ETSI GS OEU 006 V1.1.1 (2015-06)

Operational energy Efficiency for Users (OEU); Referential specification to define sustainable levels of ICT Sites

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Reference
DGS/OEU-006

Keywords
Data Centres, Energy Efficiency, ICT sites,
Referential specification, USER

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Contents

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Foreword

This Group Specification (GS) has been produced by ETSI Industry Specification Group (ISG) Operational energy Efficiency for Users (OEU).

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).

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Introduction

Further to the 1997 Kyoto protocol [i.3], the European Commission issues Directives in order to improve energy management of broadband networks of whole industry sectors including sites.

Therefore suppliers and users of information and communication technology (ICT) equipment will implement "Green" tools (indicators, recognized Green levels) to monitor the efficiency of their sustainable networks.

ICT sites constitute one of the most important area of energy consumption. Consequently, the second target of ETSI ISG OEU is the development of the Referential Specification defining lists of standards and technical documents to be used for designing, refitting, and updating sustainable ICT sites.

1 Scope

The present document defines the current position of the ISG OEU members in relation to the Referential Specification to define sustainable levels of ICT sites including operator sites, operator data centres and corporate data centres as defined in European Commission mandate M/462 [i.1].

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 http://docbox.etsi.org/Reference.

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

[1] ETSI GS OEU 001: "Operational energy Efficiency for Users (OEU); Global KPIs for ICT Sites".

[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".

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

[4] CENELEC EN 50600-1: "Information technology - Data centre facilities and infrastructures - Part 1: General concepts".

[5] CENELEC EN 50600-2-1: "Information technology - Data centre facilities and infrastructures - Part 2-1: Building construction".

[6] CENELEC EN 50600-2-2: "Information technology - Data centre facilities and infrastructures - Part 2-2: Power distribution".

[7] CENELEC EN 50600-2-3: " Information technology - Data centre facilities and infrastructures - Part 2-3: Environmental control".

[8] ISO EN 50001: "Energy management systems -- Requirements with guidance for use".

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

[10] CENELEC EN 50310: "Application of equipotential bonding and earthing in buildings with information technology equipment".

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] EU CoC Best Practices (Last version): "Best Practices for the EU Code of Conduct on Data Centres".

[i.3] Kyoto Protocol to the United Nations Framework Convention on Climate Change.

[i.4] ETSI TS 105 174-2: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment and Energy Management; Part 2: ICT sites".

[i.5] ETSI EN 300 132-3-1: "Environmental Engineering (EE); Power supply interface at the input to telecommunications and datacom (ICT) equipment; Part 3: Operated by rectified current source, alternating current source or direct current source up to 400 V; Sub-part 1: Direct current source up to 400 V".

3 Definitions and abbreviations

3.1 Definitions

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

availability: time or period during the application or the service has to be operational

NOTE: Availability is one of the criticality criteria.

co-hosting data centre: data centre in which multiple customers are provided with access to network(s), servers and storage equipment on which they operate their own services/applications

NOTE: Both the information technology equipment and the support infrastructure of the building are provided as a service by the data centre operator.

co-location data centre: data centre in which multiple customers locate their own network(s), servers and storage equipment

NOTE: The support infrastructure of the building (such as power distribution and environmental control) is provided as a service by the data centre operator.

corporate data centre: data centre that is operated by a company which has the sole purpose of the delivery and management of services to its employees and customers

Data Centre (DC): structure, or group of structures, dedicated to the centralized accommodation, interconnection and operation of information technology and network telecommunications equipment providing data storage, processing and transport services 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

NOTE: A structure can consist of multiple buildings and/or spaces with specific functions to support the primary function.

energy consumption: quantity of energy applied to operate the infrastructure

energy management: set of actions energy-related to reduced energy consumption, increased task efficiency, re-use of energy and use of renewable energy with the objective of resource conservation, climate protection and cost savings

energy re-use: quantity of energy transferred by exchange from one sub-system of the operational infrastructure with another system

NOTE: The energy can be in any form in either subsystem, but most energy recovery systems exchange thermal energy in either sensible or latent form.

environmental control system: facilities and infrastructures necessary to maintain the equipment of a data centre within its required environmental performance range

global KPI: KPI of an operational infrastructure which presents information from a number of separate objective KPIs

green data centre: in addition to energy efficiency, the "Green" approach will focus on carbon footprint

NOTE 1: Energy Efficiency is one way, to decrease CO_2 emissions, but it is not the only one.

