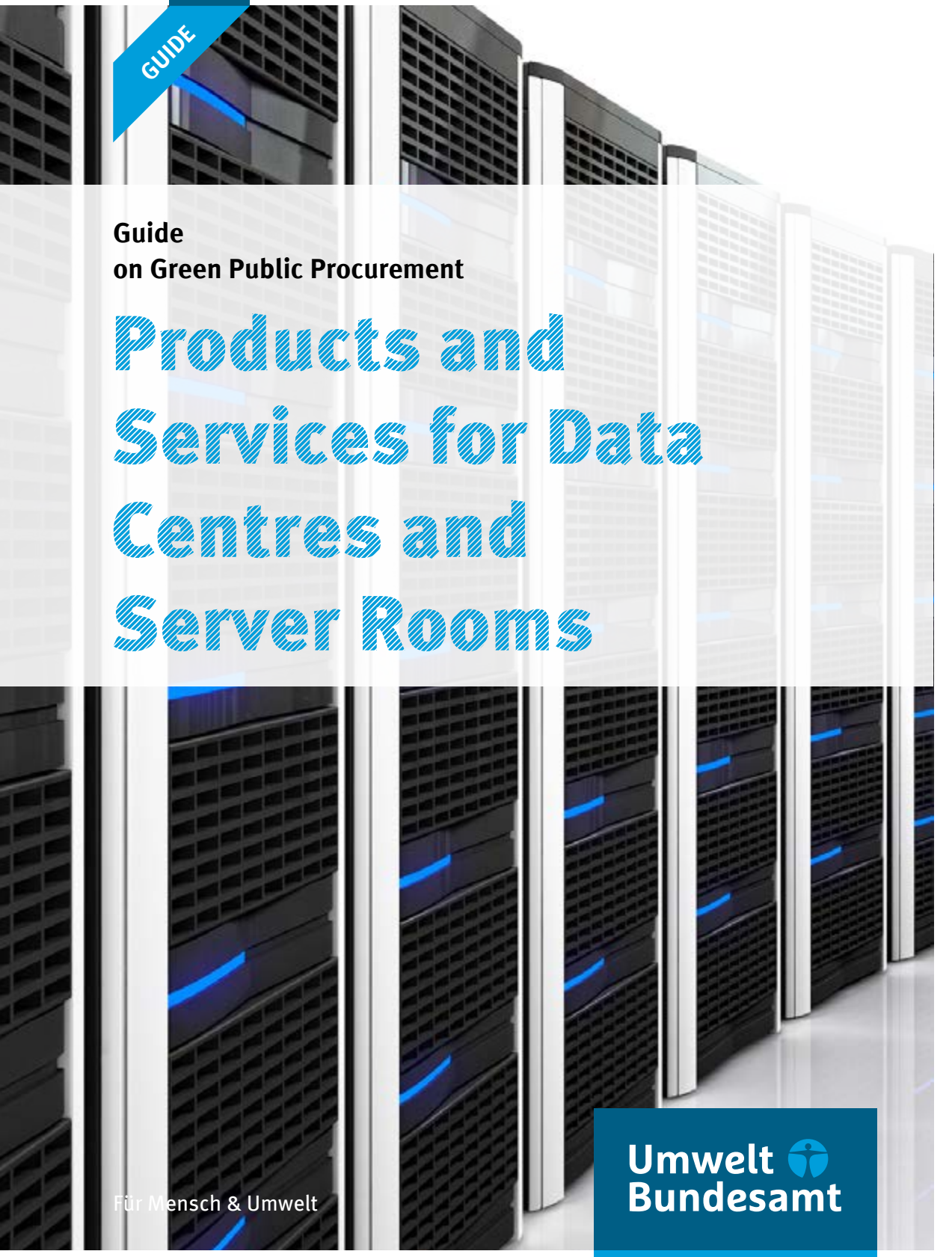
GUIDE

Guide
on Green Public Procurement

# Products and Services for Data Centres and Server Rooms



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# Products and Services for Data Centres and Server Rooms

**This guide is based on the criteria of the Blue Angel environmental label for Energy-Efficient Data Centre Operation (DE-UZ 161), version dated February 2015.**

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# 1. Introduction

According to a study commissioned by the Federal Ministry for Economic Affairs and Energy[1], the power consumption of data centres in Germany has more than doubled between 2001 and 2015 from 5.4 TWh per year to 12 TWh per year. By 2025, an increase to 16.4 TWh per year is expected.

Based on the experience of pilot projects and good practical examples, an energy saving potential of between 40 and 50 % in data centres can be assumed. Data centre operators see particularly large energy saving potentials in the fields of air-conditioning, use of energy-efficient servers and storage systems, virtualisation of servers, as well as in power generation and distribution.

In the Digital Agenda 2014–2017, the Federal Government has decided to step up its efforts within the framework of the Green IT Initiative of the Federal Government. This includes the reduction of energy and resource consumption in information and communication technology (ICT), the orientation towards sustainability criteria in public procurement and the implementation of green IT in business.

This guide supports public procurers in tendering for and procuring environmentally friendly data centre hardware, data centre infrastructure and data centre services.

# 2. How to use this guide

This guide itself contains the main information and recommendations relevant for the contracting authority for including environmental aspects in the tender and contractual documents. The technical performance characteristics of the hardware or services to be procured that go beyond the environmental aspects must be determined by the user and are not part of this guide.

When procuring products and services for data centres and server rooms, the priorities of the services to be provided can vary greatly. For example, ICT services can be used as a service by external companies without

1 Development of ICT-related electricity demand in Germany; study commissioned by the Federal Ministry for Economic Affairs and Energy; Fraunhofer IZM and the Borderstep Institute, Berlin November 2015; https://www.bmwi.de/Redaktion/DE/Downloads/E/entwicklung-des-ikt-bedingten-strombedarfs-in-deutschland-abschlussbericht.html.

purchase of hardware in the public sector itself. In other cases, new servers or storage systems can be purchased for private server rooms operated by private personnel. In order to take account of the different priorities, this guide provides various tenderer questionnaires, which can be combined in different ways depending on the subject matter of the contract.

The following four tenderer questionnaires are available:

- Data centre hardware
- Installation of measuring technology
- Energy monitoring
- Data centre operation

The following tables 1 and 2 are intended to help procurers to identify the requirements (sections 6.1 to 6.4) and the tenderer questionnaires to be used (Annex E). If none of the following descriptions a) to f) apply to the planned procurement, requirements that best cover the procurement subject are to be selected from the four tenderer questionnaires. The documents referred to in the tenderer questionnaires for data centre hardware and operations are to be prepared by the tenderers themselves and attached to the tender.

Table 1:

**Procurement of hardware**

| Description of the procurement subject | Tenderer questionnaire to be used |
|---|---|
| a) Construction or modernisation of a data centre or server room. The contracting authority is the owner of the rooms, the building services and the data centre hardware and operates them himself. | ▸ Data centre hardware and<br>▸ Installation of measuring technology |
| b) Extension or renewal of the hardware of a data centre or server room. The contracting authority is the owner of the rooms, the building services and the data centre hardware and operates them himself. | ▸ Data centre hardware |
| c) Procurement of hardware for use in an external data centre (e.g. data centres of a colocation provider). | ▸ Data centre hardware |

Table 2:

**Procurement of services**

| Description of the procurement subject | Tenderer questionnaire to be used |
|---|---|
| d) Operation of an existing data centre or server room by an external service provider. The contracting authority is the owner of the rooms, the building services and the data centre hardware. The personnel are provided by the service provider (IT service outsourcing). | ▸ Installation of measuring technology and<br>▸ Energy monitoring |
| e) Provision of external data centre space including infrastructure (power supply, cooling system, network connection and data centre management etc.) and of colocation or housing services. The service provider provides its own data processing centre and operates the hardware of the contracting authority (e.g. server and storage systems) on this area. | ▸ Data centre operation |
| f) Data processing service (e. g. data processing) in an external data centre (managed service provider, outsourcing / outtasking of the IT service). The service provider is the owner of both the data centre infrastructure and the hardware installed there. | ▸ Data centre operation |

The tenderer questionnaires for green procurement of data centre hardware (e.g. server, cooling system, measuring technology) or related services in data centres (e.g. data centre operation, provision of data processing, energy monitoring) can be found in Annex E or separately as a Word document at www.beschaffung-info.de and are intended to supplement to the specifications. With respect to the environmental requirements to the subject matter of the contract, thus, only a corresponding reference in the specifications is necessary in order to comply with the provision of the public procurement law according to which the performance is to be described unambiguously and comprehensively.

The tenderer questionnaire is also to be used for verification management. A corresponding formulation in the tender documents could be:

*"The [supplied products/provided services] must comply with the minimum criteria indicated in the attached "Tenderer questionnaire on the green procurement of data centre hardware/installation of measuring technology/energy monitoring/data centre operation" in order to be taken into consideration when the decision on the award of the contract is made. The evaluation criteria specified in the tenderer questionnaire are taken into consideration for tender evaluation. For verification purposes, the filled-in*

*tenderer questionnaire is to be provided with the respective individual verifications demanded therein."*

In the case of procurement of services as defined in Table 2 and the use of energy monitoring or data centre operations tenderer questionnaires, this wording is to be supplemented as follows:

*"If the data centre in which the service is provided is labelled with the Blue Angel DE-UZ 161 environmental label, the individual verifications may be omitted. The individual verifications may also be omitted if the data centre is marked with an equivalent environmental or label which requires the compliance with all minimum criteria indicated in the tenderer questionnaire. However, the numerical values requested in the tenderer questionnaire must always be stated and confirmed by means of a tenderer's declaration.*

*In addition, acceptance of the requirements for order execution set out in the tenderer questionnaire as an integral part of the contract and compliance with the requirements by the tenderer in the case of contract awarding must be affirmed in writing by the tenderer".*

# 3. Scope

This guide shall apply for products and services for data centres and server rooms. This means that the guide may be applied for procurement of data centre hardware (e.g. server, cooling system, measuring technology) as well as for procurement of services in data centres (e.g. data centre operation, data processing, energy monitoring) (compare section 2).

# 4. Definitions

- **Central Processing Unit (CPU)** is the central processing unit of a computer. Important characteristics of the CPU are clock frequency, width of the data bus, number of cores and number of concurrently executable operations (threads).
- **Energy Usage Effectiveness (EUE)** is a measure of the energy efficiency of the data centre infrastructure and describes the ratio of the annual energy consumption of the entire data centre to the energy consumption of the IT technology. The EUE is also the mean value

of the Power Usage Effectiveness (PUE) over a period of 12 months.

- **Annual Energy Efficiency Ratio (AEER)** describes the ratio of the amount of heat to be dissipated from the cooling system within one year to the electrical energy used by the entire cooling system.

- **Power Distribution Unit (PDU)** is the power distribution unit within a server room that distributes the low-voltage power to the individual IT components. For differentiated energy monitoring, so-called "intelligent PDUs" are equipped with measuring devices that record the power values and energy consumption of the individually connected devices. Via a signal bus (e.g. LAN network), the measured values are transferred to a central monitoring system.

- **Random Access Memory (RAM)** is the RAM of a computer or server. It enables fast read and write access. RAM is generally designed as a volatile semiconductor memory and due to this characteristic is not suitable for permanent archiving of data.

- **Server** refers to a computer integrated in a computer network providing software services. Servers are usually housed in shared cabinets (server racks) within a data centre and are one of the central IT components of the data centre.

- **Storage** serves for permanent storage of large data volumes. It is usually designed as rotating hard disks (Hard Disk Drive (HDD)), tape or as solid state disk (SSD).

- **Uninterruptible power supply (UPS)** is a device within a data centre's power supply that increases the reliability of supply. The UPS bridges short-term interruptions of the power supply network by means of battery operation and ensures that the servers and storage systems can be shut down in an orderly manner in the event of a prolonged power failure.

- **Virtualisation** uses the hardware of a single "physical" server for multiple parallel, software-emulated runtime environments (so-called "virtual servers"). The virtual servers can be operated independently of each other and without mutual interference, thus increasing the utilisation of physical servers. The **degree of virtualisation** of the servers describes the ratio of the number of virtual to physical servers.

# 5. Verification management

Public procurement bodies may specify in the tender that the tenderer shall verify the compliance with the performance requirements by providing certificates issued by a conformity assessment body (as per § 33 Regulation on the Award of Public Contracts (Vergabeverordnung, *VgV*) 2016) or by labels (as per § 34 *VgV* 2016; § 24 Ordinance for the procurement of goods and services below the EU thresholds (Unterschwellenvergabeordnung (*UVgO*) 2017[2]).

## 5.1 Verification through certificates by conformity assessment bodies

The verification that the technical requirements are complied with may be effected via a certificate issued by a conformity assessment body (e.g. TÜV, VDE, certified test laboratory) or a certification issued by them (as per § 33 *VgV* 2016).

If the public procurement body demands a certificate from a specific conformity assessment body, they must also recognize certificates from equivalent other conformity assessment bodies as per § 33 sec. 1 sentence 2 *VgV* 2016). The public procurement body shall also admit other forms of verification, for instance the technical file of the manufacturer (as per § 33 sec. 2 *VgV* 2016). As a precondition, the tenderer:

- had no access to the required certificates issued by a conformity assessment body or to the verifications provided by an equivalent body or
- Is not responsible for not being able to obtain the verifications from the conformity assessment body before the submission deadline for the tender.

In the two versions indicated above, the tenderer bears the burden of proof; this means that, if they are unable to verify that their offered performance complies with the technical requirements, they are excluded from the award procedure.

## 5.2 Verification by labels

The public procurement body may require a specific label for verifying the compliance with the technical specification, such as the Blue Angel environmental label (*VgV* 2016). In such case they must also accept labels which post equivalent requirements on the performance (§ 34 sec. 4 *VgV* 2016; § 24 sec. 4 *UVgO* 2017); in particular, this applies to labels of other EU member states.

If the performance does not have to meet all requirements of a label, the public procurement body shall indicate the respective requirements of the label (§ 34 sec. 3 *VgV* 2016; § 24 sec. 3 *UVgO* 2017).

