# BLUE ANGEL

## The German Ecolabel

# Data Centers

## DE-UZ 228

## Basic Award Criteria

**Edition January 2023**

**Version 2**

**The Environmental Label is supported by the following four institutions:**

Federal Ministry
for the Environment, Nature Conservation,
Nuclear Safety and Consumer Protection

The Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection is the owner of the label. It regularly provides information on the decisions taken by the Environmental Label Jury.

Umwelt Bundesamt

The German Environmental Agency with its specialist department for "Ecodesign, Eco-Labelling and Environmentally friendly Procurement" acts as office of the Environmental Label Jury and develops the technical criteria of the Basic Criteria for Award of the Blue Angel.

Jury Umweltzeichen

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

The 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.

If you require further information please contact:
RAL gGmbH
**RAL UMWELT**
Fränkische Straße 7
53229 Bonn
Tel: +49 (0) 228 / 6 88 95 - 190
E-Mail: umweltzeichen@ral.de
www.blauer-engel.de

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(04/2025): Editorial changes

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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, Nuclear Safety and Consumer Protection, the German 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 this requirement.

## 1.2 Objectives of the Environmental Label

The Blue Angel environmental label already formulated criteria for environmentally friendly data centers in 2012 in the ecolabel for *"Energy Efficient Data Center Operation"* (DE-UZ-161) and supplemented them with the ecolabel for *"Climate Friendly Colocation Data Centers"* (DE-UZ-214) in 2020. The first ecolabel followed an interdisciplinary approach that covered all areas of a data center, including the technical building equipment and also the information technology (IT). The second ecolabel was specifically targeted at operators of colocation data centers and not only contained requirements for the technical building equipment but also criteria for the customer relationship. The aim was to ensure that customers of colocation data centers were able to operate their IT equipment in an energy efficient and resource-conserving way.

This Blue Angel ecolabel for *"Data Centers"* unifies the two previous ecolabels and explicitly permits colocation models and also other business models. It addresses energy efficient and climate friendly data center operation, as well as resource-conserving IT operation. The Basic Award Criteria indicate who is responsible for complying with each requirement.
Applications for the use of this label can be submitted by data center operators on their own or also by IT operators who operate their information technology in a data center that has already been certified with the Blue Angel. If the data center operator and IT operator are associated with one another according to commercial law, they can only be joint applicants for this ecolabel. As a general rule, applicants are required to comply with all criteria that come under their area of responsibility. For example, an operator of a data center that provides colocation and hosting services on its white space must comply with all of the requirements for these two business models. This means that they must comply with the "requirements for data center operators" for the provision of colocation services and the "requirements for IT operators" for their own IT hardware that is used to provide hosting services. There are also requirements that apply to all applicants.

The environmental label for *"Data Centers"* may be awarded to those data centers:

- whose technical building equipment is operated in a particularly energy efficient and resource-conserving manner,

- whose operators develop and successfully implement a long-term strategy for increasing the energy and resource efficiency of the data center,
- who enable their customers to implement measures to improve energy efficiency
- and who offer guaranteed minimum standards and transparent reporting to create the conditions for IT operators to operate information technology in an energy efficient manner.

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


## 1.3 Definitions

**Colocation** – A service for the provision of space in a data center for customers to set up their own information technology. The data center space provided to the customer is offered with cooling services, a fail-safe power supply, a network connection and security technology as well as empty server racks if required. Another description for colocation is *housing*.

**Colocation data center** – The physical location where the colocation services are provided. A colocation data center is a building space in which infrastructure services and operational support for the customer's own information technology are provided.

**Colocation supplier** – A company that offers colocation as a service. The colocation supplier's area of responsibility covers the purchase of energy and the operation of the entire building infrastructure but not the purchase and operation of the customer's own information technology. The colocation supplier is a possible applicant for this environmental label.

**Commissioning of the data center** – The point in time when the data center begins to continuously supply services (provision of information technology, IT services or colocation services) to internal or external customers.

**Constructed area (CA)** – Defined according to *DIN 277:2021-08 "Areas and volumes in building construction"* as the area of land that has been built over, built under or covered by a structure. It corresponds to the total area of land less the undeveloped area.

**Cooling Efficiency Ratio (CER)** – Describes the ratio of the cooling load handled by the cooling system within one year to the total electrical energy input into the system (see DIN EN 50600-4-7).

**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.

**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.

**Data Center** – Described in DIN EN 50600-1 as a structure, or group of structures, dedicated to the centralized accommodation, interconnection and operation of information technology and network telecommunications equipment providing data storage, processing and transport services together with all the facilities and infrastructures for power distribution and environmental control together with the necessary levels of resilience and security required to provide the desired service availability.

*Note 1 on this term:* A structure can comprise multiple buildings and/or units with certain functions that support the primary function.

*Note 2 on this term:* The boundaries of the structure or unit that is considered to be a data center and which contains the information and communication technology and any additional facilities to control the environmental conditions can be defined within a larger structure or a larger building.

**Data center operator** – The company that operates at least the technical building equipment in a data center and is either the owner of the entire data center or the colocation data center or has comparable usage rights.

**Data center service provider** – The company that operates the date center and leases the white space or IT hardware to data center customers (e.g. to colocation customers, hosting customers).

**Electricity price** – The price per unit of electrical energy (e.g. euros per kilowatt hour) that includes the following price components: the purchase price, service and sales costs, grid usage fees, rental of the electricity meter, taxes, duties and levies. The gross cost of the consumed electricity is calculated by multiplying the electricity price by the amount of electricity consumed.

**Energy Reuse Factor (ERF)** – The ratio of the data center energy that is reused for external uses outside of the data center to the total energy consumed in the data center. The factor can be between zero (no energy is reused) and 1 (all of the energy is reused). All forms of energy are taken into account equally in the calculation (electrical, thermal, chemical and mechanical energy). The additional energy required to prepare (e.g. raising the temperature of the waste heat) or distribute (e.g. pump energy for a district heating system) the recovered energy for an external use is not included in the calculation (see DIN EN 50600-4-6).

**Gross floor area (GFA)** – Defined according to *DIN 277:2021-08 "Areas and volumes in building construction"* as the sum of the floor areas for all horizontal areas of a building across all usable floors.

**Hosting** – A service providing server capacity and storage space in a data center. The hardware remains the property of the data center or IT operator and is leased to the hosting customers be them.

**Information technology (IT)** – This describes all devices that are used for entering, visualizing, processing, storing and transmitting data. In data centers, it includes above all servers, storage devices and network components.

**IT operator** – The company who operates the information technology in a data center. An IT operator can also be the operator of a data center (data center operator or its customer (data center customer).

**Power Usage Effectiveness (PUE)** – A measure of how efficiently the data center infrastructure uses energy. It describes the ratio of the annual energy consumption of the entire data center to the annual energy consumption of the IT equipment (see DIN EN 50600-4-2).

**Rack** – The housing in which servers, data storage devices, network devices and, where relevant, other IT components are enclosed and connected to supply lines. Server racks are generally equipped with chassis rails or shelves.

**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 server racks.

**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).

**Total IT output** – The maximum IT output for which the data center was built or to which it has been expanded so far within the framework of a modular concept.

**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 power supply to the IT equipment is maintained until the load is covered by a substitute power supply system (e.g. an emergency power system - EPS). The UPS can also be used to ensure that the servers and storage systems can be properly shut down in the event of a prolonged power failure.

