BLUE ANGEL

The German Ecolabel

Energy Efficient Data Center Operation

DE-UZ 161

Basic Award Criteria

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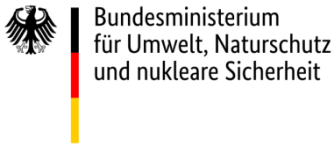
Version 2

The environmental label is underpinned by the following institutions:



The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit) is the owner of the label. It regularly provides information on the decisions taken by the Environmental Label Jury.

The Federal Environmental Agency (Umweltbundesamt) in the specialist department "Ecodesign, Eco-Labelling and Environmentally friendly Procurement" acts as the office of the Environmental Label Jury and develops the specialist criteria in the form of the Basic Award Criteria for the Blue Angel environmental labels.

The Environmental Label Jury is the independent, decision-making body for the Blue Angel and includes representatives from environmental and consumer associations, trade unions, industry, the trade, crafts, local authorities, academia, the media, churches, young people and the German federal states.

RAL gGmbH is the awarding body for the environmental label. It organises the process for developing the relevant award criteria in independent, expert hearings – which involve all relevant interest groups.

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This document is a translation of a German original. In case of dispute, the original document should be taken as authoritative.

1 Introduction

1.1 Preface

In cooperation with the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the Federal Environmental Agency and considering the results of the expert hearings conducted by RAL gGmbH, the Environmental Label Jury has set up these Basic Criteria for the Award of the Environmental Label. RAL gGmbH has been tasked with awarding the Environmental Label.
Upon application to RAL gGmbH and on the basis of a Contract on the Use of the Environmental Label to be concluded with RAL gGmbH, the permission to use the Environmental Label may be granted to all products, provided that they comply with the requirements as specified hereinafter.
The product must comply with all the legal requirements in the country in which it is to be marketed. The applicant shall declare that the product meets these conditions.

1.2 Background

As part of the digitalisation process, there will be a considerable expansion in data center capacities. A study carried out on behalf of the German Federal Ministry for Economic Affairs and Energy (BMWi)[1] forecasts that data centers will account for the largest single share of ICT-related electricity consumption in Germany in 2025 (16.4 TWh out of a total of 46 TWh). In order to operate these data centers, it will require the equivalent amount of energy generated by around four coal-fired power plants.[2]
At the same time, there is huge potential in data centers for avoiding energy losses in the supply of energy, designing more energy efficient air conditioning and better utilising the existing information technology. In the context of these optimisation measures, the Blue Angel ecolabel for data centers provides data center operators with guidance on how to better exploit the enormous potential for energy and cost savings.

1.3 Objectives of the environmental label

The Blue Angel ecolabel for "Energy Efficient Data Center Operation" (DE-UZ-161) utilises an interdisciplinary approach covering all areas of a data center and its infrastructure. This system-based approach not only focuses on the energy efficiency of individual components but, in particular, also on the overall environmentally-conscious management of the data center. This includes the competent planning of the data center with the goal of achieving the best possible utilisation of existing information technology and ensuring the durability of the hardware with the aim of reducing the consumption of resources.
In concrete terms, this means that the existing potential for efficiency in the data center has been fully exploited and thus the existing hardware resources are being optimally utilised and also that ambitious environmental criteria are observed when making new investments. The objective of the environmental label is also to provide operators with more transparency about the hardware resources used so that they can respond in an efficient manner to changes in the framework conditions at an early stage.

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[1] IZM, Borderstep on behalf of the BMWi: Development of ICT-related electricity consumption in Germany, 2015

[2] Basis for calculation: Coal-fired power plant with 800 MW electrical output, annual production of around 4 TWh

The environmental label for energy efficient data center operation can be awarded to those data centers in which the operators have made special efforts to:

- operate their data centers in an energy efficient, environmentally friendly and resource-conserving manner
- develop and successfully implement a long-term strategy for increasing the energy and resource efficiency in relation to the IT services required
- The labelling of these data centers provides customers and public or private procurers of data center services with an informative tool that enables them to consciously select energy and resource efficient data center services.

Therefore, the following benefits for the environment and health are stated in the explanatory box:

- energy efficient
- resource-conserving

1.4 Definitions

- **Central Processing Unit (CPU)** – This is the central component of a computer. Important key data for the CPU are the clock speed, width of the data bus, number of processing cores and the number of threads that can be carried out simultaneously.
- **Power Usage Effectiveness (PUE)** – A measure of how efficiently the data center infrastructure uses energy. It describes the ratio of the annual energy demand of the entire data center to the energy demand of the IT equipment.
- **Commissioning of the data center** – The point in time when the data center begins to continuously supply IT services to internal or external customers.
- **Energy Efficiency Ratio (EER)** – This describes the ratio of the annual cooling load for the cooling system to the total electrical energy input into the entire cooling system.
- **Power Distribution Unit (PDU)** – This is the distribution unit within a rack (server and data cabinet) that distributes the low voltage electricity to the individual IT components. In order to enable sophisticated monitoring of energy consumption, so-called "intelligent PDUs" (iPDU) including devices that measure the performance values and energy consumption of the individually connected devices are fitted. The measurement values are transferred to a central monitoring system via a signal bus (e.g. LAN network).
- **Random Access Memory (RAM)** – This is the working memory of a computer or server. It is characterised by quick read and write speeds. RAM is generally provided in the form of volatile semiconductor memory and this characteristic means that it is not suitable for the permanent archiving of data.
- **Server** – This is a computer that is connected to the computer network and provides it with software services. In a data center, servers are generally installed in shared server racks and represent one of the central IT components in the data center.

- **Storage** - This is used for permanently saving large volumes of data. It is generally provided in the form of rotating hard drives (Hard Disk Drive - HDD), tape memory or flash memory (Solid State Disk - SSD).
- **Uninterruptible Power Supply (UPS)** – This is an apparatus within the energy supply system for the data center that increases the reliability of the energy supply. The UPS bridges short-term interruptions to the electricity supply grid using batteries and ensures that the servers and storage systems can be properly shut down in the event of a prolonged power failure.
- **Cooling unit** – A unit that uses energy to periodically vaporise and liquefy a refrigerant held in an enclosed circuit, whereby the vaporisation process reduces the temperature of a medium (air, water) that is used to cool rooms or systems/processes. The refrigerant circuit (primary circuit) is connected to the media flow (secondary circuit) via a heat exchanger. Other names for cooling units are cooling plants, refrigeration units or air conditioning systems.
- **Cooling system** – The sum of all ventilation and air conditioning units used to cool rooms and systems. The systems can contain components such as cooling units, heat exchangers, free coolers, humidifiers and dehumidifiers, pumps, fans, valves, cold accumulators, filters and ducts. The energy efficiency ratio of a cooling system describes the annual cooling load for the cooling system to the total energy input into the system (see Anhang C).

