended that there are parallel internal and external (third party) verification processes The internal verification process should emerge as a natural consequence of the data collection process, and should be carried out right after finishing data collection with a standard process. This should also clear the path for the third party verification team. Ideally, this third party should be a certification company with expertise and competence in environmental data assurance.

The verification process should comply with ISO 14001 which establishes audit procedures that provide for the planning and conduct of an audit of an environmental management system. Specifically for GHG emissions, ISO 14064-3 specifies principles and requirements and provides guidance for those conducting or managing the validation and/or verification of greenhouse gas (GHG) assertions.[18]

## *3.4 Analysis and target setting*

Once the data are registered and stored, there are KPIs to measure the performance of a determinate period of time. Once the data and KPIs have been internally and externally verified, the organization should be prepared to set the targets, according to company needs. The evolution through time of specific data to meet specific targets can drive the company to redefine the needs to build up KPIs to better achieve targets. As a result, the KPI definition process ends up being cyclic.

The definition of targets and a correct analysis of KPIs allows ICT companies to identify gaps and facilitate their own decision-making. Examples of different types of targets are discussed in the next section.

# 4 Target definition

One of the objectives of quantifying environmental performance through KPI definition and accounting is the establishment of environmental targets. Once a company is able to reduce the uncertainty relating to the measurement of periodical change, it can measure periodical and percentage changes in specific KPIs, which can become the basis for target setting.

## *4.1 Types of environmental targets*

In general, there are three main types of ICT-related environmental targets: eco-efficiency targets, ICT enabling effect targets, and targets for external communication.

### 4.1.1 Eco-efficiency targets

*Eco-efficiency is achieved by the delivery of competitively-priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the earth's estimated carrying capacity. It focuses on business opportunities and allows companies to become more environmentally responsible and more profitable. It fosters innovation and therefore growth and competitiveness. In short, it is concerned with creating more value with less impact.*[19]

According to eco-efficiency principles, improved environmental efficiency behaviour in businesses leads to economic benefits at the same level. The easiest example is that " less electricity usage means less money spent on that electricity".

Eco-efficiency target setting requires those who set environmental KPIs to have a real understanding of the environmental performance of the company, and its evolution over time, in order to make for more accurate forecasts. If this understanding does not match reality, it will probably lead to wrong target setting, which could result in negative reputational and economic impacts, among other effects. It is also important to establish a baseline date, and make sure that the KPI inventory for that time period is complete and accurate enough to set an appropriate environmental quantitative target.

Relative and intensity KPIs are specially related to eco-efficiency because they measure the best input-output ratio instead of the absolute values – e.g. MWh per employee, volume of $CO_2$ per unit of company

[18] International Standards Organization. www.iso.org/ (2012).

[19] World Business Council for Sustainable Development – Eco-efficiency: creating more value with less impact (2000).

revenue, etc. Such KPIs better reflect efficiency with more resilience to company changes, such as changes in the size of the company or variation in demand.

It is important to note that, in most cases, efficient services rely on efficient products, so producing more efficient products leads to more efficient behaviour. The ETSI EE Technical Committee provides efficiency specifications and metrics for IT products that can help in this task.

#### 4.1.2 ICT enabling effect targets

The ICT enabling effect, described thoroughly in the SMART 2020 report, allows non-ICT sectors to become more efficient through the use of ICT goods and services, contributing to the creation of smart buildings, smart grids, smart logistics and smart industry processes, allowing dematerialization and efficient use of resources.

Due to the nature of this effect, located as it is on the customer side, it is more difficult to quantify with specific values, but it is recommended to estimate the savings of resources by the use of products and services, to successfully targets set within ICT companies.

Targets and KPIs that demonstrate the enabling effect of ICTs on the environment should be developed based on standard methodologies.

#### 4.1.3 Communication targets

There is a difference between targets being internal or external in terms of communication. There are targets that are relevant for publication in Corporate Responsibility reports and others for reporting to investment indices. , These are the external targets. There also exists the need for control of internal processes, which can be improved by the establishment of internal corporate targets, directly addressed to relevant managers and employees. These are more relevant to the working of the company, and give direct value to the company to improve its environmental performance.

### *4.2 Examples of corporate ICT environmental targets*

A number of examples of corporate ICT environmental targets are listed below. The intention is not to make a comparison of best practices in this area. Instead, the examples given below show several targets proposed by different companies. Also, not all targets for every company have been listed. This is only a sample of measurable targets. The past achievements, or targets which have been accomplished, have been omitted, as well as those that are not clear targets or have no clear baseline.

Some examples[20] of real environmental targets established by ICT companies are:

**Alcatel-Lucent** (2010 CR Report)

- Reduce absolute carbon footprint ($CO_2$ equivalent) by 50%, of 2008 baseline, by 2020
- Reduce water consumption by 20%, of 2010 baseline, by the end of 2013
- Achieve a 40% increase in the number of base stations deployed with alternative energy powering solutions (relative to 2010 baseline) by end of 2011.