2 As a Rule of Procedure, *UVgO* is put into effect with the new revision of the General Administrative Regulation on § 55 of the Federal Budget Regulations or with respective state-law regulations for the states. At national level, *UVgO* was put into effect on September 2, 2017 (circular letter of the Federal Ministry of Finance from January 9, 2017 – II A 3 - H 1012-6/16/10003:003). For implementation of *UVgO*, the budgetary provisions of the states are to be updated in the coming months.

If the tenderer is unable to provide the demanded label or an equivalent label within an adequate period, and if they are not responsible for this circumstance, the public procurement body shall also accept other suitable verification options, e.g. technical files or test reports of acknowledged bodies (§ 34 sec. 5 *VgV* 2016; § 24 sec. 5 *UVgO* 2017). The tenderer bears the burden of proof that they meet the specific requirements of the label with their alternative verification option.

## 5.3 Recommendations for verification requirements

This guide on green public procurement of products and services for data centres and server rooms allows various options for verification management. Depending on the respective criterion, the tenderer is required to provide either pure tenderer declarations (e.g. degree of virtualisation of servers), the submission of technical documentation (e.g. coolant used) or certificates from conformity assessment bodies (e.g. test protocol for efficiencies of the UPS system).

Verification of compliance with performance requirements by the Blue Angel environmental label for energy-efficient data centre operation (DE-UZ 161) is only practicable for the pure service of data centre operation (see section 6.4 and tenderer questionnaire in Annex E4), but not for the procurement of individual components. An exclusive verification of the compliance with the performance specifications by a label is only recommended if there is a sufficient number of labelled data centres offering services to the market. Only then, a competition amongst the tenderers can be guaranteed. Since it is not always clear whether the data centres awarded with the Blue Angel also offer their services to the market, it is recommended that, in addition to the environmental label, individual certificates of compliance with performance requirements should also be accepted as proof of compliance.

# 6. Environmental requirements

The following is differentiated according to environmental requirements for

- Data centre hardware, section 6.1
- Installation of measuring technology, section 6.2
- Energy monitoring, section 6.3
- Data centre operation, section 6.4

The requirements differ in the technical characteristics of the subject matter of the contract and in the requirements for execution of the order. The technical characteristics of the subject matter of the contract (e.g. hardware or building systems) must be verified when submitting the tendering together with the documents mentioned in each case

(e.g. measuring protocols). The environmental requirements for order execution (e.g. annual energy efficiency reports) must be complied with during the term of the contract. For this purpose, the tenderer declares compliance with the requirements already at the time of tendering. These requirements become part of the supply or service contract.

## 6.1 Data centre hardware

### 6.1.1 Requirements to the subject matter of the contract

If the subject matter of the contract includes the supply and installation of computer centre hardware or building services components, the following environmental requirements must be met. Requirements for components that are not the subject of procurement can be removed from the requirements catalogue.

#### 6.1.1.1 Total energy efficiency of servers

The total energy efficiency of servers (Σssj_ops/Σpower) is determined according to the SPECpower_ssj2008[3] methodology by the tenderer or specified by the server manufacturer.

**Criterion: Minimum**

The total energy efficiency (SPECpower) of the servers is at least **5,000 ssj_ops/W**.

Exception: This requirement may be deviated from in justified cases. Such cases are, for example, server architectures for which the SPECpower_ssj2008 methodology is not applicable or for which a deviating value is deliberately accepted. For such servers, the tenderer must justify the deviation from the requirement and document the energy efficiency of the server according to a suitable methodology.

**Criterion: Evaluation**

If the total energy efficiency of servers is higher than the required minimum value, this is positively taken into account for tender evaluation (compare section 7 Tender evaluation).

**Verification: Tenderer's declaration and documentation of the calculation of total energy efficiency[4]; in case of exception: Justification and other documentation**

#### 6.1.1.2 Coolant in cooling systems

**Criterion: Minimum**

**Data centres with a cooling demand > 50 $kW_{th}$**

For the cooling of data centres with a cooling demand of more than 50 $kW_{th}$ (corresponding to the connected electrical load of the data centre components to be cooled), only halogen-free coolants may be used in the cooling systems.

**Criterion: Evaluation criterion**

**Data centres with a cooling demand ≤ 50 $kW_{th}$**

In data centres with a cooling demand of up to 50 $kW_{th}$ (corresponding to the connected electrical load of the data centre components to be cooled), the use of halogen-free coolants is positively taken into account for

3 Methodology according to Standard Performance Evaluation Corporation; http://www.spec.org/power_ssj2008/.

4 As documentation, the measurement results for each server can be found directly on the website of the Standard Performance Evaluation Corporation: https://www.spec.org/power_ssj2008/results/power_ssj2008.html

tender evaluation (see section 7 Tender evaluation).

**Verification: Tenderer declaration and specification of coolants used**

#### 6.1.1.3 Cooling system energy efficiency

The Annual Energy Efficiency Ratio (AEER) of the cooling system of the data centre describes the ratio of the heat quantity $Q_{th,DC,a}$ [$MWh_{th}$/a] to the electrical work of the entire cooling system $Q_{el,CS,a}$ [$MWh_{el}$/a] to be dissipated from the data centre by the cooling system within one year (12 months).

$$AEER = \frac{Q_{th,DC,a}}{Q_{el,CS,a}}$$

For cooling systems operated with electrically operated compression cooling units, the Annual Energy Efficiency Ratio (AEER) is determined according to Annex B: Determination of key figures for the cooling system by measurements at the required locations.

As an alternative to measuring the Annual Energy Efficiency Ratio of the cooling system over a period of 12 months, the AEER value can be determined as follows:

- either on the basis of planning data from a qualified specialist planner according to the expected development condition after 12 months after commissioning for calculation of the AEER value, or
- on the basis of a load test, which simulates the expected development condition after 12 months by means of load banks and calculates the annual heat dissipation and the electrical work of the entire cooling system.

**Criterion: Minimum**

The Annual Energy Efficiency Ratio (AEER) of the cooling system must exceed a value of 7:

$$\mathbf{AEER > 7}$$

**Criterion: Evaluation criterion**

If the AEER exceeds the required minimum value, this is positively taken into account for tender evaluation (compare section 7 Tender evaluation).

Exception:

If sorption chillers are used for the cooling system instead of electrically operated compression chillers, the energy efficiency of the cooling system must be demonstrated according to the specific greenhouse gas emissions ($F_{SC}$) associated with cooling.

The specific greenhouse gas emissions of the cooling systems must comply with the following requirements:

$$\mathbf{F_{SC} < 0.09\ kg\ CO_2e/kWh_{th}}$$

For determination of the greenhouse gas emissions, the calculation rule described in Annex B: Determination of key figures for the cooling system has to be used.

In order to compare cooling systems with sorption chillers to cooling systems with compression chillers, a generic AEER value must also be determined when sorption chillers are used. This value is calculated as follows:

$$AEER = \frac{0{,}6149}{F_{SC}[kg_{CO2e}/kWh_{th}]}$$

The calculated AEER value must be specified in the tender.

**Verification: Tenderer declaration and specification of the AEER; for sorption chillers: Verification of the energy efficiency as per $F_{SC}$ according to Annex B: Determination of key figures for the cooling system**

#### 6.1.1.4 Uninterruptible power supply (UPS)

**Criterion: Minimum**

The efficiencies of the Uninterruptible Power Supplies (UPS) must be determined on the basis of a measurement according to DIN EN 62040 (or the measurement standard valid at the time of installation of the UPS system) by the UPS manufacturer or a test laboratory accredited according to DIN EN ISO/IEC 17025.

The efficiencies of the UPS must not fall below the following values for the specified load conditions:

- 92 % at an electrical output power of 100 % of the rated power
- 93 % at an electrical output power of 75 % of the rated power
- 92 % at an electrical output power of 50 % of the rated power
- 90 % at an electrical output power of 25 % of the rated power

**Verification: Documentation of efficiencies and measuring protocol**

#### 6.1.1.5 Energy-efficient power supply units

**Criterion: Minimum**

Power supply units and power supplies installed in IT components that do not fall within the scope of EC Regulation No. 278/2009[5] must meet at least the requirements of energy efficiency standard 80 PLUS GOLD[6] with regard to energy efficiency.

**Verification: Tenderer declaration, specification of the energy efficiency standard and documentation of efficiencies at 20 %, 50 % and 100 % of the rated power**

#### 6.1.1.6 Intelligent Power Distribution Units (PDUs)

The power dissipation loss must be measured in accordance with DIN EN 50564 or IEC 62301 and can be carried out on individual PDUs. Based on individual measurements, it is possible to project the total stock. The current outputs of the PDUs must be activated during the measurements, i.e. all relays or switching devices, if any, must be activated.

**Criterion: Minimum**

The power dissipation loss of intelligent PDUs must not exceed 0.5 W per available current output (socket or terminal).

**Verification: Tenderer declaration and specification of the power dissipation loss of the intelligent PDUs used in the data centre**

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5 Commission Regulation (EC) No. 278/2009 as of 6 April 2009 implementing Directive 2005/125/EC of the European Parliament and of the Council as regards ecodesign requirements for no-load power consumption of external power supply units and their average operational efficiency.

6 80 PLUS Certified Power Supplies; www.plugloadsolutions.com/80PlusPowerSupplies.aspx.

## 6.2 Installation of measuring technology

The installation of measuring technology creates the technical prerequisites for continuous measurements of the electrical performance and energy consumption of the main components of the data centre. The measurement results provide the data basis for energy monitoring and enable the operator to take targeted measures to improve the energy efficiency of the data centre and reduce its operating costs.

In addition to the installation of measuring technology, energy monitoring (see section 6.3) must also be ensured for own data centres operated by external service providers. In the case of self-operated data centres and server rooms, this monitoring must be carried out by the company's own personnel.

### 6.2.1 Requirements to the subject matter of the contract

#### 6.2.1.1 Installation of measuring points

**Criterion: Minimum**

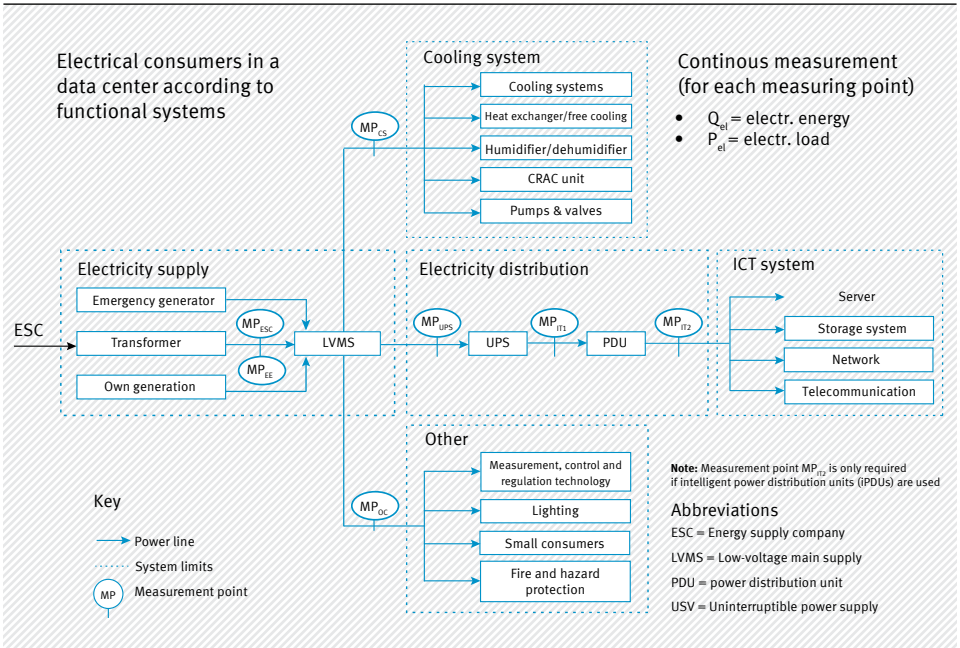
The following measuring points must be installed in the data centre on the basis of the measurement concept schematically illustrated in Figure 1:

- $MP_{DC}$: Measuring point for total data centre energy: Electrical power and electrical work to supply the entire data centre
- $MP_{EG}$: Measuring point for power generation: Electrical power and electrical work of self-generated electricity (if applicable)
- $MP_{CS}$: Measuring point for cooling system: Electrical power and electrical work of the cooling system (cooling units, heat exchangers/free coolers, humidifiers/dehumidifiers, recirculation air conditioners, pumps and valves)
- $MP_{UPS}$: Measuring point for UPS: Electrical power and electrical work at the input of the uninterruptible power supply
- $MP_{IT1}$: Measuring point for information technology 1: Electrical power and electrical work to supply the ICT system
- $MP_{IT2}$: Measuring point for information technology 2: Electrical power and electrical work to supply the ICT system
- $MP_{OC}$: Measuring point for other energy consumers: Electrical power and electrical work of other energy consumers (e.g. measurement and control technology, lighting, small consumers, fire and safety equipment)

The following illustration in Figure 1 shows the schematic arrangement of measuring points.

Figure 1:

**Arrangement of measuring points to be installed**




(source: DE-UZ 161, version dated February 2015)

The individual measuring points can also be realised by several measuring points or by means of reference measurements, which make it possible to calculate the respective measuring results.

**Verification: Tenderer declaration**

## 6.3 Energy monitoring

Energy monitoring is the key to energy-efficient operation of data centres. Energy monitoring should therefore always be implemented by the operators of data centres to enable continuous energy-related improvement of the data centre by evaluation of the monitoring results.

### 6.3.1 Requirements for execution of the order

#### 6.3.1.1 Energy monitoring

Energy monitoring must be realised with continuous measurements of the electrical performance and energy consumption of the main components of the data centre and continuous recording and evaluation of the utilisation of servers and the storage system throughout the year.

Further information on energy monitoring and measurement as well as calculation of the required values can be found in Annex A: Measuring concept, Annex B: Determination of key figures for the cooling system and Annex C: Calculation of the average IT utilisation.

