

ANNEX A: MODEL FOR THE REQUEST FOR THE RELEASE OF FUNDS

Fiche to be used for each step:

The step under review	Implementation of the adopted Building Renovation Strategy and the plan for nearly zero energy buildings is on track through renovation of existing public buildings in line with the annual 3% renovation target (Energy Efficiency Directive)
Baseline	935 buildings are renovated
Deadline of the step	June 2026
Actual results	The Law No. 08/L-242 on Energy Performance of Buildings (adopted in 2024) is partially aligned with EU Directives 2010/31/EU and (EU) 2018/844. Article 7 explicitly mandates that the Ministry of Environment and Spatial Planning prepare a National Building Renovation Strategy (NBRS) to drive cost-optimal transformations into nearly zero-energy buildings. The MESP launched the NBRS drafting process on October 20, 2025. The drafting of NBRS is being done through the professional expertise engaged by LuxDev, and is being reviewed by the Working Group appointed by MESP. The institutional mechanism was formalized via Decision No. 8913/25 on December 11, 2025, establishing the NBRS 2026–2035 Working Group. The inaugural meeting occurred on December 19, 2025, followed by a data-scoping workshop on January 23, 2026. The first draft is currently being finalized, with the final draft expected to be completed by the end of October 2026 followed by the public consultation and Government approval. In partnership with LuxDev, the MESP and MoE, are finalizing the National Register for Energy Performance in Buildings. Modules for Energy Performance Certificates (EPCs), HVAC, and service providers are complete. Quality control, assessor/independent expert licensing, and public notification modules are currently under active development. The Electronic Platform for Energy Performance of Buildings (EPEPB) will be an integral part of the National Register for Energy Performance in Buildings. MESP is responsible for establishing, operating, maintaining, and updating the EPEPB, which is used to process, issue, store, and manage EPCs and related reports, maintain data on the measured or calculated energy consumption of certified buildings, monitor compliance with independent EPC verification requirements, facilitate the implementation of the independent control system, and store information on energy assessors, including their status. Through EPEPB, MESP will also provide appropriate access to ME and the KEEF for administrative and data management purposes, to municipalities for verification purposes, and to the public to verify the validity of issued EPCs. Regulatory Framework: Supported by GIZ, the Working Group and the Legal Department finalized the Regulation on National Calculation Methodology and the Regulation on Determining Minimum Energy Performance Requirements. Following a 15-working-day preliminary consultation period initiated on April 17, 2026, the regulations have successfully advanced to the next phases of the national legislative process.

	The National Calculation Methodology provides the framework for calculating the integrated energy performance of buildings. It is used to determine the annual energy required for the normal use of buildings, calculate primary energy performance indicators, establish cost-optimal energy performance requirements for buildings, building units, and building elements, and support the preparation and issuance of EPC, while taking into account all relevant European standards. The methodology applies to a broad range of building categories, including single-family and multi-apartment residential buildings, commercial and administrative buildings, educational and healthcare facilities, hotels, restaurants, public service buildings, sports facilities, and cultural buildings. Minimum Energy Performance Requirements are applied for new buildings, existing buildings undergoing major renovation, building envelope elements that are repaired or replaced, and technical building systems when installed, replaced, or upgraded. These requirements are based on cost-optimal levels that minimize lifecycle costs, and are determined using the National Calculation Methodology, to be reviewed at least every five years to reflect technological developments. According to Law No.08/L-242 on Energy Performance of Buildings, Article 8, Paragraph 1, after the approval of the National Building Renovation Strategy, MESP in cooperation with the Ministry responsible for energy - ME, will draft the National Plan for increasing the number of buildings with near zero energy consumption). The implementation of this reform step was delayed because the extensive process of gathering and analyzing complex statistical, technical, and financial data on Kosovo's building stock from numerous central, local, and financial institutions required a longer operational timeframe than initially scheduled.
Evidence provided	1. Decision no 8913/25 on appointing NBRS (2026-2035) Working Group. 2. Decision no 7757 appointing Working Group for the drafting of the Regulation on the National Methodology for the Calculation of the Energy Performance of Buildings 3. Draft Regulation (MESP) No. __/2026 On National Calculation Methodology for Energy Performance of Buildings. 3.1. Annex 1- Procedures and Parameters of the National Calculation Methodology 4. Decision No. 7758 on appointing Working Group for the drafting of the Regulation on the Determination of Minimum Requirements for the Energy Performance of Buildings. 4.1. Draft Regulation (MESP) No. __/2026 on Minimal Requirement of the Energy Performance of Buildings.
Checks performed in the verification of the step and related findings	During verification of the step, all available and possible evidence has been collected and reviewed. The evidence has been listed down in the checklist on the conducted verification, and all documents supporting the verification have been properly stored (in order to ensure audit trail). The following checks were conducted:

	• All available documentation in line with the level of the achievement (as attached to this report) has been reviewed to verify the current stage of the reform step; • Compliance with the descriptive part of the reform step from the Commission Implementing Decision has been verified to the maximum possible extent and scope (as evidenced by the documentation available); • The attached documentation can confirm non-fulfilment of the reform step. The results of the checks indicate that the reform step has not been fulfilled by the end of the reporting period (30 Jun 2026). As soon as the information is received by the implementing units on the complete achievement and fulfilment of the reform step, the checks will be re-performed and repeated to verify the underlying completion / fulfilment.
Compliance with general principles and DNSH principle	The implementation of the steps [does not contravene/contravenes] the general principles outlined in Article 4 and 11(4) of Regulation (EU) 2024/1449 and Article 3 of the Facility Agreement. The implementation of the steps [does not contravene/contravenes] the ‘Do No Significant Harm’ principle (DNSH).
Double funding	GIZ Support (Deutsche Gesellschaft für Internationale Zusammenarbeit): • Legal drafting of the Regulation (MESP) No. __/2026 on National Calculation Methodology for Energy Performance of Buildings. • Legal drafting of the Regulation(MESP) No.__/2026 on the Determination of Minimum Requirements for the Energy Performance of Buildings. GIZ has supported the working group that is preparing these two regulations with technical assistance. The support was initially provided through the Kosovo Energy Project (KEP) II (March 2023 – February 2026) and is currently being continued through the Kosovo Energy Project (September 2025 – November 2028).
Clear conclusion on the achievement of the step	This reform step has not been achieved by June 2026 deadline. It is moved to the grace period.

ANNEX 1

PROCEDURES AND PARAMETERS OF THE NATIONAL CLACULATION METHODOLOGY

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I. INTRODUCTION

This Annex describes the calculation procedure for assessing the total energy demand of buildings or parts of buildings. The calculations enable the evaluation of all energy required for heating, air conditioning, ventilation, domestic hot water generation, and lighting of buildings, by applying an integrated approach. This implies carrying out a combined assessment of the building structure, its use, and the building's technical systems, taking into account the mutual interactions of energy flows.

The approach described in this Annex is applicable for:

- Preparation of a specific energy balance based on boundary conditions defined individually for a given building. The boundary conditions are based on real climatic conditions, the actual mode of use, and the technical characteristics of the installed systems. This approach serves to optimize design solutions, analyze technical variants, and assess energy efficiency measures with the aim of reliably predicting actual energy consumption. It also supports technical decision-making in building design, as well as the verification of energy performance.
- Preparation of the overall energy balance of buildings with boundary conditions according to unified national rules. Boundary conditions, such as reference climatic conditions, standardized usage patterns, and system parameters, are defined based on national minimum energy performance requirements for buildings. This approach ensures comparability between different buildings and provides an equal basis for evaluation. It is used to determine the energy performance indicator on the basis of which the building's energy class is assigned and the Energy Performance Certificate (EPC) of the building is generated.

The procedure for calculating the overall energy balance of a building is applicable to all residential and non-residential buildings, including both new and existing buildings.

The calculation of the building's energy balance includes the calculation of the energy needs, the delivered energy, as well as the primary energy of the building.

The procedure described in this Annex is used for calculating the balance for:

1. Heating;
2. Ventilation;
3. Air conditioning (including cooling and humidity control);
4. Domestic hot water;
5. Lighting;
6. Energy produced in the building or nearby, such as renewable energy or combined heat and power (CHP), which is used for the building's needs.

In the calculation of the energy balance in buildings, the auxiliary electrical energy directly related to the energy supply is also included.

Figure 1 schematically presents the scope covered by the calculation method and procedures.

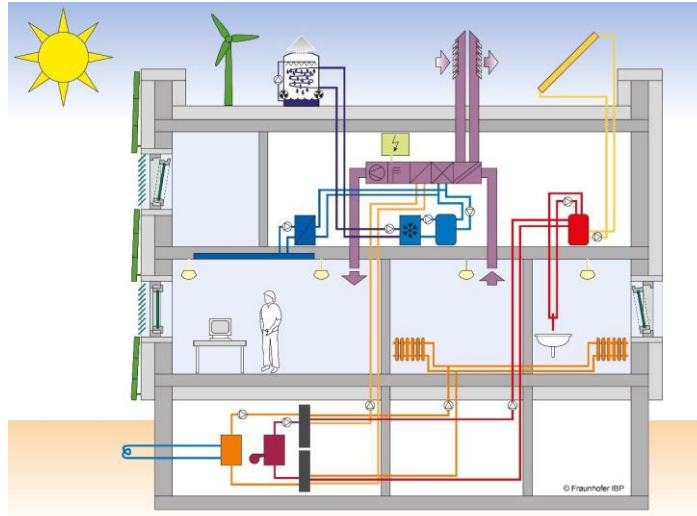


Figure 1. Schematic diagram of the aspects covered within the calculation method

The calculation procedure consists of the following five (5) steps:

1. Zoning of buildings;
2. Calculation of the building's energy needs balance;
3. Calculation of losses due to control and emission, distribution, and storage (accumulation);
4. Calculation of the energy balance for the delivered energy;
5. Assessment of primary energy and CO₂ emissions.