1.5 Information on submitting an application and compliance verification

The requirements for energy efficient data center operation formulated in these Basic Award Criteria are valid at both the time of application and also during the use of the environmental label. Compliance with these requirements must be verified at the time of application before the environmental label is awarded and also during the term of the contract using an "Energy Efficiency Report for final evaluation". The requirements stated in Paragraph 3 are split into the following subparagraphs:

- 3.1 Requirements at the time of application
- 3.2 Requirements during the term of the contract

When submitting an application, all of the compliance verifications stated in Paragraph 3.1 must be provided. The central document for verifying compliance with the requirements at the time of application is the Energy Efficiency Report according to Paragraph 3.1.3, which comprises general information on the data center, the IT and building technology used and the results of the energy and IT monitoring.

This Energy Efficiency Report must be examined and confirmed by an independent auditor. RAL gGmbH, with the support of the Federal Environmental Agency, has approved auditors (see Annex 3) that are authorised to examine the submitted documentation. The approval of the auditors guarantees that the testing of the report is carried out independently and with a high level of professional qualifications.

During the term of the Contract on the Use of the Environmental Label, the data center must be operated in an energy efficient manner and energy efficiency criteria must be taken into account when acquiring new equipment for the air conditioning system or data center. In this context, the requirements stated in Paragraph 3.2 must be observed.
Compliance with the requirements and the results of the monitoring must be documented in an Energy Efficiency Report for final evaluation and submitted to RAL gGmbH before the end of the term of contract by the deadline stated in Paragraph 3.2.3. This final Energy Efficiency Report can be created by the label holder themselves. The report does not require external auditing.

2 Scope

Within the scope of these Basic Award Criteria, a data center is defined as follows:
A data center is capable of securely, permanently and centrally processing large amounts of data over a long period of time. In the process, the data center shall still possess these capabilities even when individual capabilities are not being used e.g. operation over a long period of time. The required capabilities are described in concrete terms below:

a) *Data processing* includes e.g. the collection, transfer, calculation or storage of data.
b) *Secure data processing* is described, in technological terms, as the "minimum level of security" required for a "controlled shutdown of the computers without any loss of data in the event of damage to the supply units".
c) The term *large amount* of processed data is relative to the technical capabilities of current state-of-the-art systems and thus represents a dynamic factor over time.
d) Operation of the data center *permanently over a long period of time* requires measures to control those influences that may have a critical effects beyond a certain period of time such as heat, humidity or dust.

Operators and/or service providers of data centers who have an influence over all areas and systems of a data center that is covered by the requirements specified in these Basic Award Criteria are eligible to apply for the environmental label. The environmental label is awarded to the entire building that houses the data center (including the technical building equipment) that is defined by a fixed location and a unique name or designation. If a company operates multiple data centers[3] that are distributed over a variety of locations and/or operated independently of one another, each one represents a stand-alone data center for which it is necessary to apply for a separate environmental label.

[3] IT system dependencies are not relevant.

3 Requirements

3.1 Requirements at the time of application

Verification of compliance with the requirements stated in Paragraph 3.1 must be submitted at the time of application. The Contract on the Use of the Environmental Label will be issued on this basis.

3.1.1 Building technology and energy provision

3.1.1.1 Power Usage Effectiveness (PUE)

Power Usage Effectiveness (PUE) is a measure of the energy efficiency of the data center's infrastructure. The PUE value must be determined in accordance with the DIN EN 50600-4-2 standard for PUE category 2 (PUE_2, intermediate resolution) or using an equivalent method.
The applicant must specify the Power Usage Effectiveness (PUE) of the data center over a period of twelve months and document this value in the Energy Efficiency Report according to Paragraph 3.1.3. At the time of application, the end of the measurement period for determining the PUE must not be more than three months ago.
Depending on the date on which the data center was commissioned, the Power Usage Effectiveness (PUE) of the data center (see Paragraph 1.4 Definitions) must not exceed the following values:

Table 1: Minimum requirement for Power Usage Effectiveness

Date the data center was commissioned	**PUE**
01/01/2019 or later	PUE ≤ 1.30
Between 01/01/2015 and 31/12/2018	PUE ≤ 1.50
31/12/2014 or earlier	PUE ≤ 1.60

Exemption:

New data centers, which were commissioned less than 15 months ago at the time of the application, are exempt from the requirement that the PUE value must be calculated over a measurement period of twelve months. At the time of application, these data centers must calculate the expected PUE value 12 months after it has been commissioned based on the planning data according to DIN EN 50600 from a qualified specialist planner, in which the calculation of the PUE value reflects the expected status of the data center 12 months after it has been commissioned. These planning results must be documented in the Energy Efficiency Report (see Paragraph 3.1.3).
In the event that the exemption has been utilised for the application, the applicant must submit the measurement values for determining the PUE valve over a period of twelve months in accordance with the measurement rules stated above at the latest 15 months after the data center has been commissioned. The measurement results must verify compliance with the minimum requirements in Table 1.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 to the contract and document the calculation process and the PUE value in the Energy Efficiency Report as Annex 2 to the contract.
In the event that the exemption has been utilised, the applicant shall demonstrate compliance with the requirement for Power Usage Effectiveness (PUE) by submitting the planning data according to DIN EN 50600 as an appendix to the Energy Efficiency Report. The auditor of the Energy Efficiency Report must verify the plausibility of the documentation. In addition, the applicant shall subsequently submit the PUE value based on measurements taken at the latest 15 months after the data center has been commissioned.