[20] This is a non-exclusive list in alphabetical order.

**AT&T**[21]

- Reduce electricity consumption relative to data growth in 2011 (energy intensity metric) on the network by 17% from year 2010
- Reduce Scope 1 emissions (direct) by 14% by 2014, using 2008 baseline.

**Belgacom** (CSR Report 2010)

- Reduce the $CO_2$ emissions by 70% (period 2007-2020)
- Reach an average of 120 g $CO_2$/km for new company cars by 2012
- Monitor and improve energy efficiency in buildings by 2020.

**Cogeco Cable**[22] (2011 Corporate Social Responsibility Report)

- Air travel: Decrease air travel by 10% per RGU over 5 years
- Facilities: Decrease energy consumption by 2% per RGU over 5 years
- Vehicles: Decrease total vehicle emissions by 500 tons of $CO_2$ over 5 years.

**France Telecom Orange**

- Reduce its greenhouse gas emissions ($CO_2$ equivalent) by 20% by 2020 (2006 baseline).
- Reduce its energy consumption by 15% by 2020 (2006 baseline).
- Install solar stations: By the end of 2010, 1 554 solar stations have been installed, including 922 radio stations (BTS) in 14 African and Middle Eastern countries. Annual production of solar energy of all sites is estimated to be 8.6 GWh, corresponding to the equivalent of 45 000 tonnes of $CO_2$ emissions and 16.8 million litres of fuel being saved.

**Huawei** (CSR Report 2010)

- Reduce average energy consumption per unit business volume of shipments by 35% of the consumption level in 2009, by the end of 2012
- Reduce $CO_2$ emissions per unit sales revenue by 9% by 2011 relative to 2010 in China region.

**Nokia**[23]

*Energy:*

- Reduce energy used in production by 20% per unit produced compared to year 2008 by the end of 2012
- Reduce the average charger's no-load power consumption by 75% from 2006 level by the end of 2012.

*Emissions:*

- Reduce greenhouse gas emissions per person working in Nokia offices and R&D by a minimum of 23% compared to the year 2006 level by the end of 2012
- Reduce the offices, R&D and manufacturing facilities greenhouse gas emissions by a minimum of 30% compared to the year 2006 by the end of 2012
- Reduce greenhouse gas emissions per sales package produced by 20% compared to the year 2008 by the end of 2012.

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[21] www.att.com/gen/landing-pages?pid=7735.

[22] www.cogeco.ca/export/sites/cogeco/corporate/files/others_en/COGECO_CSR_Report_2011.pdf.

[23] http://ncomprod.nokia.com.

**NSN** (CSR Report 2010)

- Improve the energy efficiency of GSM/EDGE and WCDMA/HSPA base station products by up to 40% by 2012 (2007 baseline)
- Reduce $CO_2$ emissions from buildings by 30% by 2012, from the 2007 baseline
- Reduce $CO_2$ emissions from IT operations and use of IT products by 10% by the end of 2010, from the 2008 baseline
- Improve the energy efficiency of buildings to reduce associated energy use by 34.3 GWh by 2012
- Increase the use of renewable energy in company operations to 50% by the end of 2010 (2007 baseline)
- Reduce emissions from new cars in service fleet in Europe to 120 g/km by 2010.

**Microsoft**[24]

- Reduce carbon emissions per unit of revenue by 30% (compared with 2007 levels) by 2012.

**Swisscom**[25]

- Reduce absolute carbon footprint (scope 1 and 2) by yearly 3% by 2015 (2010 baseline)
- Increase the value of the ratio of traffic over energy consumption measured in bit/joule by 15% in 2011 compared with 2010 (i.e. 1 950 bit/joule compared with 1 699 bit/joule).

**Telefónica** (CSR Report 2010)

- Reduce energy consumption in networks per equivalent access (intensity figure) by 30% in 2015 with 2007 year baseline
- Reduce absolute energy consumption in office buildings per employee by 15% in 2015 with 2007 year baseline

**Verizon** (CR Report 2010-2011)

- Improve carbon-intensity efficiency year-over-year by 15% in 2011
- Increase the percentage of alternative-fuel vehicles in the fleet toward our target of 15% by 2015
- Implement our energy efficiency standards programs at 75% of our facilities with 200 or more people
- Expand Green Team membership to 5 000 employees
- Expand the "smart building" programme to a total of 250 facilities.

# 5 Checklist

This entire document has focused on the kinds of metrics that can be used to manage environmental and sustainability performance. Most of the KPIs are defined in the context of methodologies and guidelines, which can act as checklists.

However, the recommendation of this document is to match environmental KPIs to the needs and objectives of the business. The definition of environmental KPIs and targets in an ICT companies has to follow a structure. On that basis, a checklist for actions to standardize procedures that would help ICT companies improve their environmental performance through the definition of environmental KPIs and targets is described as follows:

24 www.microsoft.com/environment/our-commitment/our-footprint.aspx.