II. TERMS, DEFINITIONS, SYMBOLS AND UNITS

1. Definitions

1.1. Air change rate

Air volume flow (per unit of volume).

1.2. Auxiliary energy - Energy that is additionally required by heating, cooling, domestic hot water heating, air conditioning (including ventilation) and lighting systems in order to provide energy supply, for pumps, fans, control, electronics etc.

1.3. Ballast - Device connected between the electrical power supply and one or more discharge lamps and used mainly to limit the lamp current to the desired value, types of ballasts: conventional (CB), low-loss (LLB), electronic (EB).

1.4. Battery discharge time - Time during which the useful capacity of the battery is drawn from a fully charged state.

1.5. Bivalence point temperature - Temperature at which the heat output of the heat pump and the energy need of the building are equal.

1.6. Building automation - Designation of equipment, software and services for automatic control and regulation, monitoring and optimization as well as for operation and management for energy-efficient, economical and safe operation of technical building equipment.

1.7. Building management - All services related to the management, operation and supervision of buildings (including equipment and installations).

1.8. Building-attached photovoltaic system (BAPV) - Photovoltaic system in which PV modules are mounted to or on a component of the building envelope and do not take on any additional function of the building envelope besides the function of generating electricity.

1.9. Building-integrated photovoltaic system (BIPV) - Photovoltaic system that is integrated into the building envelope and thus forms a part of the building envelope, and performs at least one other function of the building envelope in addition to generating electricity.

1.10. Building services - Technical building systems providing indoor conditions (heating, cooling, domestic hot water supply, ventilation, humidification and lighting).

Note: A building service may include more than one technical building system, for instance centralized and decentralized domestic hot water generation.

1.11. Calculation period - Time-period of the energy balancing, for which the relevant energy flows in a building are calculated.

Note: The period for calculating delivered energy and primary energy is one year. Periods of one month or one day can be used for calculating partial energy values.

1.12. Calorific value (energy content) - Amount of thermal energy output by complete combustion of a specific quantity of fuel at a constant pressure of 101320 Pa.

Note: When expressed as the gross calorific value, the energy content includes the latent heat released by condensation of water vapor. The net calorific value does not include this latent heat.

1.13. Coefficient of performance COP - Ratio of the heat output to the effective power consumption of a heat pump.

1.14. Combined operation - Operation of a heat generator with double service (e.g. for space heating and domestic hot water heating).

1.15. Conditioned space/room - Space/room or group of rooms, which is heated and/or cooled to a defined set-point temperature and/or ventilated and/or humidified and/or illuminated and/or provided with domestic hot water - meaning at least one mode of conditioning applies.

1.16. Conditioning - Generation of defined conditions in indoor spaces by heating, cooling, ventilation, humidification, lighting and domestic hot water supply.

Note: Conditioning aims to meet requirements regarding the room temperature, fresh air supply, light, humidity and/or domestic hot water.

1.17. Control and emission - Subsystem in which energy is emitted (e.g. into the space), whilst maintaining the defined requirements (notably in respect of comfort).

1.18. Control system for lighting

Various types of electrical and electronic systems used to control and regulate:

- 1.18.1. Systems to protect against solar radiation and/or glare;
- 1.18.2. Artificial lighting in relation to the currently available daylight; and
- 1.18.3. To detect and record the presence of occupants.

1.19. Cooled sector - Those parts of a building, the utilization units and technical building systems which are supplied by the same refrigeration equipment source.

Note: The cooled sector can comprise multiple zones and utilization units or only parts of these.

1.20. Coverage share - Share in the total heat supply.

1.21. CO₂ equivalent (CO_{2eq}) - A carbon dioxide equivalent or CO₂ equivalent, abbreviated as CO_{2eq} is a metric measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.

1.22 Daylight factor - Ratio of the illuminance at a point on a given plane due to the light received directly or indirectly from a sky of assumed or known luminance distribution to the illuminance on a horizontal plane due to an unobstructed sky (direct sunlight is excluded for both values of illuminance).

1.23. Decentralized domestic hot water heating system - System in which heat for domestic hot water is generated in a unit and is emitted into the same space.

Note: The supply of two rooms by one unit via a common installation wall also counts as a decentralized domestic hot water heating system.

1.24. Decentralized heating system - Heating system in which heat is generated in a unit and is emitted into the same space, with water or air serving as the heat carrier.

1.25. Default value - Data which can be used for calculation if no suitable product data are available for the calculation procedure.

1.26. Degree of automation - Type, scope and allocation of automation functions within a building or zone, which are used for the control, regulation and technical energy management of the building and plant operation according to specified requirement criteria.

Note: The degree of automation can be divided into the classes A, B, C and D.

1.27. Delivered energy for air transport - Calculated electrical energy required by the system comprising fan, transmission system and motor, to transport the air flow within the period to which the calculations apply.

1.28. Distribution - Subsystem in which the required quantity of energy is transported from the generator to the heat control and emission system.

1.29. Effective heat capacity (thermal mass) - Part of the heat capacity of a building zone, which has an effect on the energy need for heating and on room conditioning in summer.

1.30. Electrical evaluation power of artificial light - Total electrical power requirements of the lighting system in the evaluation area, determined solely for calculating the delivered energy demand for lighting by means of the method described here.

Note: The electrical evaluation power can differ from the electrical power consumption when designing the electrical installations.

1.31. Energy carrier - Substance or process that can be used to produce mechanical work or heat or to operate chemical or physical processes.

1.32. Energy content - Amount of thermal energy which is output by complete combustion of a specific quantity of fuel at a constant pressure of 101320 Pa.

Note: When expressed as the gross calorific value, the energy content includes the latent heat liberated by condensation of water vapor. The net calorific value does not include this latent heat.

1.33. Energy efficiency - Evaluation of the energy quality of buildings by comparing calculated energy ratings with standard energy ratings (i.e., with economically viable energy ratings from comparable new or renovated buildings) or by comparing measured energy ratings with reference values (i.e., with mean measured energy ratings from buildings with comparable types of usage).

1.34. Energy management - Proactive, organized and systematic coordination of the procurement, conversion, distribution and use of energy to meet requirements, taking into account ecological and economic objectives.

Note: Energy management includes services such as: interdisciplinary analysis of energy consumers, determination of optimization potentials, planning of measures with regard to economic aspects, calculation of profitability, implementation of savings measures, verification of savings.

1.35. Energy need for cooling - Calculated cooling energy required in order to maintain the specified thermal room conditions within a building zone during periods in which the sources of heat generate more energy than required.

1.36. Energy need for domestic hot water preparation - Calculated energy required to supply a building zone with the amount of domestic hot water at the required supply temperature specified in the usage profile.

1.37. Energy need for heating - Calculated heating energy required in order to maintain the specified thermal room conditions within a building zone during the heating period.

1.38. Energy need for thermal air conditioning - Calculated energy required for heating and cooling of air as well as for heating for dehumidifying or generating steam for humidification in order to change the thermal conditions of the air from outdoor conditions to specified supply air conditions. This is calculated with due consideration of the arrangement of components in the system, the basic control mode of system operation and

any energy recovery system installed.

1.39. Environmental energy - Solar energy (thermal, photovoltaic and for lighting purposes), geothermal energy, environmental heating or cooling energy (energy extracted from ambient air or water), wind energy.

1.40. Expenditure factor, expenditure figure - Factor which describes the effort of a process in relation to its benefit.

Note: Basis for the assessment are energy quantities, whereby the expenditure factor itself is unitless (effort related to benefit). Processes are emission/control, distribution, storage, and generation of energy.

1.41. External temperature, outdoor temperature - Temperature of the external air, which is determined based on meteorological measurements and evaluations and is taken as a basis for the calculations.

1.42. Exhaust air conditions - Thermodynamic condition, including humidity, of the air which a VAC system emits to the outdoor environment of the building.

1.43. Extract air conditions - Thermodynamic condition, including humidity, of the air which a VAC system draws out of the section of the building served by it (serviced area).

1.44. Gross volume, external volume - Volume of a building or of a building zone, calculated on the basis of external dimensions.

Note: This volume includes, at least, all the spaces in a building or zone, which are directly or indirectly (when interconnected) conditioned as required for intended use.

1.45. Heat carrier - Any medium (e.g. water, air, etc.) used for the transfer of heat without changing its state.

Note: In addition to the water circulating in the heating circuits, such media also include: the cooled fluid circulating in an evaporator, the refrigerant circulating in a condenser and the heat recovery medium circulating in a heat recovery heat exchanger.

1.46. Heat energy - Energy used directly to meet the energy need for heating.

1.47. Heat generator with double service - Heat generator which supplies energy to two different systems (e.g. the space heating system and the domestic hot water system in combined operation).

1.48. Heat output - Quantity of heat delivered from the unit to the heat carrier per unit of time.

Note: If heat is removed from the internal heat exchanger for defrosting purposes it is taken into account.

1.49. Heat recovery efficiency, heat recovery rate - Generic term for the temperature efficiency and/or the moisture efficiency of the heat recovery component according to EN 308 with reference to the supply air side.

1.50. Heat sink - Quantity of heat which is drawn out of the building zone.

Note: This does not include the controlled removal of heat by means of the cooling system.

1.51. Heat source - Quantity of heat with temperatures above the internal temperature, which is supplied to or generated within the building zone.

Note: This does not include controlled heat energy input via the technical building systems (heating, ventilation) in order to maintain the internal temperature.

1.52. Heating area - Area that encompasses those parts of the building that are supplied by the same heating system; it can extend over a number of zones, and at the same time one zone can include a number of heating areas.

1.53. Heating time - Running time of the heating system to ensure the temperatures specified for use.

1.54. Heating, ventilation and air conditioning system (HVAC system) - Use of various technologies to control the temperature, humidity, and purity of the air in an enclosed space in order to provide thermal comfort and acceptable indoor air quality.