3.1.1.2 Energy efficiency of the cooling system

The energy efficiency ratio (EER) of the cooling system (CS) in a data center describes the ratio of the cooling load $Q_{th,DC,a}$ [MWh_{th}/a] in the data center that is handled by the cooling system within one year (12 months) to the total electrical energy input into the entire cooling system $Q_{el,CS,a}$ [MWh_{el}/a].

$$JAZ = \frac{Q_{th,RZ,a}}{Q_{el,KS,a}}$$

In cooling systems that are operated by means of electrically operated compression-type chillers, the EER must be determined using measurements carried out at the required measurement points in accordance with Anhang C Determining the key values for the cooling system.
Depending on the date on which the cooling system was commissioned, the EER calculated in this way must not exceed the values stated in the following table:

Table 2: Minimum requirement for the energy efficiency of the cooling system (EER)

Date the cooling system was commissioned	**EER**
01/01/2019 or later	EER > 8
Between 01/01/2015 and 31/12/2018	EER > 7
31/12/2014 or earlier	EER > 5

Exemption 1:

New data centers, which were commissioned less than 15 months ago at the time of the application, are exempt from the requirement that the EER value must be calculated over a measurement period of twelve months. The expected EER value for these data centers after 12 months must be calculated as follows:

- Either based on planning data from a qualified specialist planner, in which the calculation of the EER value reflects the expected status of the data center 12 months after it has been commissioned.
- Or on the basis of a load test, where the expected status of the data center after 12 months is simulated using load banks and then used to calculate the annual cooling load for the cooling system and the total electrical energy input into the entire cooling system.

In the event that this exemption is utilised, the planning results or the results of the load test must be documented in the Energy Efficiency Report (see Paragraph 3.1.3). In addition, the applicant must submit the measurement values for calculating the EER valve over a period of

twelve months in accordance with the measurement rules stated above at the latest 15 months after the data center has been commissioned. The measurement results must verify compliance with the minimum requirements in Table 2.

Exemption 2:

In the event that absorption chillers are used, the EER value does not need to be calculated as described above. Instead, the specific greenhouse gas emissions [kg_{CO2e}/kWh_{th}] associated with the cooling output must be calculated and the value documented in the Energy Efficiency Report. The specific greenhouse gas emissions for the absorption chiller (F_{ATC}) may not exceed the greenhouse gas emissions from electrically operated compression-type chillers (F_{CTC}). In order to determine the specific greenhouse emissions, the calculation guidelines described in Anhang C Determining the key values for the cooling system must be followed.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 to the contract and document the amounts of energy ($Q_{th,DC,a}$ and $Q_{el,CS,a}$) and the energy efficiency ratio (EER) in the Energy Efficiency Report in Annex 2 to the contract.
In the event that Exemption 1 has been utilised, the applicant shall demonstrate compliance with the requirement for the energy efficiency ratio (EER) by submitting the planning data or a measurement report for the load test as an appendix to the Energy Efficiency Report. In addition, the applicant shall subsequently submit the EER value based on measurements taken at the latest 15 months after the data center has been commissioned.
If absorption chillers are installed in the cooling system, the applicant shall calculate the specific greenhouse gas emissions (F_{ATC}) for the cooling output in accordance with Exemption 2 and document this value in an appendix to the Energy Efficiency Report (Annex 2).
If one of the exemptions has been utilised, the auditor of the Energy Efficiency Report must verify the plausibility of the calculations.

3.1.1.3 Refrigerant

Only chlorine-free refrigerants may be used in the cooling system for cooling the data center.
In those cooling systems that were placed into operation after the 1 January 2013, only halogen-free refrigerants may be used.

Exemption:
An exemption is made for cooling units with a maximum cooling performance of 10 kWth used for cooling battery rooms that are designed as separate ambient spaces in accordance with DIN-EN-50600-99-1. The use of refrigerants containing halogens must be justified in these cases.

Compliance verification

The applicant shall declare compliance with the requirements in Annex 1 to the contract and name the refrigerant and the quantity of refrigerant used in the Energy Efficiency Report (Annex 2).

3.1.1.4 Electrical energy

The data center must cover 100% of its electricity demand from renewable energies such as hydroelectric power, photovoltaic power, wind power or biomass power. Alternatively, electricity from decentralised combined heat and power plants can also be used.

Exemption:

Applicants that are themselves not contractual partners of an electricity supplier but rather receive their electricity via a third party (e.g. the operator of an administration building or a superordinate administrative unit of an authority or company) are exempt from this requirement. This exemption is only valid if the electricity used in the data center accounts for less than half of the total electricity supplied via the relevant electricity supply contract.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 to the contract and submit the electricity labelling data in accordance with Article 42 of the German Energy Act (Energiewirtschaftsgesetz) as Annex 5 to the contract that provides information on at least the CO_2 emissions [g/kWh] and the proportion of the electricity mix accounted for by renewable energies (subsidised according to the German Renewable Energies Act (EEG) and non-subsidised renewable energies). A specific verification based on the system used in the German Energy Act can be submitted for the share of the electricity accounted for by the data center's own systems for power generation.
In the event that the exemption has been utilised, the applicant shall demonstrate (for example using electricity bills) who the contractual partner for the electricity supply contact is on the customer side and that the amount of electricity used in the data center represents less than half of the total amount of electricity provided by the electricity supply contract or the company. This information must also to be submitted as Annex 5 to the contract. The auditor of the Energy Efficiency Report must verify the plausibility of the documentation.

3.1.2 Information technology and IT management

3.1.2.1 Creation of an inventory list

The applicant shall submit an inventory list containing all of the IT components installed in the data center. This IT inventory list must include the following IT equipment as a minimum:

- Servers
- External storage systems
- Network equipment

Exemption:

Equipment with a connected electrical rating of less than 10 Watts, of which a maximum of 5 identical pieces of equipment are utilised, do not need to be included in the IT inventory list.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 to the contract and document the IT inventory list in the Energy Efficiency Report as Annex 2a (Servers), 2b (External Storage Systems) and 2c (Network Equipment) to the contract.

3.1.2.2 Monitoring of the IT load

The data center must have a monitoring system for the IT load, which continually records the load average for the servers, storage and external data transmissions.

The following values from the monitoring of the IT load must be documented at least monthly for the past 12 months or, in the case of data centers that were commissioned less than 15 months ago, from the time the data center was commissioned:

- Load average for the CPUs [%]
- Load average for the storage [%]
- Data transmissions for external network connections [Gbit/a]

The calculation of the load average for the CPUs and storage must be carried out in accordance with the method described in Anhang D Calculating the load average of the IT equipment by monitoring at least 90% of the relevant IT equipment (CPUs, storage).

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 to the contract and document the monthly results of the monitoring for the past 12 months based on the time series in Annex 2f (Monitoring of the IT load) and submit these figures together with the Energy Efficiency Report (Annex 2). At the time of application, the end of the documented measurement period must not be more than 3 months ago.