NOTE 2: More "sustainable development" objective than economic, the key indicator is environmental footprint. Today, this concept is not still clearly defined (how to measure the anthropogenic impact on earth ?), especially if we know that data centres are not directly producers of CO_2, but indirectly, due to their energy needs during all the life cycle (construction, exploitation, end of life). If the source of power is becoming from renewable energies (hydraulic, solar, etc.) or nuclear (not so green for earth, but not producing CO_2) the carbon footprint of the data centre is lower. But if energy is becoming from coal, or fuel the CO_2 emissions are higher.

hosting data centre: data centre within which ownership of the facility and the information technology equipment is common but the software systems are dictated by others

objective KPI: KPI assessing one of the objectives of energy management or environmental viability of an operational infrastructure which may be subsequently used to define a global KPI

operator site: premises accommodating network telecommunications equipment providing direct connection to the core and access networks and which may also accommodate information technology equipment

operational infrastructure: combination of information technology equipment (ITE) together with the power supply and environmental control systems necessary to ensure provision of the overall services

power supply and distribution system: facilities and infrastructures necessary to provide power to the equipment of a data centre to meet desired operational objectives

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

task efficiency: measure of the work done (as a result of design and/or operational procedures) for a given amount of energy consumed

technical KPI: KPI assessing the energy management or environmental viability of a component, sub-assembly, product or sub-system under a specified set of conditions

3.2 Abbreviations

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

ATTM	Access Transmission Terminal and Multiplexing
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CoC	Code of Conduct
CRIP	Club des Responsables d'Infrastructure et de Production
DC	Data Centre
DCEM	Dataprocessing and Communications Energy Management
ETSI	European Telecommunications Standards Institute
EU	European Union
ICT	Information Communication Technology
ISO	International Standardization Organization
IT	Information Technology
ITE	Information Technology Equipment
ITU	International Telecommunication Union
ITU-T	ITU's Telecommunication standardization sector
KPI	Key Performance Indicator
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
UPS	Uninterruptible Power Supply

4 Data centre

4.1 General

A Data Centre is a structure, or group of structures, dedicated to the centralized accommodation, interconnection and operation of information technology and network telecommunications equipment providing data storage, processing and transport services 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.

In order to distinguish the different levels of Data Centres many classifications have been established. The most widely used standards are:

- ETSI TS 105 174-1 [9]: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment and Energy Management; Part 1: Overview, common and generic aspects".
- CENELEC EN 50600-1 [4]: "Information technology: Data centre facilities and infrastructures: General concepts".

Different qualitative Availability Classes for the overall set of data centre facilities and infrastructures are defined as shown in Table 1.The availability of the entire data centre depends on the Availability Classes of its individual infrastructures such as power sourcing and distribution, environmental control and security.

In order for the set of facilities and infrastructures of data centre to be considered to be of a given Availability Class, the design of each individual facility and infrastructure listed in Table 1 shall meet or exceed that Availability Class.

The provision of higher Availability Classes generally requires greater investment, for example in design, construction, components, systems and human resources. For example, greater investment in components can result in greater Mean Time between Failures (MTBF) or Reduced Mean Time to Recovery (MTTR).