1.55. Illuminance - Quotient of the luminous flux incident on an element of the surface divided by the area of that element.

Note: Unit of measurement: lux (lx).

1.56. Internal set-point temperature - Specified desired perceived temperature inside a building or a zone, depending on the usage profile, which represents the set-point of the room temperature when the heating or cooling system is in operation.

Note: Usually, different set-point temperatures are assumed for heating and for cooling, respectively.

1.57. Lamp - Source made in order to produce light, generally in the visible range of the spectrum.

1.58. Light exposure - Surface density of the quantity of light received, i.e. the quotient of a quantity of light received by an element within a given time and the area of that element.

Note: Unit of measurement: lux hours (lx·h).

1.59. Light reflectance - Ratio of the reflected luminous flux to the incident luminous flux.

1.60. Light transmittance - Ratio of the luminous flux transmitted by a body to the incident luminous flux.

1.61. Lighting energy - Calculated energy required to illuminate a building zone (with the quality of lighting specified in the usage profile).

1.62. Load factor - Ratio between the running time of the compressor and the total time over which the generator is switched on (stand-by and operation).

1.63. Locally generated renewable energy - Energy generated using renewable energy

sources by technical building installations directly connected to the building.

1.64. Loss in technical systems - Losses (heat emission) occurring in the subsystems between the energy need and the delivered energy, i.e. losses occurring due to control and emission, distribution, storage and generation. Where such losses occur within the conditioned spaces, they count as heat sources or heat sinks.

1.65. Luminaire - Apparatus which distributes, filters or transforms the light given by a lamp or lamps and which includes all the items necessary for fixing and protecting these lamps and, where necessary, the wiring and devices for connecting them to the supply circuit, but not the actual lamps.

1.66. Luminous flux - Physical quantity derived from the radiant flux (radiant power) by evaluating the radiation in accordance with the spectral sensitivity of the human eye (according to the CIE definition of a standard photometric observer). It is equal to the luminous power emitted by a source or striking a surface.

Note: Unit of measurement: lumen (lm).

1.67. Maintained illuminance - Value below which the average illuminance on the specified surface is not allowed to fall.

1.68. Maximum depth of discharge - Indicates the part of the nominal capacity of the battery that can be discharged without negatively affecting the service life.

1.69. Moisture efficiency of the heat recovery component - Ratio of absolute humidities of a heat recovery system according to EN 308 with reference to the supply air side.

1.70. Monitoring - Systematic recording, control and evaluation of energy consumption as well as process and state parameters for the purpose of optimised operational management.

1.71. Monthly mean supply air volume flow - Air volume flow which is transported and thermodynamically treated (i.e. conditioned) by a VAC system while it is in operation, expressed as a mean value for the respective month.

1.72. Monthly reference supply air volume flow - Mean air volume flow which is transported by a VAC system into a building zone independent of the sensible heating and cooling loads during the monthly operating time of the system.

1.73. Multi-family house - Residential building with more than 2 apartments.

1.74. Net electrical energy generated - Total electricity generated by the photovoltaic system minus the total auxiliary energy consumed within the boundary of the subsystem being considered.

1.75. Net floor area (reference area) - Useful floor area within the conditioned volume of the building.

Note: The net floor area (ANF) is used as the reference area.

1.76. Net volume, air volume (internal volume) - Volume which is subject to air exchange within a conditioned zone or within an entire building. The net volume is determined on the basis of the internal dimensions, i.e. the volume of the building structure itself is not included. It is calculated by multiplying the corresponding net floor area by the clear room height.

1.77. Nominal capacity of the battery - Maximum amount of energy that can be drawn from a battery at the rated current.

1.78. Nominal power - Maximum power delivered or consumed under specified operating conditions.

Note: For boilers it is the continuous output specified by the manufacturer for the heat generator, corresponding to the highest hourly usable heat quantity delivered to the heat carrier water. For pumps it is the electrical power consumption at nominal voltage under specified operating conditions and maximum load.

1.79. Obstruction - Obstruction in the way of the light in the form of buildings and mountains which, as seen from the respective location, cover sections of the sky. Self-obstruction (e.g. by other parts of the building under evaluation) is also deemed to be obstruction.

1.80. Operating range - Range indicated by the manufacturer, located within the upper and lower limits (e.g. in respect of temperature, air humidity, voltage) within which the unit is deemed to be fit for use and has the product data stated by the manufacturer.

1.81. Operating time - Heating time and the running time in set-back/cut-out or switch-off mode.

1.82. Operating time of a residential ventilation system - Time determined on the basis of the daily operating time and the operating time per month.

1.83. Outdoor air conditions - Thermodynamic conditions including humidity of the external air surrounding a building equipped with a VAC system.

1.84. Part load operation - Operating status of the heat generator in which the actual load requirement lies below the actual load capacity of the heat generator.

1.85. Partial ventilation - Zone is only ventilated proportionally to the area or there are different fan-assisted ventilation systems in the zone.

Note: Typical examples of partial ventilation are central supply/exhaust ventilation system in the actual living area and window ventilation in low-used adjoining rooms, or decentralised supply/exhaust ventilation units in individual rooms/groups of room and exhaust ventilation system in the remaining rooms.

1.86. Peak power - Electrical power of a photovoltaic system under standard test conditions.

1.87. Performance ratio, efficiency - Factor which describes the usable part of an energy input.

Note: Basis for the assessment are energy quantities, whereby the performance ratio itself is unitless (benefit related to effort). Processes are emission/control, distribution, storage and generation of energy.

1.88. Photovoltaic (PV) generator - Generator that uses the photovoltaic effect to convert sunlight into electricity.

1.89. Power to heat ratio - Ratio of net electrical power generation to net heat generation of a cogeneration process.

1.90. Product-specific value - Value specified by the manufacturer, that is suitable for this calculation procedure, on the basis of:

- 1.90.1 a declaration of conformity to harmonized European specifications or corresponding European directives, or
- 1.90.2 a declaration of conformity to generally recognized technical standards, or
- 1.90.3 a certificate of usability issued by a building inspectorate.

1.91. Recooling - Cooling of the supply air to meet the requirements of the utilization unit or building zone (individual room control).

Note: The supply air temperature is controlled to maintain a specific constant value. The difference required in order to maintain the room temperature can be achieved either by static heat-exchanging surfaces, secondary air-cooling systems or by recooling the supply air.

1.92. Reference internal temperature - Average internal temperature of a building or a building zone on which the calculations of the energy need for heating and cooling are based, which takes into account heating patterns with spatially or time restricted heating operation and - in case the energy need for cooling is to be calculated - the permitted temperature variations.

Note: Different temperature values are usually assumed for heating and for cooling, respectively.

1.93. Reheating - Heating of the supply air to meet the requirements of the utilization unit or building zone (individual room control).

Note: The supply air temperature is controlled to maintain a specific constant value. The difference required in order to maintain the room temperature can be achieved either by static heat-exchanging surfaces or by reheating the supply air.

1.94. Renewable energy - Energy from sources which will not be depleted by utilization, such as (thermal and photovoltaic) solar energy, wind, hydropower, renewable biomass.

Note: Energy from sources that will not be depleted within the foreseeable existence of humans, i.e., that are available indefinitely, is environmental energy. Biomass energy (solid, gaseous, liquid) also counts as renewable energy, although its availability is limited.

1.95. Residential air heating system - Heating system which supplies heat to a zone using only air as the heat carrier.

Note: Air heating systems have at least one heat generator (e.g. an exhaust-air heat pump). In addition, they may include a heat exchanger for heat recovery. Air heating systems can

be operated using external air, a combination of external air and recirculated air, or recirculated air only.

1.96. Residential ventilation system - System for supplying fresh air and/or removing exhaust air which conveys outdoor air into the building, and which may include heat recovery and air conditioning.

Note: Systems for supplying fresh air and/or removing exhaust air may be decentralized systems intended for a single room/group of rooms, or centralized supply and/or exhaust ventilation systems.

1.97. Room automation - System/application-specific devices and functions for individual room or zone control, including integrated monitoring, control, regulation and optimisation of the technical building equipment combined by communication functions, such as HVAC and cooling, lighting, window shutter control (solar/anti-glare), electricity supply and other services.

1.98. Room height, clear room height - Difference in height between the upper face of the floor and the lower face of the floor above or suspended ceiling.

1.99. Serviced area - Comprising all those parts of a building which are served by the same technical building system

Note: A serviced area (heating, domestic hot water, ventilation, cooling, lighting etc.) can cover several zones. A single zone may include more than one serviced area.

1.100. Simultaneous operation - Simultaneous generation of heat energy for space heating and for domestic hot water heating.

1.101. Single-family house - Residential building with up to 2 apartments.

1.102. Solar irradiance - Power density of radiation incident on a surface, i.e., the quotient of the radiant flux incident on the surface and the area of that surface, or the rate at which radiant energy is incident on a surface, per unit area of that surface.

Note: Solar irradiance is usually given in W/m^2 .

1.103. Solar radiation energy, solar irradiation - Energy of the radiation incident on the plane per unit area, calculated by integration of solar irradiance over a specified time interval, often an hour or a day.

Note: Solar irradiation is usually given in MJ/m^2 per defined time interval.

1.104. Specific fan power, SFP value - Sum of the electrical power required by all fans in the air-distribution system, divided by the total air volume flow achieved at design conditions.

1.105. Standby loss - Heat expenditure specified in relation to the firing capacity, which is required to maintain the heat generator at a certain temperature when no heat output is consumed.

1.106. Storage - Subsystem in which heat contained in a medium is stored.

Note: In heating circuits, this is the buffer storage tank (e.g. in a heat pump systems).

1.107. Storey height - Dimension from the top of slab of the respective floor to the top of slab of the floor above.

1.108. Supply air conditions - Thermodynamic condition, including humidity, of the air which a VAC system introduces into the section of the building served by it (served area).

1.109. System boundary, balance boundary - (Outer) Delimitation of a zone or a serviced area for which an energy balance is calculated.

