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Subject:	ANNEX to the Commission Decision on the sectoral reference document on best environmental management practices, environmental performance indicators and benchmarks of excellence for the telecommunications and information and communication technologies (ICT) services sector for the purposes of Regulation (EC) No 1221/2009 of the European Parliament and of the Council

Delegations will find attached document D073520/01 - Annex.

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ANNEX

ANNEX

to the

Commission Decision

on the sectoral reference document on best environmental management practices, environmental performance indicators and benchmarks of excellence for the telecommunications and information and communication technologies (ICT) services sector for the purposes of Regulation (EC) No 1221/2009 of the European Parliament and of the Council

Contents

1. INTRODUCTION

This Sectoral Reference Document (SRD) is based on a detailed scientific and policy report[1] ("Best Practice Report") developed by the European Commission's Joint Research Centre (JRC).

Relevant legal background

The Community eco-management and audit scheme (EMAS) was introduced in 1993, for voluntary participation by organisations, by Council Regulation (EEC) No 1836/93[2]. Subsequently, EMAS has undergone two major revisions:

Regulation (EC) No 761/2001 of the European Parliament and of the Council[3];

Regulation (EC) No 1221/2009 of the European Parliament and of the Council.

An important new element of the latest revision, which came into force on 11 January 2010, is Article 46 on the development of SRDs. The SRDs have to include best environmental management practices (BEMPs), environmental performance indicators for the specific sectors and, where appropriate, benchmarks of excellence and rating systems identifying performance levels.

How to understand and use this document

The eco-management and audit scheme (EMAS) is a scheme for voluntary participation by organisations committed to continuous environmental improvement. Within this framework, this SRD provides sector-specific guidance to the telecommunications and ICT services sector and points out a number of options for improvement as well as best practices.

The document was written by the European Commission using input from stakeholders. A Technical Working Group, comprising experts and stakeholders of the sector, led by the JRC, discussed and ultimately agreed on the best environmental management practices, sector-specific environmental performance indicators and benchmarks of excellence described in this document; these benchmarks in particular were deemed to be representative of the levels of environmental performance that are achieved by the best performing organisations in the sector.

The SRD aims to help and support all organisations that intend to improve their environmental performance by providing ideas and inspiration as well as practical and technical guidance.

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1 The scientific and policy report is publicly available on the JRC website at the following address: https://susproc.jrc.ec.europa.eu/activities/emas/telecom.html. The conclusions on best environmental management practices and their applicability as well as the identified specific environmental performance indicators and the benchmarks of excellence contained in this Sectoral Reference Document are based on the findings documented in the scientific and policy report. All the background information and technical details can be found there.

2 Council Regulation (EEC) No 1836/93 of 29 June 1993 allowing voluntary participation by companies in the industrial sector in a Community eco-management and audit scheme (OJ L *168, 10.7.1993, p. 1)*.

3 Regulation (EC) No 761/2001 of the European Parliament and of the Council of 19 March 2001 allowing voluntary participation by organisations in a Community eco-management and audit scheme (EMAS) (*OJ L 114, 24.4.2001, p. 1)*.

The SRD is primarily addressed to organisations that are already registered with EMAS; secondly to organisations that are considering registering with EMAS in the future; and thirdly to all organisations that wish to learn more about best environmental management practices in order to improve their environmental performance. Consequently, the objective of this document is to support all organisations in the telecommunications and ICT services sector to focus on relevant environmental aspects, both direct and indirect, and to find information on best environmental management practices, as well as appropriate sector-specific environmental performance indicators to measure their environmental performance, and benchmarks of excellence.

How SRDs should be taken into account by EMAS-registered organisations:

Pursuant to Regulation (EC) No 1221/2009, EMAS-registered organisations are to take SRDs into account at two different levels:

1. When developing and implementing their environmental management system in light of the environmental reviews *(Article 4(1)(b)):*

   Organisations should use relevant elements of the SRD when defining and reviewing their environmental targets and objectives in accordance with the relevant environmental aspects identified in the environmental review and policy, as well as when deciding on the actions to implement to improve their environmental performance.

2. When preparing the environmental statement *(Article 4(1)(d) and Article 4(4)):*

(a) Organisations should consider the relevant sector-specific environmental performance indicators in the SRD when choosing the indicators[4] to use for their reporting of environmental performance.

When choosing the set of indicators for reporting, they should take into account the indicators proposed in the corresponding SRD and their relevance with regards to the significant environmental aspects identified by the organisation in its environmental review. Indicators need only be taken into account where relevant to those environmental aspects that are judged as being most significant in the environmental review.

(b) When reporting on environmental performance and on other factors regarding environmental performance, organisations should mention in the environmental statement how the relevant best environmental management practices and, if available, benchmarks of excellence have been taken into account.

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[4] According to Annex IV (B.(f)) of the EMAS Regulation, then environmental statement shall contain "a summary of the data available on the environmental performance of the organisation with respect to its significant environmental aspects. Reporting shall be on both the core environmental performance indicators and the specific environmental performance indicators as set out in Section C. Where environmental objectives and targets exist, the respective data shall be reported." Annex IV – Section C.3. states that "each organisation shall also report annually on its performance relating to the significant direct and indirect environmental aspects and impacts that are related to its core business activities, that are measurable and verifiable, and that are not covered already by the core indicators. Where available, the organisation shall take account of sectoral reference documents as referred to in Article 46 to facilitate the identification of relevant sector specific indicators."

They should describe how relevant best environmental management practices and benchmarks of excellence (which provide an indication of the environmental performance level that is achieved by best performers) were used to identify measures and actions, and possibly to set priorities, to (further) improve their environmental performance. However, implementing best environmental management practices or meeting the identified benchmarks of excellence is not mandatory, because the voluntary character of EMAS leaves the assessment of the feasibility of the benchmarks and of the implementation of the best practices, in terms of costs and benefits, to the organisations themselves.

Similarly to environmental performance indicators, the relevance and applicability of the best environmental management practices and benchmarks of excellence should be assessed by the organisation according to the significant environmental aspects identified by the organisation in its environmental review, as well as technical and financial aspects.

Elements of SRDs (indicators, BEMPs or benchmarks of excellence) not considered relevant with regards to the significant environmental aspects identified by the organisation in its environmental review should not be reported or described in the environmental statement.

EMAS participation is an ongoing process. Every time an organisation plans to improve its environmental performance (and reviews its environmental performance) it shall consult the SRD on specific topics to find inspiration about which issues to tackle next in a step-wise approach.

EMAS environmental verifiers shall check if and how the SRD was taken into account by the organisation when preparing its environmental statement (Article 18(5)(d) of Regulation (EC) No 1221/2009).

When undertaking an audit, accredited environmental verifiers will need evidence from the organisation of how the relevant elements of the SRD have been selected in light of the environmental review and taken into account. They shall not check compliance with the described benchmarks of excellence, but they shall verify evidence on how the SRD was used as a guide to identify indicators and proper voluntary measures that the organisation can implement to improve its environmental performance.

Given the voluntary nature of EMAS and SRD, no disproportionate burdens should be put on the organisations to provide such evidence. In particular, verifiers shall not require an individual justification for each of the best practices, sector-specific environmental performance indicators and benchmarks of excellence which are mentioned in the SRD and not considered relevant by the organisation in light of its environmental review. Nevertheless, they could suggest relevant additional elements for the organisation to take into account in the future as further evidence of its commitment to continuous performance improvement.

Structure of the Sectoral Reference Document

This document consists of four chapters. Chapter 1 introduces EMAS' legal background and describes how to use this document, while Chapter 2 defines the scope of this SRD. Chapter 3 briefly describes the different best environmental management practices

(BEMPs)[5] together with information on their applicability. When specific environmental performance indicators and benchmarks of excellence could be formulated for a particular BEMP, these are also given. However, defining benchmarks of excellence was not possible for all BEMPs, either because of the limited availability of data or because of the specific conditions of each company and/or site (e.g. environmental and climate conditions for data centres, accessibility of remote base stations etc.) vary to such an extent that a benchmark of excellence would not be meaningful. Even when benchmarks of excellence are given, these are **not** meant as targets for all companies to reach or metrics to compare the environmental performance *across companies* of the sector, but rather as a measure of what is possible to help *individual companies assess the progress* they made and motivate them to improve further. Finally, Chapter 4 presents a comprehensive table with a selection of the most relevant environmental performance indicators, associated explanations and related benchmarks of excellence.

5 A detailed description of each of the best practices, with practical guidance on how to implement them, is available in the "Best Practice Report" published by the JRC and available on-line at: http://susproc.jrc.ec.europa.eu/activities/emas/documents/BEMP_Telecom_FinalReport.pdf.
Organisations are invited to consult it if interested in learning more about some of the best practices described in this SRD.