**Water Usage Effectiveness (WUE)** – The effectiveness of the water usage, calculated by dividing the "water usage in a data center by the energy consumption of its IT equipment". This key performance indicator is split into 3 categories.
WUE category 1: water usage without reuse
WUE category 2: water usage including reuse
WUE category 3: water usage including energy and industrial reuse (see draft standard DIN EN 50600-4-9).

**White space** – The area within a data center in which the information technology is placed. The service areas between the individual racks are part of the white space.

### 1.4 Information on submitting an application and compliance verification

The requirements for data centers 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 with the "Energy Efficiency Report at the time of application" and before the end of the term of contract with the "Energy Efficiency Report for final evaluation".

The requirements stated in Paragraph 3 are split into the following subparagraphs:

- 3.1 Requirements for all applicants
- 3.2 Requirements for data center operators
- 3.3 Requirements for IT operators.

When submitting an application, all of the compliance verifications stated in Paragraph 3 must be provided. An overview of all of the compliance verifications can be found in Annex A.
The central document for verifying compliance with the requirements at the time of application is the Energy Efficiency Report according to Paragraph 3.1.2. and its annexes. This Energy Efficiency Report must be examined and confirmed by an independent auditor. RAL gGmbH, with the support of the German Environment Agency, has approved auditors (see Annex B) 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.

All of the requirements must still be complied with during the term of the Contract on the Use of the Environmental Label. The inventory lists (see Paragraphs 3.2.3 and 3.3.1) and monitoring data (see Paragraphs 3.2.2 and 3.3.2) must be updated during the term of the contract.

Compliance with the requirements and the results of the monitoring must be documented in an "Energy Efficiency Report for final evaluation" (see Paragraph 3.1.3) and submitted to RAL gGmbH before the end of the term of contract. This final report must only be examined by an independent auditor to confirm compliance with the requirements if the applicant also wants to submit it as part of a new application.

## 2 Scope

This ecolabel certifies the energy and resource efficient operation of data centers, information technology and data center services.

The environmental label can be awarded to:

- Data centers for which the applicant is responsible for both the operation of the technical building equipment and also the operation of the predominant share of the information technology (based on the connected electrical power rating of the IT) (e.g. company data centers, a managed service provider).
- Data centers for which the applicant is responsible for the operation of the technical building equipment and, where relevant, some of the information technology (e.g. network technology, hosting servers) (e.g. colocation data centers, mixed operation of colocation and hosting services).

- Companies who operate information technology within a data center that has already been certified with this ecolabel. In this case, applicants can be customers of a colocation data center certified with the ecolabel.

A certified data center must have a fixed location and a unique designation. If a company operates multiple IT rooms or IT buildings in one location that each have independent technical infrastructure (cooling and power supplies), each of these IT rooms or IT buildings represents an independent data center for which a separate application must be submitted for the ecolabel.

The certified operation of information technology must have a fixed location and a unique designation. It must also be located within a data center that is already certified with the Blue Angel ecolabel.

## 3 Requirements

As this ecolabel can be awarded to both operators of technical building equipment in data centers ("data center operators") and also to operators of information technology ("IT operators"), the Basic Award Criteria are split according to the relevant area of responsibility.

- The requirements in Paragraph 3.1 "Requirements for all applicants" must be complied with by all applicants, irrespective of whether they are responsible for the operation of the technical building equipment or the operation of the information technology (IT).
- The requirements in Paragraph 3.2 "Requirements for data center operators" must be complied with by operators of technical building equipment in data centers.
- If a data center operator leases out white space or IT hardware or makes them available to external companies (e.g. colocation, hosting), this type of applicant is called a "data center service provider" in this document. These applicants must also comply with the requirements in Paragraph 3.2.6 "Requirements for data center service providers".
- The requirements in Paragraph 3.3 "Requirements for IT operators" must be complied with by those applicants who are responsible for the operation of information technology. This includes, for example, operators of company data centers (in addition to the requirements for the operation of the data center), operators of information technology within a certified colocation data center and operators of a mixed use data center for the portion of the information technology (e.g. network technology or storage systems) that is within the area of responsibility of the applicant.

The following table provides an overview of the different requirements according to their type, assignment to a particular area of responsibility and the time at which the verification must be submitted.
The different requirements are explained in the stated Paragraphs.

Table 1: Overview of the requirements in the Basic Award Criteria

| Requirement | Paragraph number in this document | Data center operator | Data center service provider | IT operator | Before or with the application | During the term of the contract |
|---|---|---|---|---|---|---|
| **Good corporate practice** | | | | | | |
| Energy management system | 3.1.1 | X | X | X | Process introduced | X |
| Measurement concept for the technical building equipment | 3.2.1 | X | X | | Implement | |
| Monitoring of electricity, air conditioning, water | 3.2.2 | X | X | | Process introduced | X |
| Creation of an inventory list for technical building equipment | 3.2.3 | X | X | | Create | Update |
| Creation of an IT inventory list | 3.3.1 | | | X | Create | Update |
| Monitoring the IT load | 3.3.2 | | | X | Process introduced | X |
| Reuse management | 3.3.4 | | | X | Process introduced | X |
| Energy Efficiency report | | | | | | |
| Energy Efficiency Report at the time of application | 3.1.2 | X | X | X | Create | |
| Energy Efficiency Report for final evaluation | 3.1.3 | X | X | X | | 6 months before the end |
| **Contractual requirements** | | | | | | |
| Renewable energies | 3.2.4 | X | X | | Contractually agreed | X |
| Publicly accessible information | 3.2.5 | X | X | | Submit | X |
| Monthly obligation to provide information | 3.2.6.1 | | X | | Process introduced | X |
| Financial incentives for saving energy | 3.2.6.2 | | X | | Process introduced | X |
| Advisory services for energy saving measures | 3.2.6.3 | | X | | Process introduced | X |
| **Continuous efficiency requirements** | | | | | | |
| Power Usage Effectiveness (PUE) | 3.2.7 | X | X | | Measure for 12 months | X |
| Cooling Efficiency Ratio (CER) | 3.2.8 | X | X | | Measure for 12 months | X |
| Minimum utilisation of the servers | 3.3.3 | | | X | Measure for 12 months | X |
| **Chemicals harmful to the environment** | | | | | | |
| Electrical switching systems | 3.2.11 | X | X | | Install | X |
| Refrigerant | 3.2.9 | X | X | | Install | X |
| Structural requirements | | | | | | |
| Use of waste heat | 3.2.10 | X | X | | Install | X |
| Efficient use of floor space | 3.2.12 | X | X | | Calculate | |
| **Requirements for new acquisitions** | | | | | | |
| Technical building equipment | 3.2.13 | X | X | | Process introduced | X |

## 3.1 Requirements for all applicants

### 3.1.1 Energy management system

Applicants must confirm that they have an energy management system for the data center or the subsection of the data center for which they are responsible. This should be based on DIN EN 50600-3-1, DIN EN ISO 50001[1] or EMAS III[2].

The energy management system must comprise the following points:

- An energy strategy that has been set out in writing.
- Clearly defined responsibilities for optimising energy usage
- A measurement concept for monitoring the efficiency indicators has been implemented.
- Defined efficiency improvement targets and monitoring of their achievement.
- Energy saving measures have been considered and developed across all sectors (where appropriate: IT procurement, IT operation, building management, energy controlling, purchasing and, where relevant, sales).
- A continuous improvement process for optimising energy usage has been established.
- The "total cost of ownership" must be calculated when newly acquiring all equipment, systems and their components and this information must be given appropriate consideration when making purchasing decisions.
- For new acquisitions, the criteria in the Blue Angel ecolabel (e.g. Blue Angel DE-UZ 213 for Server and Data Storage Products) or a comparable environmental label (e.g. Energy Star, TCO Certified or EPEAT) must be given appropriate consideration when making purchasing decisions.