1.110. System efficiency of the battery - Indicates the proportion of the energy supplied to the battery that can be drawn again and is therefore a measure of self-consumption, e.g. through self-discharge.

1.111. System losses - Losses (heat losses, cooling losses) occurring in subsystems between the energy need and the delivered energy, i.e., losses occurring due to control and emission, distribution, storage and generation.

Note: Where such system losses occur within the conditioned spaces, they are considered to be part of the heat sources or heat sinks.

1.112. Task area - Partial area in the workplace in which the visual task is carried out.

Note: For places where the size and/or location of the task area is unknown, the entire area where the task may occur is taken as the task area.

1.113. Technical building sub-system - Part of a technical building system that performs a specific function (e.g. heat generation, heat distribution, heat storage, heat control and emission).

1.114. Technical building system - Technical equipment for heating, cooling, ventilation, humidification, dehumidification, domestic hot water preparation, lighting, building automation and control and electricity production.

Note: A technical building system can refer to one or to several building services (e.g., heating, heating and domestic hot water). A technical building system is composed of different sub-systems. Electricity production can include cogeneration, wind power and photovoltaic systems.

1.115. Temperature efficiency of the heat recovery component - Ratio of air temperatures of a heat recovery system for the operating case without condensation according to EN 308 with reference to the supply air side.

1.116. Thermal envelope area - Outer boundary of each zone.

Note: Thermal envelope area is the boundary between conditioned spaces and the external air, the ground or unconditioned spaces. The cooled or heated spaces lose heat or gain heat via this surface, and, for this reason, it is called the “thermal envelope area”. It is formed by a material boundary, usually by the outer facade, interior walls, bottom or top floor slabs or by the roof.

1.117. Thermal transmittance or U-value - Heat flow rate in the steady state divided by area and by the temperature difference between the surroundings on both sides of a flat uniform system.

Note: U-value or thermal transmittance has the unit of measurement W/m^2K and is the reciprocal of the R-value (total thermal resistance in m^2K/W).

1.118. Thermally (un)conditioned space/room - Space/room or group of rooms, which is heated and/or cooled is called "thermally conditioned"; space/room or group of rooms, which is neither heated nor cooled is called "thermally unconditioned".

1.119. Transmission heat transfer coefficient - Heat flow through a building element per unit of time, in relation to the difference between the air temperatures on either side of the element (this being equal to the reciprocal value of the overall thermal resistance of the building element).

1.120. Unconditioned space/room - Spaces which have no form of conditioning are called "unconditioned spaces/rooms", which can be summarized in unconditioned zones.

1.121. Useful capacity of the battery - Part of the nominal capacity that is actually available for an application during operation after taking into account the maximum depth of discharge.

1.122. Utilization factor for heat sources - Factor by which the total input from the monthly or annually active heat sources is reduced in order to determine the part of the heat from the respective sources that can be used to cover the heat sinks.

Note: The non-usable part is manifested as excessive room temperature and/or excessive air exchange in the zone in the heating period. In the cooling period, it results in the cooling demand.

1.123. Ventilation and air conditioning system (VAC system) - Ventilation system with mechanical air transport, which is used to meet the indoor air quality requirements.

1.124. Ventilation heat transfer coefficient - Heat exchange by an air volume flow per unit of time, in relation to the temperature difference (heating power of an air volume flow, in relation to the temperature difference).

1.125. Visual task - Visual elements of the work being done.

1.126. Waste heat - Quantity of heating and cooling energy from processes that is used within the assessed building or is provided to another building (via a (district) heating or cooling network), and would otherwise have been released into the environment without further utilization, e.g., industrial waste heat from a production facility.

Note: Waste heat does not come from facilities whose purpose is the generation of electricity or heat. The transformation chains preceding the waste heat generation are not evaluated. Waste heat can occur within the building (the balancing zone) as an energy flow and is then accounted for as part of the internal heat sources or sinks. If waste heat is transported across the balance boundaries via a medium (e.g., water or air), it is assessed in the same way as local and district heating (the auxiliary energy must be accounted for).

1.127. Zone - Basic unit of space for calculating energy balances. A zone comprises the (net floor) area of a group of rooms with equal type of usage and conditioning and with no interferences regarding additional zoning criteria.

2. Symbols, units and subscripts

Table 1 below contains a summary of the important symbols that are generally applicable to the overall balance described in this Annex.

Table 1 - Symbols and units

Symbol	Name of quantity	Unit
α	share	—
A	area, thermal envelope area	m ²
B	width	m
β	part load level (load factor)	—
c	specific heat capacity	kJ/(kg · K), Wh/(kg · K)
c	relative absence	—
COP	coefficient of performance	—
d	number of days	d
D	diameter	m
DH	heating degree hours	Kh
Δ	difference	—
δ	declination of the sun	—
e	expenditure figure, expenditure factor	—
E	annual or monthly solar irradiation energy	kWh/(m ² a) kWh/(m ² mth)
EER	energy efficiency ratio	—
f, F	factor	—
FC	load factor	—
g	gradient of the energy need at deviating supply air set-point temperatures	Wh/(K·m ³ /h)
g	total energy transmittance	—
h	hour	h
h	height	m
h	enthalpy	kJ/kg
H (H_T / H_V)	heat transfer coefficient (general) index: T: transmission / V: ventilation	W/K
H (H_i / H_s)	calorific value index i : net / index s : gross	kWh/m ³ , kWh/l, kWh/kg
I	solar irradiance	W/m ²
k	coefficient	—
λ	thermal conductivity	W/(mK)
L	length	m

Symbol	Name of quantity	Unit
M	annual mass	kg/a
n	number	—
n	air change rate	1/h
η	efficiency, performance ratio, utilisation factor	—
θ	temperature	°C
p	pressure	Pa
P	power	kW
PLV	part load value	—
q	specific energy need in relation to the air volume flow	Wh/(m ³ /h)
R	thermal resistance, surface resistance	(m ² K)/W
$SEER$	seasonal energy efficiency ratio	—
SPF	seasonal performance factor	—
SPI	specific power input	W/(m ³ /h)
T	absolute temperature	K
T	transmission factor, transmittance	—
t	time (period)	h
τ	(thermal) time constant (of a building zone)	h
τ	solar transmission factor	—
Q	energy	kWh
$\dot{Q}$	power, output, capacity	kW
U	heat transfer coefficient	W/(m ² K)
V	(net) volume	m ³
$\dot{V}$	air volume flow	m ³ /h
v	average monthly wind speed	m/s
w	weighting factor	—
W	auxiliary energy	kWh
ϕ	geographical latitude of the location	°
ϕ	relative air humidity	—
ρ	density	kg/m ³
x	water vapour content of the air (absolute humidity)	g/kg
γ	ratio of heat sources to heat sinks	—
ζ	heat ratio	kW/kW
κ	coverage ratio	—
σ	ratio	—
Ψ	linear thermal transmittance	W/(mK)
Φ	heating load, power	W
$XC\mathcal{O}_2$	CO ₂ equivalent	g/kWh

Table 2 below lists the defined indices of the symbols used in all balance calculations.

Table 2 – Subscripts

Subscript	Term
AHU	air handling unit
a	year, annual
A	relative absence

as	after sunset
aut	automation
aux	auxiliary energy
av	average, mean
B	parapet
batt	battery
bio	biogenic
bp	bivalence point
bs	before sunrise
BT	ballasts or transformers
bu	back-up heating
c	control (system)
C	constant illuminance
c	(space) cooling system, room conditioning system
c*	HVAC cooling function, cooling energy supply for the air conditioning system
Ca	raw building carcass opening
CC	constant illuminance control
ce	control and emission (losses)
char	characteristic
CHP	combined heat and power
CO ₂	carbon dioxide
combi	combined operation (space heating and domestic hot water heating)
cond	condensation
cu	cooling unit
D	daylight (dependent)
d	distribution (losses)
D,S	daylight supply
day	during daytime
ddh	degree-day hours
DEC	sorption-supported HVAC system
del	delivered energy
dir	direct
Dis	discharge
DoD	depth of discharge
e	outdoor, external, exterior
effec	effective
EHA	exhaust air
el	electric, electricity
end	end (of usage)
ext	external supply network
EMS	energy management system
ESP	electric hot water storage tank
ESWH	electric storage water heater
ETA	extract air
ev	evaporative humidifier
eve	evaporative humidifier exhaust air (sorption-supported HVAC system)
evs	evaporative humidifier supply air (sorption-supported HVAC system)
exch	heat exchanger
fac	devices, machinery, equipment

fan	fan
FC	free cooling
G	glass
g, gen	generation (losses)
GDF	glazed double façade
geo	geometric
glob	global
goods	goods
gr-exch	ground/supply air heat exchanger
GW	groundwater
GS	ground (geothermal probe)
h	(space) heating system
h*	HVAC heating function, heating energy supply for the air conditioning system
H	heater
HK	heating circuit
Hp, hp	heat pump
HVAC	Heating Ventilation and Air Conditioning
hydr	hydraulic
I	internal (heat sources)
i	indoor, interior
IEC	indirect evaporative cooling
in	delivered (into)
inf	infiltration
int	intermittent
iu	from thermally conditioned to thermally unconditioned zone
i, j, k, x	index
l	lighting system
IWH	instantaneous water heater
LA	lighted area
Li	lintel
ltc	operating limit (switch-off point)
lx	per lux
m	mean, average
m	maintained
max	maximum
mech	mechanical
meas	measured
MF	maintenance factor
min	minimum
mod	modulation
mot	motor, engine
mth	month, monthly
NA	reduction for set-back operation (at night)
ND	no daylight
nd	energy need
NF	net floor (area)
night	during nighttime
O	occupancy dependent
oB	without battery
Obl	roof light