2. SCOPE

This reference document addresses the environmental performance of the telecommunications and ICT services sector[6]. The best environmental management practices (BEMPs) described in this document were identified as best practices that can support the efforts of all Telecommunications and ICT services providers, i.e. telecommunication operators, ICT consultancy firms, data processing and hosting companies, software developers and publishers, broadcasters, installers of ICT equipment and sites, etc. Large organisations that store and process large quantities of data on their clients, supply chain and/or products (e.g. public administrations, hospitals, universities, banks) can also find several BEMPs of relevance to their activities.

The companies and organisation of the telecommunications and ICT services sector that fall under the scope of this report are listed below:

Only certain sub-categories of publishing activities (NACE Code 58):
- 58.21 Publishing of computer games
- 58.29 Other software publishing

All the sub-categories of telecommunications activities (NACE Code 61):
- 61.1 Wired telecommunications activities
- 61.2 Wireless telecommunications activities
- 61.3 Satellite telecommunications activities
- 61.9 Other telecommunications activities

All the sub-categories of computer programming, consultancy and related activities (NACE Code 62):
- 62.01 Computer programming activities
- 62.02 Computer consultancy activities
- 62.03 Computer facilities management activities
- 62.09 Other information technology and computer service activities

Only certain sub-categories of information service activities (NACE Code 63):
- 63.11 Data processing, hosting and related activities
- 63.12 Web portals

In addition to this core target group, other types of organisations classified under the NACE codes but not belonging to the NACE code sections listed above can also find several BEMPs of relevance, because of their increasing digitalisation:

Publishing of books, newspapers, journals etc. (NACE Code 58.1) via Internet
Motion picture, video and television programme production, sound recording and music publishing activities (NACE Code 59)
Broadcasting via Internet (NACE Code 60)
News agency activities (NACE Code 63.91)
Other information service activities n.e.c. (NACE Code 63.99)

[6] Note that the European Electronic Communications Code (cf. Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code), acknowledging the convergence of the telecommunications, media and information technology sectors, now establishes common rules applicable to the broader sector including e.g. broadcasting. Where relevant and applicable, BEMPs are mentioned in reference to the new nomenclature.

Other organisations that are classified under other NACE sections and have to manage or operate large data storage, data processing and/or telecommunication infrastructures as a vital part of their activities may also find several BEMPs of relevance. Some examples are organisations belonging to:

Reproduction of software (NACE Code 18.20)
Activities of call centres (NACE Code 82.20)
Architectural and engineering activities and related technical consultancy (NACE Code 71.1)
Technical testing and analysis (NACE Code 71.20)
Research and experimental development on natural sciences and engineering (NACE Code 72.1)
Libraries, archives, museums and other cultural activities (NACE Code 91.0)
as well as large organisations that store and process large quantities of data on their clients, supply chain and/or products such as public administrations, hospitals, universities, banks, manufacturers, retailers and other service companies.

The Telecommunications and ICT Services sector as defined in this report covers only a specific part of the value chain of such services and related equipment. This choice was aimed at avoiding overlap with other best practice reports:

The ICT manufacturing industries (NACE Code 26.1, 26.2, 26.3 and 26.8), ICT trade industries (NACE Code 46.5), Installation of mainframe and similar computers (NACE Code 33.20) and recycling, reuse and repair of ICT equipment (NACE Code 95.1) are covered by the best practice report for the electrical and electronic equipment manufacturing sector[7];
The ICT retail trade (NACE Code 47.1 and 47.4) can be considered covered by the best practice report for the retail trade sector[8].

This document covers the core business activities of organisations in the Telecommunications and ICT Services sector. Beyond the direct management of ICT assets, core business activities are considered to include also the relationship with key stakeholders, although limited to practices that telecommunications and ICT services providers can implement themselves (e.g. establishing environmental criteria during procurement of ICT equipment, providing information to customers on the energy consumption of devices provided to them).

The management of offices and general company transport are also not included as these are common for all types of organisations and not specific to organisations in the Telecommunications and ICT Services sector. Besides, the best environmental management practices (BEMPs) related to mobility (business travel and employee

[7] The best practice report for the electrical and electronic equipment manufacturing sector is under development and will be available on-line at: http://susproc.jrc.ec.europa.eu/activities/emas/eeem.html

[8] The best practice report for the retail trade sector is available on-line at: http://susproc.jrc.ec.europa.eu/activities/emas/retail.html

commuting) and sustainability practices in offices are already developed in the document on BEMP in the Public Administration Sector[9]. No BEMP that is specific to the Telecommunications and ICT Services buildings and transportation was identified in these areas.

The manufacturing, retail and recycling of ICT equipment are not included in this study as they are covered in the documents on BEMP for other sectors.

This report distinguishes between:

BEMPs that minimise the environmental impacts of organisations in the Telecommunications and ICT Services sector, referred as "greening of ICT" practices;

BEMPs that organisations in the Telecommunications and ICT Services sector can implement in order to minimise environmental impacts of other sectors beyond the Telecommunications and ICT Services sector, referred as "greening by ICT" practices.

An overview of the scope of the BEMPs for the Telecommunications and ICT Services sector is given in Figure 1.

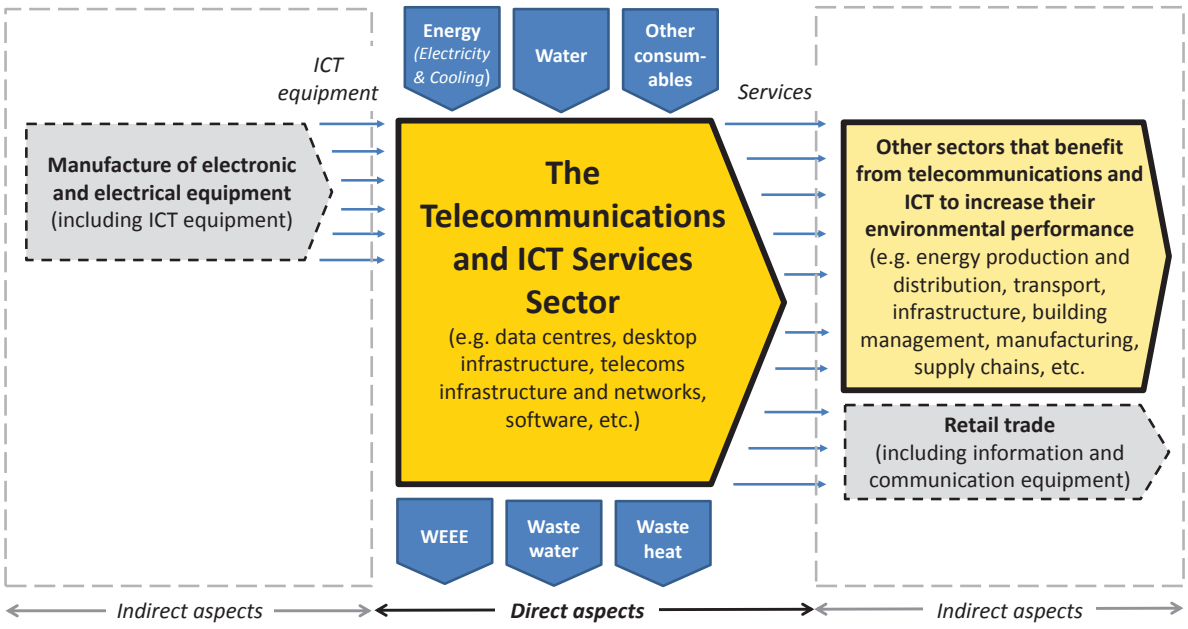

Figure 1: Overview of the scope of the document

The main environmental aspects and associated environmental pressures for the telecommunications and ICT services sector are presented in Table 1. These environmental aspects were selected as the most relevant in the sector and are those that

[9] The best practice report for the public administration sector is available on-line at: http://susproc.jrc.ec.europa.eu/activities/emas/public_admin.html

are covered in this document. However, the environmental aspects to be managed by specific organisations should be assessed on a case by case basis.

Table 1: Main environmental aspects and environmental pressures related to the Telecommunications and ICT Services sector

Service / Activity	Main environmental aspects	Main environmental pressures
Data Centre	- ICT equipment (servers, storage devices, etc.) - Software (processors) - HVAC - Power supply - Buildings	- Energy and water consumption - Generation of WEEE and waste water - GHG emissions from electricity production and refrigerant leakages
End-user devices	- ICT equipment (computers, peripheral devices, etc.) - Software	- Energy consumption to power hardware - Generation of WEEE - GHG emissions from electricity production
Telecommunication infrastructure and networks	- Buildings (central offices, base stations, etc.) - Nodes (antennas, satellites, routers, etc.) - Links (cables, fibres, landlines, etc.) - Terminals (phones, computers, modems, etc.) - Software (processors, etc.)	- Electricity consumption from network equipment and cooling systems - Fuel consumption related to transportation - Generation of WEEE - Electromagnetic waves generation - GHG emissions from electricity production - Changes to the landscape and habitats due to infrastructure deployment
Broadcasting services	- Buildings (base stations) - Transmitters (antennas, satellites, etc.) - Links (cables, fibres, etc.) - Terminals (radios, TVs, etc.) - Software (processor)	- Energy consumption - Generation of WEEE - Electromagnetic waves generation - GHG emissions from electricity production - Changes to the landscape and habitats

The BEMPs of this reference document are classified as illustrated in Table 2.