***Compliance verification***

*The applicant shall declare compliance with the requirement in Annex 2 and document the energy management system including specific information on the points described above in Annex 3.1.*

### 3.1.2 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. The information required for the creation of the Energy Efficiency Report is listed in the document template in Annex 2.

***Compliance verification***

*The Energy Efficiency Report must be examined by one of the auditors named in Annex B (List of auditors). The auditor must confirm in an audit report that the information requested in Annex 2 has been provided in full and is highly plausible.*

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1 DIN EN ISO 50001: Energy management systems - Requirements with guidance for use

2 Regulation (EC) No. 121/2009 of the European Parliament and of the Council of 25 November 2009 on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS): OJ EC No. L 342, P. 1, 22/12/2009

### 3.1.3 Energy Efficiency Report for final evaluation

The holder of the environmental label must submit an updated 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 during the term of the contract (results of the monitoring, documentation for newly acquired technology, updated inventory lists). The template provided in Annex 2 must be taken into account.
In the event of changes to the Basic Award Criteria, it is only possible to award the environmental label to the same data center again if the Energy Efficiency Report for final evaluation has been submitted.
The Energy Efficiency Report for final evaluation can also be included as part of the application for a new ecolabel. The applicant must then integrate any newly added requirements into the report or use the updated template for the report.

***Compliance verification***

*The applicant shall submit this Energy Efficiency Report to RAL gGmbH as an updated version of Annex 2 at the end of the term of contract. If the applicant wishes to reapply for the ecolabel, this Energy Efficiency Report must be included in the independent examination by the auditor.*

## 3.2 Requirements for data center operators

### 3.2.1 Measurement concept for the technical building equipment

Several requirements for this ecolabel are based on monitoring of the technology used in the data center and measurements of multiple parameters. The calculations for the key performance indicators PUE, CER, ERF and WUE (see Paragraph 3.2.5) must be based on measurement values that have been collected within the data center and which have been confirmed as plausible by an external auditor.

A schematic diagram of the electrical energy and cooling systems in the data center must be submitted with the application. The diagram must show the measurement points or meters where the required data is collected. The system components in the data center that should be included in the schematic diagram and the arrangement of the measurement points and their designations should be based on Figure 1: Measurement concept for electrical energy and Figure 2: Measurement concept for the cooling system in Appendix A of this document.

The measurement concept must include the following information:
- Block or schematic diagrams for electrical energy and the cooling system
- Designations for the measurement points or meters in the block or schematic diagram
- Description of how the key performance indicators PUE, CER, ERF and WUE are calculated with reference to the measurement points or meters.

***Compliance verification***

*The applicant shall declare compliance with the requirement in Annex 2 and submit schematic diagrams as Annexes 3.2 and 3.3 in which the relevant measurement points are marked so that the auditor can use this information to understand how the required data has been collected.*

### 3.2.2 Monitoring energy, air conditioning and water

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, as well as the cooling and water consumption, are recorded and evaluated continuously throughout the whole year. Regular measurements must be taken at at least those measurement points (MPs) described in the measurement concept (see Paragraph 3.2.1.).

The following values must be determined as a result of this monitoring on at least a monthly basis:

- Electricity consumption of the entire DC ($MP_{ESC}$ + $MP_{OSG}$ + $MP_{EPS}$) [$kWh_{el}$]
- Electricity consumption of the IT ($MP_{IT2}$) [$kWh_{el}$][3]
- Electricity consumption of the cooling system ($MP_{CS}$) [$kWh_{el}$]
- Electricity consumption of other consumers ($MP_{OC}$) [$kWh_{el}$](e.g. safety technology, lighting)
- Electrical energy from own generation (e.g. PV system) ($MP_{OSG}$) [$kWh_{el}$]
- Cooling energy generated ($MP_{CE}$) [$kWh_{th}$]
- Heat transfer in the data center ($MP_{DC}$) [$kWh_{th}$]
- Waste heat utilisation ($MP_{WHU}$) [$kWh_{th}$]
- Drinking water consumption by cooling systems with evaporative cooling [$m^3$]
- Description of the use of other water sources (e.g. rain water, well water, river water) with approximate volumes [$m^3$]
- Other non-electrical energy consumption and the type of fuel (e.g. consumption of fuel by the emergency power system, use of district heating or district cooling)

**Note:** If some of the values described above do not apply to the data center (e.g. own generation, drinking water consumption, fuel consumption), each of these values can be set to zero.

***Compliance verification***

*The applicant shall declare compliance with the requirements in Annex 2 and submit the values stated above in table form as Annex 3.4 for at least the 12 month period before the application. During the term of the contract on the use of the ecolabel, the applicant shall continue to update this table and submit it for the final evaluation.*

### 3.2.3 Inventory list for the cooling technology and energy provision

The applicant must submit an inventory list containing all of the technical building equipment installed in the data center.

The inventory list must contain at least the following components and their important properties:

- Cooling technology components

[3] Sum of all electricity consumption billed to customers and the electricity consumption for the operation of the information technology operated by the colocation supplier (e.g. IT for monitoring, GLT, etc.)

- UPS systems
- Electrical switching systems
- Emergency power systems (incl. fuel storage)

The applicant must add any new acquisitions to the inventory list so that the current equipment is always documented.

***Compliance verification***

*The applicant shall declare compliance with the requirement in Annex 2 and submit an inventory list as Annex 3.5 to the Energy Efficiency Report containing all of the technical building equipment installed in the data center.*

### 3.2.4 Renewable energies

The data center must cover 100% of its electricity consumption using renewable energies such as hydroelectric power, photovoltaic power, wind power or biomass power.

**Exemption:** The applicant can deviate from this requirement if the energy used to operate the data center is not directly sourced from an energy supply company (ESC) but via a third party, such as the landlord of a building or a separately operated business unit who has concluded a supply contract with the data center operator. This exemption can only be utilised if the data center accounts for no more than 20 percent of the total energy supplied annually by the EMC to this third party. The following applies to the electrical energy consumed in the data center that is not sourced from renewable energies: Data center operators must purchase certificates to offset the greenhouse gas emissions generated in the production of this non-renewable electricity in order to utilise this exemption during their use of the ecolabel. The recommendations for evaluating the quality of these certificates documented in Appendix B must be observed. The offsetting certificates must be submitted together with the Energy Efficiency Report for final evaluation (see Paragraph 3.1.3) before the end of the term of contract.

***Compliance verification***

*The applicant shall declare compliance with the requirement in Annex 2 and submit suitable verifications (e.g. electricity supply contract, power purchase agreement (PPA), verification from the register of guarantees of origin from the German Environment Agency, electricity labelling data in accordance with Article 42 of the German Energy Act (Energiewirtschaftsgesetz), ownership certificate for plants generating renewable energies) as Annex 3.6 to the Energy Efficiency Report. If the exemption has been utilised, the applicant shall submit suitable verifications that the data center accounts for no more than 20 percent of the total energy supplied annually by the EMC (e.g. an invoice for the total energy supplied by the EMC and monitoring data for the meter in the data center) as Annex 3.6 to the Energy Efficiency Report. The applicant shall also confirm compliance with the requirements for the utilisation of this exemption in Annex 2 to the contract.*

### 3.2.5 Publicly accessible information

The applicant must publish at least the following information on an annual basis:

- Power Usage Effectiveness (PUE) according to DIN EN 50600-4-2
- Cooling Efficiency Ratio (CER) according to DIN EN 50600-4-7
- Energy Reuse Factor (ERF) according to DIN EN 50600-4-6
- Water Usage Effectiveness (WUE) according to DIN EN 50600-4-9 (draft standard if relevant)

**Exemption:** The applicant can refrain from publishing one or more of these key performance indicators if there is a legitimate concern that their publication will endanger public or national security.

