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Part 3: Global KPIs for ICT sites

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Contents

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Foreword

This final draft ETSI Standard (ES) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM), and is now submitted for the ETSI standards Membership Approval Procedure.

In all parts of the multi-part deliverable ETSI ES 205 200, energy management deals with energy use management, not energy production management.

The present document is part 3 of a multi-part deliverable covering operational energy management and sustainability of broadband deployment, as identified below:

Part 1: "General requirements";

Part 2: "Specific requirements";

Part 3: "Global KPIs for ICT Sites";

NOTE 1: Additional documents are in development by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM) which include:

Part 4: "Monitoring of sustainability".

NOTE 2: A further document is under consideration ETSI Technical Committee CABLE to address "cable access networks".

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

Information and communication technology (ICT) sites constitute one of the most important areas of the worldwide growing energy consumption. They are responsible for at least 2 % of the worldwide greenhouse gas emissions, still growing.

Energy management performance of ICT sites is an important matter. It is now essential if not vital to implement commitments in order to reduce the energy consumption by ICT sites.

Further to the 1997 Kyoto protocol [i.7], the European Commission has issued, and will issue, Directives in order to improve energy management of networks, sites included, of whole industry sectors.

Therefore suppliers and users of ICT equipment are required to implement "Green" tools (indicators, recognized Green levels) to monitor the efficiency of their greener ICT sites.

Consequently, the first target of ETSI ATTM has been the development of this ETSI standard (ES) with support of ISG OEU members (ICT world Users) in order to define those tools.

The KPI presented in the present document is an answer to requirements by end users and European Community to justify a global sustainability level for ICT sites. On the side of the ICT site owner, it assesses an energy management performance level; on the EC side, it allows a follow-up for the global adjustment of policy for sustainability of ICT industry.

The present document presents the Objective KPIs defined in standard ETSI ES 205 200-2-1 [2] for data centres, ETSI ES 205 200-2-2 [i.10] for fixed networks, and ETSI ES 205 200-2-3 [i.11] for mobile networks and uses them to define a Global Key Performance Indicators (KPI) allowing the evaluation of performance of energy use management in ICT sites.

1 Scope

The present document defines field implementation of a so-called Global Key Performance Indicators (Global KPI) enabling the monitoring of performance of energy use management in all ICT sites including, but not limited to, data centres and operator sites.

Performance of energy management is dealt as independent layers. The present document addresses performance of hosting infrastructure that allows normal functioning of hosted ICT equipment, including climatic conditions, security and safety. The present document does not deal with other layers such as performance of ICT equipment itself, performance of usage of available processing power, and layers related to final service delivered (e.g. processing power required per built car) or overlay layers (e.g. final energy required per built car).

The present document deals with final energy consumption by ICT sites or group of sites, use of energy from renewable source and energy reuse. It does not deal with GHG gas emissions that will be taken care of in other parts. Neither does the present document deal with efficiency of power generators or adequacy of performance to given climatic conditions or availability requirements.

Energy consumption should not to be confused with power generation. Only energy actually consumed by the ICT site should be counted. Use of excess locally generated power is out of the scope of the present document.

The present document does not address the whole sustainability aspects related to ICT sites. Other aspects such as power management, global environmental footprint of the ICT site construction, operation and decommissioning are not dealt with in the present document and should be considered.

The Global KPI alone is not designed for comparison of ICT sites or group of sites. It does not define an ICT site as good or bad unless combined with other parameters considered relevant for a comparison, such as local climatic conditions, availability requirements or purpose of ICT site.

Several standards and technical documents have been taken into account during the development of the present document including EC Mandate M/462 [i.1], ETSI ES 205 200-1 [1], ETSI TS 105 174-1 [i.6], ETSI TS 105 174-2-2 [i.2], CENELEC EN 50600 Series [3], Recommendation ITU-T L.1300 [i.4], and EC DG JRC Code of Conduct for Data Centres [i.3] and [i.5]. It was initially built based on the position paper [i.13] by ETSI ISG OEU.