Table 2: Structure of the document

Section	Description
3.1 BEMPs for the cross-cutting issues	This section describes practices that can be implemented by any actor of the telecommunications and ICT services sector (implementation of an environmental management system, deployment of a green procurement policy, prevention and management of Waste Electrical and Electronic Equipment, use of renewable energy…)
3.2 BEMPs for Data centres	This set of BEMPs focuses on practices specific to data centres (cooling and airflow management, server virtualisation, etc.) and referenced within the CENELEC Technical Report CLC/TR 50600-99-1
3.3 BEMPs for electronic	This section encloses practices aiming at better managing existing wired and wireless networks (in terms of energy consumption and electromagnetic field issues), at

	communication networks	installing more energy-efficient network equipment and reducing the impact of building or renovating network infrastructures.
3.4	BEMPs for Improving the environmental performance in other sectors ("Greening by ICT")	This section encloses practices that demonstrate how ICT can reduce environmental impacts in other sectors based on real examples from companies in the telecommunications and ICT service sector

3. BEST ENVIRONMENTAL MANAGEMENT PRACTICES, SECTOR ENVIRONMENTAL PERFORMANCE INDICATORS AND BENCHMARKS OF EXCELLENCE FOR THE TELECOMMUNICATIONS AND ICT SERVICES SECTOR

3.1. BEMPs for cross cutting issues

This section focuses on cross-cutting measures which could apply to all types of organisations in the telecommunications and ICT services sector at different levels (data centres, telecommunication networks, end-user devices, etc.).

3.1.1. Making the best use of an environmental management system

ICT facilities have important environmental impacts through energy consumption, water consumption and waste generation. It is particularly important for telecommunications and ICT services companies to monitor their environmental impacts and implement an environmental management system to systematically minimise these impacts. It is considered best practice to:

Define the organisation's ICT needs and audit the existing ICT equipment, services and software.

Measure, monitor and manage the environmental performance of ICT equipment infrastructure and facilities.

Set objectives and action plans based on benchmarking and best practices.

Ensure that set objectives and action plans are part of effective company-wide environmental policies, such as an energy efficiency strategy

Applicability

This BEMP is broadly applicable to all companies and organisation of the sector. However, the resources and means allocated to the process must be adapted to the size and the environmental impact of the site or the company. For small and mid-size companies, efforts needed must be assessed and validated.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence

• Implementation of an asset management system, e.g. certified ISO 55001 (Y/N) • Share of operations with an advanced environmental management system implemented (% of facilities/operations), e.g. EMAS verified, ISO 14001 certified • Share of operations measuring and monitoring energy use and water consumption as well as waste management • Share of staff provided at least once with information on environmental objectives and training on relevant environmental management actions • Use of energy efficiency indicators (Y/N); • WEEE generation (in kg or tonnes) per unit of turnover (€) • Use of water efficiency indicators (Y/N) • Total carbon emissions (in $tCO_2eq.$) for scope 1 and 2[10] • Total carbon emissions compensated (in $tCO_2eq.$) • Carbon emissions (in $tCO_2eq.$) for scope 1 and 2 per unit of turnover (€)	• The company has a global and integrated asset management system e.g. certified ISO 55001 • 100% of operations implement an advanced environmental management system, e.g. EMAS verified or ISO 14001 certified • 100% of operations measure and monitor their energy use and water consumption as well as waste management • The company has achieved carbon neutrality (scope 1 and 2), including through the use of renewable energy and carbon compensation, after having pursued all efforts to improve energy efficiency

3.1.2. Procurement of sustainable ICT products and services

The selection and deployment of ICT products and services needs to be based on an integrated strategy to tackle their inherent environmental impacts, such as their energy consumption and the use of specific materials such as rare metals and chemicals. It is considered best practice to:

Assess the existing assets of ICT equipment and the needs in the procurement process preparation.

Include in the call for tender required specific environmental criteria to be met.

Provide training and guidance to end-users when deploying ICT solutions so they can make the best use of the products and services.

Establish energy and environmental performance criteria for ICT equipment provided to customers to help them reduce their environmental impact.

Applicability

The implementation of a policy for the procurement of sustainable ICT services and products is applicable in any company but will require specific skills on sustainability. Large organisations have greater potential to leverage influence over their suppliers, but SMEs may exert considerable influence over local suppliers.

[10] Total carbon emissions for scope 1 and 2 can be calculated based on the Greenhouse Gas Protocol, available online at: https://ghgprotocol.org/

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Share of products or services purchased by the company complying with specific environmental criteria (e.g. EU Ecolabel, top class energy label, Energy Star, TCO-certified etc.) • Use of total cost of ownership as criterion in call for tenders (Y/N) • Share of equipment purchased by the company complying with internationally recognized best practices or requirements (e.g. EU Codes of Conduct) • Share of packaging purchased by the company made from recycled materials or awarded the Forest Stewardship Council label • Share of the weight given to environmental criteria in calls for tenders • Share of suppliers that have an environmental management system or energy management system in place (e.g. EMAS verified, ISO 14001 or ISO 50001 certified) • Share of ICT products and services provided by the company to customers for which environmental information is available to end users	• All ICT equipment purchased by the company is ISO Type I eco-labelled (e.g. EU Ecolabel, Blue Angel) (if available), Energy Star, or EU Green Public Procurement criteria (if available) are applied in its procurement. • All broadband equipment purchased by the company meets the criteria in the EU Code of Conduct on broadband equipment • 100% of packaging purchased by the company is made from recycled material or was awarded the Forest Stewardship Council label • 10% of the bid weighting is dedicated to environmental performance when purchasing ICT equipment • 100% of products and services provided by the company has related environmental information available to end users • Use of total cost of ownership as criterion in call for tenders

3.1.3. Optimising the energy consumption of end-user devices

There is a large potential to reduce the energy consumption of end-user equipment used within the offices and facilities of telecommunications and ICT services companies thanks to specific power management measures. It is best practice to:

Adopt technical solutions:

Installing appropriate devices in terms of energy performance and functionalities depending on the needs of users;

Properly configuring equipment to minimise unnecessary functionalities and power consumption;

Performing regular energy audits to check devices configuration and powered-off devices;

Developing power management solutions using different types of power management modes (manual, default, through software) or using dedicated devices (smart power strip, etc.).

Adopt organisational solutions:

Assessing individual user acceptance;

Raising users' awareness.

Applicability

This BEMP is applicable to both large and small companies, although SMEs might benefit more from techniques based on individual user awareness rather than deployment of automated controls, more suited to large companies. Implementing power management depends on the leadership's commitment to support overall energy savings objectives and environmental performance. It is also dependant on the implication of the staff to contribute to the power management measures as well as support from the IT and procurement departments.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Energy use of offices (kWh) per unit of turnover or number of workstations or employees working on-site (excluding HVAC and lightning if possible) • Share of end-user ICT devices having been configured on installation at optimal power management • Share of end-user ICT devices audited on power management at an appropriate frequency (e.g. yearly, only once during the lifetime of the product etc.) • Share of staff trained at least once on energy savings	• All end-user ICT devices are configured on installation at optimal power management • All end-user ICT devices have been audited on power management at least once during their lifetime • All staff has been trained at least once on energy savings

3.1.4. Use of renewable and low carbon energy

ICT facilities have a high carbon footprint due to intensive energy use. Electricity generation from renewable sources such as biomass, solar, wind and geothermal cooling systems, significantly reduces their carbon footprint. It is considered BEMP to:

Purchase third-party green electricity.

Produce one's own electricity, either on or off-site.

Store electricity on-site in an efficient way.