***Compliance verification***

*The applicant shall confirm compliance with this requirement and state where this information is published (e.g. Internet address) in Annex 2. If the exemption has been utilised, the applicant shall provide the auditor with appropriate justification.*

### 3.2.6 Requirements for data center service providers

If a data center operator leases out white space or IT hardware in the data center to one or more legal entities (e.g. colocation customers or hosting customers) or otherwise makes them available to external companies (e.g. granting the right of use to white space or IT hardware as part of a cooperation agreement), the applicant must also comply with the following requirements in 3.2.6.1, 3.2.6.2 and 3.2.6.3. In order to differentiate between the different parties involved, the data center operator is referred to in these Paragraphs as the "data center service provider" and contractually bound IT operators as "IT customers".

#### 3.2.6.1 Obligation to provide information to IT customers

The data center service provider undertakes to regularly, although at least monthly, provide its IT customers – from a contractually agreed peak electrical load for IT of 5 kilowatts per IT customer – with information about the amount of electricity consumed and the peak electrical load of the information technology used by the respective IT customer.

- Electricity consumption for IT [$kWh_{el}$]
- Peak electrical load for IT [$kW_{el}$]

***Compliance verification***

*The applicant shall declare compliance with the requirement in Annex 2, describe in the Energy Efficiency Report in Annex 2 how they provide the required information to their IT customers and submit example customer information in Annex 3.7 to the Energy Efficiency Report as verification for the auditor.*

#### 3.2.6.2 Financial incentives for using more energy efficient information technology

The pricing model used by the data center service provider to bill the IT customers must be designed so that the customer or contractual partner has an incentive to use the most energy efficient information technology and operate the most energy efficient equipment.

The data center service provider must offer IT customers – from a contractually agreed peak electrical load for IT of 5 kilowatts – a pricing model that includes the following criteria:

- The charges billed for the service must contain a pricing component that is dependent on the amount of electricity consumed.
- The price per energy unit in this consumption-based pricing model must not be lower than the purchase price for the supplied electricity (electricity price).
- The data center service provider may not agree with the customer either a minimum purchase quantity or a fixed amount of electrical energy [$kWh_{el}$] provided free of charge.

Information on the possible design of this pricing model can be found in Appendix C.

**Exemption:** This requirement does not apply if the data center service provider does not issue any invoices to the customer for these services. This could be the case, for example, if the service is provided in the form of administrative assistance without the payment of a financial consideration or as part of a research partnership.

***Compliance verification***

*Applicants shall declare compliance with the requirement and confirm in Annex 2 that the contracts with their IT customers – who operate their own IT in the data center with a peak electrical load above the limit named above – comply with the stated criteria. The applicant shall also provide the auditor with the respective contractual conditions. If the exemption has been utilised, the applicant shall explain to the auditor why no financial invoice is issued to the customer for this service.*

#### 3.2.6.3 Advisory services for improving energy efficiency

The data center service provider must inform their IT customers about the possibilities for saving energy and support them in the implementation of these measures.
This advice can cover, for example, the selection of energy efficient information technology, consolidating IT output, reducing peak loads, making optimal use of existing resources or introducing energy monitoring systems.
The data center service provider must provide their customers or contractual partners with corresponding information (e.g. information brochures, workshops, video tutorials, etc.).

***Compliance verification***

*The applicant shall declare compliance with the requirement and describe in the Energy Efficiency Report in Annex 2 and in Annex 3.8 which information services they provide to their IT customers.*

### 3.2.7 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 (PUE2, intermediate resolution) or using an equivalent method.
- Energy used for the decoupling of waste heat (e.g. for the operation of a heat pump to increase the temperature level and pumps to operate heating networks) should not be included in the calculation of the PUE. Corresponding meters must be installed for this purpose.
- 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 must not exceed the following values as an annual average even during the term of use of the ecolabel:

Table 2: Minimum requirement for Power Usage Effectiveness (PUE)

| **Date the data center was commissioned** | **PUE** |
|---|---|
| 01/01/2024 or later | PUE ≤ 1.25 |
| Between 01/01/2019 and 31/12/2023 | PUE ≤ 1.30 |
| Between 01/01/2015 and 31/12/2018 | PUE ≤ 1.50 |
| 31/12/2014 or earlier | PUE ≤ 1.60 |

**Exemption 1:** After they have been commissioned, newly built data centers are often not yet working at full capacity. Therefore, the alternative minimum requirements for the PUE value stated in Table 3 are valid for the first two years after the commissioning date. These exemptions are valid in each case for the reporting period for the Energy Efficiency Report. These exemptions can only be utilised at the time of application or during the period of use of the environmental label if the start of the reporting period for the Energy Efficiency Report is no longer than 2 years ago.

Table 3: Exemption 1: PUE for newly commissioned data centers

| **Date the data center was commissioned** | **PUE** |
|---|---|
| Less than 1 year ago (commissioning date < 1 year) | PUE ≤ 1.50 |
| Less than 2 years ago (1 year ≤ commissioning date < 2 years) | PUE ≤ 1.40 |

**Exemption 2:** Data centers that 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 new data new 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 3.1.2). The measurement results must verify compliance with the minimum requirements in Table 3 at the latest 15 months after the commissioning date.

***Compliance verification***

*The applicant shall declare compliance with the requirement in Annex 2 and document the calculation of the Power Usage Effectiveness (PUE) in the Energy Efficiency Report as Annex 3.9 to the contract. If one of the exemptions has been utilised, the applicant shall submit the documents described above to the auditor as Annex 3.9 in order to verify the plausibility of the calculation. In the event that exemption 2 has been utilised for the application, the applicant shall 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 commissioning date to an external auditor (for the purpose of confirming their plausibility) and also to RAL gGmbH.*

### 3.2.8 Cooling Efficiency Ratio (CER)

The energy efficiency of the cooling system must be determined using the performance indicator Cooling Efficiency Ratio (CER) in accordance with the DIN EN 50600-4-7 standard. Energy used for the decoupling of waste heat (e.g. for the operation of a heat pump) ) should not be included in the calculation of the CER or the determination of the electrical energy requirement of the cooling system. Proof is provided by calculating the key figure for the proportion of reused energy (Energy Reuse Factor - ERF, in accordance with the DIN EN 50600-4-6).
The Cooling Efficiency Ratio (CER) 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 (CS) within one year (12 months) to the total electrical energy input into the entire cooling system $Q_{el,CS,a}$ [$MWh_{el}/a$].

$$CER = \frac{Q_{th,RZ,a}}{E_{KS,a}}$$

Depending on the commissioning date, the following values must be observed:

Table 4: Minimum requirement for the Cooling Efficiency Ratio (CER)

| **Date the cooling system was commissioned** | **CER** |
|---|---|
| 01/01/2024 or later | CER > 9 |
| Between 01/01/2019 and 31/12/2023 | CER > 8 |
| Between 01/01/2015 and 31/12/2018 | CER > 7 |
| 31/12/2014 or earlier | CER > 5 |

**Exemption 1:** After they have been commissioned, newly built data centers are often not yet working at full capacity. Therefore, the alternative minimum requirements for the Cooling Efficiency Ratio (CER) stated in Table 5 are valid for the first two years after the commissioning date. These exemptions are valid in each case for the reporting period for the Energy Efficiency Report. These exemptions can only be utilised at the time of application or during the period of use of the environmental label if the start of the reporting period for the Energy Efficiency Report is no longer than 2 years ago.