OC	occupancy control
ODA	outdoor air
op	operating
opaq	opaque, non-transparent
out	discharged (out)
outg	(net) energy output of generator (ce+d+s)
p	primary energy
p	persons
P0	stand-by
Pint	partial load
pk	peak
PM	pump management
Pn	full load, nominal load
PP	power plant
pre-h	pre-heater
prod	produced
PS	buffer storage
pt	peak tapplings
Pu	pump
PV	photovoltaics
R	room
RA	return (at design conditions)
rB	design operating time
rc	residential cooling system
rd	recovered
re	relative
ref	reference
re-h	re-heater
rec	heat recovery
reg	regenerative
res	residential
rl	recoverable
rL	design service life
RL	return flow temperature
ru	residential unit
rv	residential ventilation system
s	ground
s	storage losses
S	solar
S	supply
SA	sun shading activated
self	self
set	set-point value
Sh	shading
sink	heat sink
SNA	sun shading not activated
sng	single operation (space heating and domestic hot water heating)
sol	solar
source	heat source
st	humidification (system)

start	start / beginning (of usage)
storey	storey
Su	summer (design case)
sunrise	sunrise time
sunset	sunset time
SUP	supply air
sur	surrounding (area(s))
T	transmission
Ta	task area
tb	partially heated
therm	thermal energy
TI	transparent thermal insulation
tot	total
tr	transparent
u	unconditioned, unheated or uncooled room or building zone
ue	from unheated building zone to external air
use	usage(-dependent), used
v	ventilation system
V	ventilation
vc	HVAC ventilation system (cooling)
vh	HVAC ventilation system (heating)
VA	supply (at design conditions)
VL	supply flow temperature
w	domestic hot water system
WB	thermal bridge
we	weekend
WEP	wind energy plant
Wi	winter (design case)
win	window (airing)
wp	work plane
z	adjacent building zone
Z	circulation circuit
*	design conditions
"	next higher point for linear interpolation
'	next lower point for linear interpolation

Figure 2 below shows the system of indicators (indices) used for determining energy quantities in the balances.

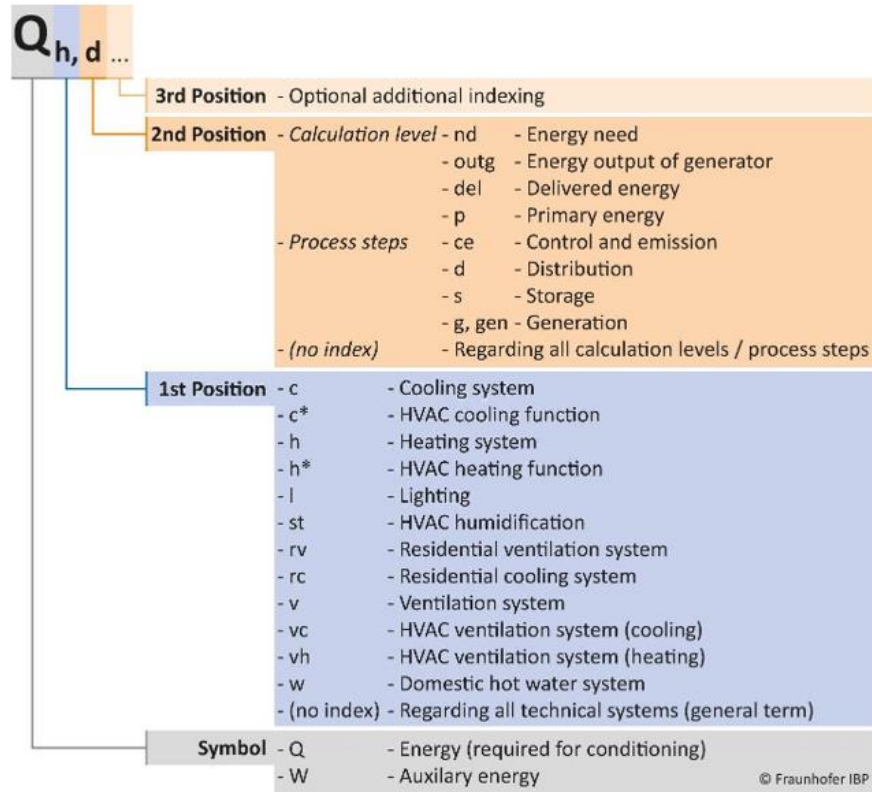


Figure 2. Subscript system

Table 3 below shows the system of naming and assignment of indicators (indices) used for determining energy quantities in the balances.

Table 3 – System of naming and assignment of indices

	Building energy need	Control and emission	Distribution	Storage	Generator heat/cooling energy output	Generation	Delivered energy
Lighting system	Energy need for lighting	—	—	—	—	—	Delivered energy for lighting
	$Q_{l,nd}$						$Q_{l,del}$
Heating system	Energy need for heating	Control and emission losses of heating system	Distribution losses of heating system	Storage losses of heating system	Generator heat output to heating system	Generation losses of heating system	Delivered energy for heating system
	$Q_{h,nd}$						$Q_{h,del}$
Cooling system	Energy need for cooling	Control and emission losses of cooling system	Distribution losses of cooling system	Storage losses of cooling system	Generator heat output to cooling system	Generation losses of cooling system	Delivered energy for cooling system
	$Q_{c,nd}$						$Q_{c,del}$
AC ventilation system (heating)	Net heating energy of air conditioning	Control and emission losses of AC ventilation system	Distribution losses of AC ventilation system	—	—	—	—
	$Q_{vh,nd}$						

	Building energy need	Control and emission	Distribution	Storage	Generator heat/cooling energy output	Generation	Delivered energy
AC ventilation system (cooling)	Net cooling energy of air conditioning	Control and emission losses of AC ventilation system	Distribution losses of AC ventilation system	—	—	—	—
	$Q_{vc,nd}$	$Q_{vc,ce}$	$Q_{vc,d}$				
HVAC heating function	Energy need for heating coil	Control and emission losses of HVAC heating function	Distribution losses of HVAC heating function	Storage losses of HVAC heating function	Generator heat output for HVAC heating function	Generation losses of HVAC heating function	Delivered energy for HVAC heating function
	$Q_{h*,nd}$	$Q_{h*,ce}$	$Q_{h*,d}$	$Q_{h*,s}$	$Q_{h*,outg}$	$Q_{h*,g}$	$Q_{h*,del}$
HVAC cooling function	Energy need for cooling coil	Control and emission losses of HVAC cooling function	Distribution losses of HVAC cooling function	Storage losses of HVAC cooling function	Generator heat output for HVAC cooling function	Generation losses of HVAC cooling function	Delivered energy for HVAC cooling function
	$Q_{c*,nd}$	$Q_{c*,ce}$	$Q_{c*,d}$	$Q_{c*,s}$	$Q_{c*,outg}$	$Q_{c*,g}$	$Q_{c*,del}$
Humidification	Energy need for humidification	Control and emission losses of humidification	Distribution losses of humidification	—	Generator heat output for humidification	Generation losses of humidification	Delivered energy for humidification
	$Q_{st,nd}$	$Q_{st,ce}$	$Q_{st,d}$		$Q_{st,outg}$	$Q_{st,g}$	$Q_{st,del}$
Ventilation system for residential buildings	Energy need for residential ventilation system	Control and emission losses of residential ventilation system	Distribution losses of residential ventilation system	Storage losses of residential ventilation system	Generator heat output to residential ventilation system	Generation losses of residential ventilation system	Delivered energy for residential ventilation system
	$Q_{rv,nd}$	$Q_{rv,ce}$	$Q_{rv,d}$	$Q_{rv,s}$	$Q_{rv,outg}$	$Q_{rv,g}$	$Q_{rv,del}$
Cooling system for residential buildings	Energy need for residential cooling system	Control and emission losses of residential cooling system	Distribution losses of residential cooling system	Storage losses of residential cooling system	Generator heat output to residential cooling system	Generation losses of residential cooling system	Delivered energy for residential cooling system
	$Q_{rc,nd}$	$Q_{rc,ce}$	$Q_{rc,d}$	$Q_{rc,s}$	$Q_{rc,outg}$	$Q_{rc,g}$	$Q_{rc,del}$
Domestic hot water supply	Energy need for domestic hot water	Control and emission losses of domestic hot water	Distribution losses of domestic hot water	Storage losses for domestic hot water	Generator heat output for domestic hot water	Generation losses of domestic hot water	Delivered energy for domestic hot water
	$Q_{w,nd}$	$Q_{w,ce}$	$Q_{w,d}$	$Q_{w,s}$	$Q_{w,outg}$	$Q_{w,g}$	$Q_{w,del}$

III. CALCULATUION PROCEDURE

The procedure for calculating the building energy balance should be carried out by considering the following steps:

1. Zoning of buildings – before performing the actual balance calculations, the building shall be divided into zones. In doing so, those areas of a building that are characterized by the same use and do not show any significant differences in the type of conditioning and other zone criteria are combined into a single zone.

2. Determination of energy needs for each zone – energy needs (for heating, cooling or air conditioning, ventilation, humidification, lighting, and domestic hot water) are determined separately for each zone of a building. For heating and cooling, this is done by comparing heat gains and heat losses in the respective zone of the building. One of the reasons for the prior zoning of a building is that, in complex buildings, heat gains and heat losses vary depending on their location within the building. However, only those spaces that are assumed to have similar heat gains and similar heat losses are grouped together into a single zone.

3. Determination of energy needs for heating and cooling through iteration – the energy required for heating and cooling is determined using an iterative method. Since the calculation of the required energy involves comparing all heat gains with all heat losses, these must first be fully calculated. The magnitude of heat gains and heat losses depends, among other factors, on the structural conditions of the building and its use. Most components of the balance can be determined once without repetition (e.g., internal heat gains from occupants (metabolic heat), transmission, ventilation, solar heat gains, etc.). On the other hand, heat gains and heat losses related to technical systems (e.g., heat gains from heating distribution pipes) depend on the building's own energy needs. However, since the building's energy needs are the objective of comparing heat gains and heat losses, repetition (iteration) is required.