Applicability

The BEMP is broadly applicable by all type of companies of the sector, including SMEs. The geographical location of the facility and its size may affect its applicability though.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Share of renewable electricity purchased (with Guarantees of Origin) out of the total electricity use (%) • Share of renewable electricity produced on site out of the total electricity use (%) • Renewable Energy factor (REF) according to EN 50 600-4-3 • Carbon Usage Effectiveness (CUE) = CO2-eq. emissions from the energy consumption of the facility (kgCO2eq) / total ICT energy consumption (kWh) • Carbon content of the energy used = CO2-eq. emissions from the energy consumption of the facility (kgCO2eq) / total energy consumption (kWh)	• 100% of electricity used is from renewable energy sources (either purchased or produced on-site)

3.1.5. Resource efficiency of ICT equipment through waste prevention, reuse and recycling

Resource efficiency and appropriate waste management in the ICT sector is important because of the use of specific materials that need to be properly treated at end-of-life to avoid damage to human health and the environment. It also offers a large potential for limiting resource depletion through recycling. Specific waste management techniques can be implemented in order to improve waste management at each stage of the waste hierarchy in ICT companies. It is BEMP to:

Develop a waste prevention plan.

Promote LCA-based eco-design through procurement.

Increase the service life and limit the obsolescence of ICT equipment.

Implement systems to enable re-use of ICT equipment.

Ensure traceable collection and proper sorting of end-of-life ICT equipment.

Applicability

The BEMP is in principle broadly applicable to all types of companies in this sector; in practice small companies may contract out some waste management operations. The

ownership model of the equipment will also dictate the available options for resource efficiency.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Share of facilities or sites with a certified zero waste management system or with a certified asset management system (% of facilities/sites) • Average service life of ICT equipment to be calculated for different product groups (e.g. servers, routers, end-user devices) • Share of ICT waste generated from own operations recovered for reuse or refurbishment or sent for recycling • Share of WEEE or ICT waste generated from clients recovered for reuse or refurbishment, or sent for recycling • Amount of ICT waste sent to landfill (t)	• 100% of facilities have a certified zero waste management system or a certified asset management system • 90% of own ICT equipment recovered for reuse or refurbishment or sent for recycling • 30% of ICT equipment from clients taken back and recovered for reuse or refurbishment or sent for recycling (for ICT companies providing equipment to customers) • Zero ICT waste sent to landfill

3.1.6. Minimising data traffic demand through green software

While software does not directly consume energy, it greatly influences the energy efficiency of the ICT hardware on which it runs. However, a large share of software code does not take into account energy consumption, and opportunities exist to optimise software, reduce the volume of data processed and transmitted, and ultimately reduce the energy consumption of hardware.

This BEMP is dedicated to practices that can be implemented either when developing new software or when optimising existing software, for servers and networks considering both mobile applications (for smartphones and tablets) and computer software (for laptop and desktop), as well as web portals and web-based applications. It is BEMP to:

Select or develop more energy efficient software that minimises power consumption of ICT equipment while running.

Design demand-adaptive software based on the assessment of end-users needs, in order to avoid energy over-consumption at usage phase and to limit the obsolescence of existing ICT devices.

Monitor the energy consumption of software to assess the real performance of the acquired software, or to assess the opportunity of improving the energy efficiency of existing software.

Assess software environmental impacts through LCA at development phase and performance measurement (CPU, RAM and energy utilisation) at usage phase.

Refactor existing software to improve its energy efficiency.

Applicability

The BEMP is applicable to all types of companies in this sector, whether companies procure or develop their own software solutions.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Share of sites that have implemented the best practices of the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding the development and deployment of new IT services; • Amount of data transferred in relation with software utilisation (bit / web page view or bit / min of mobile application use) • Share of newly acquired software for which the energy performance has been used as a selection criterion within procurement (%); • Share of newly developed software for which the energy performance has been used as a development criterion (%); • Share of demand-adaptive designed software; • Share of existing software which has been refactored or which has undergone code reviews towards higher energy efficiency (%); • Share of software for which the energy performance has been assessed or monitored (%). • Share of software for which a LCA has been carried out; • Share of software developers (staff) trained on energy efficient software (%).	• All data centres have implemented the best practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected practices of CLC/TR 50600-99-1 regarding the development and deployment of new IT services. • All staff (software developers) trained on energy efficient software. • At least one project for minimising data traffic demand through green software was implemented during the year

3.2. BEMPs for data centres

This section deals with practices that improve the environmental performance of the operations of data centres. Many of the techniques identified within this chapter can also be implemented in telecommunication central offices.

There is a large variety of data centres and many different ways to categorise them; the following characteristics can be used to differentiate between data centres: the size of the data centre (determined by the physical area, number of servers and / or workload

capacity); its geographical location; the purpose or type of the operator (e.g. enterprise data centres, co-location[11], co-hosting, or network operator facilities); and its security level (Tier I to IV). These characteristics all have an impact on the applicability of the following BEMPs to different data centres.

3.2.1. Implement an energy management system for data centres (including measuring, monitoring and management of ICT and other equipment)

The energy consumption of data centres is responsible for a major share of their environmental impacts. It is therefore important for data centre operators to have a clear and detailed view on energy consumption at the appropriate granularity levels, and to systematically exploit all opportunities to minimise it. It is considered best practice to:

Implement an energy management system (e.g. ISO 50001 or through EMAS).
Audit existing equipment and services to ensure that all areas with potential for optimisation and consolidation are identified to maximise any unused capability prior to new material investment.
Install metering equipment capable of measuring energy consumption and environmental parameters at different levels (row, cabinet, rack or ICT device level).
Monitor and report key performance indicators on equipment utilisation, energy consumption and environmental conditions.

Applicability

General remarks on the applicability of data centre BEMPs apply. Most energy management best practices will be better suited to localised, mid-tier and enterprise-class data centres.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• KPI_{DCEM} Global KPI for Data Centre according to ETSI standard • Share of facilities having an energy management system certified according to ISO 50001 or integrated in EMAS, or complying with the EU Code of Conduct on Data Centre Energy Efficiency or the "expected practices" of CLC/TR 50600-99-1 • Share of ICT, cooling or power equipment with specific metering equipment (for their utilisation, energy consumption, temperature or humidity conditions) • Share of staff provided with information on energy objectives or training on relevant energy management	• The KPI_{DCP} for existing data centres is equal to or lower than 1.5 • All data centres have an energy management system certified according to ISO 50001 or integrated in EMAS, or complying with the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the "expected practices" of CLC/TR 50600-99-1

[11] Co-location of data centres can also refer to exchange points of ICT services.

actions during the year	

3.2.2. Define and implement a data management and storage policy

Minimising the quantity of data stored onto drives and the computing capacity required to run applications, databases and services is a key measure to reduce the energy consumption of data centres by reducing the number of powered hardware (servers and storage devices). It is considered best practice to:

Implement an effective data management and storage policy to minimise the share of stored data either unnecessary, duplicated or does not require rapid access.
Deploy grid and virtualisation technologies to maximise the use of shared platforms.
Consolidate existing services and decommission unnecessary hardware (and virtual machines) to reduce the number of highly resilient and reliable hardware powered (servers, networking and storage equipment).

When properly implemented, these techniques lead to a reduction of the hardware purchased which also results in significant material resources savings.

Applicability

This BEMP is broadly applicable by all companies and organisations of the sector, irrespectively of their size, security level or purpose although application may be different for enterprises or colocation data centres. Even if virtualisation is more frequently used in bigger data centres, this technique can also be implemented in smaller server rooms.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Energy use (kWh) per rack • Average storage disks space utilisation (%) • Average server utilisation (%) • Average cabinet utilisation (%) • Share of servers virtualised (%) • Share of data centres that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding data management and storage, and management of existing ICT equipment and services	• All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected practices of CLC/TR 50600-99-1 regarding data management and storage, and management of existing ICT equipment and services

3.2.3. Improve airflow management and design

The reliability of IT systems depends on environmental conditions (temperature, humidity, dust, etc.) that must be ensured by appropriate control of the indoor air quality. Airflow management for data centres aims at avoiding air recirculation and mixing of cooling air supplied and hot air rejected from equipment. It is BEMP to:

Implement a hot aisle / cold aisle configuration for ICT equipment to ensure that hardware shares an air flow direction without mixing cold and hot air.

Ensure aisles separation and containment to avoid the recirculation of air around the servers.

Segregate ICT equipment according to their environmental requirement (mainly humidity and temperature) and provide appropriate airflows to separate environmental areas.

Improve the floor and ceiling design to reduce bypass air flow, to prevent re-circulated air, and to reduce obstructions created by cabling or other structures.

Adjust volumes and quality of supplied cooled air to the IT equipment needs (function of heat produced and environmental requirements), and provide a slight oversupply of air to minimise heated air recirculation.

Improved airflow management increases both the efficiency and the capacity of the cooling equipment, reduces the utilisation of fans and humidifiers (and their energy consumption) and minimise the production of waste heat.