3.1.2.3 Minimum load of the servers

The servers used in the data center must have a CPU load average of at least 20 percent over a period of 12 months.

$$ITEU_{SV} \geq 20\%$$

The value *IT Equipment Utilization for Servers ($ITEU_{SV}$)* must be calculated in accordance with the ISO 30134-5 standard (Information technology – Data centers – Key performance indicators -- Part 5: IT Equipment Utilization for servers (ITEUsv)) or using an equivalent method.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 to the contract and document the CPU load average for the servers in the Energy Efficiency Report.

3.1.3 Energy Efficiency Report at the time of application

An Energy Efficiency Report must be submitted at the time of application that provides information on the current technical status of the data center. In addition, the Energy Efficiency Report must document compliance with all of the requirements that are valid at the time of application according to Paragraphs 3.1.1 and 3.1.2. The information required for the creation of the Energy Efficiency Report is listed in the document template in Annex 2.
The Energy Efficiency Report must be examined by one of the approved auditors (see Paragraph 1.5). The auditor must confirm in the form of an audit report that the information requested in Annex 2 has been provided in full and is highly plausible.

Compliance verification

The applicant shall submit a fully completed Energy Efficiency Report as Annex 2 to the contract. The Energy Efficiency Report can be provided by the applicant either using the document template in Annex 2 to the Basic Award Criteria or in another suitable form, such as a printout from an online tool or a spreadsheet program. However, the report must contain the structure (Paragraph headings) and the information requested in Annex 2 to the Basic Award Criteria.

The applicant shall declare compliance with the requirement in Annex 1 to the Contract and submit an audit report as Annex 4 to the contract from one of the auditors approved in Annex 3 that confirms that the applicant has provided at least the required information in full and with a high level of plausibility.

3.2 Requirements during the term of the contract

The requirements in Paragraph 3.2 refer to the term of the contract and must be complied with by the label holder during the use of the environmental label. The requirements in Paragraph 3.2.1 refer to energy-efficient building technology, while those in Paragraph 3.2.2 refer to the acquisition of new IT components and their management. Verification of compliance with the requirements during the term of the contract must be submitted before the end of the term of the contract in the form of an Energy Efficiency Report according to Paragraph 3.2.3.

3.2.1 Building technology and energy management

3.2.1.1 Monitoring electrical energy

Monitoring must be carried out by the applicant in which measurements of the electrical output and the energy consumption of the important components of the data center are recorded and evaluated continuously throughout the whole year. For this purpose, the measurement points in accordance with Appendix B: Measurement concept, as well as further measurement points for determining the Energy Efficiency Ratio (EER) of the cooling system, must be set up as a minimum and measurements taken on a regular basis.
The following values must be determined through this energy monitoring on at least an annual basis:

- Power Usage Effectiveness (PUE) (see Paragraph 3.1.1.1)
- Energy Efficiency Ratio (EER) of the cooling system (see Paragraph 3.1.1.2)

The following values must be determined through this energy monitoring on at least a monthly basis (see Anhang B Measurement concept):

- Electricity demand of the entire DC (MP_{ESC} + MP_{OSG}) [kWh_{el}]
- Electricity demand of the IT equipment (MP_{IT2}) [kWh_{el}]
- Electricity demand of the cooling system (MP_{CS}) [kWh_{el}]
- Electricity demand of other consumers (MP_{OC}) [kWh_{el}]
- Cooling load of the entire DC [kWh_{th}]

Compliance verification

The holder of the environmental label shall document the results of the energy monitoring in Annex 2e (Energy Monitoring) and submit it together with the Energy Efficiency Report for final evaluation (Annex 2) according to Paragraph 3.2.3 by the stated deadline. The documentation shall include, as a minimum, those values that must be determined on a monthly basis as a time series according to the requirements.

3.2.1.2 Acquisition of new components for the cooling system

If new components are acquired for the cooling system, the energy efficiency ratio (EER) of the cooling system must not be worse (smaller) than the EER at the time of application.
The energy efficiency ratio (EER) of the cooling system must be determined and documented in accordance with the rules defined in Paragraph 3.1.1.2 Energy efficiency of the cooling system.

In the case of newly acquired cooling units, no halogenated hydrocarbons may be used as a refrigerant.

Compliance verification

The holder of the environmental label shall document the newly installed components for the cooling system in the Energy Efficiency Report for final evaluation according to Paragraph 3.2.3 and name the refrigerant, the quantity of refrigerant used and the energy efficiency ratio (EER) of the cooling system in this report.
In the event that the exemptions described in Paragraphs 3.1.1.2 and 3.1.1.3 have been utilised, verification in accordance with the verification requirements in these paragraphs shall be submitted in addition to the Energy Efficiency Report for final evaluation.

3.2.1.3 Acquisition of new Uninterruptible Power Supply (UPS) systems

If new uninterruptible power supply systems are acquired, the following minimum requirements for their efficiency must be fulfilled. In double conversion mode, the efficiency of the uninterruptible power supply must not be lower than:

- 92 % at an electrical output of 100 % of the nominal output
- 95 % at an electrical output of 75 % of the nominal output
- 95 % at an electrical output of 50 % of the nominal output
- 90 % at an electrical output of 25 % of the nominal output

Compliance verification

The holder of the environmental label shall document the newly acquired UPS systems in the Energy Efficiency Report for final evaluation according to Paragraph 3.2.3 and state their efficiency levels in this report.

3.2.1.4 Acquisition of new switching systems

Newly acquired medium-voltage and low-voltage switching systems may not contain the highly potent greenhouse gas sulphur hexafluoride (SF_6) as an insulation medium. SF_6-free switching systems must be acquired.

Compliance verification

The holder of the environmental label shall document the newly acquired switching systems in the Energy Efficiency Report for final evaluation according to Paragraph 3.2.3 and state the insulation medium used in this report.

3.2.2 Information technology and IT management

3.2.2.1 Continued use of the IT inventory list

If new servers, external storage systems, network equipment and intelligent power distribution units (PDUs) are acquired, the holder of the environmental label must continue to use the IT inventory list described under 3.1.2.1 and document the current status at the time the report is submitted.

Compliance verification

The holder of the environmental label shall document the existing IT technology in Annexes 2a (Servers), 2b (External Storage Systems), 2c (Network Equipment) and Annex 2d (Acquisition

of New Intelligent PDUs) and submit these Annexes together with the Energy Efficiency Report for final evaluation (Annex 2) according to Paragraph 3.2.3 by the stated deadline as Annex 2.

