Access, Terminals, Transmission and Multiplexing (ATTM);
Carbon Intensity Management;
Operational infrastructures;
Implementation of Global KPIs;
Part 3: ICT Sites; Sub-part 2: DCCM
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Foreword

This ETSI Standard (ES) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

The present document is part 3, sub-part 2 of a multi-part deliverable. Full details of the entire series can be found in part 1 [i.1].

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.

Executive summary

The present document proposes a series of KPIs to evaluate the operational impact on greenhouse gas emissions of ICT infrastructures in operation. The present document only deals with carbon intensity related to work done as defined in relevant standards ETSI EN 305 200-2-3 [2], ETSI EN 305 200-2-2 [1] and ETSI EN 305 200-3-1 [3]. It does not consider greenhouse gas related to other LCA phases (e.g. construction, decommissioning) nor other LCA considerations (e.g. raw materials, water) that will be dealt of in a future part of the series.
Introduction

Greenhouse gas emissions continue to rise, a trend that will continue in the future, while broadband penetration is introducing new active equipment to the network architecture. In this context, and to reflect other environmental aspects of sustainability, it is vital that the main telecommunication operators implement effective general engineering of fixed and mobile broadband networks and sites provisioning, managing or using those networks (i.e. ICT sites) in order to respond to critical issues of greenhouse gas emissions while proposing essential solutions to broadband deployment. To guide this process, it is essential that metrics are defined, termed Global Key Performance Indicators (KPIs), that enable greenhouse gas usage to be managed more effectively.

The Global Key Performance Indicators specified in the ETSI EN 305 200 [i.2] series address operational infrastructures and do not consider design or operation of individual components comprising those infrastructures.

ETSI EN 305 200 [i.2] series of standards comprises:

- ETSI EN 305 200-1 [i.1] a generic requirements document addressing Global KPIs for operational infrastructures;
- a sub-series ETSI EN 305 200-2 that defines the Global KPIs, and drives energy management targets, for specific operational networks and sites and which describes how the Global KPIs are to be applied (which may be used to support future regulatory objectives):
  - ETSI EN 305 200-2-1 [i.11]: ICT sites;
  - ETSI EN 305 200-2-2 [1]: Fixed broadband access networks;

  NOTE: Excluding cable access networks.

- ETSI EN 305 200-2-3 [2]: Mobile broadband access networks.

The standards do not define weightings of Objective KPIs or targets or limits for Global KPIs but may contain information on values that have been used by certain organizations:

- a sub-series ETSI EN 305 200-3 including the present document that defines particular implementations of Global KPIs within ICT sites based on the requirements of ETSI EN 305 200-2-1 [i.11], and which may define levels of performance to simplify and provide clearer understanding of Global KPIs allowing the evaluation of performance of energy and carbon use management in ICT sites:
  - ETSI EN 305 200-3-1 [3]: Data processing and Communications Energy Management (DCEM);
  - ETSI EN 305 200-3-2: the present document;

- a sub-series ETSI EN 305 200-4 including ETSI EN 305 200-4-4 [i.7] that defines design assessments of Global KPIs, and drives energy management targets, for specific operational networks and sites and which describes how the Global KPIs are to be applied (which may be used to support future regulatory objectives).

These standards may be considered to be a contribution to the application of ISO 14001 [i.8] in relation to the development of policy for the continuous improvement of greenhouse gas management and will accelerate:

- the availability of operational infrastructure architectures and network implementations that reduce greenhouse gas emissions;
- the definition and attainment objectives for other environmental aspects of sustainability for operational broadband networks.
1 Scope

The present document specifies the requirements for a Global KPI for carbon management in operation ($KPI_{DCCM}$) and their underpinning Objective KPIs addressing the following objectives for the ICT sites of broadband deployment:

- Greenhouse gas emissions
- Effectiveness of energy generation over greenhouse gas emissions
- Avoided greenhouse gas emission
- Reused greenhouse gas emission

The management of energy efficiency is outside the scope of the present document.

Within the present document:

- clause 4.1 describes the energy parameters for ICT sites together with inclusions/exclusions of different energies contributions;
- clause 4.2 specifies the requirements for measurement, calculation, classification and reporting of $KPI_{DCCM}$.