The following values must be determined at least annually by means of energy monitoring:

- Energy Usage Effectiveness (EUE)
- Annual Energy Efficiency Ratio of the cooling system (AEER)

The following values must be determined at least monthly by means of energy monitoring (arrangement and designation of measuring points, compare Annex A: Measuring concept):

- Total DC power consumption ($MP_{DC}$ + $MP_{EG}$) [$kWh_{el}$]
- Total DC peak load ($MP_{DC}$ + $MP_{EG}$) [$kW_{el}$]
- IT power consumption ($MP_{IT2}$) [$kWh_{el}$]
- IT peak load ($MP_{IT2}$) [$kW_{el}$]
- Cooling system power consumption ($MP_{CS}$) [$kWh_{el}$]
- Cooling system peak load ($MP_{CS}$) [$kW_{el}$]
- UPS power consumption (loss) ($MP_{UPS}$ - $MP_{IT1}$) [$kWh_{el}$]
- PDU power consumption (loss) ($MP_{IT1}$ - $MP_{IT2}$) [$kWh_{el}$]
- Other power consumption ($MP_{OC}$) [$kWh_{el}$]
- Total DC cooling load [$kWh_{th}$]

The following values must be determined monthly by monitoring the IT load for at least 90 % of the respective IT components (CPUs, RAM, storage) (compare Annex C: Calculation of the average IT utilisation):

- Average utilisation of CPUs [%]
- Average utilisation of RAM [%]
- Average utilisation of Storage [%]

**Verification: Tenderer declaration**

#### 6.3.1.2 Annual monitoring report

At the latest 14 months after the order has been placed and during the term of the contract **every 12 months (annually)**, the tenderer is required to submit a **monitoring report** with the measured values specified in section 6.3.1.1 broken down by month and presented as annual values. The monitoring report additionally illustrates the development of the annual values since placement of the order, particularly the development of the Energy Usage Effectiveness (EUE and the Annual Energy Efficiency Ratio (AEER). Presentation of the monitoring results should indicate a continuous improvement in energy efficiency and server utilisation (if applicable).

**Verification: Tenderer declaration**

## 6.4 Data centre operation

If the service of operating data centres or server rooms is to be outsourced, energy efficiency and resource saving must be ensured in compliance with the principle of green procurement. For this purpose, the following environment-related requirements are formulated with regard to the suitability of the service provider (suitability criteria), the subject matter of the contract and the execution of the contract.

The aforementioned conditions should be included as contractual conditions in the tender documents.

### 6.4.1 Suitability criteria

#### 6.4.1.1 Energy management system

The tenderer is required to confirm that an energy management system is in place. This is to be based on DIN EN ISO 50001[7] or EMAS III[8].
The energy management system must at least cover the following:

- Written energy strategy
- Development of cross-divisional energy-saving measures (IT procurement, IT operation, building management, energy controlling, purchasing and, if necessary, sales)
- Clear regulations regarding the responsibilities for optimising energy use
- Existing continuous improvement process to optimise energy use
- Review of defined efficiency increase targets with regard to their achievement

**Verification: Certificate according to DIN EN ISO 50001, EMAS certificate or tenderer declaration with the following information: Energy strategy of the company, efficiency increase targets, optimisation measures, responsibilities and monitoring**

### 6.4.2 Requirements to the subject matter of the contract

#### 6.4.2.1 Energy Usage Effectiveness (EUE)

**Criterion: Minimum**

Energy Usage Effectiveness (EUE) is a measure of the energy efficiency of the data centre infrastructure. In order to determine the EUE value, a measurement concept in accordance with section 6.2 Installation von Messtechnik must be implemented in the data centre. On the basis of the measured energy consumption values, the EUE value must be determined according to the calculation rule described there.

Depending on the date of commissioning, the EUE of the data centre must not exceed the following values (Δt) as of the date of the tender:

**Table 3:**

**Energy Usage Effectiveness (EUE) minimum requirements**

| Data centre commissioning | EUE |
|---|---|
| 12 months ago or less ($\Delta t \leq 12$ months) | EUE ≤ 1.4 |
| 12 months to 5 years ago (12 months < $\Delta t$ < 60 months) | EUE ≤ 1.6 |
| 5 or more years ago ($\Delta t \geq 60$ months) | EUE ≤ 1.8 |

Exception: For data centres commissioned less than 12 months ago at the time of the tender and for which it was not possible to determine the EUE value by measurements

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

8 Regulation (EC) No. 121/2009 of the European Parliament and of the Council as of 25 Nov. 2009 on the voluntary participation of organisations in a community eco-management and audit scheme: ABl. EC No. L 342, S. 1, 22.12.2009.

over a period of 12 months, the EUE value expected after 12 months has to be determined as follows:

- either on the basis of planning data from a qualified specialist planner (planning according to DIN EN 50600 or comparable) according to the expected development condition after 12 months after commissioning for calculation of the EUE value, or
- on the basis of a load test, which simulates the expected development condition after 12 months by means of load banks and calculates the annual energy consumption values of the data centre and the IT systems.

**Criterion: Evaluation criterion**

If the EUE falls below the maximum admissible value, this is positively taken into account for tender evaluation (compare section 7 Tender evaluation).

**Verification: Tenderer declaration, specification of the EUE value and documentation of calculation**

#### 6.4.2.2 Cooling system energy efficiency

**Criterion: Minimum**

The Annual Energy Efficiency Ratio (AEER) of the cooling system of the data centre describes the ratio of the heat quantity $Q_{th,DC,a}$ [MWhth/a] to the electrical work of the entire cooling system $Q_{el,CS,a}$ [$MWh_{el}$/a] to be dissipated from the data centre by the cooling system within one year (12 months).

$$AEER = \frac{Q_{th,DC,a}}{Q_{el,CS,a}}$$

For cooling systems operated with electrically operated compression cooling units, the Annual Energy Efficiency Ratio (AEER) is determined according to Annex B: Determination of key figures for the cooling system by measurements at the required locations.

Depending on the date of commissioning of the cooling system, the AEER must exceed the values specified in the following table as of the date of tender (Δt):

**Table 4:**

**Annual Energy Efficiency Ratio (AEER) minimum requirements**

| Data centre Cooling system commissioning | AEER |
|---|---|
| 12 months ago or less (Δt ≤ 12 months) | AEER › 7 |
| 12 months to 5 years ago (12 months ‹ Δt ‹ 60 months) | AEER › 5 |
| 5 or more years ago (Δt ≥ 60 months) | AEER › 3.5 |

For data centres commissioned less than 12 months ago at the time of the tender and for which it was not possible to determine the AEER value by measurements over a period of 12 months, the AEER value of the cooling system has to be determined as follows:

- either on the basis of planning data from a qualified specialist planner according to the expected development condition after 12 months after commissioning for calculation of the AEER value, or
- on the basis of a load test, which simulates the expected development condition after 12 months by means of

load banks and calculates the annual heat dissipation and the electrical work of the entire cooling system.

**Criterion: Evaluation criterion**

If the AEER exceeds the required minimum value, this is positively taken into account for tender evaluation (compare section 7 Tender evaluation).

Exception:
If sorption chillers are used for the cooling system instead of electrically operated compression chillers, the energy efficiency of the cooling system must be demonstrated according to the specific greenhouse gas emissions ($F_{SC}$) associated with cooling.

The specific greenhouse gas emissions of the cooling systems must comply with the following requirements:

**Table 5:**

**Minimum requirements for specific greenhouse gas emissions of the cooling system ($F_{sc}$)**

| Cooling system commissioning | $F_{sc}$ |
|---|---|
| 12 months ago or less ($\Delta t \leq 12$ months) | $F_{SC} < 0.09$ kg $CO_{2e}/kWh_{th}$ |
| 12 months to 5 years ago (12 months $< \Delta t <$ 60 months) | $F_{SC} < 0.13$ kg $CO_{2e}/kWh_{th}$ |
| 5 or more years ago ($\Delta t \geq 60$ months) | $F_{SC} < 0.18$ kg $CO_{2e}/kWh_{th}$ |

For determination of the greenhouse gas emissions, the calculation rule described in Annex B: Determination of key figures for the cooling system has to be used.

In order to compare cooling systems with sorption chillers to cooling systems with compression chillers for tender evaluation, a generic AEER value must also be determined when sorption chillers are used. This value is calculated as follows:

$$AEER = \frac{0{,}6149}{F_{SC}\,[\mathrm{kg_{CO2e}/kWh_{th}}]}$$

The calculated AEER value must be specified in the tender.

**Verification: Tenderer declaration, specification of AEER and documentation of calculation; for sorption chillers: Verification of the energy efficiency as per $F_{sc}$ according to Annex B: Determination of key figures for the cooling system**

#### 6.4.2.3 Uninterruptible power supply (UPS)

**Criterion: Minimum**

The efficiencies of the Uninterruptible Power Supplies (UPS) must be determined on the basis of a measurement according to DIN EN 62040 (or the measurement standard valid at the time of installation of the UPS system) by the UPS manufacturer or a test laboratory accredited according to DIN EN ISO/IEC 17025.

The efficiencies of the UPS must not fall below the following values for the specified load conditions:

- 90 % at an electrical output power of 100 % of the rated power
- 85 % at an electrical output power of 75 % of the rated power

- 80 % at an electrical output power of 50 % of the rated power
- 80 % at an electrical output power of 25 % of the rated power

**Verification: Documentation of efficiencies and measuring protocol**

#### 6.4.2.4 Electricity

**Criterion: Minimum**

The data centre must cover its power consumption predominantly, i.e. more than 50 %, from renewable energies such as hydropower, photovoltaics, wind power, biomass or combined heat and power plants.

The specific greenhouse gas potential of the electricity mix used must not exceed 370 g carbon dioxide equivalents per kilowatt hour of electricity (in accordance with the electricity labelling pursuant to § 42 of the Energy Industry Act). For electricity generated wholly or partly by the company itself (e.g. CHP or photovoltaic electricity), individual verification of the specific greenhouse gas potential can be carried out in accordance with the systematics of the Energy Industry Act.

**Verification: Tenderer declaration and electricity labelling according to § 42 of the Energy Industry Act**

#### 6.4.2.5 Coolant in cooling systems

**Criterion: Minimum**

**Data centres with a cooling demand > 50 $kW_{th}$**

For the cooling of data centres with a cooling demand of more than 50 kWth (corresponding to the connected electrical load of the data centre components to be cooled), only halogen-free coolants may be used in the cooling systems.

Exception: Cooling systems commissioned before 1 January 2013 are excluded from this requirement. In this kind of system, only chlorine-free coolants may be used.

**Criterion: Evaluation criterion**

**Data centres with a cooling demand ≤ 50 $kW_{th}$**

In data centres with a cooling demand of up to 50 $kW_{th}$ (corresponding to the connected electrical load of the data centre components to be cooled), the use of halogen-free coolants is positively taken into account for tender evaluation (see section 7 Tender evaluation).

**Verification: Tenderer declaration and specification of coolants used**

#### 6.4.2.6 Preparation of an IT inventory list

**Criterion: Minimum**

The operator of the data centre presents an inventory list of the IT components used for the execution of the contract (see Annex D: IT inventory list).

The IT inventory list must include at least the following IT components:

- Servers
- External storage systems
- Network devices

Exception: Devices with a connected electrical load of less than 10 watts, of which a maximum of 5 devices of the same design are used, do not have to be included in the IT inventory list.

**Verification: IT inventory list**

### 6.4.3 Requirements for execution of the order

#### 6.4.3.1 Virtualisation of servers

Virtualisation of servers serves to improve the utilisation of data centre hardware and should therefore be used, as a rule. However, with certain server architectures this is not possible or not useful. In consultation with the responsible IT specialist planner, the procurement office should therefore only define this requirement if virtualisation is feasible.

Server virtualisation has to be applied for operation of the data centre. The average degree of virtualisation (number of virtual servers per physical server in the entire data centre) must be greater than two.

- Degree of virtualisation > 2

**Verification: Tenderer declaration**

#### 6.4.3.2 Energy monitoring

Energy monitoring must be realised with continuous measurements of the electrical performance and energy consumption of the main components of the data centre and continuous recording and evaluation of the utilisation of servers and the storage system throughout the year.

The following values must be determined at least annually by means of energy monitoring:

- Energy Usage Effectiveness (EUE) (compare section 6.4.2.1)
- Annual Energy Efficiency Ratio of the cooling system (AEER) (compare section 6.4.2.2)

The following values must be determined at least monthly by means of energy monitoring (arrangement and designation of measuring points, compare 6.2 Installation von Messtechnik):

- Total DC power consumption ($MP_{DC}$ + $MP_{EG}$) [$kWh_{el}$]
- IT power consumption ($MP_{IT2}$) [$kWh_{el}$]

**Verification: Tenderer declaration**

#### 6.4.3.3 Annual energy efficiency report

The data centre operator is required to submit an **energy efficiency report** no later than 14 months after the order is placed and **every 12 months** during the term of the contract (annually) in which his activities on energy and resource-conscious data centre operation are presented.

The energy efficiency report must document the following requirements:

1. Energy management system according to section 6.4.1.1
2. Energy Usage Effectiveness (EUE) according to section 6.4.2.1

3. Energy efficiency of the cooling system according to section 6.4.2.2

4. Efficiencies of uninterruptible power supply according to section 6.4.2.3

5. Composition of electricity according to section 6.4.2.4

6. Coolant in cooling systems according to section 6.4.2.5

7. Changes in hardware equipment of the data centre used for order execution by updating the IT inventory list in accordance with section 6.4.2.6

8. Use of virtualisation of servers according to section 6.4.3.1

9. Power consumption of IT components operated for the contracting authority as evaluation of energy monitoring in accordance with section 6.4.3.2

**Verification: Tenderer declaration**

# 7. Tender evaluation

## 7.1 Life cycle costs

Energy efficiency must be taken into account as an appropriate criterion for the procurement of energy-related goods.[9] This can be done both by taking life cycle costs into account[10] and by evaluating specific energy consumption data.[11]

If the evaluation of life cycle costs is required, the purchase of new equipment and installations should be based on a calculation of life cycle costs over the planned operating life and taken into account in the tender evaluation.

The German Environment Agency provides a calculation tool on the website http://beschaffung-info.de/ to determine the life cycle costs for data centre operation.