4. Determination of technical system losses, supplied energy, and primary energy – if there are multiple technical systems, the calculated energy requirement for each zone is distributed among them. System losses due to emissions, distribution, and storage are added to the energy required for all technical systems. This gives the amount of energy to be supplied by the generator. The generator is then assessed, which includes determining the generator's thermal losses. The last two steps consist of determining the supplied energy for the generators and evaluating the primary energy of the supplied energy. The balances of supplied and primary energy also include the auxiliary electrical energy used.

If the building's technical systems serve more than one zone (e.g., a central cooling system or a heating system for the entire building), or if more than one system is available for a particular building service in each zone (e.g., both central and decentralized domestic hot water supply in a cafeteria), the characteristic values for each zone served by this building service should be determined once and then distributed across the zones.

5. Time steps – Supplied energy or primary energy balances are calculated for a one (1) year period. Partial balances can be calculated in smaller time steps, e.g., by days or by months.

The annual characteristic energy values are calculated by summing the corresponding monthly values of the energy characteristics.

In the case of monthly breakdowns of the determined annual characteristic values, the following procedure is used:

- Assessment of the generators: monthly generator losses Q_g result from the annual loss in proportion to the generator heat output Q_{outg} . The same applies to the delivered energy $Q_{del,in}$ supplied to the generator from outside, the delivered energy $Q_{del,out}$ provided by the generator for processes outside the system boundary, and the (regenerative) delivered energy $Q_{del,prod}$.
- Assessment of losses for storage, distribution and emission: monthly losses of emission Q_{ce} , distribution Q_d and storage Q_s result from the respective annual losses proportional to the energy need Q_{nd} .

- Assessment of auxiliary energies: monthly auxiliary energies W result from the respective annual auxiliary energy proportional to the corresponding delivered energy Q .

1. General calculation procedure

The calculation procedure in general case comprises the following steps.

- 1) Determination of the boundary conditions of use and, where applicable, zoning of the building according to type of usage, building physics, and technical installations and equipment, including lighting.
- 2) Compilation of the input data required for calculating the balances of the building zones (areas, characteristics related to building physics and technical installations and equipment of the building, and supply air temperature and air change rates for certain types of ventilation systems).
- 3) Determination of the energy need and delivered energy for lighting, and the heat sources due to lighting in the respective zone.
- 4) Determination of heat sources and heat sinks due to mechanical ventilation in the respective zone.
- 5) Determination of heat sources and heat sinks due to persons, appliances, etc. (excluding the technical installations and equipment of the building).
- 6) Initial balance estimate of the energy need for heating and cooling of the zone (separately for days of usage and days of non-usage), taking into account the heat sources and heat sinks already known.
- 7) Preliminary allocation of the balance of energy need among the building services (air handling, residential ventilation, heating and cooling).
- 8) Determination of the heat sources due to heating in the respective zone (distribution, storage and, where applicable, generation within the zone) on the basis of the estimated energy need for heating.
- 9) Determination of the heat sources and heat sinks due to cooling in the respective zone (distribution, storage and, where applicable, generation within the zone) on the basis of the estimated energy need for cooling.
- 10) Determination of the heat sources due to domestic hot water preparation (distribution, storage and, where applicable, generation within the zone).
- 11) Calculation for balancing the energy need for heating or cooling of the respective zone (determined separately for days of usage and days of non-usage), repeated in an iteration loop (but not more than 10 times) until two consecutive results for the energy need for heating and the energy need for cooling differ by not more than 0,1 %.
- 12) Determination of the energy need for air conditioning, handling and, where applicable, calculation of the sum of the energy needs for cooling for all zones (VAV systems).
- 13) Final allocation of the balance of energy need among the building services (air handling,

residential ventilation, heating and cooling).

- 14) Determination of the losses due to control and emission, distribution and storage for heating (generator heat output).
- 15) Determination of the losses due to control and emission and distribution for the air transport systems.
- 16) Determination of the losses due to control and emission, distribution and storage for heat supply to HVAC system (generator heat output).
- 17) Determination of the losses due to control and emission, distribution and storage for cooling (generator cooling energy output).
- 18) Determination of the losses due to control and emission, distribution and storage for domestic hot water preparation (heat output of the generator).
- 19) Allocation of the heat output of all generators among the different generation systems.
- 20) Allocation of the cooling/refrigeration energy output of all generators among the different generation systems.
- 21) Determination of losses occurring during the generation of cooling energy.
- 22) Determination of losses occurring during steam generation.
- 23) Determination of losses in the generation of heating energy (heat generator, residential ventilation systems, domestic hot water heating, CHP units and, where applicable, surplus heat from chillers).
- 24) Grouping of auxiliary energies determined as above (e.g., for air transport).
- 25) Grouping of delivered energies and energy carriers.
- 26) Primary energy evaluation.
- 27) The calculation procedure is simplified when residential buildings are assessed. There is no zoning of the building, energy balancing is not performed separately for days of usage and days of non-usage, and the lighting is not included in energy balancing.

The calculation procedure is simplified when evaluating residential buildings. There is no division into building zones, the energy balance is not carried out separately for days of use and non-use, and lighting is not included in the energy balance.

A detailed description of the calculation procedure mentioned above is presented in the following chapters.

IV. ZONING OF BUILDINGS

For energy balancing of non-residential buildings, it is usually necessary to divide the building into several zones. A zone comprises the rooms, spaces or sections of the floor area of a building which is/are characterized by uniform boundary conditions of usage (e.g. temperature, ventilation and lighting). The aim of zoning is to combine those areas of a building with similar heat sources

and heat sinks and thus similar amounts of energy need into one zone.

The most important characteristic for similar energy need or heat sources and heat sinks is the same type of usage, for example 'single office'. Thus, this is always the first zoning criteria to be applied. When rooms are used differently, they must be assigned to different zones.

Even with the same usage, similar energy need or heat sources and heat sinks can only be assumed for rooms with the same type of conditioning. Thus, in case of different conditioning, rooms must be assigned to different zones despite of the same usage, e.g. 'single office with lighting, heating, ventilation and cooling' versus 'single office with lighting, heating and ventilation'.

In addition to type of usage and of conditioning, there are other criteria that can lead to such different energy needs or heat sources and heat sinks, that the affected rooms cannot be represented in a common energy balance and thus in one zone. These characteristics are referred to as "additional zoning criteria". They mainly concern cooled rooms, where for instance also the proportion of glazed wall is relevant. That means 'Offices with heating, ventilation and cooling but with a transparent share of the façade of 25 %' need to be zoned separately of those with a proportion of 75 %.

The principle of zoning is thus a principle of exclusion, with the aim of combining areas, which are as homogeneous as possible and then balancing them as one zone. The energy demand of the building is then the sum of the energy demands of all zones within the building.

The following Figure 3 shows a flow chart of the zoning procedure with different types of usage and conditioning as well as additional zoning criteria, depicting the examples introduced above.

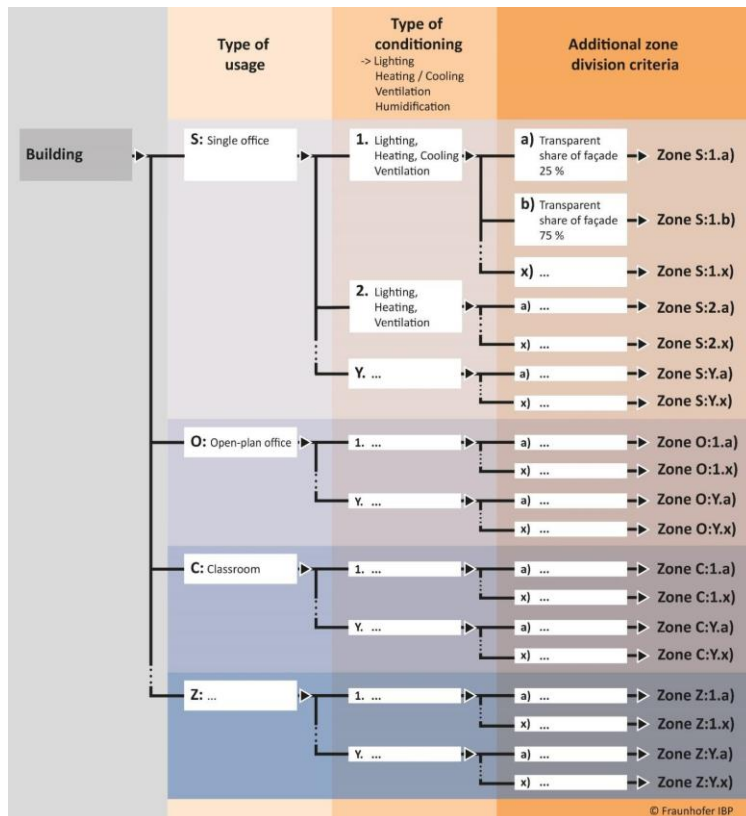


Figure 3. Exemplary flow chart of zoning, based on usage, conditioning and additional criteria

To simplify the building's energy balance, only as many zones should be formed as are necessary to consider the most important energetic differences within the building. It should be avoided to generate too many zones, as this can significantly increase the calculation effort without decisively improving the result.

1. Definitions of zones

1.1. Zone

A zone is the basic calculation unit according to this Annex. A zone includes the floor area (net floor area) of a group of rooms within a building that are characterized by the same type of use, the same type of conditioning (heating, cooling, ventilation, humidification, lighting, and domestic hot water supply), and additional uniform zoning criteria.

1.2. Conditioned zone/thermally conditioned zone

A zone may have all types of conditioning (heating, cooling, ventilation, humidification, lighting) or just a single one (e.g. lighting). Rooms or zones having at least one type of conditioning are so called "conditioned rooms" or "conditioned zones". In case a zone is heated and/or cooled, it is called a "thermally conditioned zone".