The present document addresses in a simple way the following objectives defined in standard ETSI ES 205 200-2-1 [2] for data centres, ETSI ES 205 200-2-2 [i.10] for fixed networks and ETSI ES 205 200-2-3 [i.11] for mobile networks:

- energy consumption;
- task efficiency;
- energy reuse;
- renewable energy.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI ES 205 200-1: "Access, Terminals, Transmission and Multiplexing (ATTM); Energy management; Global KPIs; Operational infrastructures; Part 1: General requirements".

[2] ETSI ES 205 200-2-1: "Access, Terminals, Transmission and Multiplexing (ATTM); Energy management; Global KPIs; Operational infrastructures; Part 2: Specific requirements; Sub-part 1: Data centres".

[3] CENELEC EN 50600 Series: "Information technology - Data centre facilities and infrastructures".

[4] CENELEC EN 1434 Series: "Heat meters".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] EC Mandate M/462: "Standardisation mandate addressed to CEN, CENELEC and ETSI in the field of ICT to enable efficient energy use in fixed and mobile information and communication networks".

[i.2] ETSI TS 105 174-2-2: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment - Energy Efficiency and Key Performance Indicators; Part 2: Network sites; Sub-part 2: Data centres".

[i.3] European Commission DG JRC: "Code of Conduct for Data Centre Energy Efficiency".

[i.4] Recommendation ITU-T L.1300: "Series L: Construction, installation and protection of cables and other elements of outside plant: Best practices for green data centres".

[i.5] European Commission DG JRC: "Code of Conduct on Energy Consumption of Broadband Equipment".

[i.6] ETSI TS 105 174-1: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment and Energy Management; Part 1: Overview, common and generic aspects".

[i.7] Kyoto Protocol to the United Nations Framework Convention on Climate Change.

[i.8] ETSI ES 205 200 Series: "Access, Terminals, Transmission and Multiplexing (ATTM); Energy management; Global KPIs; Operational infrastructures".

[i.9] Directive 2010/31/EU of the European parliament and of the council of 19 May 2010 on the energy performance of buildings.

[i.10] ETSI ES 205 200-2-2: "Access, Terminals, Transmission and Multiplexing (ATTM); Energy management; Global KPIs; Operational infrastructures; Part 2: Specific requirements; Sub-part 2: Fixed broadband access networks".

[i.11] ETSI ES 205 200-2-3: "Access, Terminals, Transmission and Multiplexing (ATTM); Energy management; Global KPIs; Operational infrastructures; Part 2: Specific requirements; Sub-part 3: Mobile access networks".

[i.12] ETSI ES 203 228: "Environmental Engineering (EE); Assessment of mobile network energy efficiency".

[i.13] ETSI GS OEU 001: "Operational energy Efficiency for Users (OEU); Technical Global KPIs for Data Centres".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

energy consumption: total consumption of energy by an operational infrastructure

final energy consumption: energy consumption as seen by the consumer of a power source

NOTE: This consumption does not include losses resulting from transformation of primary energy, if any.

fossil energy: any energy not classified as renewable energy

global KPI: compound KPI obtained by combination of objective KPIs in order to assess overall performance of energy management

ICT equipment: equipment providing data storage, processing and transport services

ICT site: site containing structures or group of structures dedicated to the accommodation, interconnection and operation of ICT equipment together with all the facilities and infrastructures for power distribution and environmental control together with the necessary levels of resilience and security required to provide the desired service availability

objective KPI: KPI assessing one of the objectives of operational energy performance which is subsequently used to define a Global KPI for energy management (DC_{EM})

operational infrastructure: combination of information technology equipment and/or network telecommunications equipment together with the power supply and environmental control systems necessary to ensure provision of service

renewable energy: energy produced from dedicated generation systems using resources that are naturally replenished when energy required for production is no higher than 10 % of the produced energy

3.2 Symbols

For the purposes of the present document, the following symbols apply:

DC_{CLASS}	DC_{EM} class of energy management performance
DC_{EC}	DC_{EM} yearly energy consumption
DC_G	DataProcessing & Communication energy consumption gauge for a single ICT site
DC_P	DataProcessing & Communication Performance for a single ICT site
DC_{EM}	Global KPI for DataProcessing & Communication energy management
EC_{FEN}	Portion of KPI_{EC} not considered renewable for the purpose of the present document
EC_{HE}	Energy consumption by equipment that manage data for calculation, storage or transport purposes in an ICT site
EC_{REN}	Portion of KPI_{EC} considered renewable for the purpose of the present document.
EC_{REUSE}	Total of energy consumption from reused energy
EC_{TH}	Energy consumption from externally-provided thermal energy (either hot or cold)
EER	Energy Efficiency Ratio expressed as thermal kWh extracted by one electrical kWh
KPI_{EC}	Objective KPI for "Energy Consumption"
KPI_{EC1}	KPI for "Energy consumption per square metre"
KPI_{REN}	Objective KPI for "Renewable Energy"
KPI_{REUSE}	Objective KPI for "Energy Reuse"
KPI_{TE}	Objective KPI for "Task Efficiency"
K_{TH}	Conversion ratio from thermal energy to electricity
W_{CRs}	CRs mitigation ratio; ranges from 0 to 1
W_{REN}	Mitigation factor for KPI_{REN}
W_{REUSE}	Mitigation factor for KPI_{REUSE}

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

DC	Dataprocessing & Communication
EC DG JRC	European Commission Directorate General Joint Research Centre
GWh	Giga Watt Hour
ICT	Information and Communication(s) Technology
IT	Information Technology
ITE	IT Equipment
KPI	Key Performance Indicator
MWh	Mega Watt Hour
NTE	Network Telecommunications Equipment
PSU	Power Supply Unit
PUE	Power Usage Effectiveness

4 Definition of Key Performance Indicators

4.1 Objective KPIs for ICT sites operation

4.1.1 Energy Consumption (KPI_{EC})

4.1.1.1 General

The present document applies in a simple format the requirements of KPI_{EC} of ETSI ES 205 200-2-1 [2] for data centres, ETSI ES 205 200-2-2 [i.10] for fixed networks, and ETSI ES 205 200-2-3 [i.11] for mobile networks.

All energy required to maintain an ICT site at its design level of service availability, including energy required by hosted ICT equipment and by technical equipment such as cooling, power distribution, surveillance systems, access control, flood and fire detection, fire extinguishing system and lighting shall be allocated to KPI_{EC}.

All other energy consumptions within the boundaries of an ICT site but not necessary to deliver the design level of service availability (such as office facilities) are out of the scope and shall not be included in any measurements of KPI_{EC}.

All energy consumptions shall be recorded by electricity counters when possible. In other cases, final energy consumption by systems for producing and distributing other kinds of energy (e.g. cold loop network) shall be recorded.

Energy from local renewable hot or cold sources (e.g. air, river water) and waste heat, used for maintaining an ICT site to its design availability level shall not be counted. Anyhow, energy for devices required to distribute it to the ICT site (e.g. fans, pumps) shall be counted.

4.1.1.2 Scale

KPI_{EC} applies to all ICT sites of all sizes and includes IT rooms located in buildings.

4.1.1.3 Evolution

KPI_{EC} applies to all states of ICT sites, from initial operation to end of life.

4.1.1.4 Formula

$$KPI_{EC} = EC_{REN} + EC_{FEN}$$

Where:

- $EC_{REN:}$ Yearly energy consumption by ICT site from local renewable energy sources or from grids powered at all times only by renewable energy sources minus the energy required to extract such energy (if applicable).

- $EC_{FEN:}$ Yearly energy consumption by ICT site from other power sources.

KPI_{EC} shall be expressed in MWh.

4.1.1.5 Measurement points and processes

For the purposes of calculating this objective KPIs two kinds of energy consumptions shall be measured separately: renewable energy and non-renewable energy.

Energy consumptions from local renewable energy sources or coming from grids using at all times only renewable energy sources (such as shared wind turbine systems, hydroelectric…) shall be considered as renewable. All other Energy consumptions (e.g. electricity from public grids whether "green" or not, energy converted from non-electrical energy sources) shall be considered non-renewable. Inclusion of green mix shall be considered in future versions when the mix is certified by relevant authorities.