9 See § 67 *VgV* 2016.

10 See § 59 *VgV*.

11 Calculation of life cycle costs and references to suitable calculation tools (LCC tools) can be found in the training scripts "Green Procurement". See training script 2, "Introduction to Life Cycle Cost Calculation and Use of Life Cycle Costs in Procurement"; https://www.umweltbundesamt.de/publikationen/umweltfreundliche-beschaffung-schulungsskript-2.

In this tool, the following parameters must be specified:

- One-off payments for the procurement of the product
  - Purchase price for hardware
  - Purchase price for software
  - Purchase price for additional services
- Information on the calculation of usage-related costs
  - annual total energy consumption
  - annual cooling demand (thermal load)
  - annual license fees
  - annual costs for services
  - annual costs for consumables
  - annual costs for additional services
- One-off payments at the end of use
  - Disposal costs at the end of use, future price

These input parameters should be requested directly from the tenderer on receipt of the tender. On the basis of this data, the life cycle cost calculation tool determines the annual costs of the respective procurement option, which can be used to evaluate tenders.

## 7.2 Benefit analysis

In addition to price and life cycle costs, qualitative, environmental or social award criteria may also be taken into account for tender evaluation.[12] Such assessment criteria including weighing have to be specified to the tenderer in the call for tender.[13] When evaluating data centre hardware or data centre services, over-fulfilment of the minimum requirements should be positively taken into account.

The evaluation criteria cited in the above requirements are:

- Total energy efficiency of servers (SPECpower) (section 6.1.1.1)
- Use of halogen-free coolants for a cooling demand of up to 50 $kW_{th}$ (sections 6.1.1.2 and 6.4.2.5)
- Annual Energy Efficiency Ratio (AEER) of the cooling system (sections 6.1.1.3 and 6.4.2.2)
- Energy Usage Effectiveness (EUE) (section 6.4.2.1)

The benefit value analysis is suitable as a method for joint assessment of monetary tender conditions (prices or life cycle costs) and non-monetary tender conditions (over-fulfilment of minimum criteria). The tender conditions are converted into points, weighted and added together. The tender with the most points will then be the most economical offer. The German Environment Agency provides a calculation tool on its website http://beschaffung-info.de/, which can be used to carry out a benefit analysis of

12 See § 58 section 2 VgV 2016.

13 See § 58 section 3 VgV 2016.

products and services for data centres and server rooms. The calculation tool can be adapted to the products and services procured. In Table 6, the systematic of this benefit analysis is illustrated.

**Table 6:**

**Benefit analysis for tender evaluation**

| Evaluation criteria | Value range/ example values | Weighing [%] | Calculation of points |
|---|---|---|---|
| Financial tender conditions | 100,000 € | 50 % | Points = 100 x minimum value / tenderer value |
| Total energy efficiency of servers (SPECpower) | 4,000 .. 8,000 | 15 % | Points = 100 x tenderer value / maximum value |
| Use of halogen-free coolants for a cooling demand of up to 50 $kW_{th}$ | FALSE / TRUE | 10 % | FALSE: Points = 0, TRUE: Points = 100 |
| Annual Energy Efficiency Ratio (AEER) of the cooling system | 3.5 .. 7 | 15 % | Points = 100 x tenderer value / maximum value |
| Energy Usage Effectiveness (EUE) | 1.1 .. 1.8 | 10 % | Points = 100 x minimum value / tenderer value |

# Annex A: Measuring concept

## Installation of measuring technology

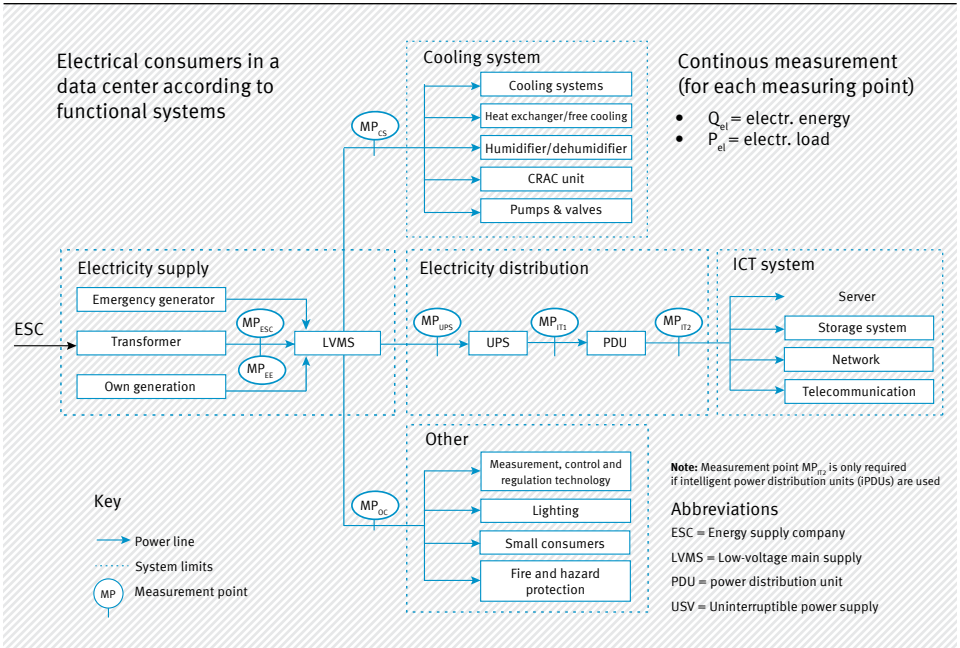
The installation of measuring technology creates the technical prerequisites for continuous measurements of the electrical performance and energy consumption of the main components of the data centre. For this purpose, a measuring concept with at least the following measuring points must be implemented. The individual measuring points can also be realised by several measuring points or by means of reference measurements, which make it possible to calculate the respective measuring results.

- $MP_{DC}$: Measuring point for total data centre energy: Electrical power and electrical work to supply the entire data centre
- $MP_{EG}$: Measuring point for power generation: Electrical power and electrical work of self-generated electricity (if applicable)
- $MP_{CS}$: Measuring point for cooling system: Electrical power and electrical work of the cooling system (cooling units, heat exchangers/free coolers, humidifiers/dehumidifiers, recirculation air conditioners, pumps and valves)
- $MP_{UPS}$: Measuring point for UPS: Electrical power and electrical work at the input of the uninterruptible power supply
- $MP_{IT1}$: Measuring point for information technology 1: Electrical power and electrical work to supply the ICT system
- $MP_{IT2}$: Measuring point for information technology 2: Electrical power and electrical work to supply the ICT system
- $MP_{OC}$: Measuring point for other energy consumers: Electrical power and electrical work of other energy consumers (e.g. measurement and control technology, lighting, small consumers, fire and safety equipment)

The following illustration in Figure 2 shows the schematic arrangement of measuring points.

Figure 2:

**Arrangement of measuring points to be installed**




(source: DE-UZ 161)

## Determination of Energy Usage Effectiveness (EUE)

The Energy Usage Effectiveness (EUE) describes the ratio of the energy consumption of the entire data centre ($Q_{el,DC,a}$ [$kWh_{el}$/a]) to the energy consumption of the entire IT system ($Q_{el,IT,a}$ [$kWh_{el}$/a]) for the period of one year.[14]

$$EUE = Q_{el,DC,a} / Q_{el,IT,a}$$

The EUE is also the mean value of the PUE (Power Usage Effectiveness) over the last 12 months.

To measure the energy consumption of the entire data centre ($Q_{el,DC,a}$) the following distinction is made:

1. Data centres that are supplied with electrical power exclusively from an energy tenderer company (ESC):

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

2. Data centres that generate additional electrical energy themselves (e.g. via a combined heat and power plant or a photovoltaic system):

$$Q_{el,DC,a} = MP_{DC} + MP_{EG}$$

14 The EUE corresponds to PUE category 2 according to *"Recommendations for Measuring and Reporting Overall Data Centre Efficiency"*. This guide have been developed by a working group consisting of the following organisations: 7x24 Exchange, ASHRAE, The Green Grid, Silicon Valley Leadership Group, U.S. Department of Energy Save Energy Now Program, U.S. Environmental Protection Agency's ENERGY STAR Program, United States Green Building Council, and Uptime Institute. The guidelines can be found under: https://www.thegreengrid.org/en/resources/library-and-tools/216-Recommendations-for-Measuring-and-Reporting-Overall-Data-Center-Efficiency-Version-2-%e2%80%93-Measuring-PUE-for-Data-Centers-(May-2011).

In order to determine the energy consumption of the entire IT system ($Q_{el,IT,a}$) the following case distinction must also be made:

1. No intelligent power distribution units (PDUs) are used in the data centre for power distribution:

$$Q_{el,IT,a} = MP_{IT1}$$

Measurements are taken directly behind the uninterruptible power supply (UPS)

2. Intelligent power distribution units (PDUs) with power dissipation loss are used in the data centre for power distribution:

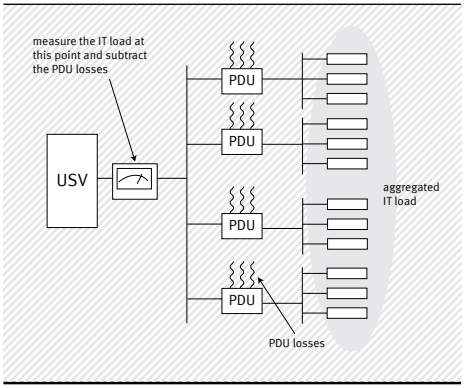
$$Q_{el,IT,a} = MP_{IT2}$$

Measurements are taken behind the PDUs. Alternatively, the PDU losses are subtracted from the amount of energy measured behind the UPS:

$$Q_{el,IT,a} = MP_{IT1} - Q_{el,PDU\_loss,a}$$

Figure 3:

**IT load measurement**




(source: DE-UZ 161)

## Further information

The value of the annual energy consumption of the entire data centre ($Q_{el,DC,a}$) corresponds to the sum of the individual loads to be taken into account as follows:

$$Q_{el,DC,a} = Q_{el,IT,a} + Q_{el,UPS,a} + Q_{el,PDU\_loss,a} + Q_{el,CS,a} + Q_{el,OC,a}$$

Assignment of the consumption values to measuring points is to be realised as follows:

$Q_{el,DC,a} = MP_{DC} + MP_{EG}$
(annual power consumption of the entire data centre)

$Q_{el,IT,a} = MP_{IT}$
(annual power consumption of IT components)

$Q_{el,CS,a} = MP_{CS}$
(annual power consumption of the cooling system)

$Q_{el,PDU\_loss,a} = MP_{IT1} - MP_{IT2}$
(annual own power consumption of the PDU)

$Q_{el,UPS,a} = MP_{UPS} - MP_{IT1}$
(annual power consumption of the UPS)

$Q_{el,OC,a} = MP_{OC}$
(annual power consumption of other consumers)

Information on $MP_{IT1}$: The power consumption of the entire IT system can only be measured at the measuring point behind the UPS if the IT equipment only is protected by the UPS. If other components such as the fans of the circulating air conditioners are protected by the UPS, these must be deducted from the measured values, or the energy

requirements of the non-IT equipment must be measured separately.

When calculating the annual energy consumption of the entire data centre ($Q_{el,DC,a}$), the energy consumption of secondary users that cannot be directly allocated to the data centre operation and are not listed in Figure 2 (e.g. offices, cafeteria, elevators or car park lighting) is not taken into account.

## Annex B: Determination of key figures for the cooling system

### Determination of the Annual Energy Efficiency Ratio (AEER)

The Annual Energy Efficiency Ratio (AEER) of the cooling system of the data centre describes the ratio of the heat quantity to the electrical work of the entire cooling system to be dissipated from the data centre by the cooling system within one year (12 months).

The annual amount of heat to be dissipated ($Q_{th,DC,a}$ [kWh/a]) is determined in accordance with VDI Guideline 2078 by summing up all power dissipation losses in the facilities to be cooled.

The annual electrical work of the entire cooling system ($Q_{el,CS,a}$ [kWh/a]) is based on the DIN V 18599 standard and results from the electrical work of all components of the entire cooling system (i.e. including the drive energy for fans, pumps, heat exchangers or sorption chillers).

Both energy values must be determined by measurement over a period of 12 months in accordance with the measuring concept illustrated in Figure 1.

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

In this case, the Annual Energy Efficiency Ratio (AEER) is calculated as follows:

$$AEER = \frac{Q_{th,DC,a}}{Q_{el,CS,a}}$$

### Determination of the specific greenhouse gas emissions of sorption chillers

When sorption chillers are used, the specific greenhouse gas emissions from cooling generation ($F_{SC}$) must be calculated and documented annually.

For this, the following calculation steps must be carried out:

Calculation of the thermal Annual Energy Efficiency Ratio of the cooling system with sorption chiller ($AEER_{th}$):

$$AEER_{th} = \frac{Q_{th,DC,a}}{Q_{th,Input\_CS,a}}$$

Calculation of the electrical Annual Energy Efficiency Ratio of the cooling system with sorption chiller ($AEER_{el}$):

$$AEER_{el} = \frac{Q_{th,DC,a}}{Q_{el,CS,a}}$$

Calculation of specific greenhouse gas emissions from cooling:

$$F_{SC} = \frac{Q_{el,CS,a} \times F_{el} + Q_{th,Input\_KS,a} \times F_{th}}{Q_{th,DC,a}} \frac{F_{el}}{AEER_{el}} + \frac{F_{th}}{AEER_{th}} \quad [kg_{CO2e}/kWh_{th}]$$

With the emission factor for electricity from the German electricity mix ($F_{el}$) in 2013[15]:

$$F_{el} = 0.559\ kg_{CO2e}/kWh_{el}$$

Deviating from this value, current emission factors can be used for electricity.