1.3. Unconditioned zone/thermally unconditioned zone

Areas of a building that are not conditioned are grouped together as "unconditioned" rooms or zones. A building can have several "unconditioned zones" (e.g. attic floor). In case the zone is only illuminated and/or ventilated but not heated and/or cooled, it is called a "thermally unconditioned zone".

1.4. Serviced area

A serviced area (supplied by heating, domestic hot water, ventilation, cooling, lighting, etc.) comprises the parts of a building that are served by one and the same technical building system. One serviced area can cover several zones and one zone can include several serviced areas.

A building can be divided into serviced areas completely independent of zoning. The characteristic energy values or energy balance shares determined for a serviced area can be divided among the zones of the building.

2. Steps for definition of zones

A building is divided into zones in three steps:

Step 1: Combining areas of equal usage;

Step 2: If necessary, further dividing the combined usage areas due to different types of conditioning and additional zoning criteria;

Step 3: Including very small areas due to insignificance.

Rooms that are not directly heated or cooled (e.g. cellar, attic, technical rooms etc.) are to be combined into one or more "thermally unconditioned building zones". The temperature in this zone is determined solely on the basis of the heat flows from neighboring rooms or heat sources

or sinks. These rooms must also be assigned to a usage profile.

Step 1: Combining areas of equal use

Rooms are grouped into one zone when they can be assigned to the same usage profile, when they are equally conditioned and when no restrictions regarding the additional zone division criteria occur.

The boundary conditions for the most common types of usage should be specified in national rulebooks. In case other types of usage are required, the relevant boundary conditions must be determined.

In case of high air exchange between different rooms or groups of rooms, in particular due to forced air flows by mechanical (fan-assisted) ventilation, one of the following methods is selected:

- The rooms with the high air exchange among each other can be combined into one building zone.
- The air volume flow between the rooms can be taken into account by calculating the resulting heat sources or heat sinks in the balance of the zones.

In the following section, the additional zoning criteria are described. In case none of these rules apply, zoning is based only on the assignment to usage profiles.

Step 2: Applying additional zone division criteria

An area with rooms of equal usage must be further divided, when structural or technical characteristics vary in such a way, that separate energy balancing for heating, cooling, lighting, etc. is required. The following criteria makes further zoning necessary. However, these zoning criteria always need to be applied after the allocation to usage profiles.

Table 4 – Additional zone division criteria (to be applied after the allocation to usage profiles)

Criterion		Description
1	Types of conditioning	Rooms (or areas) of one usage-profile are to be separated into different zones, when the requirements for conditioning differ. They may be combined into one zone in case of: — same requirements for thermal conditioning and lighting, — solely requirements for lighting, — solely requirements for thermal conditioning.
2	Types of ventilation systems	Rooms (or areas) of one usage-profile are to be separated into different zones, when they are equipped with different ventilation and air-conditioning systems. They may be combined into one zone in case of: — free ventilation only, — HVAC/ventilation systems with a constant air flow rate, — HVAC/ventilation systems with a variable air flow rate, — HVAC/ventilation systems with air/water system, — room air conditioners (split/multi-split units).

Table 5 contains further boundary conditions (criteria 1 to 6) that can lead to the division of a zone

beyond its usage. These are only relevant regarding the energy balancing for cooling and thus only for rooms or areas being cooled. Again, the characteristics are to be applied separately, meaning rooms are only combined into one zone, when they are classified equal in all characteristics according to Table 5.

Table 5 – Additional zone division criteria, only to be applied for cooled zones

Criterion		Description
1	Functions of the HVAC system	Rooms (or areas) with HVAC systems are to be separated into different zones when the systems provide different functions. They may be combined into one zone in case of equal system characteristics regarding: — heating; — cooling; — humidification and dehumidification.
2	External air supply volume flow dependent on operating mode	Rooms (or areas) with HVAC systems are to be separated into different zones, when the systems provide different operational fresh air flow rates. This applies to rooms (or areas), where the HVAC system: — is operated with a fresh air flow rate of 5 % or more of the building's total air flow rate — provides a cooling capacity of 12 kW or more; — provides an air volume flow rate of 3000 m³/h or more.
3	Installed power of artificial lighting	Rooms (or areas) are to be separated into different zones, when the installed power of artificial lighting differs. This applies, when the installed specific power in an area is at least 20 W/m ² higher than the specific power installed in the rest of the zone, and when the area affected includes more than 10 % of the total zone area; or when the installed power in the area with the higher power is greater than 5 kW, these spaces/rooms shall be assigned to different zones.
4	Depth of building and rooms	Rooms (or areas) are to be separated into different zones, when they differ with respect to available daylight or space air conditioning. Buildings with a depth of more than 16 m (external dimensions) must be divided up into an inner zone and an outer zone parallel to the facades which have windows. This criterion does not apply to halls or similar floor plans which would have no material boundaries between the inner and outer zones. Note: When only lighting is affected, there is also the option to create separate lighting areas within the zone.

Criterion		Description
5	Façade design and proportion of glazed surfaces	Rooms (or areas) bordering on façades are to be separated into different zones, when they differ with respect to the proportion of glazed wall area available. This applies to the following proportions of glazed wall area: — < 30% — $\geq 30\%$ and < 50% — $\geq 50\%$ and < 70% — $\geq 70\%$ Deviating therefrom, individual grouping of rooms (or areas) with other proportions of glazed wall area is possible, when the proportions do not differ by more than 20% within a zone.
6	Sun shading and building orientation	Rooms (or areas) bordering on façades are to be separated into different zones, when they differ with respect to shading against solar radiation, e.g. by different sun shading systems or orientation. Each of the categories listed below requires that the respective room/area should be assigned to a particular zone. Without respect to orientation: — permanently shaded facades — external sun shading with $g_{\text{tot}} < 0,12$ Depending on the orientation (facing South, East, West or North): — external sun shading with $g_{\text{tot}} \geq 0,12$; — internal sun shading with $g_{\text{tot}} < 0,35$; — internal sun shading with $g_{\text{tot}} \geq 0,35$; — no sun shading.

Step 3: Including very small areas due to insignificance

After dividing the building into zones or as a last step within this procedure, remaining areas may be included in other zones due to insignificance according to the following rules:

- Small areas with a percentage of up to 5 % of the total building area may be added to other zones with highly similar technical conditioning but different usage, provided that the internal loads of the zones do not differ significantly. The heating, cooling and ventilation systems may differ. For this, the zone with the most similar type of usage and of supply systems shall be selected.

EXAMPLE: Heated, cooled, ventilated and illuminated meeting rooms with a constant volume flow system can be assigned to the zone "heated, cooled, ventilated and illuminated offices with a variable volume flow system". Only the usage and ventilation supply differ here, the types of conditioning are the same and the internal loads are similar.

- Very small areas with a percentage of up to 1 % of the total building area may be added to another zone, even with different types of conditioning. In this case, a zone must be selected being as similar as possible regarding usage and conditioning.

EXAMPLE: Heated, cooled, ventilated and lighted meeting rooms, can be assigned to the zone "heated, ventilated and lighted (but not cooled) offices", as there is similar use and correspondence in three types of conditioning.

Step 3 of zoning is not applicable to areas with very high internal loads and air exchange rates (e.g. in canteen kitchens).

3. Serviced areas

After completion of zoning, the building is divided into serviced areas with regard to technical building services. A serviced area groups together the areas of the building that are supplied by the same system technology. This is done completely independently from the zoning, following the respective technical calculation requirements.

The supply areas are relevant for determination of partial energy characteristic values (e.g. heat losses of a heat generator that supplies several zones).

4. Assignment of balance components

The energy balance described in this document serves to identify delivered and primary energy characteristic values for buildings seen as an entity. However, the full set of characteristic values for each zone of a building also need to be determined. These are:

- the heat sources and heat sinks of the zone;
- the type of energy need in the zone;
- the system losses and auxiliary energy of the zone;
- the delivered and primary energy required by the zone.

One result of zoning is that the boundaries between zones and between serviced areas are not always one and the same. In particular, system losses and the delivered and primary energy required are initially determined for each serviced area rather than for each zone. The required characteristic values relating to the zones are then determined.

The following rules apply when assigning part-balances to the zones on the basis of building services:

- if a serviced area includes more than one zone or if a zone boundary passes through a serviced area, the energy requirement is to be distributed over the individual zones;
- if a zone is subdivided into several serviced areas, then the energy need of the zone is the sum of the energy to be required for all partial floor areas of all serviced areas within the zone.

In the following, the assignment rules are explained in detail using the building shown in Figure 4 as an example. The balance calculations for the building energy needs, system losses, auxiliary energy, delivered energy and primary energy are described below.