Systems where a facility produces renewable energy that is conveyed to the ICT sites via the public grid is allocated to non-renewable energy unless ICT sites and the facility are owned by the same entity and the energy produced by the facility is not considered in the public mix and there is no feed-in contract. The portion of such energy allocated to the ICT site added with other ICT site consumptions shall not exceed the overall energy consumption by the ICT site. Losses due to use of public grid shall be included in the calculation. If grid losses are not known a default factor of 10 % shall be used. For instance, a renewable power source of 100 kW cannot be accounted for more than 90 kW using a loss factor of 10 %.

Consumption of renewable energies shall be allocated to $EC_{REN,}$ others to $EC_{FEN.}$

Measurement points for utility energies:

- Grid electricity:

  - Electrical energy shall be measured reading counter values and/or sub counters of the electricity provider feeding the site - these counters shall be certified by the electricity grid operator.

- Hot/Cold distribution using loops (EC_{TH}):

  - Thermal energy shall be measured by a calories counter / integrator at the ICT site entry, according to CENELEC EN 1434 Series [4] where the distribution loop is considered a closed loop. EC_{TH} shall be obtained by converting that thermal energy into MWh.

  - The electrical energy required to produce and deliver that thermal energy shall be obtained by dividing EC_{TH} by a conversion factor K_{TH}. This factor will be used if certified; otherwise for cold loops a default factor of 2,5 shall be used, corresponding to a reference installation using chillers with air condensing and a network loss of 8 %. Energy taken into account shall be EC_{TH} / K_{TH}.

NOTE: The same method is used for reused energy (EC_{REUSE}) - see clause 4.1.3.5.

Measurement points for locally generated energies:

Dedicated to the ICT site

- Energy is measured at output of topmost generators. It is not measured when generated using energies that have already been counted (either locally or from utility). All electricity consumptions required to generate and distribute local energy shall be allocated to $EC_{DC.}$ Energy shall be measured as follows depending on its type:

  - **Electricity:** using meters at output of generators.

  - **Hot loops:** calories counter at output of heat generator (unless heat comes from waste heat or renewable local source (see clause 4.1.1.1)) converted to MWh.

For shared use:

- Energy consumption shall be metered by sub counters at entry of ICT site using counters depending on energy type. That consumption shall be converted into energy required to produce it according to the energy production infrastructure that has been implemented locally (see previous clause). Energy shall be measured as follows depending on its type:
  - **Electricity:** using electricity consumption meters at ICT site entry.
  - **Hot / Cold loops:** using calories counters at ICT site entry. An equipment that is dedicated to the ICT site is included in the boundary of the site.

Remarks:

- Assessed energy consumption excludes spaces that are not directly related to the function and/or operation of the ICT Site (see clause 4.1.1.1).

4.1.2 Task efficiency (KPI_{TE})

4.1.2.1 General

The present document applies in a simple format the requirements of KPI_{TE} of ETSI ES 205 200-2-1 [2] for data centres, ETSI ES 205 200-2-2 [i.10] for fixed networks, and ETSI ES 205 200-2-3 [i.11] for mobile networks.

KPI_{TE} is the ratio of KPI_{EC} to the electricity consumption by equipment that manage data for calculation, storage or transport purposes inside the ICT site. KPI_{TE} is dimensionless and has the following properties:

- $KPI_{TE} \geq 1$;
- $KPI_{TE} = 1$ is an ideal value;
- A KPI_{TE} of between 2 and 2,5 is frequently reached.

The improvement margins allow winning several tenths. The last tenths are not attainable without changing infrastructures or technical innovations. This means the KPI_{TE} will not improve, and it is then necessary to rethink the whole ICT Site, including the physical part.

4.1.2.2 Scale

KPI_{TE} applies to all ICT sites of all sizes and includes IT rooms located in buildings.

4.1.2.3 Evolution

KPI_{TE} applies to all states of ICT sites, from initial operation to end of life.

4.1.2.4 Formula

$$KPI_{TE} = KPI_{EC} / EC_{HE}$$

Where:

- KPI_{EC} is the energy consumption KPI as defined in clause 4.1.1
- EC_{HE} is the yearly energy consumption by equipment that manage data for calculation, storage or transport purposes. It is expressed in MWh

4.1.2.5 Measurement points and processes

Energy consumption should at the ICT equipment PSUs feeds. When this is not implemented, standard ETSI ES 205 200-2-1 [2] for data centres, ETSI ES 205 200-2-2 [i.10] for fixed networks, and ETSI ES 205 200-2-3 [i.11] for mobile networks will give guidance on how to compensate the measurement.