The present document addresses CO$_2$ equivalent emissions (CO$_2$eq) resulting from energy consumption by operational equipment in ICT sites or groups of sites. It does not deal with other GHG gas emissions coming from cooling/heating (including heat recovery systems equipment leakages such as described in the Directive F-Gas EU-517-2014 [i.6] and emissions related to manufacturing, transportation and end of life.

The Global KPI alone is not designed for comparison of ICT sites or groups 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 the ICT site.


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 EN 305 200-2-2: "Access, Terminals, Transmission and Multiplexing (ATTM); Energy management; Operational infrastructures; Global KPIs; Part 2: Specific requirements; Sub-part 2: Fixed broadband access networks".

[2] ETSI EN 305 200-2-3: "Access, Terminals, Transmission and Multiplexing (ATTM); Energy management; Operational infrastructures; Global KPIs; Part 2: Specific requirements; Sub-part 3: Mobile broadband access networks".
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] ETSI EN 305 200-1: "Access, Terminals, Transmission and Multiplexing (ATTM); Energy management; Operational infrastructures; Global KPIs; Part 1: General requirements".

[i.2] ETSI EN 305 200 series: "Access, Terminals, Transmission and Multiplexing (ATTM); Energy management; Operational infrastructures; Global KPIs".

[i.3] ETSI ES 203 228: "Environmental Engineering (EE); Assessment of mobile network energy efficiency".


[i.7] ETSI EN 305 200-4-4: "Integrated broadband cable telecommunication networks (CABLE); Energy management; Operational infrastructures; Global KPIs; Part 4: Design assessments; Sub-part 4: Cable access networks".

[i.8] ISO 14001: "Environmental management systems".


NOTE: Available at ipcc_wg3_ar5_annex-iii.pdf.


NOTE: Available at Emissions from Photovoltaic Life Cycles (acamedia.info).

[i.11] ETSI EN 305 200-2-1: "Access, Terminals, Transmission and Multiplexing (ATTM); Energy management; Operational infrastructures; Global KPIs; Part 2: Specific requirements; Sub-part 1: ICT Sites".
3 Definition of terms, symbols and abbreviations

3.1 Terms

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

**carbon emission factor**: kilograms of equivalent carbon dioxide emitted per kWh (kg of CO₂eq/kWh)

**carbon intensity**: quantity of CO₂ equivalent emission per unit of final energy consumption for an operational period of time

**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, storage and transportation of primary energy, if any.

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

**ICT equipment**: equipment providing data storage, data processing and data 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 carbon emission which is subsequently used to define a Global KPI for Carbon management

**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, including climatic conditions, security and safety installations

**renewable energy**: energy produced from dedicated generation systems using resources that are naturally replenished

  NOTE: In addition, for the purpose of the present document, the energy required for production is not higher than 10% of the produced energy.

**ton**: non-SI unit of mass equal to 1 000 kilograms

3.2 Symbols

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

\[ CE_{Fi} \] Carbon Emission Factor of source i
\[ CE_{REFi} \] Carbon Emission Factor reference for source i
\[ CE_{REC} \] Carbon Emission Requirements avoided by reusing ICT site waste heat
\[ DCC.CLASS \] Carbon emission Class part of \( KPI_{DCCM} \)
\[ DCC.CE \] Carbon emission part of \( KPI_{DCCM} \)
\[ DCMP \] Carbon Management Performance
\[ DC.G \] Energy consumption gauge
\[ EC_{i} \] Total Energy consumption of source i
\[ EC_{REF} \] Reference Carbon Emission of an ICT site
\[ KPI_{AE} \] Objective KPI for "CO₂eq Avoided Emission"
\[ KPI_{DCCM} \] Global KPI for DCCM
\[ KPI_{EC} \] Objective KPI for "Energy Consumption"
\[ KPI_{CE} \] Objective KPI for "CO₂eq Emission"
3.3 Abbreviations