3.2.2.2 Monitoring of the IT load

Monitoring must be carried out in which measurements of the IT load of the data center is carried out continuously throughout the whole year.
The following values must be documented on at least a monthly basis by monitoring the IT load:

- Load average for the CPUs [%]
- Load average for the storage [%]
- Data transmissions for external network connections [Gbit/a]

The calculation of the load average for the CPUs and storage must be carried out in accordance with the method described in Anhang D Calculating the load average of the IT equipment by monitoring at least 90% of the relevant IT equipment (CPUs, storage).

Compliance verification

The holder of the environmental label shall document the results of the IT monitoring in Annex 2f (Monitoring of the IT load) and submit it together with the Energy Efficiency Report for final evaluation (Annex 2) according to Paragraph 3.2.3 by the stated deadline. The documentation shall include, as a minimum, those values that must be determined on a monthly basis as a time series according to the requirements.

3.2.2.3 Acquisition of new servers

Power consumption of the servers in an idle state (idle state power, P_{idle})
The power consumption of the newly acquired servers measured by the manufacturer in an idle state ($P_{idle\_measured}$) may not exceed the maximum value for P_{idle} stated in the ecodesign regulation for servers and data storage products[4].

If a server is newly acquired after the ecodesign requirements for servers and data storage products comes into force (planned for 1 March 2020), the value for P_{idle} must be at least 20% lower than the maximum value for P_{idle} stated in the regulation.

Energy efficiency of the servers in an active state (Eff_{active})
Depending on the server type and number of installed processors, the energy efficiency of the servers in an active state (Eff_{active}) must achieve at least the following values:

Table 3: Minimum requirements for the energy efficiency of the server in an active state(Eff_{active})

Server type	**Minimum value Eff_{active}[5]**
1 installed processor	

[4] The regulation laying down the ecodesign requirements for servers and data storage products pursuant to Directive 2009/125/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No. 617/2013 is currently available in draft form: http://ec.europa.eu/transparency/regcomitology/index.cfm?do=search.documentdetail&Dos_ID=16742&ds_id=58881&version=2&page=1&AttLang=de

[5] The minimum values correspond to the Energy Star requirements: Energy Star Program Requirements - Product Specification for Computer Servers - Eligibility Criteria Version 3.0 https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Version%203.0%20Computer%20Servers%20Program%20Requirements.pdf

Server type	Minimum value Eff_{active}[5]
Rack	11
Tower	9.4
Blade or Multi-Node	9
Resilient	4.8
2 installed processors	
Rack	13
Tower	12
Blade or Multi-Node	14
Resilient	5.2
More than 2 installed processors	
Rack	16
Blade or Multi-Node	9.6
Resilient	4.2

Until publication of the ecodesign regulation for servers and data storage products, the energy efficiency value Eff_{active} must be determined using the metric SPEC SERT 2 from the Standard Performance Evaluation Corporation (SPEC).[6] From the date on which the ecodesign regulation for servers and data storage products is published, the metric stated in the regulation must be used.

Exemption:

Deviations from this requirement are permitted in justified cases. Such cases include, for example, server architecture that is not applicable for the SPEC SERT 2 metric or the metric stated in the ecodesign regulation for servers and data storage products or for which the deviating efficiency level has been consciously accepted. These servers must also be documented in the Energy Efficiency Report and the deviation from the requirement justified.

Compliance verification

The holder of the environmental label shall document the newly acquired servers and state the manufacturer, model, nominal power output and total energy efficiency (Eff_{active}) of the servers in the IT inventory list (see Paragraph 3.2.2.1).
In the event that the exemption has been utilised, the applicant shall provide justification for why the server is exempt from this requirement in the Energy Efficiency Report for final evaluation according to Paragraph 3.2.3.

3.2.2.4 Acquisition of new energy efficient external power supplies

Newly acquired external power supplies and external power supplies built into newly acquired servers must fulfil at least the energy efficiency requirements in the 80 PLUS PLATINUM[7] energy efficiency standard.

[6] SPEC SERT 2, https://www.spec.org/sert2/
[7] 80 PLUS Certified Power Supplies; http://www.plugloadsolutions.com/80PlusPowerSupplies.aspx

Compliance verification

The holder of the environmental label shall document the newly acquired external power supplies and state the manufacturer, model, nominal power output and total energy efficiency standard of the external power supplies in the IT inventory list (see Paragraph 3.2.2.1).

3.2.2.5 Acquisition of new intelligent power distribution units (PDUs)

The power losses from newly acquired intelligent power distribution units (PDUs, see Paragraph 1.4 Definitions) must not be greater than 0.5 W per available power outlet (power socket or connection terminal).

Compliance verification

The holder of the environmental label shall document the newly acquired intelligent PDUs and state the manufacturer, model, number of available power outlets and power losses of the intelligent PDUs in the IT inventory list (see Paragraph 3.2.2.1).
The measurement of the power losses must be carried out in accordance with DIN EN 50564 or IEC 62301 and can be carried out on individual PDUs and then extrapolated for the total number of units. The power outlets on the PDUs must be activated for the measurements, meaning all relays or switching equipment that may exist must be active.

3.2.2.6 Taking into account life cycle costs when making acquisitions

The applicant obligates themselves to carry out a calculation of the life cycle costs for the planned period of use (e.g. investment costs, maintenance and energy costs, disposal costs) when acquiring new equipment and systems and to take this into account when evaluating quotations.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 to the contract.

3.2.3 Energy Efficiency Report for final evaluation

The holder of the environmental label must submit an Energy Efficiency Report at the latest 6 months before the end of the agreed term of contract in which compliance with the requirements during the term of the contract is documented. The reporting period must cover a period from the beginning of the term of contract through to at least 9 months before the end of the term of contract.
The Energy Efficiency Report for final evaluation primarily consists of information that was collected in the previous Paragraphs 3.2.1 and 3.2.2 during the term of the contract (results of the monitoring, documentation for newly acquired building technology, updated IT inventory list).
If the holder of the environmental label does not fulfil his/her obligation to submit an Energy Efficiency Report for final evaluation or the report shows that the requirements placed on the data center or the operation of the data center have not been complied with, this represents an infringement of the Contract on the Use of the Environmental Label (see Paragraph 5) and can be sanctioned by RAL gGmbH with the removal of permission to use the environmental label. It is only possible to award the environmental label again if the Efficiency Report for final evaluation has been submitted.