The calculation also takes into account the emission factor for thermal energy ($F_{th}$) depending on the energy source used. The origin of the respective emission factors is to be documented in the calculation. The publications of the German Environment Agency provide assistance in this regard.[16] The following table shows examples of energy sources:

**Table 7:**

**Emission factors for thermal energy**[17]

| Energy source | $F_{th}$ |
|---|---|
| Fuel oil HH/CTS | 0.321 $kg_{CO2e}/kWh_{th}$ |
| Natural gas HH/CTS | 0.251 $kg_{CO2e}/kWh_{th}$ |
| Liquid gas HH/CTS | 0.270 $kg_{CO2e}/kWh_{th}$ |
| Wood pellets | 0.023 $kg_{CO2e}/kWh_{th}$ |
| Woodchips (Forest) | 0.022 $kg_{CO2e}/kWh_{th}$ |
| Woodchips (SRP – Populus) | 0.037 $kg_{CO2e}/kWh_{th}$ |

Legend: HH=Households, CTS=Commercial trade services, SRP=Short rotation plantation

For comparison with the cooling provided by a cooling system with electrically operated compression-type chillers, the specific greenhouse gas emissions of the cooling system with alternative compression chillers must also be calculated as follows:

$$F_{CTC} = \frac{F_{el}}{AEER_{el\_CTC}} \times 1{,}1 \quad [kg_{CO2e}/kWh_{th}]$$

15 UBA 2014, development of the specific carbon dioxide emissions of the German electricity mix in the years 1990 to 2013, Internet: http://www.umweltbundesamt.de/publikationen/entwicklung-der-spezifischen-kohlendioxid-0.

16 https://www.umweltbundesamt.de/publikationen/.

17 Source: GEMIS 4.6, March 2011, Scenario: Energy: Heat - end energy-related 2010 [kWh].

The Annual Energy Efficiency Ratio of the cooling system with compression chiller ($AEER_{el\_CC}$) is applied as the minimum requirements of this guide (section 6.1.1.3 or 6.4.2.2).

The factor 1.1 within the formula for calculating the specific greenhouse gas emissions of cooling systems with compression-type chillers ($F_{CTC}$) takes into account the direct coolant emissions of the compression chillers, which also have an effect on the climate.

In order to demonstrate that the specific greenhouse gas emissions of the sorption chiller do not exceed the greenhouse gas emissions of electrically operated compression chillers, the following condition must be met:

$$F_{SC} \leq F_{CTC} \quad [kg_{CO2e}/kWh_{th}]$$

The values of $F_{SC}$ are to be documented as annual time series. The comparison value $F_{CTC}$ must respectively be specified.

## Annex C: Calculation of the average IT utilisation

In order to monitor the IT load, it is necessary to determine the average values of the utilisation of physical CPUs, RAMs and storage systems (storage) used in the physical servers and to document them in the energy efficiency report.

### Average utilisation of CPUs

To determine the average utilisation of an individual CPU (average CPUi load), the arithmetic average value of the individual utilisation during the measurement intervals is determined. Only the intervals during which the CPU was activated and thus consumed power have to be taken into account:

Average utilisation of $CPU_i$ [%]

$$= \frac{\sum_{n=1}^{measurement\ intervals} load\ CPU_i\ in\ measurement\ interval\ n}{total\ number\ of\ measurement\ intervals}$$

The average utilisation of all CPUs in the data centre (average utilisation of CPU ) is determined by means of weighting of the average individual utilisation based on CPU performance as follows:

Average utilisation of CPUs [%]

$$= \frac{\sum_{i=1}^{total\ number\ of\ CPUs} (CPU\ performance_i * load\ average\ CPU_i)}{\sum_{i=1}^{total\ number\ of\ CPUs} CPU\ performance_i}$$

The method for determining CPU performance can be selected by the user and must be documented in the energy efficiency report. The *Passmark CPU Mark*[18] is one of the methods available. To simplify things, the CPU performance per CPU can also be calculated as follows:

CPU Performancei = Clock frequencyi * Number of processor coresi * Number of Threadsi

In order to determine the average utilisation of CPUs for the data centre with sufficient accuracy, at least 90 % of all CPUs used in the data centre in servers must be covered by monitoring and included in the calculation.

18 Passmark CPU Mark; https://www.cpubenchmark.net/cpu_list.php.

## Average utilisation of RAMs

In order to determine the average utilisation of RAM, the average utilisation of the individually recorded RAM units (average utilisation of $RAM_i$) must first be calculated as follows:

Average utilisation of $RAM_i$ [%]

$$= \frac{\sum_{n=1}^{measurement\ intervals} load\ RAM_i\ in\ measurement\ interval\ n}{total\ number\ of\ measurement\ intervals}$$

The average utilisation of all RAMs in the data centre (average utilisation of RAM) is determined by means of weighting of the average individual utilisation based on the respectively available RAM capacity as follows:

Average utilisation of RAM [%]

$$= \frac{\sum_{i=1}^{total\ number\ of\ RAM\ memory\ units} (RAM\ capacity_i * load\ average\ RAM_i)}{total\ capacity\ of\ RAM\ memory\ units}$$

In order to determine the average utilisation of RAM units for the data centre with sufficient accuracy, at least 90 % of the total capacity of RAM units must be covered by monitoring and included in the calculation.

## Average utilisation of storage systems

Storage systems (storage) that must be covered by monitoring are flash-based storage systems (SSD) and storage systems with rotating hard disks (HDD). Other storage systems (e.g. magnetic tape systems) do not have to be taken into account in order to calculate the average utilisation of the storage systems.

The average utilisation of the storage systems is determined in the same way as the RAM. First, the average utilisation of the individual storage units (average utilisation Storagei) is calculated as follows:

Average utilisation of $Storage_i$ [%]

$$= \frac{\sum_{n=1}^{measurement\ intervals} load\ storage_i\ in\ measurement\ interval\ n}{total\ number\ of\ measurement\ intervals}$$

The average utilisation of all storage systems in the data centre (average utilisation of Storage) is determined by means of weighting of the average individual utilisation based on the respectively available storage capacity as follows:

Average utilisation of Storage [%]

$$= \frac{\sum_{i=1}^{total\ number\ of\ storage\ systems} (storage\ capacity_i * load\ average\ storage_i)}{total\ capacity\ storage}$$

In order to determine the average utilisation of storage systems for the data centre with sufficient accuracy, at least 90 % of the total capacity of storage systems (storage) must be covered by monitoring and included in the calculation.

## Annex D: IT inventory list

The IT inventory list contains a tabular overview of the IT components of servers, external storage systems, and network devices used for order execution with at least the following detailed information;

### Servers

1. Serial number
2. Date of commissioning
3. Manufacturer
4. Model
5. Rated power of power supply units without redundancy [W]
6. Energy-efficient standard power supply units
7. Total RAM capacity [GB]
8. SPEC-Power [∑ssj_ops/∑power]

### External storage systems

1. Serial number
2. Date of commissioning
3. Manufacturer
4. Model
5. Type of storage (z. B. HDD hard disk, tape)
6. Rated power of power supply units without redundancy [W]
7. Energy-efficient standard power supply units
8. Total storage capacity [GB]

### Network devices

1. Serial number
2. Date of commissioning
3. Manufacturer
4. Model
5. Rated power of all power supply units without redundancy [W]
6. Energy-efficient standard power supply units

Devices with a connected electrical load of less than 10 watts, of which a maximum of 5 devices of the same design are used, do not have to be included in the IT inventory list.

# Annex E: Tenderer questionnaires for green procurement of products and services for data centres and server rooms

## Annex E1: Tenderer questionnaire on green procurement of data centre hardware

| | |
|---|---|
| Product name | |
| Manufacturer | |
| Tenderer | |
| Tenderer contact details | |

### 1. Requirements to the subject matter of the contract

The hardware and components supplied must meet the following requirements for the subject matter of the order. If it is not possible to comply with the minimum criteria set out, the tender is not to be considered in awarding the contract.

Notice to the procurement office: Requirements for hardware and components that are not the subject of procurement can be removed from the requirements catalogue.

| No. | Criterion | Comment | Criterion fulfilled and verification provided[19] (To be filled in by the tenderer) |
|---|---|---|---|
| **A1** | **Total energy efficiency of servers** | | |
| A1.1 | The total energy efficiency of servers (Σssj_ops/Σpower) according to the SPECpower_ssj2008[20] methodology is at least 5,000 ssj_ops/W.<br>The technical documentation contains information on the manufacturer, model, rated power and total energy efficiency of the server (Σssj_ops/ Σpower) calculated according to the SPECpower_ssj2008 methodology. | Minimum criterion<br>Verification<br>Tenderer declaration and documentation of calculation of the total energy efficiency by the manufacturer[21] or own measurements (Annex 1) | ☐ |
| A1.2 | Die Gesamtenergieeffizienz der Server (Σssj_ops/ Σpower) berechnet nach der Methodik SPECpower_ssj2008 beträgt: _____ ssj_ops/W. | Evaluation criterion[22]<br>The height of SPECpower_ssj2008 is taken into account for tender evaluation. The tender with the highest value receives the maximum number of points. | ☐ |

19 As verification, the documents indicated under "note" shall be attached to the filled in questionnaire.
20 Methodology according to Standard Performance Evaluation Corporation; http://www.spec.org/power_ssj2008/.
21 As documentation, the measurement results for each server can be found directly on the website of the Standard Performance Evaluation Corporation: https://www.spec.org/power_ssj2008/results/power_ssj2008.html.
22 Evaluation criteria must be specified by the tenderer to enable evaluation of the tender in comparison to competitors. The tenderer with the best values - from an environmental and economic point of view - receives the maximum number of points for this evaluation criterion.

| No. | Criterion | Comment | Criterion fulfilled and verification provided[19] (To be filled in by the tenderer) |
|---|---|---|---|
| | | Verification<br>Tenderer declaration and documentation of calculation of the total energy efficiency by the manufacturer[23] or own measurements<br>(Annex 1) | |
| A1.3 | Exceptional rule:<br>The SPECpower_ssj2008 methodology cannot be used for servers. | If applicable:<br>Minimum criterion<br>Verification<br>Reasons for the deviation and documentation of the energy efficiency of the servers according to a suitable methodology.<br>(Annex 1) | ☐ |

23 As documentation, the measurement results for each server can be found directly on the website of the Standard Performance Evaluation Corporation: https://www.spec.org/power_ssj2008/results/power_ssj2008.html

| No. | Criterion | Comment | Criterion fulfilled and verification provided[19] (To be filled in by the tenderer) |
|---|---|---|---|
| **A2** | **Coolant in cooling systems** | | |
| | Cooling capacity:<br>The cooling systems have the following cooling capacity:<br>_____ $kW_{th}$<br>Coolants:<br>The following coolants are used:<br>_____ | Tenderer declaration<br>If multiple cooling systems are supplied, the summed-up values of all cooling systems must be specified.<br>Technical documentation of cooling systems with information on cooling capacity, coolants (Annex 2) | ☐ |
| | The requirements for the coolants used in cooling systems vary depending on the cooling demand of the data centre (corresponds to the connected electrical load of the data centre components to be cooled): | | |
| A2 a | Cooling demand › 50 $kW_{th}$<br>Only halogen-free coolants are used in the cooling systems. | Minimum criterion | ☐ |

| No. | Criterion | Comment | Criterion fulfilled and verification provided[19] (To be filled in by the tenderer) |
|---|---|---|---|
| A2 b | OR<br>Cooling demand › 50 $kW_{th}$<br>Optional requirement:<br>Only halogen-free coolants are used in the cooling systems. | Evaluation criterion<br>Compliance with this requirement is taken into account for tender evaluation. | ☐ |
| **A3** | **Cooling system energy efficiency** | | |
| | **AEER definition**<br>The Annual Energy Efficiency Ratio (AEER) of the cooling system of the data centre describes the ratio of the heat quantity $Q_{th,DC,a}$ [$MWh_{th/}a$] to the electrical work of the entire cooling system $Q_{el,CS,a}$ [$MWh_{el}/a$] to be dissipated from the data centre by the cooling system within one year (12 months).<br>$$AEER = \frac{Q_{th,DC,a}}{Q_{el,CS,a}}$$<br>Further details on measurement and calculation of the AEER value can be found in Annex B (determination of key figures for the cooling system) of the award basis for "Energy-Efficient Data Centre Operation" (DE-UZ 161), version dated February 2015[24]. | | |
| A3.1 | The Annual Energy Efficiency Ratio (AEER) of the cooling system complies with the requirement:<br>AEER › 7 | Minimum criterion<br>Verification<br>Tenderer declaration and specification of the AEER | ☐ |

24 Criteria for awarding the Blue Angel environmental label for energy-efficient data centre operation (DE-UZ 161); https://www.blauer-engel.de/en/products/electric-devices/rechenzentren.

| No. | Criterion | Comment | Criterion fulfilled and verification provided[19] (To be filled in by the tenderer) |
|---|---|---|---|
| A3.2 | The cooling system has the following Annual Energy Efficiency Ratio (AEER):<br><br>AEER = _____ | Evaluation criterion<br>The height of the Annual Energy Efficiency Ratio (AEER) is taken into account for tender evaluation. The tender with the highest AEER receives the maximum number of points.<br>Verification<br>Tenderer declaration and specification of the AEER | ☐ |
| A3.3 | One of the following methods for measurement or calculation of the AEER value was selected: | Minimum criterion | ☐ |
| A3.3a | One of the following methods for measurement or calculation of the AEER value was selected:<br>Calculation is realised:<br>▸ on the basis of measurements carried out over a period of 12 months in accordance with Annex B (determination of key figures for the cooling system) of the award basis for "Energy-Efficient Data Centre Operation" (DE-UZ 161), version dated February 2015 | Minimum criterion (Please check the applicable method)<br>Documentation of calculation by measurement (Annex 3) | ☐ |

| No. | Criterion | Comment | Criterion fulfilled and verification provided[19] (To be filled in by the tenderer) |
|---|---|---|---|
| A3.3b | ▸ on the basis of planning data from a qualified specialist planner (planning according to DIN EN 50600 or comparable) according to the expected development condition after 12 months after commissioning for calculation of the AEER value | Documentation of calculation by planning data (Annex 3) | ☐ |
| A3.3c | ▸ on the basis of a load test, which simulates the expected development condition after 12 months by means of load banks and calculates the annual heat dissipation and the electrical work of the entire cooling system. | Documentation of the calculation by measurement based on load tests (Annex 3) | ☐ |

| No. | Criterion | Comment | Criterion fulfilled and verification provided[19] (To be filled in by the tenderer) |
|---|---|---|---|
| A3.4 | OR (please check if applicable)<br>Exception for sorption chillers:<br>One or more sorption chillers are used to cool the data centre.<br>The specific greenhouse gas emissions of the cooling system were determined according to the calculation rule in accordance with Annex B (determination of key figures for the cooling system) of the award basis for "Energy-Efficient Data Centre Operation" (DE-UZ 161), version dated February 2015. | Tenderer declaration | ☐ |
| A3.5 | The specific greenhouse gas emissions (FSC) comply with the requirement:<br>$F_{SC}$ ‹ 0.09 $kg_{CO2e}/kWh_{th}$<br>The specific greenhouse gas emissions ($F_{SC}$) associated with cooling are:<br>$F_{SC}$ = _____ $kg_{CO2e}/kWh_{th}$ | Minimum criterion | ☐ |

| No. | Criterion | Comment | Criterion fulfilled and verification provided[19] (To be filled in by the tenderer) |
|---|---|---|---|
| A3.6 | In accordance with the calculation rule in accordance with Annex B (determination of key figures for the cooling system) of the award basis for "Energy-Efficient Data Centre Operation" (DE-UZ 161), version dated February 2015, this corresponds to an AEER value of:<br>$AEER = \frac{0{,}6149}{F_{SC}\ [\mathrm{kg_{CO2e}/kWh_{th}}}$<br>AEER = _____ | Evaluation criterion<br>The height of the generic Annual Energy Efficiency Ratio (AEER) is taken into account for tender evaluation. The tender with the highest AEER receives the maximum number of points.<br>Verification: Documentation of calculation (Annex 3) | ☐ |