Applicability

Most of these actions can only be implemented by the data centre operator since they require changes in operational conditions, evolutions of the design of the facility or installation of new equipment. Although the best practices identified can be implemented in data centres of any size, scale effects can be observed in larger data centres with shorter return on investments.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Air flow efficiency (fan power in kWh / fan airflow in m3/hour) • Return Temperature Index (identification of air recirculation) • Flow performance of the air handler (unit less) • Thermal performance of the air handler (unit less). • Rack cooling index (difference between allowable intake temperature and the one recommended by ASHRAE) • Share of racks installed with hot aisle/cold aisle configuration (with containment)	• 100% of new racks are installed with hot aisle/cold aisle configuration (with containment) • All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected practices of CLC/TR 50600-99-1

• Share of data centres that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding airflow management and design	regarding airflow management and design, and installation of ICT equipment to optimise airflow management.

3.2.4. Improve cooling management

Cooling is needed to remove the heat produced by ICT equipment in a data centre or a network room and to ensure the right operating conditions for ICT equipment to perform reliably. Sizing the necessary cooling system of a data centre depends on the environment where the data centre is located, on the efficiency of the IT equipment used in the data centre and on the airflow management performance. It is BEMP to:

Maintain the cooling system in optimum condition depending on IT load requirements to preserve its efficiency.

Review and adapt the cooling system capacity by shutting down unused equipment and better taking into account specific equipment operating requirements.

Optimise and automate the cooling system output by connecting CRAC units or using smart and multifactor units.

Applicability

The BEMP is broadly applicable in all companies of the sector. Maintaining the cooling system and carrying out regular reviews of its capacities can be done in most data centres, irrespectively of their size, security level or purpose.

However, automating the cooling system output can imply costs to purchase smart equipment, making it more appropriate for large size data centres.

It must be noted that specific regulation and environmental guidance can conflict with the decrease of cooling needs. For instance, BREEAM and LEED give points for increasing insulation of data centres. An increased insulation of data centres will require additional cooling needs since the heat produced by servers cannot dissipate.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• COP (coefficient of performance): average cooling load (kW) / average cooling system power (kW) • Share of data centre total energy use dedicated to the cooling system (%) • Carbon Usage Effectiveness (CUE) • Water Usage Effectiveness (WUE) • Share of data centres that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy	• Select equipment with a COP of 7 or higher for water chillers, and 4 or higher for Direct Expansion (DX) cooling systems • All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency (parts 5.2, 5.4 and 5.5)

Efficiency (parts 5.2, 5.4 and 5.5) or the Expected Practices of CLC/TR 50600-99-1 regarding cooling management	or the expected practices of CLC/TR 50600-99-1 regarding cooling management

3.2.5. Review and adjust temperature and humidity settings

ICT facilities are often overcooled, and the server intake temperature set point can be raised within the recommended or allowable temperature ranges (given in the manufacturer specifications) in order to reduce the cooling capacity and the energy consumption of the cooling system.

A similar situation is generally observed regarding humidity, and the energy and water consumption of humidifiers can be reduced by allowing a broader range of humidity levels. It is therefore BEMP to:

Review and raise temperature set points of cooling systems if practical, to reduce cooling needs and maximise the use of economisers.
Review and change humidity settings of cooling systems if practical, to reduce the needs for humidifiers.

Applicability

The BEMP is broadly applicable to all types of companies in this sector. Raising temperature set points, adjusting volumes and quality of supplied cool air, and reviewing humidity settings can be done in most data centres, irrespectively of their size, security level or purpose, within the operational specification given by the server manufacturer and within acceptable working conditions.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Airflow Efficiency (fan power in kWh / airflow in m3/hour) • Return Temperature Index (RTI) • Share of data centres that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding temperature and humidity settings	• All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected practices of CLC/TR 50600-99-1 regarding temperature and humidity settings

3.2.6. BEMPs related to selecting and deploying new equipment for data centres

The section deals with practices for the improvement of the energy efficiency of individual equipment and ICT services used in data centres:

3.2.6.1. Selection and deployment of environmentally friendly equipment for data centres

The selection and deployment of ICT devices as well as cooling and power supply equipment needs to be based on an integrated strategy to minimise their overall environmental performance (energy use, water use, embodied energy, resource efficiency). It is BEMP to:

Implement a green procurement policy specific to data centres equipment, from process preparation to bid evaluation.

Select and install environmentally-performant servers and storage equipment; i.e. equipment with the option to enable power management features, equipment suitable for the data centre power density and cooling delivery capabilities, equipment meeting the expected environmental conditions (temperature and humidity), etc.

Select environmentally-performant cooling equipment; i.e. equipment with high CoP or variable speed controls, appropriately sized cooling units, centralised cooling systems, economisers, etc..

Select environmentally-performant power equipment; i.e. highly efficient UPS, modular UPS, etc.

Applicability

Techniques on green procurement and environmentally-performant servers are broadly applicable to any new and existing data centre.

For cooling systems, the location of the data centre is a fundamental factor concerning the feasibility and the performance of a free cooling system. Alternative cooling systems such as liquid cooling or free-air cooling are most easily implemented in new data centres rather than existing ones. For power systems, the elements to take into consideration for the adoption of new, more efficient UPS systems vary depending on when a new infrastructure is being built or when upgrading an existing infrastructure.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Design PUE (dPUE) • Share of ICT products or services purchased by the company complying with specific environmental criteria (e.g. EU Ecolabel, EnergyStar) • Share of suppliers with an environmental management system or energy management system in place (e.g. EMAS verified, ISO 14001 or ISO 50001 certified) • Share of facilities that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding the selection and deployment of new IT	• All new Data Centre ICT equipment is ISO Type I eco-labelled (e.g. EU Ecolabel, Blue Angel, etc.) (if available) or Energy Star labelled • All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding the selection and deployment of new ICT equipment / of cooling system / of new power equipment / of other data centre

equipment / power equipment / cooling equipment • Average energy efficiency of UPS (given by manufacturers) • Average COP of cooling equipment (given by manufacturers)	equipment. • UPS meet the requirements of the Code of Conduct for UPS • Select equipment with a COP of 7 or higher for water chillers, and 4 or higher for Direct Expansion (DX) cooling systems

3.2.7. BEMPs related to new build or refurbishment of data centres

The section deals with practices for the improvement of the energy efficiency of new built or refurbished data centres.

3.2.7.1. Planning of new data centres

When building or upgrading a data centre, the planning phase offers the most significant opportunities to ensure its environmental performance. Data centres are often oversized to allow future extensions, which generates energy inefficiencies. In many cases, the building can prevent the data centre from upgrading to new and more energy efficient equipment. It is BEMP to:

Limit the level of physical infrastructure resilience and service availability according to business requirements.

Build a modular data centre to avoid oversizing and maximise infrastructure efficiency under partial and variable load conditions.

Applicability

This BEMP is broadly applicable to all companies of the sector, being most relevant for localised, mid-tier and enterprise-class data centres. Building a data centre according to a modular architecture is particularly relevant for big data centres.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Energy use of the data centre per floor area (kWh/m²) • Design PUE (dPUE) • Share of sites that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding Utilisation, management and planning of new build or refurbishment of data centres	All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected practices of CLC/TR 50600-99-1 regarding utilisation, management and planning of new build and refurbishment of data centres

3.2.7.2. Reuse of data centre waste heat

As any electrical equipment, IT equipment requires power supply and produces waste heat while running. Data centres produce large quantities of waste heat, which is an opportunity for heat reuse. It is BEMP to:

Re-use the waste heat produced in some rooms of the data centre to provide low grade heating to industrial or office space (including other areas of the data centre).

Applicability

This BEMPs can be broadly implemented by any data centre regardless of its size, tier or purpose.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Energy Reuse Factor (ERF) • Energy Reuse Effectiveness (ERE) • Share of sites that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding reuse of data centre waste heat	• All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding reuse of data centre waste heat

3.2.7.3. Design of the data centre building and physical layout

The physical layout of the data centre influences significantly its cooling system performance, since cooled areas (where racks are located) may be unnecessarily located close to internal heat sources (such as mechanical or electrical equipment) or in areas heated by external sources (e.g. solar radiation). It is BEMP to:

Minimise direct solar heating of the cooled areas of the data centre, in order to minimise cooling requirements.

Locate cooling equipment in appropriate areas of the data centre, such as areas with free air movement, areas with sufficient space to optimise cooling performance, areas free of obstructions and free of equipment generating heat.

Applicability

This BEMP is most relevant for building new, enterprise-class data centres, as it aims to shape the aspect and structure of the new built data centre and can be costly to implement.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Share of sites that have implemented the expected minimum practices in the EU Code of	• All data centres have implemented the expected minimum

Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding data centre building physical layout	practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected practices of CLC/TR 50600-99-1 regarding data centre building physical layout

3.2.7.4. Selecting the geographical location of the new data centre

The geographical location of the data centre has great influence on its future carbon and environmental impacts. It is considered best practice to:

Favour brownfield locations over greenfield.

Select a geographical location with environmental conditions improving the performance of side-economisers, offering opportunities for installing equipment for the production of renewable energy or limiting threats and natural disasters.