Table 5: Exemption 1: CER for newly commissioned data centers

| **Date the data center was commissioned** | **CER** |
|---|---|
| Less than 1 year ago (commissioning date < 1 year) | CER > 5 |
| Less than 2 years ago (1 year ≤ commissioning date < 2 years) | CER > 6.5 |

**Exemption 2:** Data centers that were commissioned less than 15 months ago at the time of the application are exempt from the requirement that the CER value must be calculated over a measurement period of twelve months. These new data centers must calculate the expected CER value 12 months after they have been commissioned for the application as follows:

- Either using planning data produced by a qualified specialist planner in accordance with DIN EN 50600, in which the calculation of the CER 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 this information is used to calculate the annual cooling load for the cooling system and the total electrical energy input into the entire cooling system.

These planning results must be documented in the Energy Efficiency Report (see Paragraph 3.1.2). The measurement results must verify compliance with the minimum requirements in Table 5 at the latest 15 months after the commissioning date.

***Compliance verification***

*The applicant shall declare compliance with the requirement in Annex 2 and document the amounts of energy ($Q_{th,DC,a}$ and $Q_{CS,a}$) and the Cooling Efficiency Ratio (CER) in the Energy Efficiency Report in Annex 3.9 to the contract. If one of the exemptions has been utilised, the applicant shall submit the documents described above to the auditor as Annex 3.9 in order to verify the plausibility of the calculation. In the event that exemption 2 has been utilised for the application, the applicant shall submit the measurement values for determining the CER valve over a period of twelve months in accordance with the measurement rules stated above at the latest 15 months after the commissioning date to an external auditor (for the purpose of confirming their plausibility) and also to RAL gGmbH.*

### 3.2.9 Refrigerant

In those cooling systems, heat pumps and dehumidifiers that were placed into operation after the 1 January 2013, only halogen-free refrigerants may be used.

An exemption applies to systems with a maximum cooling performance of 10 $kW_{th}$.

***Compliance verification***

*The applicant shall confirm compliance with the requirement and state which refrigerant is used in the Energy Efficiency Report in Annex 2.*

### 3.2.10 Use of waste heat

The waste heat from data centers can make an important contribution to decarbonising the heating supply system. Therefore, new data centers should preferably be constructed in locations where there is a demand for heating.

Data centers placed into operation after 1 January 2023 must comply with the following criteria:

- Part of the waste heat from the data center must be utilised by the data center operator in their own buildings or facilities or by external heat consumers (ERF > 0).
- Data centers with a connected electrical rating of 100 kW or higher must be suitably equipped for the utilisation of the waste heat outside of the data center. Connections must be installed for this purpose.
- If the data center operator is not able to utilise all of the waste heat in their own buildings or facilities or has not already agreed supply contracts for the total volume of waste heat, data centers with a connected electrical rating of 100 kW or higher must publish information on the temperature level and the amount of heat that they can supply. The data center operator must give potential heat consumers the opportunity to conclude a supply contract on request.
- The key performance indicator for the proportion of reused energy (Energy Reuse Factor – ERF, according to the DIN EN 50600-4-6 standard) must be published at least once a year (see Paragraph 3.2.5).

***Compliance verification***

*The applicant shall confirm compliance with the requirements in Annex 2 and state where the information on the temperature, volume of available heat and Energy Reuse Factor (ERF) is published (e.g. a website or public register of data centers). The applicant shall describe how the waste heat is used and how the Energy Reuse Factor has been calculated in Annex 3.10.*

### 3.2.11 Electrical switching systems

Electrical switching systems within the area of responsibility of the data center operator that were installed after 1 January 2023 may not contain the highly potent greenhouse gas sulphur hexafluoride ($SF_6$) as an insulation medium.

***Compliance verification***

*The applicant shall confirm compliance with the requirement in Annex 2.*

### 3.2.12 Efficient use of floor space

In order to help reduce soil sealing, the data center should make the most efficient use of space possible. In the Energy Efficiency Report, the applicant shall state the following key performance indicators as information about their efficient use of floor space:

- Total IT output per square metre of gross floor area [$kW_{el}/m^2_{GFA}$]
- Total IT output per square metre of constructed area [$kW_{el}/m^2_{CA}$]
- Total IT output per square metre of white space [$kW_{el}/m^2_{white\ space}$]

The terms "Total IT output", "gross floor area (GFA)", "constructed area (CA)" and "white space" are defined in Paragraph 1.3 Definitions.

**Exemption:** If the data center operator only uses part of the building for the data center and its administration, e.g. as a tenant of a commercial building that is used by several parties or a department of a larger company or an authority, the efficient use of the floor space can be stated using the following key performance indicators:

- Total IT output per square metre of floor area used [$kW_{el}/m^2_{FAU}$]
- Total IT output per square metre of white space [$kW_{el}/m^2_{white\ space}$]

The "floor area used (FAU)" is defined here as the floor area used for the operation and administration of the data center, which is stated, for example, in the lease agreed by the data center operator or in a comparable user agreement.

***Compliance verification***

*The applicant shall confirm compliance with the requirements and document the key performance indicators and their input values in the Energy Efficiency Report in Annex 2.*

### 3.2.13 New acquisitions during the term of the contract

If components of the technical building equipment are changed, replaced or newly acquired, the applicant must ensure in advance that they still comply with all of the Basic Award Criteria for this ecolabel.

This applies in particular to the following Basic Award Criteria:
- Power Usage Effectiveness (PUE) (see Paragraph 3.2.7)
- Cooling Efficiency Ratio (CER) (see Paragraph 3.2.8)
- Electrical switching systems (see Paragraph 3.2.11)
- Refrigerants (see Paragraph 3.2.9)

Newly acquired components and their important properties must be documented in the inventory list of cooling technology and energy provision (see Paragraph 3.2.3).

***Compliance verification***

*The applicant shall confirm compliance with the requirement in Annex 2, update the inventory list for the cooling technology and energy provision during the term of the contract and submit it as an updated Annex 3.5 together with the Energy Efficiency Report for final evaluation at the end of the term of the contract (see Paragraph 3.1.3).*

## 3.3 Requirements for IT operators

### 3.3.1 IT inventory list

The applicant must submit an inventory list containing all of the IT components installed in the data center.

The IT inventory list must contain at least the following IT components and their important properties:

- Servers
- Storage systems
- Network equipment

The applicant must add any new acquisitions to the inventory list so that the current equipment is always documented.

***Compliance verification***

*The applicant shall confirm compliance with the requirement in Annex 2 and submit an IT inventory list as Annex 4.1 to the Energy Efficiency Report containing all of the IT components installed in the data center. During the term of the contract, the IT operator shall update the IT inventory list and submit it as an updated Annex 4.1 together with the Energy Efficiency Report for final evaluation at the end of the term of the contract (see Paragraph 3.1.3).*

### 3.3.2 Monitoring the IT load

In order to ensure the efficient operation of the information technology, the applicant must have implemented a process to monitor the IT utilisation.
The data center must have a monitoring system for the IT load that collects the following datasets:

- For all servers: Average CPU utilisation per server, as an average figure for a period of one month
- For all storage systems: Average storage space utilised per storage system, as an average figure for a period of one month

Instructions on how to calculate the average values can be found in Appendix D to this document.