<table>
<tr><th>No.</th><th>Criterion</th><th>Comment</th><th>Criterion fulfilled and verification provided[19] (To be filled in by the tenderer)</th></tr>
<tr><td>A4</td><td>Uninterruptible power supply (UPS)</td><td></td><td></td></tr>
<tr><td></td><td>The efficiencies of the Uninterruptible Power Supplies (UPS) comply with all of the following requirements:<br><br><table><tr><th>Ratio of output power to rated power</th><th>Efficiency (actual value) (please complete)</th><th>Requirement (exclusion criteria)</th></tr><tr><td>100 %</td><td>$\eta_{100}$ = _____</td><td>$\eta_{100} \geq 92\%$</td></tr><tr><td>75 %</td><td>$\eta_{75}$ = _____</td><td>$\eta_{75} \geq 93\%$</td></tr><tr><td>50 %</td><td>$\eta_{50}$ = _____</td><td>$\eta_{50} \geq 92\%$</td></tr><tr><td>25 %</td><td>$\eta_{25}$ = _____</td><td>$\eta_{25} \geq 90\%$</td></tr></table><br>A measuring protocol according to DIN EN 62040 (or the measurement standard valid at the time of installation of the UPS system) by the UPS manufacturer or a test laboratory accredited according to DIN EN ISO/IEC 17025 must be attached.</td><td>Minimum criterion<br><br><u>Verification</u><br>Documentation of efficiencies and measuring protocol (Annex 4)</td><td>☐</td></tr>
</table>

<table>
<tr><th>No.</th><th>Criterion</th><th>Comment</th><th>Criterion fulfilled and verification provided[19] (To be filled in by the tenderer)</th></tr>
<tr><td>A5</td><td>Energy-efficient power supply units</td><td></td><td></td></tr>
<tr><td>A5.1</td><td>Power supply units and power supplies installed in IT components that do not fall within the scope of EC Regulation No. 278/2009 meet at least the requirements of energy efficiency standard 80 PLUS GOLD[25] with regard to energy efficiency.<br>Optionally (please check as applicable):<br>▸ The power supply units are external power supplies which fall within the scope of EC Regulation No. 278/2009 and for which the EC Regulation establishes ecodesign requirements for power consumption at zero load and average operational efficiency.<br>▸ The power supply units are marked with the following energy efficiency standard:<br>_____</td><td>Minimum criterion<br><br>Verification<br>Tenderer declaration</td><td></td></tr>
<tr><td>A5.2</td><td>The power supply units have the following efficiencies:<br><table><tr><th>Ratio of output power to rated power</th><th>Efficiency (actual value) (please complete)</th><th>Requirement (exclusion criteria)</th></tr><tr><td>20 %</td><td>$\eta_{20}$ = _____</td><td>$\eta_{20} \geq 90\%$</td></tr><tr><td>50 %</td><td>$\eta_{50}$ = _____</td><td>$\eta_{50} \geq 92\%$</td></tr><tr><td>100 %</td><td>$\eta_{100}$ = _____</td><td>$\eta_{100} \geq 89\%$</td></tr></table></td><td>Tenderer declaration</td><td>☐</td></tr>
</table>

25 80 PLUS Certified Power Supplies; http://www.plugloadsolutions.com/80PlusPowerSupplies.aspx.

| No. | Criterion | Comment | Criterion fulfilled and verification provided[19] (To be filled in by the tenderer) |
|---|---|---|---|
| **A6** | **Intelligent Power Distribution Units (PDUs)** | | |
| | The power dissipation loss of intelligent Power Distribution Units (PDUs) does not exceed 0.5 W per available current output (socket or terminal).<br><br>It is _____ W per available current output. | Exclusion criterion<br>Verification<br>Tenderer declaration and specification of the power dissipation loss of the intelligent PDUs used in the data centre<br>(Annex 5) | ☐ |

Annexs:
(Note: Annexs are to be prepared by the tenderers themselves and attached to the tender).

Annex 1: Total energy efficiency of servers (SPECpower_ssj2008)

Annex 2: Technical documentation of cooling systems

Annex 3: Documentation and calculation of the cooling system energy efficiency

Annex 4: Measuring protocol and efficiencies of the uninterruptible power supply (UPS)

Annex 5: Power dissipation loss of intelligent Power Distribution Units (PDUs)

## Annex E2: Tenderer questionnaire on green procurement of the installation of measuring technology

| | |
|---|---|
| Designation of the tender | |
| Tenderer | |
| Address of the tenderer | |

## 1. Requirements to the subject matter of the contract

The service provided must meet the following requirements for the subject matter of the order. If it is not possible to comply with the minimum criteria set out, the tender is not to be considered for awarding the contract.

| No. | Criterion | Comment | Criterion fulfilled[26] (To be filled in by the tenderer) |
|---|---|---|---|
| **A1** | **Installation of measuring points** | | |
| | The installation of measuring technology creates the technical prerequisites for continuous measurements of the electrical performance and energy consumption of the main components of the data centre.<br>For this purpose, the tenderer must declare that the following measuring points have been installed according to figure 1 and make them available for continuous measurement.[27] | | |
| A1.1 | $MP_{DC}$: Measuring point for total data centre energy: Electrical power and electrical work to supply the entire data centre | Minimum criterion | ☐ |
| A1.2 | $MP_{EG}$: Measuring point for power generation: Electrical power and electrical work of self-generated electricity (if applicable) | Minimum criterion | ☐ |

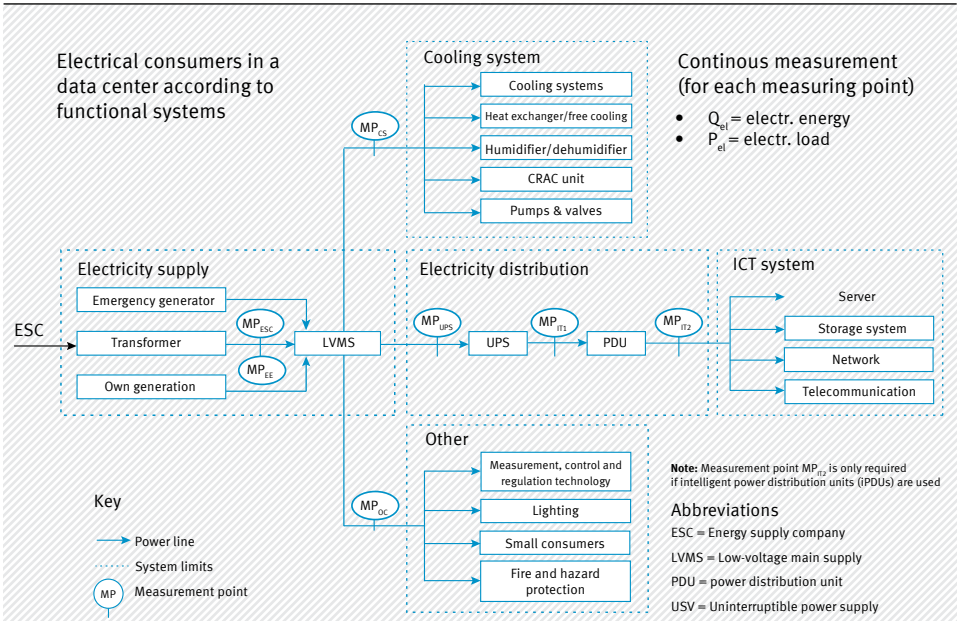
26 As verification, the documents indicated under "note" shall be attached to the filled in questionnaire.

27 The individual measuring points can also be realised by several measuring points or by means of reference measurements, which make it possible to calculate the respective measuring results. If this is the case, the requirements are also considered fulfilled.

| No. | Criterion | Comment | Criterion fulfilled[26] (To be filled in by the tenderer) |
|---|---|---|---|
| A1.3 | $MP_{CS}$: Measuring point for cooling system: Electrical power and electrical work of the cooling system (cooling units, heat exchangers/free coolers, humidifiers/dehumidifiers, recirculation air conditioners, pumps and valves) | Minimum criterion | ☐ |
| A1.4 | $MP_{UPS}$: Measuring point for UPS: Electrical power and electrical work at the input of the uninterruptible power supply | Minimum criterion | ☐ |
| A1.5 | $MP_{IT1}$: Measuring point for information technology 1: Electrical power and electrical work to supply the ICT system | Minimum criterion | ☐ |
| A1.6 | $MP_{IT2}$: Measuring point for information technology 2: Electrical power and electrical work to supply the ICT system | Minimum criterion | ☐ |
| A1.7 | $MP_{OC}$: Measuring point for other energy consumers: Electrical power and electrical work of other energy consumers (e.g. measurement and control technology, lighting, small consumers, fire and safety equipment) | Minimum criterion | ☐ |

Figure 1:

## Arrangement of measuring points to be installed




(Source: Criteria for awarding the Blue Angel environmental label for energy-efficient data centre operation (DE-UZ 161); version dated February 2015 https://www.blauer-engel.de/en/products/electric-devices/data-centers-until-12-2019

## Annex E3: Tenderer questionnaire on green procurement of energy monitoring services in data centres

| | |
|---|---|
| Designation of the tender | |
| Tenderer | |
| Address of the tenderer | |

## 1. Requirements for execution of the order

The service provided for energy monitoring in data centres meets the following requirements. If it is not possible to comply with the minimum criteria set out, the tender is not to be considered for awarding the contract.

| No. | Criterion | Comment | Criterion fulfilled[28] (To be filled in by the tenderer) |
|---|---|---|---|
| **V1** | **Energie-Monitoring** | | |
| | Energy monitoring must be realised with continuous measurements of the electrical performance and energy consumption of the main components of the data centre and continuous recording and evaluation of the utilisation of servers and the storage system throughout the year.<br>Further details on energy monitoring and measurement as well as calculation of the required values can be found in the award basis for "Energy-Efficient Data Centre Operation" (DE-UZ 161), version dated February 2015[29]. | | |
| | The tenderer declares that the following values are determined at least annually on order execution for energy monitoring: | Verification<br>Tenderer declaration | |
| V1.1 | ▸ Energy Usage Effectiveness (EUE) | Minimum criterion | ☐ |
| V1.2 | ▸ Annual Energy Efficiency Ratio of the cooling system (AEER) | Minimum criterion | ☐ |

28 As verification, the documents indicated under "note" shall be attached to the filled in questionnaire.

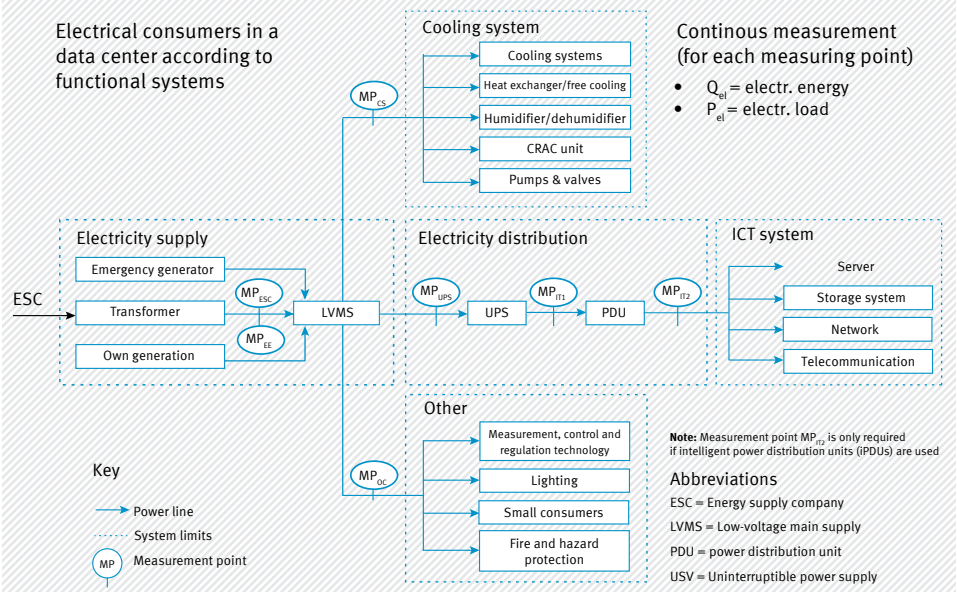
29 Criteria for awarding the Blue Angel environmental label for energy-efficient data centre operation (DE-UZ 161); https://www.blauer-engel.de/de/produktwelt/buero/rechenzentren.