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

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEF</td>
<td>Carbon Emission Factor</td>
</tr>
<tr>
<td>CO2eq</td>
<td>CO2 equivalent</td>
</tr>
<tr>
<td>DCCM</td>
<td>Dataprocessing &amp; Communications Carbon Management</td>
</tr>
<tr>
<td>DCEM</td>
<td>Dataprocessing and Communications Energy Management</td>
</tr>
<tr>
<td>EC</td>
<td>European Community</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>GHG</td>
<td>GreenHouse Gas</td>
</tr>
<tr>
<td>GWP</td>
<td>Global Warming Potential</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
</tr>
<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
</tr>
<tr>
<td>kWh</td>
<td>kiloWatt per hour</td>
</tr>
<tr>
<td>LCA</td>
<td>Life Cycle Assessment</td>
</tr>
<tr>
<td>MWh</td>
<td>MegaWatt per hour</td>
</tr>
<tr>
<td>OEU</td>
<td>Operational energy Efficiency for Users (ETSI Industry Specification Group)</td>
</tr>
<tr>
<td>PV</td>
<td>PhotoVoltaic</td>
</tr>
<tr>
<td>SEAP</td>
<td>Sustainable Energy Action Plan</td>
</tr>
<tr>
<td>SI</td>
<td>International System of Units</td>
</tr>
</tbody>
</table>

4 Definition of Key Performance Indicators

4.1 Objective KPIs for ICT sites operation

4.1.1 Carbon Emission of an ICT Site ($KPI_{CE}$)

4.1.1.1 General

The operational Carbon emission of an ICT site is directly correlated to its energy consumption $KPI_{EC}$ as defined in appropriate related standard (ETSI EN 305 200-2-2 [1], ETSI EN 305 200-2-3 [2] or ETSI EN 305 200-3-1 [3]).

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 are 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 are not included in any measurements of $KPI_{EC}$.

All energy consumptions shall be recorded by energy meters 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 sources shall be clearly identified and translated into equivalent CO2 emission (CO2eq).

4.1.1.2 Scale

$KPI_{CE}$ applies to all ICT sites of all sizes and includes ICT rooms located in buildings.
4.1.1.3 Evolution

\( KPI_{CE} \) applies to all states of ICT sites, from initial operation to end of life.

4.1.1.4 Formula

\[
KPI_{CE} = \sum_{i=1}^{n} (EC_i \times CEF_i)
\]

Where:

- \( EC_i \): Yearly energy consumption by ICT site from power source \( i \) (e.g. local, heat/cold loops, grid) expressed as MWh.
- \( CEF_i \): Yearly average Carbon Emission Factor of the source \( i \).
- \( KPI_{CE} \) shall be expressed in Tons of CO\(_2\)eq.

NOTE: \( \sum_{i=1}^{n} EC_i = KPI_{EC} \).

4.1.1.5 Measurement points and processes

Measurement points and processes related to energy consumptions \( EC_i \) are defined in appropriate related standard (ETSI EN 305 200-2-2 [1], ETSI EN 305 200-2-3 [2] or ETSI EN 305 200-3-1 [3]).

Emission Factors \( CEF_i \) applicable for each type of energy source at the time of writing as well as related general principles are listed in Annex A.

NOTE 1: If the country mix value for the considered period is not already known at the date of the assessment, the latest official known value will be used.

NOTE 2: Are considered only scope 1 and scope 2 emissions.

NOTE 3: Indirect GHG emissions due to refrigerant and GHG leakages are not considered.

4.1.2 Carbon Emission Effectiveness \( (KPI_{CEE}) \)

4.1.2.1 General

\( KPI_{CEE} \) is the ratio of CO\(_2\)eq to actual work done in an ICT site over one year.

4.1.2.2 Scale

\( KPI_{CEE} \) applies to all ICT sites of all sizes and includes ICT rooms located in buildings.

4.1.2.3 Evolution

\( KPI_{CEE} \) applies to all states of ICT sites, from initial operation to end of life.

4.1.2.4 Formula

\[
KPI_{CEE} = \frac{KPI_{CE} \times KP_{ITE}}{KPI_{EC}}
\]

Where:

- \( KPI_{CE} \) is the Carbon emission KPI as defined in clause 4.1.1.
- \( KPI_{EC} \) is the total energy consumption as defined in appropriate related standard (ETSI EN 305 200-2-2 [1], ETSI EN 305 200-2-3 [2] or ETSI EN 305 200-3-1 [3]).
• $KPI_{TE}$ is the task effectiveness as defined in appropriate related standard (ETSI EN 305 200-2-2 [1], ETSI EN 305 200-2-3 [2] or ETSI EN 305 200-3-1 [3]).