Measurements shall be done in MWh and can be approximated by using regular power measurements.

Measurement shall be done over a yearly period, so as to take into account the yearly climate changes.

4.1.3 Energy reuse (KPI_{REUSE})

4.1.3.1 General

The present document applies in a simple format the requirements of KPI_{REUSE} of ETSI ES 205 200-2-1 [2] for data centres, ETSI ES 205 200-2-2 [i.10] for fixed networks, and ETSI ES 205 200-2-3 [i.11] for mobile networks.

KPI_{REUSE} is the ratio of reused energy for external uses to total ICT site energy. Thermal energy can be reused in different forms, liquid or gas (air). KPI_{REUSE} shall be measurable and quantifiable and results in a dimensionless number.

Reuse of waste heat from power generators shall not be allocated to KPI_{REUSE}.

The reused energy should be mitigated by an efficiency factor depending on the heat transport system, whether air or water.

Possible initiatives to reuse the calories produced by information technology equipment (ITE) and network telecommunications equipment (NTE) in ICT sites include:

- water heating;
- heating of nearby offices and apartments:
  - For instance, heating a square metre of office space to 20 °C would be equivalent to 16 watts power electrical heating in average climatic conditions in south of France.
- warming of arboretums;
- pre-heating of diesel engines.

It is obvious that the viability of energy reuse will depend on ICT site configuration.

4.1.3.2 Scale

KPI_{REUSE} applies to all ICT sites of all sizes and includes IT rooms located in buildings.

4.1.3.3 Evolution

KPI_{REUSE} applies to all states of ICT sites, from initial operation to end of life.

4.1.3.4 Formula

$$KPI_{REUSE} = EC_{REUSE} / KPI_{EC}$$

Where:

- EC_{REUSE} is the yearly energy that has been reused usage outside of the ICT site,
- KPI_{EC} is the yearly energy consumption KPI as defined in clause 4.1.1.

4.1.3.5 Measurement points and processes

According to methodology defined in clause 4.1.1.5.

Measurement equipment shall be nearest to the reused energy consumption points so as to take into account the losses in the distribution circuits.

When using a complex distribution circuit for reuse (several scattered consumers) it is possible to locate the measuring equipment at the ICT site output and then apply a mitigating factor to EC_{REUSE} to take into account the losses in the distribution circuit.

When no measurement procedure is available, an approved external certification company will certify the measurement.

4.1.4 Use of renewable energy (KPI_{REN})

4.1.4.1 General

The present document applies in a simple format the requirements of KPI_{REN} of ETSI ES 205 200-2-1 [2] for data centres, ETSI ES 205 200-2-2 [i.10] for fixed networks, and ETSI ES 205 200-2-3 [i.11] for mobile networks.

KPI_{REN} is the ratio of energy consumption from renewable sources (EC_{REN}, see clause 4.1.1) over the total ICT site energy consumption (KPI_{EC}, see clause 4.1.1). It is a dimensionless number.

Only the sources contributing to KPI_{EC} will be taken into account, whether dedicated or shared.

4.1.4.2 Scale

KPI_{REN} applies to all ICT sites of all sizes and includes IT rooms located in buildings.

4.1.4.3 Evolution

KPI_{REN} applies to all states of ICT sites, from initial operation to end of life.

4.1.4.4 Formula

$KPI_{REN} = EC_{REN} / KPI_{EC}$ Where:

- KPI_{EC} is the yearly energy consumption KPI as defined in clause 4.1.
- EC_{REN} is the yearly energy consumption of energy from renewable power sources as defined in clause 4.1.1.5.

4.1.4.5 Measurement Points and processes

According to methodology defined in clause 4.1.1.5.

The quantity of energy coming from renewable sources is the total of energy coming from such sources, used by the ICT site, minus the traditional energy required to produce or deliver this energy to the consumption point.

All the measurements shall be done over the same evaluation period.