| No. | Criterion | Comment | Criterion fulfilled[28] (To be filled in by the tenderer) |
|---|---|---|---|
| | The following values are determined at least monthly by means of energy monitoring (arrangement and designation of measuring points, compare figure 1): | Verification Tenderer declaration | ☐ |
| V1.3 | ▸ Total DC power consumption ($MP_{DC}$ + $MP_{EG}$) [$kWh_{el}$] | Minimum criterion | ☐ |
| V1.4 | ▸ Total DC peak load ($MP_{DC}$ + $MP_{EG}$) [$kW_{el}$] | Minimum criterion | ☐ |
| V1.5 | ▸ IT power consumption ($MP_{IT2}$) [$kWh_{el}$] | Minimum criterion | ☐ |
| V1.6 | ▸ IT peak load ($MP_{IT2}$) [$kW_{el}$] | Minimum criterion | ☐ |
| V1.7 | ▸ Cooling system power consumption ($MP_{CS}$) [$kWh_{el}$] | Minimum criterion | ☐ |
| V1.8 | ▸ Cooling system peak load ($MP_{CS}$) [$kW_{el}$] | Minimum criterion | ☐ |
| V1.9 | ▸ UPS power consumption (loss) ($MP_{UPS}$ - $MP_{IT1}$) [$kWh_{el}$] | Minimum criterion | ☐ |
| V1.10 | ▸ PDU power consumption (loss) ($MP_{IT1}$ - $MP_{IT2}$) [kWhel] | Minimum criterion | ☐ |
| V1.11 | ▸ Other power consumption ($MP_{OC}$) [$kWh_{el}$] | Minimum criterion | ☐ |
| V1.12 | ▸ Total DC cooling load [kWhth]<br>The following values are determined monthly by monitoring the IT load for at least 90 % of the respective IT components (CPUs, RAM, storage) (compare “Annex C: Calculation of the average IT utilisation” of award basis (DE-UZ 161): | Minimum criterion<br>Verification Tenderer declaration | ☐ |
| V1.13 | ▸ Average utilisation of CPUs [%] | Minimum criterion | ☐ |
| V1.14 | ▸ Average utilisation of RAM [%] | Minimum criterion | ☐ |
| V1.15 | ▸ Average utilisation of Storage [%] | Minimum criterion | ☐ |

| No. | Criterion | Comment | Criterion fulfilled[28] (To be filled in by the tenderer) |
|---|---|---|---|
| **V2** | **Annual monitoring report** | | |
| V2.1 | At the latest 14 months after the order has been placed and during the term of the contract every 12 months (annually), a monitoring report with the measured values specified in section A1 broken down by month and presented as annual values is presented. | Minimum criterion | ☐ |
| V2.2 | The monitoring report additionally illustrates the development of the annual values since the start of energy monitoring, particularly the development of the Energy Usage Effectiveness (EUE) and the Annual Energy Efficiency Ratio (AEER) of the cooling system. | Minimum criterion | ☐ |

Figure 1:

**Arrangement of measuring points**




(Source: Criteria for awarding the Blue Angel environmental label for energy-efficient data centre operation (DE-UZ 161); version dated February 2015 https://www.blauer-engel.de/de/produktwelt/buero/rechenzentren)

## Annex E4: Tenderer questionnaire on green procurement of data centre operation services

| | |
|---|---|
| Designation of the tender | |
| Tenderer | |
| Address of the tenderer | |

| **Is the Blue Angel environmental label present?** | |
|---|---|
| The data centre in which the service is offered is certified with the Blue Angel environmental label for energy efficient data centre operation (DE-UZ 161)[30].<br>Label usage contract no.: __<br>Verification: Copy of the certification document<br>If this is the case, additional documents (Annexs) for verification of compliance with the criteria stated in the following questionnaire are not required. However, the values requested in the questionnaire must be provided and confirmed by the provider. | ☐ Yes |
| **Equivalent label present?** | |
| The data centre in which the service is provided is certified with an equivalent label.<br>Designation of the label: __<br>If this is the case, the tenderer has the option to alternatively present the equivalent label according to § 34 of the regulation on the award of public contracts[31] (VgV). On the basis of the following questionnaire and the required Annexs, the tenderer is required to demonstrate that equivalence is given. | ☐ Yes |

30 Criteria for awarding the Blue Angel environmental label for energy-efficient data centre operation (DE-UZ 161); https://www.blauer-engel.de/de/produktwelt/buero/rechenzentren.

31 Regulation on the award of public contracts (Vergabeverordnung – VgV) in the version of the regulation on the modernisation of procurement law (Vergaberechtsmodernisierungsverordnung – VergRMod-VO) dated 12 April 2016 (BGBl. [Bundesgesetzblatt, German federal law gazette] I p. 624).

| Is there no equivalent label present? | |
|---|---|
| The data centre is neither certified with the Blue Angel environmental label for energy-efficient data centre operation nor with an equivalent label.<br>On the basis of the following questionnaire and the required Annexs, the tenderer is required to demonstrate that service meets the specified criteria. | ☐ Yes |

## 1. Suitability criteria

In order to prove suitability for the performance of this service, the tenderer is required to submit the following proofs of suitability.[32]

| No. | Criterion | Comment | Criterion fulfilled and verification provided [33] (To be filled in by the tenderer) |
|---|---|---|---|
| **E1** | **Energy management system** | | |
| E1.1 | The data centre uses an energy management system in compliance with DIN EN ISO 50001[34] or EMAS[35]. | Tenderer declaration | ☐ |
| | The energy management system must at least cover the following: | | |
| E1.2 | ▸ Written energy strategy | | ☐ |

32 Compare § 42 and § 49 VgV 2016; Regulation on the award of public contracts (Vergabeverordnung – VgV) in the version of the regulation on the modernisation of procurement law (Vergaberechtsmodernisierungsverordnung – VergRMod-VO) dated 12 April 2016 (BGBl. [Bundesgesetzblatt, German federal law gazette] year 2016 Part I No. 16, S. 624).

33 As verification, the documents indicated under "note" shall be attached to the filled in questionnaire.

34 DIN EN ISO 50001: Energy management systems – Requirements with guidance for use.

35 Regulation (EC) No. 121/2009 of the European Parliament and of the Council as of 25 Nov. 2009 on the voluntary participation of organisations in a community eco-management and audit scheme: ABl. EC No. L 342, S. 1, 22.12.2009.

| No. | Criterion | Comment | Criterion fulfilled and verification provided [33] (To be filled in by the tenderer) |
|---|---|---|---|
| E1.3 | ▸ Development of cross-divisional energy-saving measures (IT procurement, IT operation, building management, energy controlling, purchasing and, if necessary, sales) | | ☐ |
| E1.4 | ▸ Clear regulations regarding the responsibilities for optimising energy use | | ☐ |
| E1.5 | ▸ Existing continuous improvement process to optimise energy use | | ☐ |
| E1.6 | ▸ Review of defined efficiency increase targets with regard to their achievement | | ☐ |

## 2. Requirements to the subject matter of the contract

The service provided is provided by a data centre that meets the following requirements for the subject matter of the contract. If it is not possible to comply with the minimum criteria set out, the tender is not to be considered for awarding the contract.

| No. | Criterion | Comment | Criterion fulfilled and verification provided[36] (To be filled in by the tenderer) |
|---|---|---|---|
| **A1** | **Time of data centre commissioning** | | |
| E1.1 | The requirements vary depending on the time of commissioning of the data centre. This takes account of the fact that newer data centres can use more efficient technology due to technical progress. However, the continued operation of older data centres offers environmental benefits for resource conservation that are not taken into account by the energy efficiency ratios.<br>The tenderer is therefore required to provide information regarding the commissioning time of the data centre and state the age of the data centre at the time of the tender ($\Delta t_{DC}$): | | |
| | Time of tender: _____ (month/year)<br>Data centre commissioning: _____ (month/year)<br>Age of data centre ($\Delta t_{DC}$): _____ (months) | Tenderer declaration | ☐ |
| **A2** | **Energy Usage Effectiveness (EUE)** | | |
| | **EUE definition**<br>The Energy Usage Effectiveness (EUE) is a measure of the energy efficiency of a data centre and is calculated as the ratio of the power consumption of the entire data centre ($Q_{el,ESC,a}$ + $Q_{el,EG,a}$ [kWhel/a]) measured within one year to the power consumption of the information technology ($Q_{el,IT,a}$ [$kWh_{el}$/a]) over a period of 12 months. | | |

36 As verification, the documents indicated under "note" shall be attached to the filled in questionnaire.

<table>
<tr><th>No.</th><th>Criterion</th><th>Comment</th><th>Criterion fulfilled and verification provided[36] (To be filled in by the tenderer)</th></tr>
<tr><td>A2.1</td><td>Further details on power consumption measurement, measuring point arrangement and EUE calculation can be found in Annex A (measuring concept) of the award basis for “Energy-Efficient Data Centre Operation” (DE-UZ 161), version dated February 2015[37].<br><br>The Energy Usage Effectiveness (EUE) of the data centre complies with the following requirements:<br><br>
<table>
<tr><th>Selection</th><th>Data centre commissioning</th><th>EUE requirement</th></tr>
<tr><td>☐</td><td>up to 12 months ago ($\Delta t_{DC} \leq 12$ months)</td><td>EUE ≤ 1.4</td></tr>
<tr><td>☐</td><td>12 months to 5 years ago (12 months ‹ $\Delta t_{DC}$ ‹ 60 months)</td><td>EUE ≤ 1.6</td></tr>
<tr><td>☐</td><td>5 or more years ago ($\Delta t_{DC} \geq 60$ months)</td><td>EUE ≤ 1.8</td></tr>
</table>
</td><td>Minimum criterion[38]</td><td>☐</td></tr>
</table>

37 Criteria for awarding the Blue Angel environmental label for energy-efficient data centre operation (DE-UZ 161); https://www.blauer-engel.de/de/produktwelt/buero/rechenzentren.

38 Exclusion criteria must be adhered to by the tenderer in order not to be excluded from awarding the contract.

| No. | Criterion | Comment | Criterion fulfilled and verification provided[36] (To be filled in by the tenderer) |
|---|---|---|---|
| A2.2 | The data centre has the following Energy Usage Effectiveness (EUE):<br>EUE = _____ | Evaluation criterion[39]<br>The height of the EUE is taken into account for tender evaluation. The tender with the lowest EUE receives the maximum number of points. | ☐ |
| A2.3a | The EUE value was determined on the basis of measurements carried out over a period of 12 months in accordance with Annex A (measuring concept) of the award basis for "Energy-Efficient Data Centre Operation" (DE-UZ 161), version dated February 2015.<br>The end of the measurement period is no more than six months prior to the date of the tender. | Minimum criterion<br>Verification:<br>Documentation of calculation by measurement (Annex 1) | ☐ |

39 Evaluation criteria must be specified by the tenderer to enable evaluation of the tender in comparison to competitors. The tenderer with the best values – from an environmental and economic point of view - receives the maximum number of points for this evaluation criterion.

| No. | Criterion | Comment | Criterion fulfilled and verification provided[36] (To be filled in by the tenderer) |
|---|---|---|---|
| | OR (please check if applicable):<br>Exception for new data centres:<br>Operation of a new data centre, which was commissioned less than 12 months ago when the tender was submitted.<br>The EUE value expected after 12 months was determined: | The following two options are only applicable as exceptions for new data centres ($\Delta t_{DC} \leq 12$ months) | |
| A2.3b | ▸ on the basis of planning data from a qualified specialist planner (planning according to DIN EN 50600 or comparable) according to the expected development condition after 12 months after commissioning for calculation of the EUE value | Minimum criterion<br>Verification:<br>Documentation of calculation by planning data (Annex 1) | ☐ |
| A2.3c | ▸ on the basis of a load test, which simulates the expected development condition after 12 months by means of load banks and calculates the annual energy consumption values of the data centre and the IT systems. | Minimum criterion<br>Verification:<br>Documentation of the calculation by measurement based on load tests (Annex 1) | ☐ |

| No. | Criterion | Comment | Criterion fulfilled and verification provided[36] (To be filled in by the tenderer) |
|---|---|---|---|
| **A3** | **Time of cooling system commissioning** | | |
| | The cooling system includes all technical equipment for cooling the data centre (e.g. cooling installations, fans, pumps, evaporators, heat exchangers, etc.; see DIN V 18599).<br>The requirements for the cooling system vary depending on the time of commissioning. This takes account of the fact that newer cooler systems can use more efficient technology due to technical progress. However, the continued operation of older cooling systems offers environmental benefits for resource conservation that are not taken into account by the energy efficiency ratios.<br>The tenderer is therefore required to provide information regarding the commissioning time of the cooling system and state the age of the cooling system at the time of the tender ($\Delta t_{CS}$): | | |
| | Time of tender: _____ (month/year)<br>Cooling system commissioning: _____ (month/year)<br>Age of cooling system ($\Delta t_{CS}$): _____ (months) | Tenderer declaration | ☐ |