Locate the data centre close to energy, cooling and heating sources, to minimise energy losses due to energy transport and to offer opportunities for the reduction of carbon emissions (consumption of renewable energy, waste heat or free cooling).

Minimise impacts of the building on the environment (noise, aesthetic impacts, needs for telecommunication networks and other infrastructures, etc.).

Applicability

The BEMP is broadly applicable in all types of companies from the sector, including SMEs, but most relevant for mid-tier and enterprise-class data centres.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Share of new facilities with free cooling solutions (air-side economisers, geothermal cooling, etc.) • Share of new facilities with renewable energy production on site (photovoltaic panels, wind turbine, etc.) • Share of new facilities with heat reuse system • Share of sites that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding data centre geographical location	• All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected and optional practices of CLC/TR 50600-99-1 regarding data centre geographical location

3.2.7.5. Use of alternative sources of water

Water is used in data centres for two purposes: cooling and humidification, which are intimately linked. In particular, evaporative chillers require significant amount of water. It is BEMP to:

Monitor water consumption from all sources in all data centre spaces.
Limit impact on potable water resources by using non-potable water sources (rainwater, wastewater, etc.).

Applicability

This BEMP is relevant for large, enterprise-class data centres. The choice of the cooling system solution depends on the size of the data centre, which is intimately linked to the activity and the size of the company.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Share of water consumed in data centres by source, such as mains water, rainwater or non-utility water sources • Water consumption of the data centre per floor area (m3 consumed /m² of data centre) • Water Usage Effectiveness (WUE) • Share of sites that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding water sources	• All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected practices of CLC/TR 50600-99-1 regarding water sources

3.3. BEMPs related to electronic communication networks

The section describes practices focusing on the network configuration of the different elements that form electronic communication infrastructure and networks[12].

3.3.1. Improving the energy management of existing networks

Due to end-user demand variability, traffic loads on electronic communication networks vary significantly over time and space. The energy consumption of modern telecommunications equipment is the highest when the equipment is operating at maximum traffic load, but it does not decrease much when the equipment is underutilised. A large part of the daily network energy consumption is thus spent for

[12] Please note that "electronic communication networks" is used in the broad sense of the European Electronic Communications Code (including wireless, optical...) and not referring strictly to communications based only on a physical layer exchanging *electronic* signals.

providing full system capacity, even when the actual traffic demand is much lower. It is BEMP to:

Measure the energy consumption of network elements by using smart energy meters and automated analysis.

Use smart stand-by functions to implement network energy management, and switch as many devices as possible to low consumption mode when the traffic load is low to adapt the overall capacity of the network to the demand.

Use dynamic power scaling opportunities to adapt the operation mode of network equipment to low or moderate traffic period times.

Take advantage of dynamic scheduling transmission to better manage data traffic, and to control the amount and the timing of data packet transmission.

Provide energy-aware services to reduce the traffic demand at peak load, as well as the overall capacity of the network.

Applicability

The applicability of the various measures of this BEMP is presented in Table 3.

Table 3. Applicability of best practices aiming at improving the energy management of existing electronic communication networks (ECNs)

Technique	Network segment	Network technology	End-users' requirements	Actor
Measure the energy consumption	From core to access network	All type of technology	All type of end-users	Electronic communications networks (ECN) operators
Using smart stand-by functions	From core to access network	All type of technology	Inappropriate for users requiring connexion stability or a very short resuming time	ECN operators
Using dynamic power scaling opportunities	From core to access network	All type of technology	All type of end-users	ECN operators
Taking advantage of dynamic scheduling transmission	From core to access network	All type of technology	Inappropriate for users requiring fast transmission rates	ECN operators
Providing energy-aware services	From core to access network	All type of technology	Inappropriate for users requiring high Quality of Services	ECN operators and ICT service providers

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Average energy consumption per customer or subscriber in kWh / customer or subscriber[13]	• 50% of the network energy usage is real-time monitored at

[13] This indicator is not suited to benchmark between different types of operators.

• Mobile/Fixed Network data Energy Efficiency (the data volume delivered / the energy consumption) in bit / J • Share of network energy usage for which energy consumption is measured (in %) • Share of network nodes for which dynamic power management solutions (such as dynamic power scaling or dynamic scheduling transmission) are implemented (in %)	telecommunication sites level (base stations and /or fixed-network nodes), or above • An energy management system is in place for telecommunication networks

3.3.2. Improving risk management for electromagnetic fields through assessment and transparency of data

Electromagnetic fields (EMF) are a public concern in relation to the growing wireless networks. Strict regulations have been defined and intense research works have been carried out to tackle this issue. It is best practice for telecom operators to:

Improve risk management for electromagnetic fields through assessment and transparency of data on EMF exposure.

Applicability

The implementation of this BEMP depends on the content of national regulations regarding EMF and on the local context (existence of associations against EMF exposure, media coverage of EMF issues, visibility of antennas, etc.). It is most relevant for network operators.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• The percentage of sites assessed by measurement for compliance with EMF limits; • The percentage of sites regularly or continuously monitored (also with a software) for compliance with EMF limits; • The percentage of the results from the two indicators above that are made publicly available and transparent to the public (%).	N/A

3.3.3. Selecting and deploying more energy-efficient electronic communication network equipment

Both mobile and wireline networks use ICT equipment that require electricity and specific environmental conditions to properly function. Electronic communication[14] operators have the opportunity when selecting and deploying such materials within their networks to improve energy efficiency by selecting and configuring appropriate equipment. It is best practice to:

[14] In the sense of the European Electronic Communications Code

Opt for selecting and deploying the most energy-efficient ICT equipment (radio, telecommunication, broadband and IT devices) in telecommunication networks (more energy efficient technology, power management features, etc.).

Opt for deploying integrated and multi-standard solutions, instead of multiple single-standard systems running in parallel and not properly configured.

Opt for selecting and deploying the most energy-efficient cooling systems in base stations (e.g. passive cooling, simple fans, heat exchangers, etc.) and central offices (e.g. hot aisle / cold aisle blanking plates, hot air containments, air ducting, etc.).

Opt for selecting and deploying the most energy-efficient UPS (e.g. high efficient UPS, modular UPS, etc.) in base stations and central offices.

Opt for designing telecommunication sites which maximise energy-efficiency by migrating distributed functions to central servers in wireline networks, moving radio equipment closer to the antenna, and using an appropriate design of UPS.

Use software enabling energy savings all along the network, to implement virtualisation (for increasing equipment sharing and reducing the number of needed hardware equipment) or networking functions (for allowing a greater flexibility and efficiency of the network).

Applicability

The applicability of the measures of this BEMP is presented in Table 4.

Table 4: Applicability of the measures of this BEMP

Technique	Network segment	Network technology	End-users' requirements	Actor
Select more energy-efficient ICT equipment (radio, telecommunication, broadband and IT devices)	From core to access network	All type of technology	All type of end-users	ECN operators and technology providers
Deploy integrated and multi-standard solutions	Access networks	Mobile networks	All type of end-users	ECN operators and installers
Select and deploy more energy efficient cooling systems	From core to access network	All type of technology	All type of end-users	ECN operators, technology providers, and installers
Select and deploy more energy efficient UPS	From core to access network	All type of technology	All type of end-users	ECN operators, technology providers, and installers
Design more energy-efficient telecommunication sites	Access networks	All type of technology	All type of end-users	ECN operators and installers
Use software enabling energy savings	From core to access network	All type of technology	All type of end-users	ECN operators

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Percentage of broadband equipment meeting the Broadband Code of Conduct[15] requirements in terms of energy consumption • Percentage of equipment able to deliver dynamic energy management • Share of base stations with multi-standard solutions • Share of base stations with a Remote Radio Head or Active Antenna System • Share of sites equipped with hardware compliant with the ETSI standard[16] • Share of sites with non-mechanical cooling • The temperature is set at the maximum allowable according to the equipment on site (Y/N) • Average UPS System Efficiency • Average COP of cooling systems	• 100% of new installed broadband equipment meets the requirements of the EU Code of Conduct for broadband equipment in terms of energy consumption • Energy efficiency of power/energy stations is 96% or higher • Select equipment with a COP of 7 or higher for water chillers, and 4 or higher for Direct Expansion (DX) cooling systems

3.3.4. Installing and upgrading telecommunication networks

Beyond the installation of new energy efficient equipment on network sites, organisational solutions can deliver significant energy savings, for instance, by ensuring that unused equipment is plugged off and power and cooling supply are not oversized and are optimised to the actual current needs. It is best practice to:

Take advantage of technology transition (e.g. deploying 5G technology in existing base station sites or for fixed stations switching from copper to fibre networks) to optimise network sites, undertaking decommissioning/switch off of the unused equipment, replacement of the obsolete equipment, proper configuration of the cooling systems, etc.