Table 1: Availability Classes and example implementations (CENELEC EN 50600-1 [4])

	Availability Class 1	**Availability Class 2**	**Availability Class 3**	**Availability Class 4**
Availability of overall set of facilities and infrastructures	Low	medium	High	very high
Example for power distribution	Single-path (no redundancy of components)	Single-path (resilience provided by redundancy of components)	Multi-path (resilience provided by redundancy of systems)	Multi-path (fault tolerant even during maintenance)
Example for environmental control	No specific requirements	Single-path (no redundancy of components)	Single-path (resilience provided by redundancy of components)	Multi-path (resilience provided by redundancy of systems), allows maintenance during operation
Example for telecommunications cabling	Single-path using direct connections	Single-path using fixed infrastructure	Multi-path using fixed infrastructure	Multi-path using fixed infrastructure with diverse pathways

4.2 Normative documents to be taken into account

ETSI TS 105 174-2-2 [2] introduces the issue of energy consumption and efficiency within data centres and addresses the associated operational best practices to meet the objectives of reduced consumption and increased efficiency - containing sections on power distribution infrastructures, environmental control systems and the ITE accommodated by the data centre. It also reviews the possible Key Performance Indicators which would indicate improvement against the primary objectives of reduced energy consumption and increased energy efficiency.

CENELEC EN 50600-2-1 [5] defines the requirements and recommendation for building construction, independent of the size and function of the data centre. It addresses a wide range of situations including the choice of location and site selection for a new data centre to the assessment of existing buildings and structures.

4.3 Informative documents to be taken into account

Void.

5 Energy management methodology

5.1 General

Energy management is done by a global monitoring of energy of the operational data centre. Every local energy should be taken into account. From water flow engine to solar power system, a local electrical power source distributed by a micro or district grid by opposition to a regional or national centralized power plant improved a better use of energy. It can include energy sources or storage or cogeneration of heat and electricity using any primary energy renewable or not. Data centre produce significant quantities of waste heat, there are some applications to reuse this energy.

Successful implementation of energy management requires both process definition and monitoring of relevant KPIs.

5.2 Energy management process

Energy management processes should be based on the ISO EN 50001 standards [8].

5.3 Monitoring of energy management performance

Energy management is combination of reduced energy consumption and increased task efficiency, re-use of energy and use of renewable energy.

Energy management is done by a global monitoring of energy of the operational data centre.

In relation to energy management for data centres a Global Key Performance Indicator (KPI $_{DCEM}$) has been defined and addresses the following four Objective KPIs:

- energy consumption (KPI_{EC});
- task efficiency (KPI_{TE});
- energy re-use (KPI_{REUSE});
- renewable energy (KPI_{REN}).

5.4 Normative documents to be taken into account

ETSI GS OEU 001 [1], "Operational energy Efficiency for Users (OEU); Global KPIs for Data Centres", defines the current position of the ISG OEU members in relation to the so-called Global Key Performance Indicators (Global KPIs) enabling the monitoring of data centre (DC) energy management.

ETSI ES 205 200-1 [3], "ATTM, Energy management; global KPIs; operational infrastructures; general requirements Part 1: General requirements", defines the energy management landscape of the operational infrastructures of broadband deployment addressed by this multi-part deliverable, their inter-relationship and boundaries.

ISO EN 50001 [8]: The objective of this International standard is to enable organizations to establish the systems and processes necessary to improve energy performance, including energy efficiency, use and consumption.

5.5 Informative documents to be taken into account

Best Practices for the EU Code of Conduct on Data Centres (Last version) [i.2] provides the full list of identified best practices for data centre operators as referenced in the Code of Conduct Participant and Endorser Guidelines documents.

6 Power distribution systems

6.1 General

The power distribution systems consider the distribution of energy from public grid to the data centre equipment (hosted equipment, cooling, facilities) including locally generated energy.

The power distribution shall be designed in accordance with the chosen availability class as defined in CENELEC EN 50600-1 [4].