This KPI shall be considered only if the amount of conventional energy required to produce it is no greater than 10 % of the produced renewable energy.

4.2 Definition of Global KPI DC_{EM}

4.2.1 General

KPI DC_{EM} (Dataprocessing & Communications Energy Management) determines in a simple way the performance of energy use management by a single ICT site or a group of ICT sites.

It is composed of two values, DC_{EC} and DC_{Class}, where:

- DC_{EC} is the energy consumption by a single ICT site or a group of ICT Sites, expressed in MWh over a year.
- DC_{CLASS} is the energy use management performance class of a single ICT Site or a group of ICT sites, expressed as a letter.

The present document defines the principles for calculating energy use management performance of ICT sites with default weighting factors, and provides a default number of classes and default gauges. The final user of KPI DC_{EM} may tailor those weighting factors, number of classes and gauges to its needs.

4.2.2 Global KPI DC_{EM} for a single ICT site

4.2.2.1 General

For a single site, DC_{EC} and DC_{CLASS} are calculated as follows:

- $DC_{EC} = KPI_{EC}$ as defined in clause 4.1.1.
- DC_{CLASS} is determined according to energy use management performance DC_P for a given energy consumption gauge DC_G.

4.2.2.2 Definition of energy consumption gauge (DC_G)

DC_G is an intermediate KPI defining the energy consumption gauge based on the KPI_{EC} as defined in clause 4.1.1. A set of weighting factors W_{REUSE} and W_{REN} (see clause 4.2.2.3) is associated to each gauge. The default number of gauges is 7 as shown in table 1.

Table 1: Default Gauges (DC_G)

DC_G	KPI_{EC} range
XXS	$KPI_{EC} \leq$ 0,04 GWh
XS	0,04 GWh < $KPI_{EC} \leq$ 0,2 GWh
S	0,2 GWh < $KPI_{EC} \leq$ 1 GWh
M	1 GWh < $KPI_{EC} \leq$ 5 GWh
L	5 GWh < $KPI_{EC} \leq$ 25 GWh
XL	25 GWh < $KPI_{EC} \leq$ 120 GWh
XXL	KPI_{EC} > 120 GWh

The number of classes and ranges are at the hand of EC depending on the policy it chooses to promote.

4.2.2.3 Definition of energy management performance (DC_P)

The following formula where weighting factors depend on DC_G applies for the calculation of DC_P for all gauges:

$$DC_P = KPI_{TE} \times (1 - W_{REUSE} \times KPI_{REUSE}) \times (1 - W_{REN} \times KPI_{REN})$$

where:

W_{REUSE} = Mitigation factor for KPI_{REUSE} (the value may vary depending on the gauge (ffs) within the range 0 to 1, the default value is 0,8), the value used is at the hand of the EC depending on the policy it chooses to promote.

W_{REN} = Mitigation factor for KPI_{REN} (the value may vary depending on the gauge (ffs) within the range 0 to 1, the default value is 0,8). the value used is at the hand of the EC depending on the policy it chooses to promote.

4.2.2.4 Definition of Energy use management performance class (DC_{CLASS})

The energy use management performance class of an ICT site is determined by its DC_P. As explained in the scope this KPI alone is not designed for comparison of ICT sites or group of sites. It does not define an ICT site as good or bad unless combined with other parameters considered relevant for a comparison, such as local climatic conditions, availability requirements or purpose of ICT site.

Table 2: Default Classes

	DC_P	
DC_{CLASS}	≥	<
A		1,00
B	1,00	1,40
C	1,40	1,70
D	1,70	1,90
E	1,90	2,10
F	2,10	2,30
G	2,30	

4.2.3 Global KPI DC_{EM} for a group of ICT sites

4.2.3.1 General

For a group of sites, DC_{EC} and DC_{CLASS} are calculated as follows:

- DC_{EC}= energy consumption by a group of ICT sites,
- DC_{CLASS}= energy management efficiency class for a group of ICT Sites.

Network access ICT sites shall be considered in a different group that of the rest of ICT sites so as to keep a consistent view across industries that require diffuse networks (e.g. telecom and other mobility industries, smart cities) and those that do not. Use of standard [i.12] may help to determine such groups.