Put in place a decommissioning plan through the integration of such practices in a management process focused on upgrading base station sites.

Applicability

This BEMP is more relevant for large mobile companies which own thousands of sites, and for operators of networks in rural areas (where the sites are more spaced out). Telecommunication operators and their suppliers in charge of the installation of ICT equipment are the main actors concerned by this BEMP.

Associated environmental performance indicators and benchmarks of excellence

[15] EU Code of Conduct on Energy Consumption of Broadband Equipment: https://e3p.jrc.ec.europa.eu/communities/ict-code-conduct-energy-consumption-broadband-communication-equipment

[16] ETSI ES 202 336

Environmental performance indicators	Benchmarks of excellence
• Mobile Network data Energy Efficiency (EEMN,DV) • Mobile Network coverage Energy Efficiency (EEMN,CoA) • Wireline network efficiency (ICT energy use / total energy use of the network) • Quantity of unused or inefficient equipment decommissioned and removed from base station sites each year (kg) • Switch off from copper to fibre networks i.e. copper exchanges (%)	• A plan and a management process for optimising all existing network sites have been defined (to remove unused and inefficient equipment, to properly configure cooling systems, etc.)

3.3.5. Reducing the environmental impacts when building or renovating telecommunication networks

Telecommunication and broadcasting infrastructures generate neighbourhood nuisances (aesthetic impact, noise from generators and cooling system, etc.) and are responsible for land-use (potentially associated with biodiversity disturbance). To limit such impacts when building new infrastructures or when renovating existing ones, it is BEMP to:

Plan capacity and forecast demand ahead of building or renovation

Co-locate ICT infrastructures, in order to limit the number of different infrastructures.

Locate network infrastructures (fixe-lined, antennas, buildings, etc.) close to existing access roads and out of conservation areas

Install noise reducing solutions, such as barriers, absorptive material or mufflers.

Applicability

The applicability of the measures of this BEMP is presented in Table 5.

Table 5: Applicability of the measures of this BEMP

Technique	Network segment	Operation	Actor
Co-location and sharing of ICT infrastructures	Radio Access Networks (RAN)	New build and renovation	Network operators; owners of other infrastructures
Location close to existing access roads and out of conservation areas	Any network infrastructure	New build	Network operators; local authorities
Installation of noise	Base stations and	New build and renovation	Network operators;

reducing solutions	central office (generators and cooling systems)		local authorities

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• Percentage of sites passive sharing (%); • Percentage of sites active sharing (%); • Measures to reduce visual and environmental impacts applied e.g. noise-reduction solutions when building new wireline networks (Y/N).	• At least 30% of sites are shared with other operators (wherever feasible, e.g. legally)

3.4. Improving the energy and environmental performance in other sectors ("Greening by ICT")

This section deals with practices focussing on the most relevant opportunities for the telecommunications and ICT service sector to contribute to improving the environmental performance of other sectors.

3.4.1. Greening by ICT

Across all sectors, four main change levers for reducing GHG emissions and improving environmental performance in general through ICT are available:

Digitalisation and dematerialisation

Data collection and communication

System integration

Process, activity, and functional optimisation

These solutions are closely related to one another and complementary. They apply at different lifecycle stages: while developing the services or products, between the development phase and the utilisation phase, and at the user's site.

From an ICT company perspective and for each of these four main levers, it is best practice to:

keep on developing new solutions that offer opportunities to reduce environmental impacts (through R&D investments, partnerships with companies from other sectors, etc.);

help companies deploy such solutions into their operations and business (by specifically designing the solution according to its client needs, by providing training and communication, etc.);

internally deploy these solutions, if relevant.

Applicability

The BEMP is broadly applicable to all types of companies in this sector.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
• GHG emissions based on the Greenhouse Gas Protocol, scope 3 emissions • number of innovative dematerialisation solutions proposed to clients • Share of products and services (in terms of turnover) delivered digitally to the client	• N/A

4. RECOMMENDED SECTOR-SPECIFIC KEY ENVIRONMENTAL PERFORMANCE INDICATORS

Table 4.1 lists a selection of key environmental performance indicators for the telecommunications and ICT services sector, together with the related benchmarks and reference to the relevant BEMPs. These are a subset of all the indicators mentioned in Section 3.

Table 4.1: Key environmental performance indicators and benchmarks of excellence for the telecommunications and ICT services sector

Indicator	Common units	Main target group	Recommended minimum level of monitoring	Related EMAS core indicator[17]	Benchmark of excellence	Related BEMP[18]
BEMPs for cross cutting issues						
Implementation of an asset management system, e.g. certified ISO 55001	Y/N	All Telecom / ICT companies	Site	Material efficiency	The company has a global and integrated asset management system e.g. certified ISO 55001	3.1.1
Share of operations with an advanced environmental management system implemented, e.g. EMAS verified, ISO 14001 certified	% of facilities/ operations	All Telecom / ICT companies	Site	All	100% of operations implement an advanced environmental management system, e.g. EMAS verified or ISO 14001 certified	3.1.1
Share of operations measuring and monitoring energy use and water consumption as well as waste management	% of facilities/ operations	All Telecom / ICT companies	Site	Energy efficiency, Water, waste	100% of operations measure and monitor their energy use and water consumption as well as waste management	3.1.1
Total carbon emissions for scope 1 and 2	$tCO_2eq.$	All Telecom / ICT companies	Corporate	Emissions	The company has achieved carbon neutrality (scope 1 and 2), including through the use of renewable energy and carbon compensation ,	3.1.1

17 EMAS core indicators are listed in Annex IV to Regulation (EC) No 1221/2009 (Section C.2).

18 The numbers refer to the sections in this document.

Indicator	Common units	Main target group	Recommended minimum level of monitoring	Related EMAS core indicator[17]	Benchmark of excellence	Related BEMP[18]
					after having pursued all efforts to improve energy efficiency	
Share of products or services purchased by the company complying with specific environmental criteria (e.g. EU Ecolabel, top class energy label, Energy Star, TCO-certified etc.)	%	All Telecom / ICT companies	Corporate	All	All ICT equipment purchased by the company is ISO Type I eco-labelled (e.g. EU Ecolabel, Blue Angel) (if available), Energy Star, or EU Green Public Procurement criteria (if available) are applied in its procurement.	3.1.2
Share of equipment purchased by the company complying with internationally recognized best practices or requirements (e.g. EU Codes of Conduct)	%	All Telecom / ICT companies	Corporate	Energy efficiency	All broadband equipment purchased by the company meets the criteria in the EU Code of Conduct on broadband equipment	3.1.2
Share of packaging purchased by the company made from recycled materials or awarded the Forest Stewardship Council label	%	All Telecom / ICT companies	Corporate	Material efficiency, Biodiversity	100% of packaging purchased by the company is made from recycled material or was awarded the Forest Stewardship Council label	3.1.2
Share of the weight given to environmental criteria in calls for tenders	%	All Telecom / ICT companies	Corporate	All	10% of the bid weighting is dedicated to environmental performance when purchasing ICT equipment	3.1.2
Share of ICT products and services provided by the company to customers for which environmental information is available to end users	%	All Telecom / ICT companies	Corporate	All	100% of products and services provided by the company has related environmental information available to end users	3.1.2

Indicator	Common units	Main target group	Recommended minimum level of monitoring	Related EMAS core indicator[17]	Benchmark of excellence	Related BEMP[18]
Use of total cost of ownership as criterion in call for tenders	(Y/N)	All Telecom / ICT companies	Corporate	Material efficiency, Energy efficiency	Use of total cost of ownership as criterion in call for tenders	3.1.2
Share of end-user ICT devices having been configured on installation at optimal power management	%	All Telecom / ICT companies	Site	Energy efficiency	All end-user ICT devices are configured on installation at optimal power management	3.1.3
Share of end-user ICT devices audited on power management at an appropriate frequency (e.g. yearly, only once during the lifetime of the product etc.)	%	All Telecom / ICT companies	Site	Energy efficiency	All end-user ICT devices have been audited on power management at least once during their lifetime	3.1.3
Share of staff trained at least once on energy savings	%	All Telecom / ICT companies	Site	Energy efficiency	All staff has been trained at least once on energy savings	3.1.3
Share of renewable electricity purchased (with Guarantees of Origin) out of the total electricity use Share of renewable electricity produced on site out of the total electricity use	%	All Telecom / ICT companies	Corporate	Energy efficiency	100% of electricity used is from renewable energy sources (either purchased or produced on-site)	3.1.4
Share of facilities or sites with a certified zero waste management system or with a certified asset	%	All Telecom / ICT companies	Site	Waste Material	100% of facilities have a certified zero waste management system or a certified asset management system	3.1.5