All datasets must be updated during the term of the Contract on the Use of the Environmental Label and submitted to the auditor as verification in the Energy Efficiency Report for final evaluation if the applicant wishes to reapply for the ecolabel.

***Compliance verification***

*The applicant shall confirm compliance with the requirement, describe the process for monitoring the IT utilisation in the Energy Efficiency Report in Annex 2 and submit datasets covering a period of at least 3 months for the average CPU utilisation per server and average storage space utilised per storage system as Annex 4.2 to the Energy Efficiency Report. During the term of the contract, the IT operator shall update the datasets and submit them in aggregated form (e.g. average for all servers and storage systems) together with the Energy Efficiency Report for final evaluation at the end of the term of the contract.*

### 3.3.3 Minimum utilisation of the servers

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

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

Instructions on how to calculate the average values can be found in Appendix D to this document.

**Exemption 1:** Data centers that were commissioned less than 15 months ago at the time of the application are exempt from the requirement that the $ITEU_{SV}$ value must be calculated over a measurement period of twelve months. These new data centers can also measure the $ITEU_{SV}$ from the date on which the data center was commissioned. However, the measurement period must cover at least one full month.

**Exemption 2:** It is not necessary to calculate the IT Equipment Utilization for Servers ($ITEU_{SV}$) for those servers that are not covered by the ISO/IEC 30134-5 standard, e.g. because the predominant share of the electrical load on the servers is not generated by CPUs but rather by GPUs (Graphics Processing Units).

***Compliance verification***

*The applicant shall declare compliance with the requirement in Annex 2 und state the average CPU utilisation over a period of 12 months ($ITEU_{SV}$) in the Energy Efficiency Report in Annex 2. The applicant shall document the average monthly values for all servers that were used for calculating the $ITEU_{SV}$ as a dataset in Annex 4.3 to the Energy Efficiency Report.*
*In the event that exemption 1 has been utilised for the application, the applicant shall submit the measurement values for determining the $ITEU_{SV}$ over a period of twelve months in accordance with the measurement rules stated above at the latest 15 months after the commissioning date to RAL gGmbH as an updated version of Annex 4.3. In the event that exemption 2 has been utilised, the applicant must describe the server architecture for the relevant server and present this information to the auditor to demonstrate that the ISO/IEC 30134-5 standard is not applicable for this server.*

### 3.3.4 Reuse management

In order to satisfy the guidelines for the avoidance of waste (see German Circular Economy Act (Kreislaufwirtschaftsgesetz) § 6 waste hierarchy), the ecolabel aims to promote the reuse of information technology (servers and storage devices) after the end of their service life in the data center.
Information technology that leaves the data center may not be scrapped or destroyed. The applicant must present a secure process for the deletion of data and a contractual agreement with a refurbishing company (maintenance and refurbishment). The servers may be donated free of charge to charitable organisations or also sold for a fee to professional refurbishing companies (e.g. the manufacturer).

**Exemption:** Data media that contain confidential information ("classified documents") according to the General Administrative Provision for the Material Protection of Classified Information

(accessible at: GMBl. 2018 no. 44–47, p. 826) or other sensitive data for which there is no secure and non-destructive deletion process available that meets the requirements of the Federal Office for Information Security (BSI) are exempt from this requirement.

***Compliance verification***

*The applicant shall declare compliance with the requirement in Annex 2 and submit information in Annex 4.4 on the contractual agreement with one or more refurbishing companies. If the exemption has been utilised, the applicant must state in the Energy Efficiency Report in Annex 2 that no secure and non-destructive deletion process approved by the BSI is available. The auditor must examine the plausibility of this justification.*

### 3.3.5 Outlook on future requirements for IT operators

The efficiency of the IT technology is the most important lever for making data centers more efficient overall. Therefore, it is probable that future revisions of the ecolabel will introduce further efficiency requirements for the IT. In addition, it is likely that further criteria defining resource-conserving corporate practices will be introduced.
An outlook on the future requirements will be provided below. IT operators are already invited to implement these criteria and check their practicality. Compliance with them is currently voluntary.

- The IT operator should select at least 10 representative servers and produce weekly curves of their CPU utilisation based on average hourly values (per server at least 7d * 24h = 168 values per week) and constantly update this information during the term of the contract.
- As well as the average monthly CPU utilisation for all servers (see Paragraph 3.3.2), the IT operator should determine suitable metrics and measurement tools for monitoring the GPU utilisation (Graphics Processing Unit) and calculate the average monthly GPU utilisation for all servers.
- The IT operator should select at least 10 representative storage systems and calculate the key performance indicator Server Idle Energy Coefficient (SIEC) on a monthly basis. The SIEC describes the ratio of the energy consumed by the server in idle mode and the total energy consumed by the server. Further information on this key performance indicator can be found in Appendix E.
- To improve the quality of the energy management system (see Paragraph 3.1.1), an environmental management system will be introduced that also takes into account waste flows (e.g. IT technology, cables, batteries, paper) and other operational processes at the data center that are relevant to the environment.
- The German federal government is planning to set up an efficiency register for data centers. If this register is introduced by the time of the next revision, the transparency requirements in Paragraph 3.2.5 (PUE, CER, ERF and WUE) will refer to it and make publication of these values in the register an obligation.
- A very cautious approach has been taken when introducing requirements for the use of waste heat in these Basic Award Criteria. It is expected that specific minimum requirements for the use of waste heat (ERF value) will be included in the next revision.

## 4 Applicants and Parties Involved

*Operators of data centers* or *operators of information technology* 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 (German Environmental Agency) which after the signing of the contract receives all data and documents submitted in applications 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.

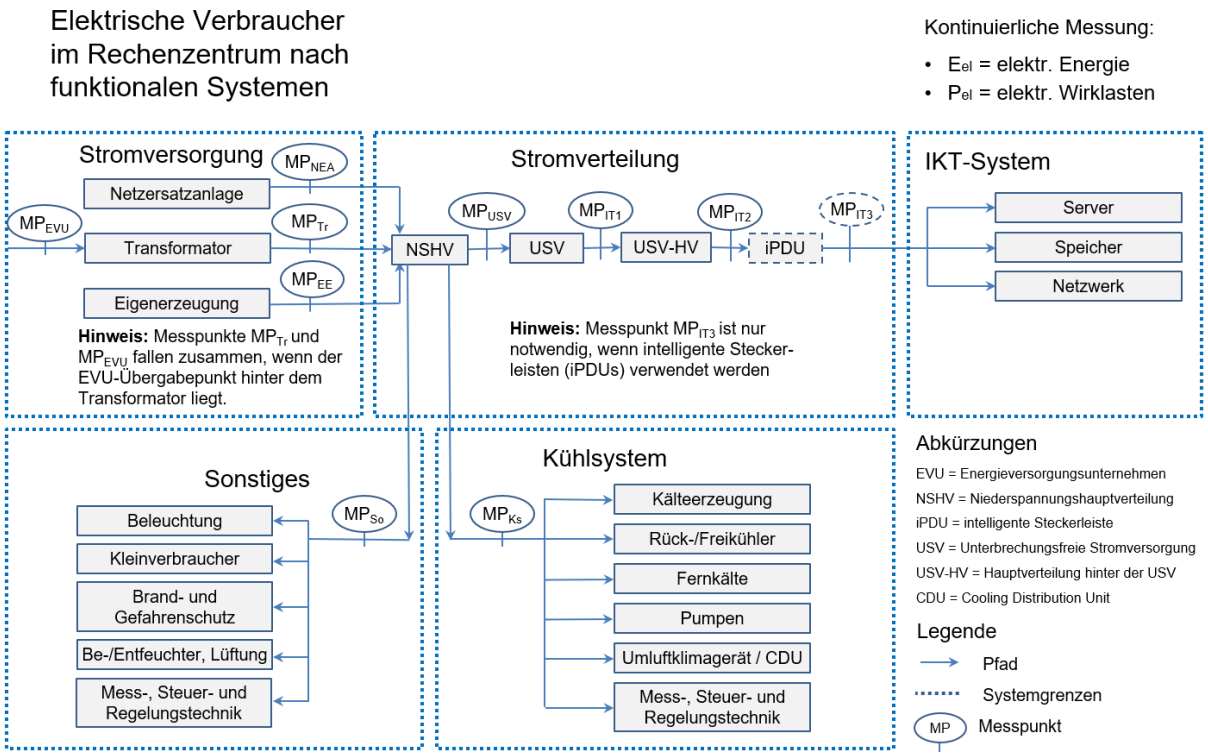
Contracts on the Use of the Environmental Label are concluded to fix the terms for the certification of products under Paragraph 2. Such contracts shall run until December 31, 2026.
They shall be extended by periods of one year each, unless terminated in writing by March 31, 2026 or March 31 of the respective 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 organisations.