4.2.3.2 Formula for Group Energy Consumption

$$DC_{EC} = \sum_{i=1}^{n} KPI_{EC}(i)$$

Where $KPI_{EC}(i)$ is the energy consumption as defined in clause 4.1 by the i^{th} ICT site in a group of n ICT sites.

4.2.3.3 Formula for Group Energy management performance Class

The class associated with a group of ICT sites is a weighted average of all ICT sites classes.

$$DC_{CLASS} = \frac{\sum_{i=1}^{n} DC_{CLASS}\ (i) * KPI_{EC}(i)}{\sum_{i=1}^{n} KPI_{EC}(i)}$$

For this calculation, class letters are translated to their rank, i.e. A=1, B=2…; DC_{CLASS} is expressed as a letter.

4.2.4 Scale

KPI DC_{EM} applies to all sites or groups of ICT sites of all sizes.

4.2.5 Evolution

KPI DC_{EM} applies to all states of ICT sites or group of ICT sites, from initial operation to end of life.

4.2.6 Measurement points and processes

Not relevant to this KPI.

Annex A (informative): The status of Key Performance Indicators (KPIs)

A.1 Technical KPIs

Individual components or sub-assemblies can be designed to have improved task efficiency i.e. less energy is consumed for a given output or task. Such components or sub-assemblies may be inherently more efficient in the way in which they use energy under specific operating conditions but are essentially unable to manage that consumption. An example of such a product would be a power supply unit which may be more efficient under higher load conditions.

More complex products may contain hardware and/or software which automatically reduce energy consumption under specific operating conditions by putting certain functions into "idle" states if not required. This is distinctly different than that of a single task component or sub-assembly detailed above.

Technical KPIs can be applied to both of the above by assessing energy consumption for a number of specific operating conditions and also across a combination of such operating conditions. Assuming those operating conditions reflect the probable operating environment for the component, sub-assembly or product, a customer may make valued judgements in relation to the appropriateness of the Technical KPI.

For example, two products that have equal "combined" Technical KPIs, may be more efficient under very specific conditions. For example, a design of power supply that is more task efficient under high load conditions may be inappropriate for users who plan to predominantly operate under low load conditions (and vice versa).

A higher level of task efficiency management is also possible where groups of products are managed to reduce energy consumption by either allocating loads in such a way that the group is operating at maximum task efficiency and/or by putting individual products within the group into an "idle" mode. Examples of such managed solutions are seen in data centre software plug-ins (such as those developed under the Fit4Green and GAMES projects funded by Cooperation-ICT within European Commission Programme FP7) and in documents developed by ETSI TC EE. Once again, the value of such approaches can be validated by the establishment of Technical KPIs which can be applied to both of the above by assessing energy consumption of a defined group of products for a number of specific operating conditions and also across a combination of such operating conditions.

Figure A.1 provides a schematic in relation to energy-related KPIs. The left-hand side of that schematic relates to the Technical KPIs of the design and engineering phase for components, sub-assemblies, products and systems.

A.2 Objective KPIs

The Objective KPIs described in the documents of the ETSI ES 205 200 series [i.8] relate to specific elements of energy management described in figure B.1 for operational infrastructures under the control of operators as follows:

- energy consumption: the total consumption of energy by an operational infrastructure;
- task efficiency: a measure of the work done (as a result of design and/or operational procedures) for a given amount of energy consumed;
- energy re-use: transfer or conversion of energy (typically in the form of heat) produced by the operational infrastructure to do other work;
- renewable energy: energy produced from dedicated generation systems using resources that are naturally replenished.

The procurement of products and systems based upon their Technical KPIs for energy consumption and/or task efficiency underpins the relevant Objective KPIs. However, the ETSI ES 205 200 series documents [i.8] define requirements for the measurement of those Objective KPIs for operational infrastructures i.e. taking into account the real operating conditions over a defined period of time.