<table>
<tr><th>No.</th><th>Criterion</th><th>Comment</th><th>Criterion fulfilled and verification provided[36] (To be filled in by the tenderer)</th></tr>
<tr><td>A4</td><td colspan="3">Cooling system energy efficiency</td></tr>
<tr><td></td><td colspan="3">AEER definition<br>The Annual Energy Efficiency Ratio (AEER) of the cooling system of the data centre describes the ratio of the heat quantity $Q_{th,DC,a}$ [$MWh_{th}$/a] to the electrical work of the entire cooling system $Q_{el,CS,a}$ [$MW_{hel}$/a] to be dissipated from the data centre by the cooling system within one year (12 months).<br>$$AEER = \frac{Q_{th,DC,a}}{Q_{el,CS,a}}$$<br>Further details on measurement and calculation of the AEER value can be found in Annex B (determination of key figures for the cooling system) of the award basis for “Energy-Efficient Data Centre Operation” (DE-UZ 161), version dated February 2015.</td></tr>
<tr><td>A4.1</td><td colspan="3">The Annual Energy Efficiency Ratio (AEER) of the cooling system complies with the following requirements:<br><table><tr><th>Selection</th><th>Data centre commissioning</th><th>EUE requirement</th></tr><tr><td>☐</td><td>12 months ago or less ($\Delta t_{CS} \leq 12$ months)</td><td>AEER › 7</td></tr><tr><td>☐</td><td>12 months to 5 years ago (12 months ‹ $\Delta t_{CS}$ ‹ 60 months)</td><td>AEER › 5</td></tr><tr><td>☐</td><td>5 or more years ago ($\Delta t_{CS} \geq 60$ months)</td><td>AEER › 3.5</td></tr></table></td><td></td><td>☐</td></tr>
</table>

| No. | Criterion | Comment | Criterion fulfilled and verification provided[36] (To be filled in by the tenderer) |
|---|---|---|---|
| A4.2 | The cooling system has the following Annual Energy Efficiency Ratio (AEER):<br>AEER = _____ | Evaluation criterion<br>The height of the Annual Energy Efficiency Ratio (AEER) is taken into account for tender evaluation. The tender with the highest AEER receives the maximum number of points. | ☐ |
| A4.3a | The AEER value was determined on the basis of measurements carried out over a period of 12 months in accordance with Annex B (determination of key figures for the cooling system) of the award basis for "Energy-Efficient Data Centre Operation" (DE-UZ 161), version dated February 2015 | Minimum criterion<br>Verification:<br>Documentation of calculation by measurement (Annex 2) | ☐ |

| No. | Criterion | Comment | Criterion fulfilled and verification provided[36] (To be filled in by the tenderer) |
|---|---|---|---|
| | OR (please check if applicable)<br>Exception for new data centres:<br>Operation of a new data centre, which was commissioned less than 12 months ago when the tender was submitted.<br>The AEER value expected after 12 months was determined: | The following two options are only applicable as exceptions for new data centres ($\Delta t_{DC} \leq$ 12 months) | |
| A4.3b | ▸ on the basis of planning data from a qualified specialist planner (planning according to DIN EN 50600 or comparable) according to the expected development condition after 12 months after commissioning for calculation of the AEER value | Minimum criterion<br>Verification:<br>Documentation of calculation by planning data (Annex 2) | ☐ |
| A4.3c | ▸ on the basis of a load test, which simulates the expected development condition after 12 months by means of load banks and calculates the annual heat dissipation and the electrical work of the entire cooling system | Minimum criterion<br>Verification:<br>Documentation of the calculation by measurement based on load tests (Annex 2) | ☐ |

<table>
<tr><th>No.</th><th>Criterion</th><th>Comment</th><th>Criterion fulfilled and verification provided[36] (To be filled in by the tenderer)</th></tr>
<tr><td>A4.4</td><td><u>OR (please check if applicable)</u><br><u>Exception for sorption chillers:</u><br>One or more sorption chillers are used to cool the data centre.<br>If this is the case, the specific greenhouse gas emissions of the cooling system were determined according to the calculation rule in accordance with Annex B (determination of key figures for the cooling system) of the award basis for “Energy-Efficient Data Centre Operation” (DE-UZ 161), version dated February 2015.</td><td>Tenderer declaration</td><td>☐</td></tr>
<tr><td>A4.5</td><td>The specific greenhouse gas emissions ($F_{SC}$) comply with the following requirements:<br><table><tr><th>Selection</th><th>Data centre commissioning</th><th>EUE requirement</th></tr><tr><td>☐</td><td>12 months ago or less ($\Delta t_{CS} \leq 12$ months)</td><td>$F_{SC} < 0.09$ $kg_{CO2e}/kWh_{th}$</td></tr><tr><td>☐</td><td>12 months to 5 years ago (12 months $< \Delta t_{CS} <$ 60 months)</td><td>$F_{SC} < 0.13$ $kg_{CO2e}/kWh_{th}$</td></tr><tr><td>☐</td><td>5 or more years ago ($\Delta t_{CS} \geq 60$ months)</td><td>$F_{SC} < 0.18$ $kg_{CO2e}/kWh_{th}$</td></tr></table></td><td>Minimum criterion</td><td>☐</td></tr>
</table>

| No. | Criterion | Comment | Criterion fulfilled and verification provided[36] (To be filled in by the tenderer) |
|---|---|---|---|
| A4.6 | The specific greenhouse gas emissions (FSC) associated with cooling are:<br>$F_{SC}$ = _____ $kg_{CO2e}/kWh_{th}$ | Tenderer declaration<br>Verification: Documentation of calculation (Annex 2) | ☐ |
| A4.7 | In accordance with the calculation rule in accordance with Annex B (determination of key figures for the cooling system) of the award basis for "Energy-Efficient Data Centre Operation" (DE-UZ 161), version dated February 2015, this corresponds to an AEER value of:<br>$$AEER = \frac{0{,}6149}{F_{SC}\,(kg_{CO2e}/kWh_{th})}$$<br>AEER = _____ | Evaluation criterion<br>The height of the generic Annual Energy Efficiency Ratio (AEER) is taken into account for tender evaluation. The tender with the highest AEER receives the maximum number of points.<br>Verification: Documentation of calculation (Annex 2) | ☐ |

<table>
<tr><th>No.</th><th>Criterion</th><th>Comment</th><th>Criterion fulfilled and verification provided[36] (To be filled in by the tenderer)</th></tr>
<tr><td>A5</td><td>Uninterruptible power supply</td><td></td><td></td></tr>
<tr><td></td><td>The efficiencies of the Uninterruptible Power Supplies (UPS) comply with all of the following requirements:<br><table><tr><th>Ratio of output power to rated power</th><th>Efficiency (actual value) (please complete)</th><th>Requirement (minimum criteria)</th></tr><tr><td>100 %</td><td>$\eta_{100}$ = _____</td><td>$\eta_{100} \geq 90$ %</td></tr><tr><td>75 %</td><td>$\eta_{75}$ = _____</td><td>$\eta h_{75} \geq 85$ %</td></tr><tr><td>50 %</td><td>$\eta_{50}$ = _____</td><td>$\eta_{50} \geq 80$ %</td></tr><tr><td>25 %</td><td>$\eta_{25}$ = _____</td><td>$\eta_{25} \geq 80$ %</td></tr></table></td><td>Minimum criterion<br><br><u>Verification:</u> Measuring protocol (Annex 3)</td><td>☐</td></tr>
<tr><td>A6</td><td>Electricity</td><td></td><td></td></tr>
<tr><td>A6.1</td><td>The data centre covers its power consumption predominantly, i.e. more than 50 %, from renewable energies such as hydropower, photovoltaics, wind power, biomass or combined heat and power plants (CHP).<br>The proportion of electricity from renewable energy sources or combined heat and power plants used in the data centre is:<br>_____ %.</td><td>Minimum criterion</td><td>☐</td></tr>
</table>

| No. | Criterion | Comment | Criterion fulfilled and verification provided[36] (To be filled in by the tenderer) |
|---|---|---|---|
| A6.2 | The specific greenhouse gas potential of the electricity used does not exceed 0.37 kg carbon dioxide equivalents per kilowatt hour of electricity (in accordance with the electricity labelling pursuant to § 42 of the Energy Industry Act).<br>The specific $CO_2$ emissions of the power used in the data centre are:<br>_____ $kg_{CO2e}/kWh_{el}$ | Minimum criterion<br>Verification:<br>Tenderer declaration and electricity labelling according to § 42 of the Energy Industry Act[40] (Annex 4) | ☐ |
| **A7** | **Coolant in cooling systems** | | |
| A7.1 | Cooling capacity:<br>The data centre has the following cooling demand (corresponds to the connected electrical load of the data centre components to be cooled):<br>_____ $kW_{th}$<br>Commissioning:<br>Time of cooling system commissioning:<br>_____ (month/year)<br>Coolants:<br>The following coolants are used:<br>_____ | Tenderer declaration | ☐ |

40 For electricity generated wholly or partly by the company itself (e.g. CHP or photovoltaic electricity), individual verification of the specific greenhouse gas potential can be carried out in accordance with the systematics of the Energy Industry Act.

<table>
<tr><th>No.</th><th>Criterion</th><th>Comment</th><th>Criterion fulfilled and verification provided[36] (To be filled in by the tenderer)</th></tr>
<tr><td>A7.2</td><td>Distinction:<table><tr><th>Selection</th><th>Cooling demand</th><th>Year of commissioning</th><th>Application of no.</th></tr><tr><td>☐</td><td>› 50 $kW_{th}$</td><td>‹ 2013</td><td>A7.2a</td></tr><tr><td>☐</td><td>› 50 $kW_{th}$</td><td>≥ 2013</td><td>A7.2b</td></tr><tr><td>☐</td><td>≤ 50 $kW_{th}$</td><td>independent</td><td>A7.2c</td></tr></table></td><td>Tenderer declaration</td><td>☐</td></tr>
<tr><td>A7.2a</td><td><u>Cooling demand › 50 $kW_{th}$;</u><br><u>Year of commissioning ‹ 2013</u><br>For cooling of the data centre, only chlorine-free coolants are used in cooling systems.</td><td>Minimum criterion</td><td>☐</td></tr>
<tr><td>A7.2b</td><td><u>Cooling demand › 50 $kW_{th}$;</u><br><u>Year of commissioning ≥ 2013</u><br>For cooling of the data centre, only halogen-free coolants are used in cooling systems.</td><td>Minimum criterion</td><td>☐</td></tr>
<tr><td>A7.2c</td><td><u>Cooling demand ≤ 50 $kW_{th}$;</u><br><u>independent of the year of commissioning</u><br><u>Optional requirement:</u><br>For cooling of the data centre, only halogen-free coolants are used in cooling systems.</td><td>Evaluation criterion Compliance with this requirement is taken into account for tender evaluation. Halogen-free coolants receive the maximum number of points.</td><td>☐</td></tr>
</table>

| No. | Criterion | Comment | Criterion fulfilled and verification provided[36] (To be filled in by the tenderer) |
|---|---|---|---|
| **A8** | **Preparation of an IT inventory list** | | |
| | An inventory list of the IT components used for order execution (at least servers, external storage systems, network devices) is attached. Devices with a connected electrical load of less than 10 watts, of which a maximum of 5 devices of the same design are used, do not have to be included in the IT inventory list. | Minimum criterion<br>Verification:<br>IT inventory list (Annex 5)<br>For a tabular template for the IT inventory list, refer to Annex 2a of the award basis for "Energy-Efficient Data Centre Operation" (see above), version dated February 2015. | ☐ |

## 3. Requirements for execution of the order

If the tenderer is awarded the contract, he undertakes to comply with the following requirements for the execution of the contract. These requirements form an integral part of the contract and are included in the clauses for order execution.[41]

| No. | Criterion | Comment | Criterion fulfilled and verification provided[42] (To be filled in by the tenderer) |
|---|---|---|---|
| **V1** | **Virtualisation of servers** | | |
| | Virtualisation of servers is applied in the data centre.<br>(if applicable [43]) | Tenderer declaration | ☐ |
| | The average degree of virtualisation (ratio of number of virtual servers to number of physical servers in the entire DC) is higher than 2.<br>The degree of virtualisation is: _____ | Tenderer declaration | ☐ |
| | <u>OR:</u><br>For the tendered data centre operation, full virtualisation of servers is not possible or not useful. | Tenderer declaration<br><u>Verification</u>: Written justification (Annex 6) | ☐ |

41 Compare § 31 VgV 2016 and § 97 section 4(2) GWB; Gesetz gegen Wettbewerbsbeschränkungen [German restriction of competition act] as of 26 June 2013.

42 As verification, the documents indicated under "note" shall be attached to the filled in questionnaire.

43 With certain server architectures, virtualisation of servers is not possible or not useful. In consultation with the responsible IT specialist planner, the procurement office should therefore only define this requirement if virtualisation is feasible.

| No. | Criterion | Comment | Criterion fulfilled and verification provided[42] (To be filled in by the tenderer) |
|---|---|---|---|
| **V2** | **Energy monitoring** | | |
| | Energy monitoring is realised with continuous measurements of the electrical performance and energy consumption of the main components of the data centre and continuous recording and evaluation of the utilisation of servers and the storage system throughout the year.<br>The following values are determined at least annually by means of energy monitoring:<br>▸ Energy Usage Effectiveness (EUE)<br>▸ Annual Energy Efficiency Ratio of the cooling system (AEER)<br>The following values are determined at least monthly by means of energy monitoring (arrangement and designation of measuring points according to figure 1 of the award basis for "Energy-Efficient Data Centre Operation" (DE-UZ 161), version dated February 2015):<br>▸ Total DC power consumption ($MP_{DC}$ + $MP_{EG}$) [$kWh_{el}$]<br>▸ IT power consumption ($MP_{IT2}$) [$kWh_{el}$] | Tenderer declaration | ☐ |

| No. | Criterion | Comment | Criterion fulfilled and verification provided[42] (To be filled in by the tenderer) |
|---|---|---|---|
| **V3** | **Annual energy efficiency report** | | |
| | An energy efficiency report is submitted no later than 14 months after the order is placed and every 12 months during the term of the contract (annually), in which activities on energy and resource-conscious data centre operation are presented.<br>The energy efficiency report documents the following requirements:<br>1. Energy management system (compare no. E1)<br>2. Energy Usage Effectiveness (EUE) (compare no. A2)<br>3. Cooling system energy efficiency (compare no. A4)<br>4. Efficiencies of uninterruptible power supply (UPS) (compare no. A5)<br>5. Composition of electrical energy (compare no. A6)<br>6. Coolant in cooling systems (compare no. A7)<br>7. Changes in hardware equipment of the data centre used for order execution by updating the IT inventory list (compare no. A8)<br>8. Application of virtualisation of servers (compare no. V1)<br>9. Power consumption of IT components operated for the contracting authority as evaluation of energy monitoring (compare no. V2) | Tenderer declaration | ☐ |

Annexs[44]:
(Note: Annexs are to be prepared by the tenderers themselves and attached to the tender).

Annex 1: Documentation of Energy Usage Effectiveness (EUE) calculation

Annex 2: Documentation and calculation of the cooling system energy efficiency

Annex 3: Measuring protocol and efficiencies of the uninterruptible power supply (UPS)

Annex 4: Electricity labelling according to § 42 of the Energy Industry Act

Annex 5: IT inventory list

Annex 6: Reasons for non-applicability of server virtualisation (if applicable)

44 If the data centre in which the service is provided is certified with the Blue Angel environmental label for energy-efficient data centre operation (DE-UZ 161), the Annexs are not required.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