The Contract on the Use of the Environmental Label shall specify:
- Applicant (*operator of the data center* or *information technology*)
- Brand/trade name, product description
- Distributor (label user), i.e. the above-mentioned marketing organisations.

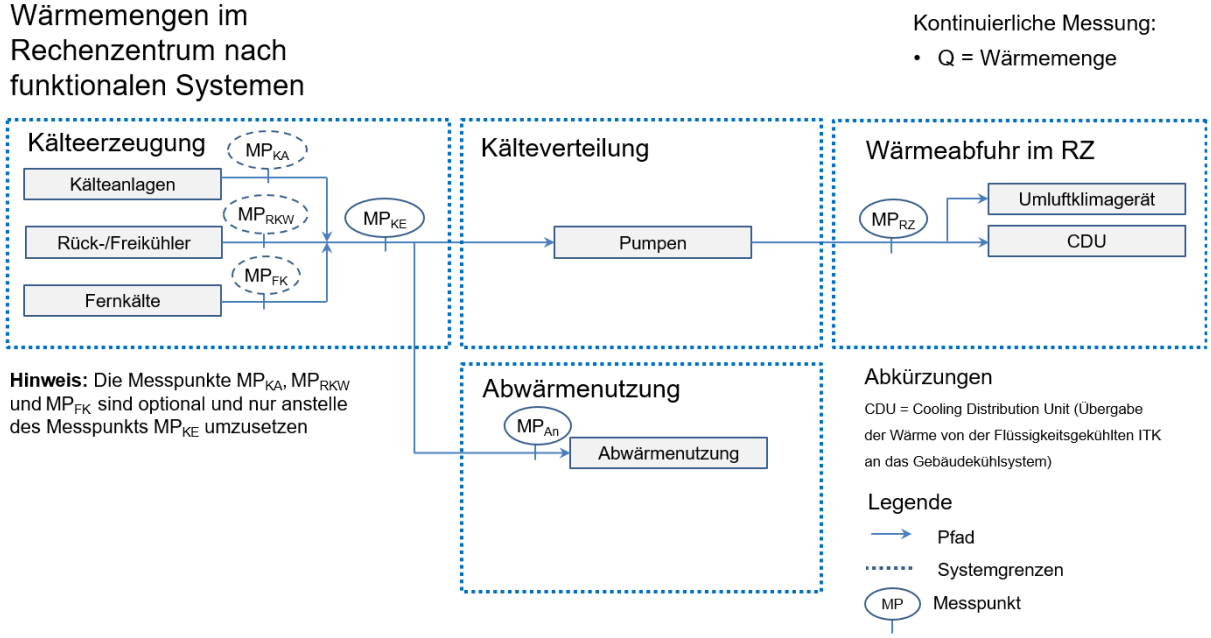
## Appendix A Measurement concept

Figure 1: Measurement concept for electrical energy (volumes of electricity)




Source: Own diagram

Figure 2: Measurement concept for the cooling system (cooling load)




Source: Own diagram

## Appendix B Quality of emission reduction credits (offsetting certificates)

Offsetting is only permitted when the greenhouse gases cannot be avoided or reduced. Emission reduction credits (often also described as certificates) must be acquired and cancelled for this purpose.

**How can emission reduction credits be acquired?**
An overview of the carbon offset providers (without any claim to the quality or completeness of the list) can be found here:

- https://www.dehst.de/SharedDocs/downloads/DE/projektmechanismen/Anbieter.html
-

**What should be taken into account when acquiring emission reduction credits?**
Ambitious climate protection projects, whose emission reduction credits are used for the purpose of carbon offsetting, must deliver an additional emission reduction (additionality) and should provide additional benefits above and beyond purely reducing greenhouse gas emissions (so-called co-benefits).

The following criteria are important for determining the quality of emission reduction credits and this information should be requested from the carbon offsetting providers:

a) verification of the additionality of the supported projects,
b) verification of the sustainable additional benefits of the measure,
c) the use of tested methodologies under the umbrella of a recognised standard,
d) the permanence of the achieved emission reduction,
e) inclusion of any carbon leakage and associated project emissions in the calculation of the emission reduction,
f) avoidance of double counting and
g) verification of the project and the emission reduction by an independent expert.

Further information on the stated criteria is available here:

- Guide issued by the German Environment Agency: https://www.umweltbundesamt.de/publikationen/freiwillige-co2-kompensation-durch

**How are emission reduction credits cancelled?**
The carbon offsetting provider cancels the emission reduction credits acquired for offsetting purposes on behalf of the client and issues a cancellation certificate (verification of the cancellation of the credit) that must be submitted to the UBA in order to receive the Blue Angel.

Further information on voluntary offsetting is available here:

- German Emissions Trading Authority (DEHSt) at the German Environment Agency: http://www.dehst.de/Freiwillige-Kompensation
- A study by the German Environment Agency "Future role for voluntary carbon markets in the Paris era": https://www.umweltbundesamt.de/publikationen/future-role-for-voluntary-carbon-markets-in-the
- Carbon Credit Quality Initiative: https://carboncreditquality.org
- Carbon Offset Guide: https://www.offsetguide.org

## Appendix C Instructions on the possible design of pricing models

### 1 Consumption-based pricing model

**Requirement:** The charges billed for the service must contain a pricing component that is dependent on the amount of electricity consumed.

The costs billed to the customers should include a variable component that increases as the customer's consumption of electricity increases. The pricing model could comprise, for example, fixed flat-rate costs and a consumption-based component that increases on a straight-line basis as presented in the following example:

Billed costs [€] =
fixed flat-rate costs [€] + electricity consumption$_{Customer}$ [kWh$_{el}$] * consumption price [€/kWh$_{el}$]

The billed costs could also include other variable cost components, such as the white space used, height units in the rack, electrical rating, service hours, software licences or other storage capacities used in addition to the customer's own IT. The consumption-based electricity component can also have a non-linear design (e.g. degressive or progressive increases in prices). The applicant must indicate for the pricing model used in their contracts which pricing component is dependent on the volume of electrify used by the customer (electricity consumption$_{Customer}$ [kWh$_{el}$]) and which consumption price is used to bill this level of consumption ([€/kWh$_{el}$]).

### 2 Electricity price used

**Requirement:** The price per energy unit in this consumption-based pricing model must not be lower than the purchase price for the supplied electricity (electricity price).