• $KPI_{CEE}$ shall be expressed in kg of CO$_2$eq/MWh for ICT sites and kg of CO$_2$eq/data transmitted for mobile and fixed network as defined in relevant standards.

4.1.2.5 Measurement points and processes
Measurement points and processes related to energy consumption $KPI_{CE}$ are defined in appropriate related standard (ETSI EN 305 200-2-2 [1], ETSI EN 305 200-2-3 [2] or ETSI EN 305 200-3-1 [3]).

NOTE 1: Measurements are done over a yearly period, so as to take into account the yearly climate changes.

NOTE 2: Carbon emission factors follow rules expressed in clause 4.1.1.

4.1.3 Avoided Emission ($KPI_{AE}$)

4.1.3.1 General

$KPI_{AE}$ is the ratio of the CO$_2$eq emission avoided due to the use of low carbon energy sources to the Reference Carbon Emission of the ICT site $EC_{REF}$.

Avoided emissions is the amount of CO$_2$eq that would have been emitted during one year if the grid had been used instead of the actual implemented power sources except when backup power had been used.

$KPI_{AE}$ is a dimensionless number the maximum of which is 1, with the following meanings:

• 0: equivalent to the carbon intensity if all power was coming from the public grid

• 1: carbon free ICT site

• $< 0$: implemented solution has a worse carbon emission than if it had been connected to the grid

4.1.3.2 Scale

$KPI_{AE}$ applies to all ICT sites of all sizes.

4.1.3.3 Evolution

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

4.1.3.4 Formula

$$KPI_{AE} = 1 - \frac{\sum_{i=1}^{N} KPI_{CE} \cdot CEF_{REF}}{\sum_{i=1}^{N} EC_{i} \cdot CEF_{i}}$$

Where:

• $KPI_{CE}$ is the Carbon emission (CO$_2$eq) KPI as defined in clause 4.1.1.

• $EC_{i}$ is the yearly energy consumption of the source $i$.

• $CEF_{i}$ is the yearly average Carbon Emission Factor (CEF) of source $i$.

• $CEF_{REF}$ is the yearly average Carbon Emission Factor (CEF) of the public grid for each energy source except for backup power sources. In this case the CEF value of the current backup power source shall be used. Reference Carbon emission for standard diesel generators shall be considered in future versions of the present document.
NOTE: \[ \sum_{i=1}^{N} EC_i \times CEF_{REF_i} = KPI_{CEREF}. \]

4.1.3.5 Measurement points and processes

Measurement points and processes related to energy consumption \( EC_i \) are defined in appropriate related standards (ETSI EN 305 200-2-2 [1], ETSI EN 305 200-2-3 [2] or ETSI EN 305 200-3-1 [3]).

4.1.4 Recycled Emission (\( KPI_{REC} \))

4.1.4.1 General

\( KPI_{REC} \) is the ratio of the CO\(_2\)eq emission avoided due to energy reuse for external uses to \( KPI_{CE} \). Energy can be reused in different forms, liquid or gas (air). \( KPI_{REC} \) shall be measurable, quantifiable, and result reported in a dimensionless number.

Shall be considered as avoided emissions, the CO\(_2\) equivalent emission linked to energy reused by existing usages which could not be reduced by other action and new usages which not have been created thank to the reuse of the output heat (e.g. heating of storage room or arboretum, etc.).

Emission avoided \( KPI_{REC} \) will be calculated taking into account the reference Energy source type which would have been used if the reused energy had not been available. The reference energy source shall be determined considering the public grid or available local energy sources.

4.1.4.2 Scale

\( KPI_{REC} \) applies to all ICT sites of all sizes and includes ICT rooms located in buildings.

4.1.4.3 Evolution

\( KPI_{REC} \) applies to all states of ICT sites in operation, from initial operation to end of life.