Indicator	Common units	Main target group	Recommended minimum level of monitoring	Related EMAS core indicator[17]	Benchmark of excellence	Related BEMP[18]
management system (% of facilities/sites)				efficiency		
Share of ICT waste generated from own operations recovered for reuse or refurbishment or sent for recycling	%	All Telecom / ICT companies	Site	Waste Material efficiency	90% of own ICT equipment recovered for reuse or refurbishment or sent for recycling	3.1.5
Share of WEEE or ICT waste generated from clients recovered for reuse or refurbishment, or sent for recycling	%	All Telecom / ICT companies	Site	Waste Material efficiency	30% of ICT equipment from clients taken back and recovered for reuse or refurbishment or sent for recycling (for ICT companies providing equipment to customers)	3.1.5
Amount of ICT waste sent to landfill	t/year	All Telecom / ICT companies	Site	Waste	Zero ICT waste sent to landfill	3.1.5
Share of sites that have implemented the best practices of the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding the development and deployment of new IT services	%	All Telecom / ICT companies	Site	Energy efficiency	All data centres have implemented the best practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected practices of CLC/TR 50600-99-1 regarding the development and deployment of new IT services.	3.1.6
Share of software developers (staff) trained on energy efficient software	%	All Telecom / ICT companies	Corporate	Energy efficiency	All staff (software developers) trained on energy efficient software.	3.1.6
Share of newly developed software for which the energy performance has	%	All Telecom / ICT	Corporate	Energy	At least one project for minimising data traffic demand through green software was	3.1.6

Indicator	Common units	Main target group	Recommended minimum level of monitoring	Related EMAS core indicator[17]	Benchmark of excellence	Related BEMP[18]
been used as a development criterion (%);		companies		efficiency	implemented during the year	
Data centres BEMPs						
KPI_{DCEM} Global KPI for Data Centre according to ETSI standard		Data centre operators	Site	Energy efficiency	The KPI_{DCP} for existing data centres is equal to or lower than 1,5	3.2.1
Share of facilities having an energy management system certified according ISO 50001 or integrated in EMAS, or complying with the EU Code of Conduct on Data Centre Energy Efficiency or the "expected practices" of CLC/TR 50600-99-1	%	Data centre operators	Site	Energy efficiency	All data centres have an energy management system certified according to ISO 50001 or integrated in EMAS, or complying with the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the "expected practices" of CLC/TR 50600-99-1	3.2.1
Share of data centres that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding **data management and storage,** and **management of existing ICT equipment and services**	%	Data centre operators	Site	Energy Efficiency	All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected practices of CLC/TR 50600-99-1 regarding **data management and storage,** and **management of existing ICT equipment and services**	3.2.2
Share of racks installed with hot aisle/cold aisle configuration (with containment)	%	Data centre operators	Site	Energy Efficiency	100% of new racks are installed with hot aisle/cold aisle configuration (with containment)	3.2.3

Indicator	Common units	Main target group	Recommended minimum level of monitoring	Related EMAS core indicator[17]	Benchmark of excellence	Related BEMP[18]
Share of data centres that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding **airflow management and design**	%	Data centre operators	Site	Energy Efficiency	All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected practices of CLC/TR 50600-99-1 regarding **airflow management and design,** and installation of ICT equipment to optimise airflow management	3.2.3
COP (coefficient of performance): average cooling load (kW) / average cooling system power (kW)	-	Data centre operators	Site	Energy Efficiency	Select equipment with a COP of 7 or higher for water chillers, and 4 or higher for Direct Expansion (DX) cooling systems	3.2.4, 3.3.1, 3.5.3
Share of data centres that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency (parts 5.2, 5.4 and 5.5) or the Expected Practices of CLC/TR 50600-99-1 regarding **cooling management**	%	Data centre operators	Site	Energy Efficiency	All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency (parts 5.2, 5.4 and 5.5) or the expected practices of CLC/TR 50600-99-1 regarding **cooling management**	3.2.4
Share of data centres that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding **temperature and humidity settings**	%	Data centre operators	Site	Energy Efficiency	All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected practices of CLC/TR 50600-99-1 regarding **temperature and humidity settings**	3.2.5

Indicator	Common units	Main target group	Recommended minimum level of monitoring	Related EMAS core indicator[17]	Benchmark of excellence	Related BEMP[18]
Design PUE (dPUE)	-	Data centre operators	Site	Energy Efficiency	-	3.2.6.1, 3.4.1
Share of ICT products or services purchased by the company complying with specific environmental criteria (e.g. EU Ecolabel, EnergyStar)	%	Data centre operators	Site	Energy Efficiency Material Efficiency	All new Data Centre ICT equipment is ISO Type I eco-labelled (e.g. EU Ecolabel, Blue Angel, etc.) (if available) or Energy Star labelled	3.2.7.1
Share of facilities that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding the **selection and deployment of new IT equipment / power equipment / cooling equipment**	%	Data centre operators	Site	Energy Efficiency	All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding the **selection and deployment of new ICT equipment / of cooling system / of new power equipment / of other data centre equipment.**	3.2.6.1
Average energy efficiency of UPS (given by manufacturers)	-	Data centre operators	Site	Energy Efficiency	UPS meet the requirements of the Code of Conduct for UPS	3.2.6.1
Share of sites that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/FprTR 50600-99-1 regarding **Utilisation, management and planning of new build or**	%	Data centre operators	Site	Material Efficiency, Energy Efficiency	All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected practices of CLC/TR 50600-99-1 regarding **utilisation, management and planning of new build and refurbishment of data centres**	3.2.7.1

Indicator	Common units	Main target group	Recommended minimum level of monitoring	Related EMAS core indicator[17]	Benchmark of excellence	Related BEMP[18]
refurbishment of data centres						
Share of sites that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding **reuse of data centre waste heat**	%	Data centre operators	Site	Energy Efficiency	All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding **reuse of data centre waste heat**	3.2.7.2
Share of sites that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding **data centre building physical layout**	%	Data centre operators	Site	Energy Efficiency	All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected practices of CLC/TR 50600-99-1 regarding **data centre building physical layout**	3.2.7.3
Share of sites that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding **data centre geographical location**	%	Data centre operators	Site	Energy Efficiency	All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected and optional practices of CLC/TR 50600-99-1 regarding **data centre geographical location**	3.2.7.4
Water consumption of the data centre per floor area (m3 consumed /m² of data centre)		Data centre operators	Site	Water	-	3.2.7.5

Indicator	Common units	Main target group	Recommended minimum level of monitoring	Related EMAS core indicator[17]	Benchmark of excellence	Related BEMP[18]
Share of sites that have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the Expected Practices of CLC/TR 50600-99-1 regarding **water sources**	%	Data centre operators	Site	Water	All data centres have implemented the expected minimum practices in the EU Code of Conduct on Data Centre Energy Efficiency or the expected practices of CLC/TR 50600-99-1 regarding **water sources**	3.2.7.5
Electronic communication networks BEMPs						
Share of network energy usage for which energy consumption is measured	%	Network operators	Site	Energy Efficiency	50% of the network energy usage is real-time monitored at telecommunication sites level (base stations and /or fixed-network nodes), or above	3.3.1
Average energy consumption per customer or subscriber (*NB* This indicator is not suited to benchmark between different types of operators)	kWh / customer or subscriber	Network operators	Site	Energy Efficiency	An energy management system is in place for telecommunication networks	3.3.1
Percentage of sites assessed by measurement for compliance with EMF limits	%	Network operators	Site	Emissions	-	3.3.2
Percentage of broadband equipment meeting the Broadband Code of Conduct requirements in terms of energy consumption	%	Network operators	Site	Energy Efficiency	100% of new installed broadband equipment meets the requirements of the EU Code of Conduct for broadband equipment in terms of energy consumption	3.3.3

Indicator	Common units	Main target group	Recommended minimum level of monitoring	Related EMAS core indicator[17]	Benchmark of excellence	Related BEMP[18]
Average UPS System Efficiency	%	Network operators	Site	Energy Efficiency	Energy efficiency of power/energy stations is 96% or higher	3.3.3
Quantity of unused or inefficient equipment decommissioned and removed from base station sites each year	kg	Network operators	Site	Material efficiency Energy Efficiency	A plan and a management process for optimising all existing network sites have been defined (to remove unused and inefficient equipment, to properly configure cooling systems, etc.)	3.3.4
Percentage of sites passive sharing	%	Network operators	Site	Material efficiency	At least 30% of sites are shared with other operators (wherever feasible, e.g. legally)	3.3.5
Greening by ICT BEMPs						
GHG emissions based on the Greenhouse Gas Protocol, scope 3 emissions	tCO_2eq	All Telecom / ICT companies	Corporate	Emissions	N/A	3.4.1