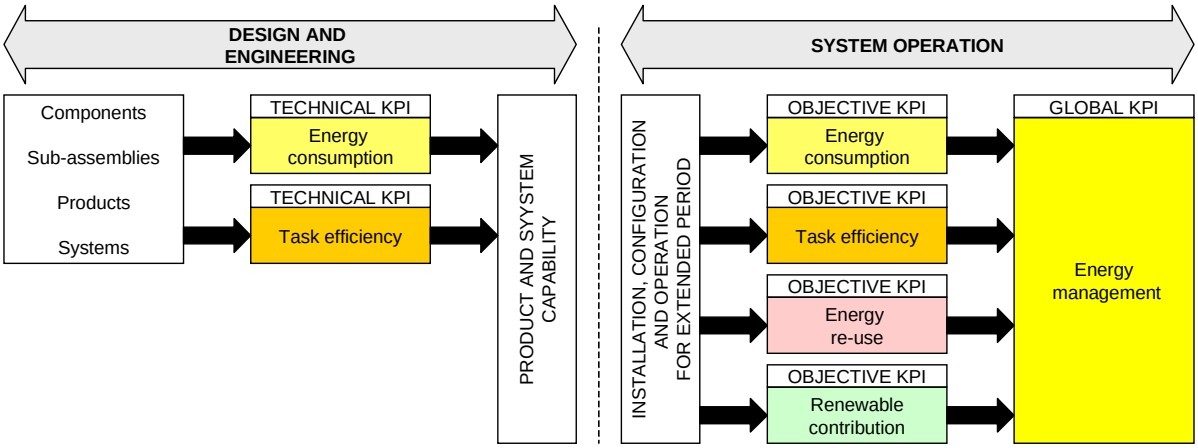

Figure A.1: The relationship of energy-related Technical, Objective and Global KPIs

Technical KPIs for energy consumption and task efficiency performance of products and systems are established at the design and engineering stages. Actual performance of products and systems may differ when the operating conditions lie outside of those applied when measuring these technical KPIs, and are equally important when subjected to user configuration and controls which may undermine the sophisticated systems available.

The right-hand side of the schematic in figure A.1 relates to the Objective KPIs of complete infrastructures in the operational phase.

A.3 Global KPIs

The Objective KPIs, of which task efficiency is one element, are using a formula appropriate to the specific operational infrastructure to produce a Global operational KPI. The Global operational KPI reflects the overall performance of the operational infrastructures against wider energy management targets which may be self-imposed by the operators or externally applied by legislators.

Global KPIs provide a wider view of a user's commitment to strategic energy management practices than the Objective KPIs. For example, achieving class-leading provision of local renewable energy together with very poor task efficiency does not meet overall energy goals.

A.4 Summary

Global Operational KPIs and Objective KPIs are fundamentally different to the Technical KPIs applied to products and systems at the design and engineering stages. The former are used to monitor and drive user behaviour whereas the latter are substantial indications of potential operational performance.

It is therefore important to support, but differentiate, the role of the Technical KPIs from the Objective and Global operational KPIs.

Annex B (informative): Energy Consumption per square metre (KPI_{EC1})

B.1 Generalities

KPI_{EC1} is calculated from KPI_{EC} and takes into account the IT room floor space.

B.2 Scale

KPI_{EC1} applies to all ICT sites of all sizes and includes IT rooms located in buildings.

B.3 Evolution

KPI_{EC1} applies to all states of ICT sites, from initial operation to end of life.

B.4 Formula

$$KPI_{EC1} = \left(\frac{KPI_{EC}}{\left(1 + W_{CRs} \times (CRs - 1)\right)}\right)$$

where:

CRs = IT room floor space used (by racks, networking, disk arrays and tape robots) = raw footprint of IT and Telco equipment).

W_{CRs} = CRs mitigation ratio; ranges from 0 to 1.

B.5 Measurement points and procedures

See clause 4.1.1.5.

Annex C (informative): Renewable energy sources

According to Directive 2010/31/EU [i.9] aiming to "***promote the energy Performance of Buildings"*** energy from renewable sources' means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.

For the purpose of the present document, an energy is considered renewable only if energy required to extract it does not exceed 10 % of the produced energy in order to avoid considering as renewable poorly designed renewable power sources, electrically powered chillers and heat pumps.

History

Document history		
V1.0.0	January 2017	Membership Approval Procedure MV 20170305: 2017-01-04 to 2017-03-06