4.1.4.4 Formula

\[ KPI_{REC} = \frac{CE_{REC}}{KPI_{CE}} \]

Where:

- \( KPI_{CE} \) is the Carbon emission (CO\(_2\)eq) KPI as defined in clause 4.1.1.
- \( CE_{REC} \) is the yearly CO\(_2\) equivalent emission of the energy that would have been required if the reused heat had not been available. It is expressed in Tons of CO\(_2\)eq. For Operator sites and Operator data centres, \( CE_{REC} \) is based on the \( EC_{REUSE} \) as defined in ETSI EN 305 200-3-1 [3], converted to equivalent Carbon emission.

4.1.4.5 Measurement points and processes

Measurement points and processes related to energy reuse \( EC_{REUSE} \) are defined in ETSI EN 305 200-3-1 [3].

4.2 Definition of Global KPI \( KPI_{DCCM} \)

4.2.1 General

\( KPI_{DCCM} \) (Dataprocessing & Communications Carbon Management) determines in a simple way the conformance to a given “Carbon management” policy by a single ICT site or a group of ICT sites.
It is composed of two values, $DC_{CE}$ and $DC_{CLASS}$, where:

- $DC_{CE}$ is the CO$_2$eq emission by a single ICT site or a group of ICT Sites, expressed in Tons of CO$_2$eq over a year.
- $DC_{CLASS}$ is the CO$_2$eq emission 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 CO$_2$ equivalent emission performance of ICT sites and provides a default number of classes and default gauges.

### 4.2.2 Global KPI $KPI_{DCCM}$ for a single ICT site

#### 4.2.2.1 General

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

- $DC_{CE} = KPI_{CE}$ as defined in clause 4.1.1.
- $DC_{CLASS}$ is a banded representation of Carbon Management Performance $DC_{CMP}$ detailed in clause 4.2.2.3.

#### 4.2.2.2 Definition of Energy Consumption Gauge (DC$_G$)

Within $KPI_{DCCM}$, DC$_G$ is a banded representation of Objective KPI of energy consumption ($KPI_{EC}$) and is used to define the applicable weightings for $W_{AE}$ and $W_{REC}$ within the calculation of $DC_{CMP}$ of clause 4.2.2.3.

<table>
<thead>
<tr>
<th>$KPI_{EC}$ range</th>
<th>DC$_G$</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.04 GWh</td>
<td>'XXS'</td>
</tr>
<tr>
<td>0.04 GWh $\geq$ $KPI_{EC} &lt; 0.2 $ GWh</td>
<td>'XS'</td>
</tr>
<tr>
<td>0.2 GWh $\geq$ $KPI_{EC} &lt; 1$ GWh</td>
<td>'S'</td>
</tr>
<tr>
<td>1 GWh $\geq$ $KPI_{EC} &lt; 5$ GWh</td>
<td>'M'</td>
</tr>
<tr>
<td>5 GWh $\geq$ $KPI_{EC} &lt; 25$ GWh</td>
<td>'L'</td>
</tr>
<tr>
<td>25 GWh $\geq$ $KPI_{EC} &lt; 120$ GWh</td>
<td>'XL'</td>
</tr>
<tr>
<td>$\geq$ 120 GWh</td>
<td>'XXL'</td>
</tr>
</tbody>
</table>

The number of classes and ranges are at the hand of EC and Member States in order to define the minimum level to be reached for each DC$_G$.

#### 4.2.2.3 Formula for Carbon Management Performance (DC$_{CMP}$)

Formula: $DC_{CMP} = KPI_{CEE} \times (1 - W_{AE} \times KPI_{AE}) \times (1 - W_{REC} \times KPI_{REC})$ subject to a minimum value of 0.

Where:

- $KPI_{CEE}$ is the Carbon emission effectiveness KPI as defined in clause 4.1.2.
- $KPI_{AE}$ is the Avoided emissions KPI as defined in clause 4.1.3.
- $KPI_{REC}$ is the Recycled emissions KPI as defined in clause 4.1.4.
- $W_{AE}$ is a weighting factor ranging from 0 to 1.
- $W_{REC}$ is a weighting factor ranging from 0 to 1.
• \( D_{\text{CMP}} \) shall be expressed in kg of CO\(_2\)eq/MWh for ICT sites and kg of CO\(_2\)eq/data transmitted for mobile and fixed network as defined in relevant standards.

The weighting factors are at the hand of EC and Member States in order to define a policy for each \( DC_G \).