Exemption:

If the end of the reporting period for the Energy Efficiency Report at the time of application according to Paragraph 3.1.3 was less than 12 months ago at the deadline for submitting this report (6 months before the end of the term of the contract), it is not necessary to submit the Efficiency Report for final evaluation.

Compliance verification

The holder of the environmental label shall submit an Energy Efficiency Report and an updated IT inventory list – according to Annexes 2a (Servers), 2b (External Storage Systems), 2c (Network Equipment), Annex 2d (Acquisition of New Intelligent PDUs), Annex 2e (Energy Monitoring) and Annex 2f (Monitoring of the IT Load) – at the latest 6 months before the end of the term of the contract.

4 Applicants and parties involved

Operators of data centers or providers of data center services according to Paragraph 2 shall be eligible for application.

Parties involved in the award process are:

- RAL gGmbH to award the Blue Angel environmental label,
- the federal state being home to the applicant's production site,
- Umweltbundesamt, (Federal Environmental Agency) which after the signing of the contract receives all data and documents submitted in application for the Blue Angel in order to be able to further develop the Basic Award Criteria.

5 Use of the Environmental Label

The use of the environmental label by the applicant is governed by a contract on the use of the environmental label concluded with RAL gGmbH.

Within the scope of such contract, the applicant undertakes to comply with the requirements under Paragraph 3 while using the environmental label.

Contracts on the Use of the Environmental Label are concluded to fix the terms for the certification of data centers according to Paragraph 2. Such contracts shall run until 31/12/2023. They shall be extended by periods of one year each, unless terminated in writing by 31/03/2023 or 31 March of the respective year of extension.
After the expiry of the contract, the Environmental Label may neither be used for labelling nor for advertising purposes. This regulation shall not affect products being still in the market.

The applicant shall be entitled to apply to RAL gGmbH for an extension of the right to use the ecolabel on the product entitled to the label if it is to be marketed under another brand/trade name and/or other marketing organizations.

The Contract on the Use of the Environmental Label shall specify:

- Applicant (Owner/Operator of the data center)
- Brand/trade name, product description

- Location, detailed description of the data center

Anhang A Quoted laws and standards, literature

The observance of relevant existing laws and legal requirements is a prerequisite for those products used in the data center. In particular, the following legal requirements must be observed:

[1] The WEEE Directive (2012/19/EU)[8] implemented in German law in the Electrical and Electronic Equipment Act (ElektroG)[9] that regulates the disposal of products.

[2] The ROHS Directive (2011/65/EU)[10] implemented in German law in the German Material Ordinance for Electrical and Electronic Equipment (ElektroStoffV)[11] that regulates the pollutant content of products.

[3] The External Power Supplies Directive (278/2009/EC)[12] that regulates the ecodesign requirements for external power supplies.

[4] The F-Gas Regulation (517/2014/EU)[13], which regulates the gradual phasing out of the use of partly fluorinated hydrocarbons (HFC).

[5] The ecodesign regulation for cooling systems and heat pumps (2281/2016/EU)[14]

[6] The ecodesign regulation for servers and data storage systems[15]

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[8] Directive 2012/19/EU on waste electrical and electronic equipment (new version); WEEE Directive

[9] Law for the sale, return and environmental disposal of electrical and electronic equipment, Electrical and Electronic Appliance Act from 20 October 2015 (BGBl. I P. 1739); ElektroG

[10] Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (new version); ROHS Directive

[11] Ordinance to limit the use of hazardous substances in electrical and electronic equipment (Material Ordinance for Electrical and Electronic Equipment); ElektroStoffV

[12] Regulation (EC) No. 278/2009 implementing directive 2009/125/EC (previously: 2005/32/EC) with regard to ecodesign requirements for no-load condition electric power consumption and average active efficiency of external power supplies; External Power Supplies Directive

[13] Regulation (EU) 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006, F-Gas Regulation

[14] Commission Regulation (EC) No. 2016/2281 of 30 November 2016 implementing Directive 2009/125/EC of the European Parliament and of the Council establishing a framework for the setting of ecodesign requirements for energy-related products, with regard to ecodesign requirements for air heating products, cooling products, high temperature process chillers and fan coil units

[15] Currently available in draft form: http://ec.europa.eu/transparency/regcomitology/index.cfm?do=search.documentdetail&Dos_ID=16742&ds_id=58881&version=2&page=1&AttLang=de

Anhang B Measurement concept

The installation of measurement technology creates the prerequisites for the continuous measurement of the electrical output and energy consumption of the most important components of the data center. This requires the implementation of a measurement concept comprising at least the following measurement points. In this process, the individual measurement points can be realised using multiple measurement locations or reference measurements that enable the relevant measurement results to be calculated.

- MP_{ESC}: Measurement point for the electricity supply company: electrical power and electrical work for supplying the data center by the electricity supply company (ESC)
- MP_{OSG}: Measurement point for own systems of power generation: electrical power and electrical work of the data center's own systems for power generation (if available)
- MP_{CS}: Measurement point for the cooling system: electrical power and electrical work for the cooling system (cooling plants, free cooling / heat exchanger, humidifier/dehumidifier, pumps and valves)
- MP_{UPS}: Measurement point for UPS: electrical power and electrical work input into the uninterruptible power supply
- MP_{IT1}: Measurement point for IT 1: electrical power and electrical work output from the uninterruptible power supply
- MP_{IT2}: Measurement point for IT 2: electrical power and electrical work for supplying the ICT system
- MP_{OC}: Measurement point for energy consumers: electrical power and electrical work for the other energy consumers (e.g. measurement, management and control technology, lighting, small consumers, fire and hazard protection equipment)

The following schematic diagram shows the arrangement of the measurement points:

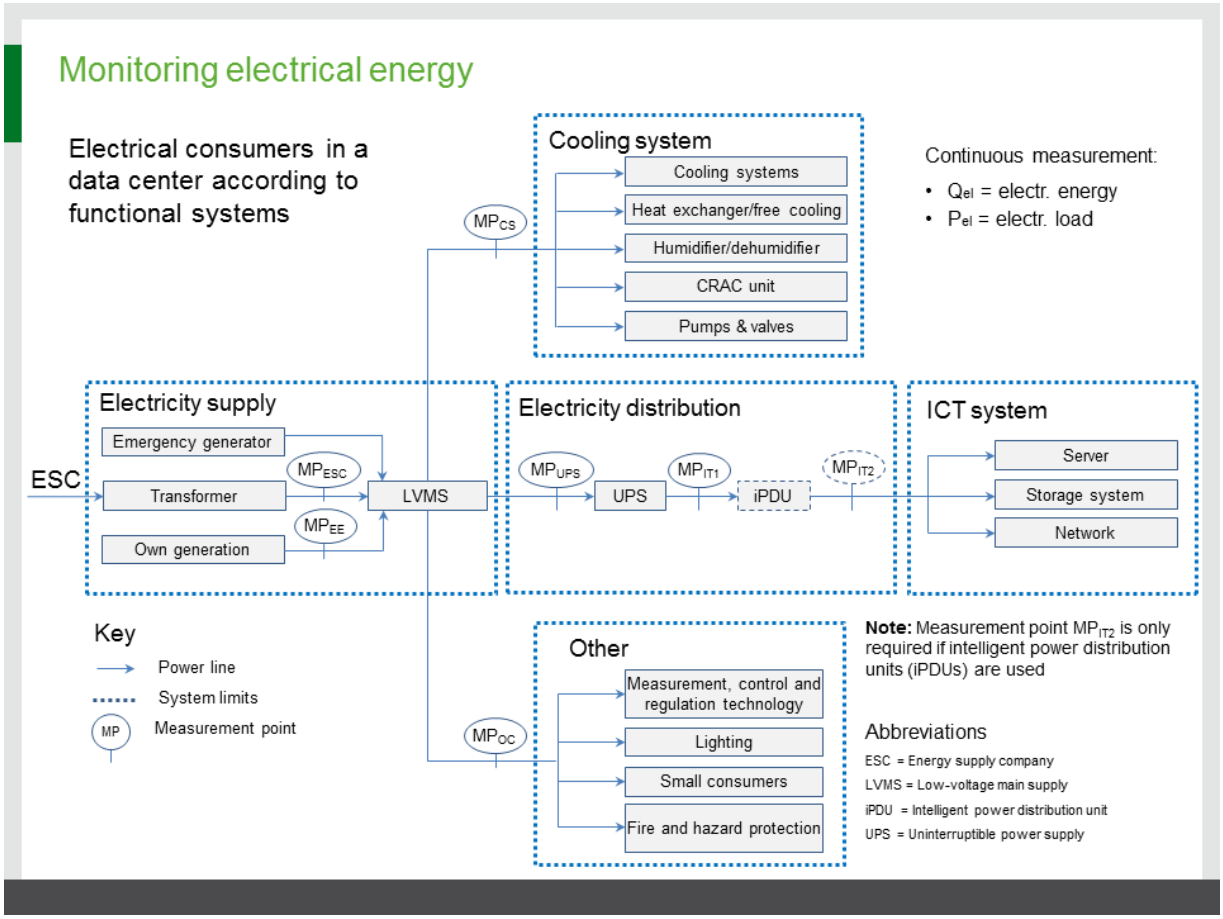

Figure 1: Measurement of the main components of a data center

Anhang C Determining the key values for the cooling system

1 Determining the energy efficiency ratio (EER)

The energy efficiency ratio (EER) of the cooling system in a data center describes the ratio of the cooling load in the data center that is handled by the cooling system within one year (12 months) to the total electrical energy input into the entire cooling system.
The annual cooling load for the cooling system ($Q_{th,RZ,a}$, [kWh/a]) is determined in accordance with VDI Guideline 2078 as the sum of all electrical losses in the rooms being cooled.
The total electrical energy supplied to the entire cooling system ($Q_{el,KS,a}$, [kWh/a]) per year is determined in accordance with the DIN V 18599 standard from the electrical energy input into all of the components in the entire cooling system (i.e. also including the operating power for fans, pumps, re-cooling systems or absorption chillers).
Both energy values must be determined through measurements in accordance with the measurement concept in Figure 1 and presented for a period of 12 months.

$$Q_{el,CS,a} = MP_{CS}$$

The energy efficiency ratio (EER) is then calculated as follows:

$$JAZ = \frac{Q_{th,RZ,a}}{Q_{el,KS,a}}$$

2 Determining the specific greenhouse gas emissions of absorption chillers

In the event that absorption chillers are utilised, the specific greenhouse gas emissions for the cooling output (F_{ATC}) must be calculated and documented annually.

The following calculation steps must be carried out:

- Calculation of the thermal Energy Efficiency Ratio for a cooling system with an absorption chiller (EER_{th}):

$$JAZ_{th} = \frac{Q_{th,RZ,a}}{Q_{th,Input\_KS,a}}$$

- Calculation of the electrical energy efficiency ratio for a cooling system with an absorption chiller (EER_{el}):

$$JAZ_{el} = \frac{Q_{th,RZ,a}}{Q_{el,KS,a}}$$

- Calculation of the specific greenhouse gas emissions for the cooling supply:

$$F_{SKM} = \frac{Q_{el,KS,a} \times F_{el} + Q_{th,Input\_KS,a} \times F_{th}}{Q_{th,RZ,a}} = \frac{F_{el}}{JAZ_{el}} + \frac{F_{th}}{JAZ_{th}}$$

[kg_{CO2e}/kWh_{th}]

Using the emissions factor for electricity from the German electricity mix (F_{el}) in 2016[16]:

F_{el} = 0.516 kg_{CO2e}/kWh_{el}

As an alternative to this value, the currently valid emission factors for the relevant electricity can be used. The calculation also includes the emission factor for thermal energy (F_{th}) based on the energy source used. The source of the relevant emission factor must be documented for the calculation. In the following table, some energy sources are shown as examples:

Table 4: Emission factor for thermal energy(F_{th}) based on the energy source used

Energy source	**F_{th}**
Heating oil HH/GHD	0.319 kg_{CO2e}/kWh_{th}
Natural gas HH/GHD	0.250 kg_{CO2e}/kWh_{th}
Liquefied gas HH/GHD	0.277 kg_{CO2e}/kWh_{th}
Wood pellets	0.027 kg_{CO2e}/kWh_{th}
Wood chips	0.019 kg_{CO2e}/kWh_{th}

Examples for emission factors, source GEMIS 4.95[17]

For comparison with the cooling supply from a cooling system with electrically operated compression-type chillers, it is necessary to also calculate the specific greenhouse gas emissions with alternative compression-type chillers as follows:

$$F_{KKM} = \frac{F_{el}}{JAZ_{el\_KKM}} \times 1{,}1$$

[kg_{CO2e}/kWh_{th}]

The minimum requirements from the Basic Award Criteria (Paragraph 3.1.1.2) must also be applied for the energy efficiency ratio for cooling systems with compression-type chillers (EER_{el_CTC}).
The factor 1.1 within the formula for calculating the specific greenhouse gas emissions for cooling systems with compression-type chillers (F_{CTC}) takes into account the impact on the climate caused by direct refrigerant emissions from the compression-type chillers.