The consumption price stated in the formula above [€/kWh$_{el}$] must not be lower than the purchase price for the consumed electricity including all fees, taxes and duties. As a general rule, the consumption price should exceed the purchase price by at least the PUE rate because the electricity consumption for the technical building equipment should also be transferred to the customers. It is usual and permitted in practice to also include profit margins and risk surcharges in the consumption price. Verification of the purchase price must be provided to the auditor either by (confidentially) submitting the electricity invoices from the energy supply company (ESC) containing the electricity price or by providing information on a comparable wholesale market price for electricity in the relevant billing period.

### 3 Minimum purchase quantities or fixed amounts offered free of charge

**Requirement:** The data center service provider may not agree with the customer either a minimum purchase quantity or a fixed amount of electrical energy [kWh$_{el}$] provided free of charge.

The reason for this requirement is that a minimum purchase quantity or a fixed amount of electrical energy provided free of charge would mean that the customer has no incentive to save energy below these agreed volumes. The costs have thus already been factored into the price. If the data center operator wants to include flat-rate cost components in the pricing model, this

can still be achieved using other performance components (e.g. white space, flat-rate service fees or guaranteed electrical rating [$kW_{el}$]), but not via the electricity consumption [$kWh_{el}$].

## Appendix D Calculating the average utilisation of the IT equipment

For the monitoring of the IT load, the average utilisation of 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 average utilisations are based on the German 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)[4].

### 1 Average utilisation factor for the CPUs

The average utilisation factor for the 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 utilisation factors 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:

- $ITEU_{SV}(t)$: average utilisation factor for all servers in a DC at time t
- N: Number of servers in a DC or in a group that are used at time t
- $CUS_i(t)$: CPU utilisation factor for server i at time t in percent

**Notes:**

- If a server has a multi-core processor, $CUS_i(t)$ corresponds to the average utilisation factor for each individual core. If a server has multiple CPUs, $CUS_i(t)$ corresponds to the average utilisation factor for each individual CPU.
- The $ITEU_{SV}$ differs from the average CPU utilisation measured as part of the IT monitoring for Paragraph 3.3.2 due to its 12 month measurement period. The $ITEU_{SV}$ can also be calculated as an average of the monthly values.
- In the event of the low utilisation of data center, a higher $ITEU_{SV}$ value can be achieved, in particular, by reducing the number of servers used (N). This can be achieved by consolidating the load on certain servers and switching other servers off or into a power-saving sleep mode.
- To simplify the collection of data for heterogeneous IT systems, it is sufficient when calculating the average $ITEU_{SV}$ value if the $ITEU_{SV}$ value for 90 percent of all physical servers is measured and averaged. The number of measured servers and their share of the total number of servers must be documented in the Energy Efficiency Report.

[4] 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

## 2 Average utilisation of the storage systems

Storage that must be covered by the monitoring system includes 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 average utilisation of the storage systems.
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.
The average utilisation of the storage systems 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:

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

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:

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

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 average utilisation of the storage systems is calculated on a monthly basis as:

$$\text{Average utilisation of storage [\%]} = \frac{\mathbf{Speicherleistung_{Speicherplatz,\ belegt}}}{\mathbf{Speicherleistung_{Speicherplatz,\ installiert}}}$$

The measurement period for determining the average utilisation of storage must cover one month and be presented for at least twelve months as a yearly gradient.
In order to ensure that the average utilisation of 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.

## Appendix E Server Idle Energy Coefficient (SIEC)

The Server Idle Energy Coefficient (SIEC) is a key performance indicator that describes the share of the total energy consumption of the servers that is consumed in idle mode. This performance indicator was presented with the designation "SIC" for the first time in a white paper from Harryvan[5].
You can read more about this coefficient and how it was renamed as "SIEC" in a German article by Ackermann and Harryvan[6].

The Server Idle Energy Coefficient (SIEC) is defined as follows:

$$SIEC = \frac{E_{idle}}{E_{server}} \cdot 100\%$$

$E_{idle}$ is the energy that the server consumes in idle mode and $E_{Server}$ is the total amount of energy consumed by the server during the same measurement interval. In order to determine $E_{idle}$, it is necessary to collect a series of measurements for both the CPU utilisation and the energy consumption of the servers with time stamps in each case.
$E_{Server}$ is simply the sum of the CPU utilisation multiplied by the length of the measurement interval.

$$E_{Server} = \sum_{n=1}^{N} P(n) \cdot t(n)$$

$E_{idle}$ is calculated as follows:

$$E_{idle} = P_{idle} \cdot \sum_{n=1}^{N} \big(1 - CPU(n)\big) \cdot t(n)$$

Key for the calculation formula:
- n is the number of the measurement interval;
- CPU(n) is the measured CPU utilisation for interval n;
- $P_{idle}$ is the electrical power consumption in idle mode;
- t(n) is the duration of the measurement interval;
- N is the number of measurements.

$P_{idle}$ can be determined using two methods:
a) If there is a measurement interval where the CPU utilisation is below 1%, the measured power consumption in this interval can be considered to be $P_{idle}$.

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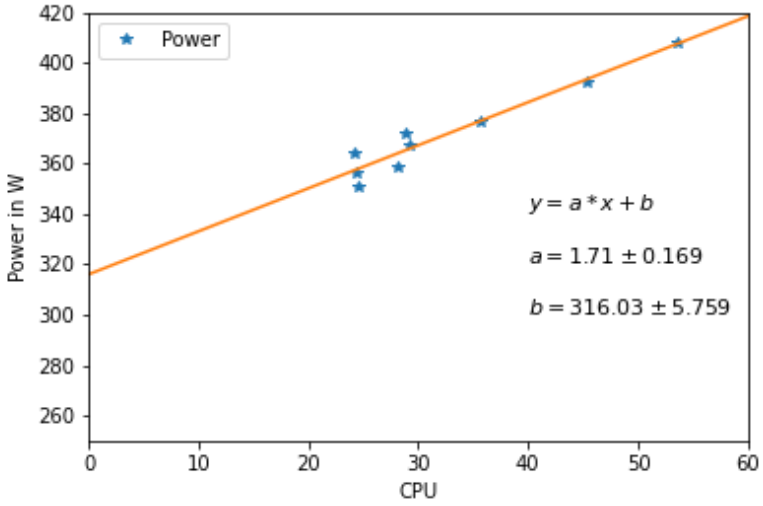
[5] Harryvan, D. H. (2021): The idle coefficients. KPIs to assess energy wasted in servers and data centres. Hg. v. IEA 4E Technology Collaboration Programme. Available online at https://www.iea-4e.org/wp-content/uploads/2021/10/Server-Idle-Coefficients-FINAL-1.pdf.

[6] Ackermann, L.; Harryvan, D. (2022): Effiziente Rechenzentren: Energieverschwendung ungenutzter Ressourcen offenlegen; https://www.heise.de/hintergrund/Effiziente-Rechenzentren-Energieverschwendung-ungenutzter-Ressourcen-offenlegen-7138559.html.

b) The linear extrapolation of the measured power consumption as a function of the CPU utilisation curve towards 0% CPU utilisation is $P_{idle}$. This method can be seen in the following diagram using the example numbers from the previous table. In this example $P_{idle}$ = 316 W.

The measurement interval recommended by Harryvan is between 1 minute and 1 hour with a minimum length of the measurement period of one week so that daily and weekly patterns in the server utilisation are recorded.

Figure 3: Determining $P_{idle}$ from the measured data points




Source: own diagram based on Harryvan (2021)