Then design of the power distribution infrastructure shall take into account:

- Scalability for ramp-up needs
- Performance of equipment in accordance with the predicted load
- Consumption metering points in accordance with CENELEC EN 50600-2-2 [6]

New technologies have to be considered:

- 400 Volts Direct Courant distribution
- On-line UPS
- No-break UPS
- By pass UPS

6.2 Normative documents to be taken into account

CENELEC EN 50600-2-2 [6]: This European Standard addresses power distribution within data centres based upon the criteria and classifications for "availability", "physical security" and "energy efficiency enablement" within CENELEC EN 50600-1 [4].

The European Standard CENELEC EN 50600-1 [4] specifies requirements and recommendations for the following:

a) power supplies to data centres;

b) power distribution systems within data centres;

c) facilities for both normal and emergency lighting;

d) equipotential bonding and earthing (by reference to CENELEC EN 50310 [10]);

e) lightning protection (by reference to CENELEC EN 50310 [10]);

f) electrostatic discharge;

g) devices for the measurement of the power consumption characteristics at points along the power distribution system and their integration within management tools.

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

CENELEC EN 50310 [10]: "Application of equipotential bonding and earthing in buildings with information technology equipment".

6.3 Informative documents to be taken into account

ETSI TS 105 174-2 [i.4]: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment and Energy Management; Part 2: ICT sites" details measures which may be taken to improve the energy efficiency within ICT sites.

Best Practices for the EU Code of Conduct on Data Centres (Last version) [i.2].

ETSI EN 300 132-3-1 [i.5]: "Environmental Engineering (EE); Power supply interface at the input to telecommunications and datacom (ICT) equipment; Part 3: Operated by rectified current source, alternating current source or direct current source up to 400 V; Sub-part 1: Direct current source up to 400 V".

7 Environmental control

7.1 General

The environment control is defined as systems required to maintain environmental condition in accordance with hosted equipment vendor specifications.

Conditions per equipment category are defined taking into account:

- Temperature of IT equipment Air Intake
- Limit Temperature of Air Intake to operate
- Widest operating range (T°, Rh%) for reliability and performance
- Position of the controlling measurements
- Tolerated variation in °C/Hour and Rh%/Hour
- Air quality

The couple, humidity and temperature, shall be adapted according to hosted equipment specifications in order to minimize the energy consumption.

7.2 Normative documents to be taken into account

CENELEC EN 50600-2-3 [7]: "Information technology: Data centre facilities and infrastructures: Environmental control" defines environmental control within data centres based upon the criteria and classifications for "availability", "security" and "energy efficiency enablement" within EN CENELEC 50600-1 [4].

7.3 Informative documents to be taken into account

EU CoC Best Practices (Last version) [i.2]: "Best Practices for the EU Code of Conduct on Data Centres".

Annex A (informative): Bibliography

ETSI EN 300 019 series: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".

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

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".

CENELEC EN 50173-2: "Information technology - Generic cabling systems - Part 2: Office premises".

CENELEC EN 50173-5: "Information technology - Generic cabling systems - Part 5: Data centres".

CENELEC EN 50173-6: "Information technology - Generic cabling systems - Part 6: Distributed building services".

CENELEC EN 50174-1: "Information technology - Cabling installation - Part 1: Installation specification and quality assurance".

CENELEC EN 50174-2: "Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings".

European Commission DG JRC: "Code of Conduct on Energy Consumption of Broadband Equipment".

CENELEC EN 50600-2-4: "Information technology - Data centre facilities and infrastructures - Part 2-4: Telecommunications cabling infrastructure".

CENELEC EN 50600-2-5: "Information technology - Data centre facilities and infrastructures - Part 2-5: Security systems".

CENELEC EN 50600-2-6: "Information technology - Data centre facilities and infrastructures - Part 2-6: Management and operational information".

ISO/IEC TR 30133: "Information technology - Data centres - Guidelines for resource efficient data centres".

ISO/IEC 30134-1: "Information Technology - Data Centres - Key Performance Indicators - Part 1: Overview and general requirements".

ISO/IEC 30134-2: "Information Technology - Data Centres - Key Performance Indicators - Part 2: Power Usage Effectiveness (PUE)".

History

Document history		
V1.1.1	June 2015	Publication