The members of OEU consider factors value \( W_{AE} = 1 \) and \( W_{REC} = 1 \).

4.2.2.4 Definition of Carbon Management Performance class (\( DC_{\text{CLASS}} \))

The Carbon Management performance class of an ICT site is determined by its \( D_{\text{CMP}} \). 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>
<thead>
<tr>
<th>( DC_{\text{CLASS}} )</th>
<th>( DC_{\text{CMP}} ) Range</th>
<th>( DC_{\text{CMP}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>( \geq 40 )</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>40 ( \leq 100 )</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>100 ( \leq 180 )</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>180 ( \leq 280 )</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>280 ( \leq 400 )</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>400 ( \leq 540 )</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>540</td>
<td></td>
</tr>
</tbody>
</table>

4.2.3 Global KPI \( KPI_{DCCM} \) for a group of ICT sites

4.2.3.1 General

For a group of sites, \( DC_{CE} \) and \( DC_{\text{CLASS}} \) are calculated as follows:

• \( DC_{CE} \) = Carbon Emission by a group of ICT sites

• \( DC_{\text{CLASS}} \) = Carbon Management class for a group of ICT Sites

Network access ICT sites shall be considered in a different group than the rest of the 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 ETSI ES 203 228 [i.3] may help to determine such groups.

4.2.3.2 Formula for Group CO\(_2\) equivalent emission

\[
DC_{CE} = \sum_{i=1}^{n} KPI_{CE}(i)
\]

Where \( KPI_{CE}(i) \) is the Carbon emission 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 CO\(_2\) equivalent emission performance Class

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

\[
DC_{\text{CLASS}} = \frac{\sum_{i=1}^{n} DC_{\text{CLASS}}(i) \times KPI_{CE}(i)}{\sum_{i=1}^{n} KPI_{CE}(i)}
\]

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

4.2.4 Scale

\( KPI_{DCCM} \) applies to all ICT sites, networks or groups of ICT sites of all sizes.
4.2.5 Evolution

$KPI_{DCCM}$ applies to all states of ICT sites, networks or groups 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):
Emission factors

A.1 Carbon emission factors of energy sources

GreenHouse Gases (GHGs) emissions are measured as CO₂eq. This universal unit allows the global warming potential of different GHGs to be compared. Values for CH₄ and N₂O are presented as CO₂eq using Global Warming Potential (GWP) factors, consistent with reporting under the Kyoto Protocol [i.4] and the second assessment report of the Intergovernmental Panel on Climate Change (IPCC) [i.9].

CO₂eq emissions can be either measured by continuously monitoring source emissions or estimated by multiplying activity data (e.g. litres of used fuel, consumption of natural gas) by relevant emissions factors. These factors convert activity data into Tons of CO₂eq.

Tables A.1 to A.3 correspond to tables 5, 6 and 7 extracted from Guidebook "How to Develop a Sustainable Energy Action Plan (SEAP)" [i.5]© European Union, 2010. Reproduction is authorized provided the source is acknowledged.

A.2 National emission factors for consumed Electricity

Carbon Emission Factor for public Electricity Network is the average mix value for the considered period as published by the country's Energy regulation authority.