[16] Data source: UBA 2018, Development of the specific carbon monoxide emissions from the German electricity mix in the years 1990 to 2017, Internet: https://www.umweltbundesamt.de/publikationen/entwicklung-der-spezifischen-kohlendioxid-4

[17] Data source: IINAS GmbH, GEMIS 4.95, April 2017, Scenario for heating and process heat systems, end-energy-based 2010 [kWh], Internet: http://iinas.org/tl_files/iinas/downloads/GEMIS/2017_GEMIS-Ergebnisse-Auszug.xlsx

In order to verify that the specific greenhouse gas emissions for the absorption chiller do not exceed the greenhouse gas emissions for the electrically operated compression-type chiller, the following conditions must be fulfilled:

$$F_{SKM} \leq F_{KKM} \quad [kg_{CO2e}/kWh_{th}]$$

The value for F_{ATC} must be documented in an annual time series. The comparative value F_{CTC} must be given in each case.

Anhang D Calculating the load average of the IT equipment

For the monitoring of the IT load, the load average for the physical CPUs integrated into the physical servers and the storage must be calculated and documented in the Energy Efficiency Report.
The methods for determining the load average are based on the Federal Environment Agency research report "Kennzahlen und Indikatoren für die Beurteilung der Ressourceneffizienz von Rechenzentren und Prüfung der praktischen Anwendbarkeit" (Key figures and indicators for assessing the resource efficiency of data centers and examining their practical application)[18].

1 Load average for the CPUs

The load average for CPUs is calculated in accordance with the ISO 30134-5 standard (Information technology – Data centers – Key performance indicators – Part 5: IT Equipment Utilization for servers (ITEUsv)) or an equivalent method.
The arithmetic mean of the individual loads for all servers used during the measurement period is calculated here as follows:

$$ITEU_{SV} = \frac{\sum_{i=1}^{N} CUS_i(t)}{N}$$

where:

- $ITEU_{SV}(t)$: Load average for all servers in a DC at time t
- N: Number of servers in a DC or in a group used at time t
- $CUS_i(t)$: CPU load average of server I at time t in percent

If a server has a multi-core processor, $CUS_i(t)$ corresponds to the load average on each individual core. If a server has multiple CPUs, $CUS_i(t)$ corresponds to the load average on each individual CPU.
The measurement period for determining the load average of the CPUs must cover one month and be presented for at least twelve months as a yearly gradient.
In order to ensure that the load average for the CPUs in the data center is determined with sufficient accuracy, at least 90% of all of the CPUs installed in the servers in the data center must be monitored and included in the calculations.

2 Load average for the storage

Storage that must be covered by the monitoring include flash-based storage systems (SSD) and storage systems with rotating hard drives (HDD). Other storage systems (e.g. magnetic tape systems) do not need to be monitored for the calculation of the load average for the storage.
Using the utilised storage space as a measurement unit, it is possible to make a statement about the volume of data stored at the data center by users.

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[18] Schödwell, B.; Zarnekow, R.; Liu, R.; Gröger, J.; Wilkens, M.; Kennzahlen und Indikatoren für die Beurteilung der Ressourceneffizienz von Rechenzentren und Prüfung der praktischen Anwendbarkeit (Key figures and indicators for assessing the resource efficiency of data centers and examining their practical application), https://www.umweltbundesamt.de/publikationen/kennzahlen-indikatoren-fuer-die-beurteilung-der

The load average for the storage is determined using the utilised storage capacity expressed as a ratio of the installed storage capacity.
The utilised storage space in the data center is calculated as follows:

$$\text{Storage capacity}_{\text{Storage space, utilised}} = \sum_{i=1}^{N} S_{i,\text{Storage space,utilised}}(t)$$

where:

- $\text{Storage capacity}_{\text{Storage space, utilised}}$: Average storage space utilised at the data center over the measurement period (GB)
- $S_{\text{i, Storage space, utilised}}$: Utilised storage space at the data center i (GB)
- N: Number of data storage systems used at time t

The installed storage space is calculated as follows:

$$\text{Storage capacity}_{\text{Storage space, installed}} = \sum_{i=1}^{N} S_{i,\text{Storage space,installed}}(t)$$

where:

- $\text{Storage capacity}_{\text{Storage space, installed}}$: Average storage space installed at the data center over the measurement period (GB)
- $S_{\text{i, Storage space, installed}}$: Installed storage space at the data center i (GB)
- N: Number of data storage systems used at time t

The load average for the storage is calculated on a monthly basis as:

$$\text{Load average for the storage [\%]} = \frac{\text{Storage capacity}_{\text{Storage space,utilised}}}{\text{Storage capacity}_{\text{Storage installed}}}$$

The measurement period for determining the load average for the storage must cover one month and be presented for at least twelve months as a yearly gradient.
In order to ensure that the load average for the storage in the data center is determined with sufficient accuracy, at least 90% of the total capacity of the storage must be monitored and included in the calculations.

3 Data transmissions via the external network connection

Data transmissions via the external network is a measurement for the network activity of the data center. It is determined using the *data transmission capacity of the external network connection*, which is calculated over a defined measurement period.
The data transmission capacity is calculated as follows:

$$\text{Data transmission capacity}_{\text{external}} = \sum_{i=1}^{N} S_{i,Data\,traffic,external}$$

where:

- Data transmission capacity$_{external}$: Data transmission capacity of the external network connection, i.e. the volume of data sent and received externally during the measurement period (Gbit)
- $S_{i,\ Data\ traffic,\ external}$: Volume of data sent and received externally via one individual network device (Gbit)
- N: Number of network devices at the interface to the outside world (productive network)

The measurement period for determining the data transmissions via the external network is one month. The value must be presented both as a monthly value (Gbit/month) and also a yearly value (Gbit/a).