25 http://2010.swisscom-report.ch/en/gri.

| | | |
|---|---|---|
| 1. | Alignment of environmental and business strategies in the short and long term | ☐ |
| 2. | Definition of environmental aspects to be assessed (waste, energy, materials, GHG, etc.) | ☐ |
| 3. | Identification of primary input value of the environmental aspect identified | ☐ |
| 4. | Establishment of relevant KPIs for environmental performance management | ☐ |
| 5.<br>5.1<br>5.2<br>5.3<br>5.4<br>5.5 | Creation of a standardized process for data gathering and KPI build up<br>Identify a responsible KPI data group to carry out the process.<br>Identify organizational and geographical boundaries<br>Identify key data managing actors.<br>Have a reliable database or data software to store and/or manage the data.<br>Establish time periods for data gathering. | ☐ |
| 6. | Definition of environmental targets | ☐ |
| 7. | Definition of activities and programs to meet the targets | ☐ |
| 8. | Follow up targets and improve your environmental performance | ☐ |

# 6 Conclusions

The need for sustainable and efficient management of ICT environmental data grows in every company. It is necessary to agree on standard processes in order to manage them effectively, not only for efficiency reasons, but also to have an appropriate way to compare similar companies.

Environmental KPIs and targets have to be aligned with corporate policies and should give value to the company in terms of facilitating decision making and effective resource allocation. It has been already said that defining the needs of an organization is very important, and one of the reasons to do so is to set targets that will actually help the company; otherwise, they would only be a waste of resources.

ICT companies should consider that the definition of environmental targets has to include a plan to achieve them. The main reason for target setting is to improve the performance and efficiency of an organization, and one of the definitions of environmental efficiency is to reduce costs while reducing negative environmental effects. Once a target is set, there must be measures taken to achieve it. Some of the measures might have already been expected or planned, but others may be unexpected, or even created after defining targets in order to meet objectives.

Most of the KPIs reflected in this analysis include energy and carbon related management aspects and there are some gaps that should be evaluated in terms of other environmental issues. There is a need for information on KPIs to manage electric and electronic waste (e-waste) in ICT companies, and also in the provision of ICT products to final customers. These information gaps are worth investigating and evaluating.

Apart from the business implications of setting a target, not achieving the goal could have reputational consequences. The organization will give the impression of setting targets just for “face-lifting” purposes, and that reduces trust regarding its environmental performance. Setting achievable targets is very important, and preferable to setting impressive ones.

Setting environmental targets supports effective environmental load reduction of the different ICT facilities and processes. In addition it could help to comply with environmental regulations whenever they emerge, even if they do not already exist.

The variety of environmental KPIs and targets defined by several ICT companies suggests that the ICT sector should work in defining standards and methodologies that could help them improve their environmental performance. Within the framework of ITU-SG 5 activities and methodology development, different KPIs should be included as global suggestions for ICT companies.

KPIs are required to really put a value to the environmental benefits that ICT could bring to the world economy.

# 7 Glossary

| | |
|---|---|
| CDP | Carbon Disclosure Project |
| CR | Corporate Responsibility |
| CSR | Corporate Social Responsibility |
| DCiE | Data Center infrastructure Efficiency |
| DJSI | Dow Jones Sustainability Index |
| EDGE | Enhanced Data rates for GSM Evolution |
| EoLT | End of Life Treatment |
| ETNO | European Telecommunications Network Operators' Association |
| ETSI | European Telecommunications Standards Institute |
| GHG Protocol | Greenhouse Gas Protocol is an accounting tool to quantify and manage greenhouse gas emissions |
| GRI | Global Reporting Initiative |
| GSM | Global System for Mobile Communications |
| GSMA | GSM Association |
| HSPA | High Speed Packet Access, a mobile telephony protocol |
| IEC | International Electrotechnical Commission (IEC) |
| KPIs | Key Performance Indicators |
| LCA | Life Cycle Assessment |
| LCI | Life Cycle Inventory |
| LCIA | Life Cycle Impact Assessment |
| MWh | Mega Watt hours, usually defining the quantity of electricity purchased |
| PUE | Power Usage Effectiveness |
| PUE | Power Usage Effectiveness value |
| RGU | Revenue Generating Unit |
| Scopes 1, 2 and 3 | Categorization of direct and indirect emissions, as defined by the Greenhouse Gas (GHG) protocol |
| SG 5 | International Telecommunications Union Study Group 5 |
| Tonnes $CO_2$eq | Greenhouse gas emissions denominated in tonnes of carbon dioxide equivalents |
| WBCSD | World Business Council for Sustainable Development |
| WCDMA | Wide-band Code Division Multiple Access, a 3G technology to increase GSM transmission rates |

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