<table>
<thead>
<tr>
<th>Country</th>
<th>[t CO₂/MWh]</th>
<th>Standard emission factor</th>
<th>LCA emission factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>0.209</td>
<td>0.310</td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>0.285</td>
<td>0.402</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>0.624</td>
<td>0.706</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>0.461</td>
<td>0.760</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>0.440</td>
<td>0.639</td>
<td></td>
</tr>
<tr>
<td>Finland</td>
<td>0.216</td>
<td>0.418</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>0.056</td>
<td>0.146</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0.543</td>
<td>0.658</td>
<td></td>
</tr>
<tr>
<td>Greece</td>
<td>1.149</td>
<td>1.167</td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>0.732</td>
<td>0.870</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>0.483</td>
<td>0.708</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.435</td>
<td>0.716</td>
<td></td>
</tr>
<tr>
<td>Portugal</td>
<td>0.369</td>
<td>0.750</td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>0.023</td>
<td>0.079</td>
<td></td>
</tr>
<tr>
<td>Bulgaria</td>
<td>0.819</td>
<td>0.906</td>
<td></td>
</tr>
<tr>
<td>Cyprus</td>
<td>0.874</td>
<td>1.019</td>
<td></td>
</tr>
<tr>
<td>Czech Republic</td>
<td>0.950</td>
<td>0.802</td>
<td></td>
</tr>
<tr>
<td>Estonia</td>
<td>0.908</td>
<td>1.593</td>
<td></td>
</tr>
<tr>
<td>Hungary</td>
<td>0.586</td>
<td>0.678</td>
<td></td>
</tr>
<tr>
<td>Lithuania</td>
<td>0.153</td>
<td>0.174</td>
<td></td>
</tr>
<tr>
<td>Latvia</td>
<td>0.109</td>
<td>0.563</td>
<td></td>
</tr>
<tr>
<td>Poland</td>
<td>1.191</td>
<td>1.185</td>
<td></td>
</tr>
<tr>
<td>Romania</td>
<td>0.701</td>
<td>1.084</td>
<td></td>
</tr>
<tr>
<td>Slovenia</td>
<td>0.557</td>
<td>0.602</td>
<td></td>
</tr>
<tr>
<td>Slovakia</td>
<td>0.252</td>
<td>0.353</td>
<td></td>
</tr>
<tr>
<td>EU-27 (EU-Wide mean) (see note)</td>
<td>0.460</td>
<td>0.578</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.
A.3 Emission factors for fuel combustion

Table A.2

<table>
<thead>
<tr>
<th>Fuel combustion</th>
<th>Standard emission factor</th>
<th>LCA emission factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Gasoline</td>
<td>0.249</td>
<td>0.299</td>
</tr>
<tr>
<td>Anthracite</td>
<td>0.267</td>
<td>0.305</td>
</tr>
<tr>
<td>Residual Fuel Oil</td>
<td>0.279</td>
<td>0.310</td>
</tr>
<tr>
<td>Anthracite</td>
<td>0.354</td>
<td>0.393</td>
</tr>
<tr>
<td>Other Bituminous Coal</td>
<td>0.341</td>
<td>0.380</td>
</tr>
<tr>
<td>Sub-Bituminous Coal</td>
<td>0.346</td>
<td>0.385</td>
</tr>
<tr>
<td>Lignite</td>
<td>0.364</td>
<td>0.375</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>0.202</td>
<td>0.237</td>
</tr>
<tr>
<td>Municipal Wastes (non-biomass)</td>
<td>0.330</td>
<td>0.330</td>
</tr>
<tr>
<td>Sustainable wood</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Unsustainable wood</td>
<td>0.402</td>
<td>0.405</td>
</tr>
<tr>
<td>Plant oil</td>
<td>0.000</td>
<td>0.182</td>
</tr>
<tr>
<td>Biodiesel</td>
<td>0.000</td>
<td>0.156</td>
</tr>
<tr>
<td>Bioethanol</td>
<td>0.000</td>
<td>0.206</td>
</tr>
<tr>
<td>Sustainable wood</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Geothermal</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Also consider the following table [i.9].
A.4 Emission factors for local renewable electricity production

Table A.3

<table>
<thead>
<tr>
<th>Country</th>
<th>Standard emission factor</th>
<th>LCA emission factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV</td>
<td>0.000</td>
<td>0.020 - 0.050 (see note 1)</td>
</tr>
<tr>
<td>WindPower</td>
<td>0.000</td>
<td>0.007 (see note 2)</td>
</tr>
<tr>
<td>HydroPower</td>
<td>0.000</td>
<td>0.024</td>
</tr>
</tbody>
</table>

NOTE 1: Source: Vasilis et al., 2008 [i.10].
NOTE 2: Based on results from one plant, operated in coastal areas with good wind conditions.
Annex B (informative):
Change History

<table>
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<th>Date</th>
<th>Version</th>
<th>Information about changes</th>
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<tbody>
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<td>03/2021</td>
<td>0.0.0</td>
<td>Initial document</td>
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</tbody>
</table>
### History

<table>
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<th>Document history</th>
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<tr>
<td><strong>V1.1.0</strong></td>
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<tr>
<td><strong>V1.1.1</strong></td>
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