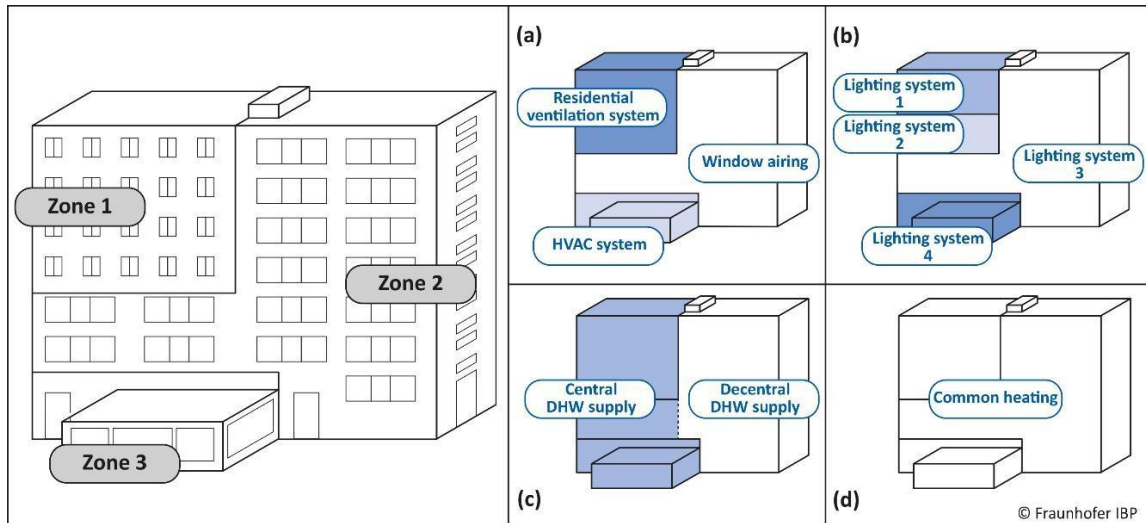


Figure 4. Building used as an example for assignment

The energy needs for all modes of conditioning (heating, cooling, ventilation, humidification, lighting and domestic hot water supply) are determined once only for each zone. It is assumed that the energy needs are evenly distributed throughout the respective zone. For the purposes of the balance this means that the following components of the energy need are to be determined for each zone:

- the energy need for heating (as described Chapter V, sub-chapter 2);
- the energy need for cooling (as described Chapter V, sub-chapter 2);
- the energy need for air conditioning including humidification;
- the energy need for domestic hot water preparation (as described Chapter V, sub-chapter 4);
- the energy need for lighting (as described Chapter V, sub-chapter 1).

This means that the energy need (in relation to the net floor area) is the same for any part of the zone.

In order to determine the energy needs for heating and cooling of a zone, the heat sources and heat sinks in the zone need to be known. When a balance is calculated by the method described in Chapter V, all heat sources and heat sinks in a zone are assumed to be evenly distributed across the entire net floor area.

4.1. Assignment rules

If energy characteristic values/balance components of serviced areas are to be determined according to zones, a distinction is to be made between three types of case.

Case 1: Supply area and zone are identical

If a zone has only one technical building system for each service (balance boundary of the zone and the service area is the same), then:

- all system losses of the technical building systems,
- all delivered energy including environmental energy utilized by the technical building

systems,

- all auxiliary energy of the technical building systems, and
- all heat sources and heat sinks resulting from the above within the zone, are balanced only once for this zone. No assignment is required in this case.

In the calculations, all system losses, all auxiliary energy and all resulting heat sources and heat sinks are assumed to be evenly distributed throughout the zone. This means that the energy characteristics, defined in relation to the net floor area, are the same for any part of the zone.

EXAMPLE: This case applies to the type of ventilation system in the example building shown in Figure 4 (see (a) in Figure 4). The zones 1 and 3 each have a system of mechanical ventilation.

Case 2: Several serviced areas in one zone

If one zone has multiple technical building systems for the same building service, then initially

- all system losses of the technical building systems,
- all delivered energy including environmental energy utilized by the technical building systems,
- all auxiliary energy of the technical building systems, and
- all heat sources and heat sinks resulting from the above within the zone, are balanced individually for each serviced area.

The resulting absolute values (in kWh/unit of time) for system losses, delivered energy, auxiliary energy and the resulting heat sources and heat sinks are then added together for all serviced areas within the zone in order to obtain overall values. In the calculations, it is assumed that the overall values are evenly distributed over the respective zone. This means that the relative energy values, defined in relation to the net floor area, are the same for any part or sector of the zone.

Case 3: Several zones per supply area

If one and the same technical building system serves an area which is larger than a single zone, then the balance of the characteristic values is as specified below:

- The system losses due to control and emission shall be determined as characteristic values for each zone.
- The system losses due to distribution shall be determined as characteristic values for each zone. The basic data required for the calculations (especially the pipe lengths and pump capacities) shall be determined once for the entire serviced area, and if no actual project data are available, default values shall be used. These are then distributed over the zones according to the ratio of the respective net floor areas. The same procedure is applied for the internal heat sources and heat sinks as well as for the auxiliary energy for distribution.
- The system losses due to storage shall be determined once as an absolute value for the entire serviced area and then distributed over the serviced zones. The share of the storage losses and the associated auxiliary energy for each zone is calculated by weighting these according to the energy need for heating or cooling of the zones serviced by the respective storage vessel. The internal heat sources are only fully effective within the zone in which

the storage vessel is installed (i.e. these heat sources are not distributed over a number of zones).

- The system losses due to generation, as well as the usable environmental energy, and the associated auxiliary energy for generation are distributed among the serviced zones according to the shares of the generator heat/cooling energy output of these zones. The internal heat sources and heat sinks are not assigned to several zones, but (without assignment) are fully effective only in the zone where the generator is located.

This case applies to the central domestic hot water supply (see (c) in Figure 4) and the heating system (see (d) in Figure 4) in the building shown in Figure 4 above.

4.1.1. Breakdown of annual values into monthly values

In general, the energy assessment is based on a monthly balance. However, individual calculation steps of the evaluation procedure are only provided on an annual basis. If no other rule exists for the distribution of the annual characteristic values to monthly values, the following applies:

- Control and emission, distribution and storage losses (as well as the associated auxiliary energy) are distributed in proportion of the monthly to the annual energy need Q_{nd} ;
- Generation losses (and associated auxiliary energy) are distributed in proportion of the monthly to the annual generator energy output Q_{outg} .

V. ZONING OF BUILDINGS

Energy needs result directly from the conditions of use and have to be provided by each building service. The following are classed as forms of energy need:

1. **Energy need for lighting**, i.e. electrical energy required to ensure adequate lighting of the building or the building zone;
2. **Energy need for heating**, i.e. the amount of heat that is additionally supplied to the building or building zone in a (demand) controlled manner in order to maintain the internal set-point temperature;
3. **Energy need for cooling**, i.e. the amount of cooling energy that is additionally supplied to the building or building zone in a (demand) controlled manner in order to maintain the internal set-point temperature;
4. **Energy need for air conditioning**, i.e. the amount of energy that has to be transferred to or from a ventilation and air conditioning system for heating, cooling, humidification and dehumidification in order to maintain the required supply air quality;
5. **Energy need for domestic hot water preparation**, i.e. the amount of energy required to heat the domestic hot water from the cold water temperature to the hot water temperature at the tapping point.

Air conditioning in this context comprises the handling of external air drawn in until it achieves a specified supply air quality under a control method which is not dependent on the current demand in the building zone (central system). The balanced energy need for heating and cooling in the building zone is the additional demand which has to be met by reheating/recooling the air, by increasing the air volume or by other means of heating or cooling in order to maintain the internal

set-point temperature.

In buildings with ventilation and air conditioning systems, the calculated energy need for heating and cooling in the building zone are allocated to different components of the heating and cooling system, depending on the type of system. The energy need for heating and cooling are thus divided up among different building systems.

The energy need for heating and cooling can also be divided up in buildings or building zones which have no ventilation and air conditioning system, if these contain different heating and/or cooling systems operated in parallel.

1. Energy need for lighting

The energy need for lighting $Q_{l,nd}$ is the amount of energy required to ensure adequate lighting of the building or the building zone by artificial means. The balance area is the zone in which lighting requirements are set. However, for determination of the lighting energy, the zones are additionally divided into spaces,

e.g. depending on daylight benefit. Additional energy use which is not directly associated with the actual lighting function, such as energy used by control equipment, is not considered to be part of the lighting energy.

The determination of lighting energy does not follow the calculation procedure of deriving delivered energy from the energy need added by system and distribution losses, as for heating and cooling. For lighting the energy need is equivalent to the delivered energy which is explained and calculated in Chapter VII.

The entire energy need for lighting is usually effective as an internal heat source.

2. Energy need for heating and cooling

The balance area is the building zone. The balance boundaries are formed by the elements of the thermal envelope enclosing the building zone. In the case of ventilation systems, the balance boundary for the supply air flow is the point where it enters the devices which reheat or recool the supply air as a function of the energy need in the building zone.

In principle, an average day in the month is used as the reference period for which the heat sources and heat sinks are to be balanced (calculation period). Where applicable, a separate balance is calculated for days on which the operating conditions deviate significantly from the average (e.g., weekends, holiday periods etc.). The values pertaining to the days of normal usage and to the exceptions (weekends, holidays) are then added together.

The energy need for heating and cooling in the building zone is influenced by the magnitude of the uncontrolled energy gains and losses in the form of heat sources and heat sinks. These must first be determined for each zone.

2.1. Determination of all internal heat sources and heat sinks

The heat flows within a building zone and at the boundaries of the zone are effective as heat sources (e.g., heat input, heat gains) or heat sinks (e.g. cold input, heat losses) for the respective zone (see Table 6 below). The sum of the heat sinks and the sum of the heat sources are put in relation to each other in order to establish the energy balance, from which the energy needs for

heating and cooling are then determined.

The following heat sources and sinks are included in the energy balance (only sensible heat being taken into consideration):

1. Transmission heat sinks or sources due to thermal conduction through building elements and heat transfer through the boundary surfaces of the building zone;
2. Ventilation heat sinks or sources due to exchange of indoor air for external air (infiltration and window airing) and/or with air from other building zones;
3. Ventilation heat sinks or sources due to air exchange in a space by means of ventilation systems, which usually introduce pre-conditioned supply air into the zone;
4. Solar heat sources due to solar radiation entering the spaces through transparent building elements;
5. Heat sinks or sources due to solar radiation absorption and heat radiation on the external surfaces of non-transparent building elements;
6. Internal heat sources and heat sinks due to the operation of (electrical) appliances, artificial lighting, dissipation of heat by humans and animals (metabolic heat), introduction of warm or cold materials and/or goods into the building zone, flow of heating and cooling mediums in distribution pipes and ducts;
7. In the case of reduced operation at weekends or during holidays, the heat stored in the thermal envelope during the usage period that escapes during the period of reduced operation is taken into account.

Table 6 – Heat sinks and heat sources

Energy balance item			Heat source Q_{source}	Heat sink Q_{sink}
Q_T Transmission	Q_T	Transmission via building element surfaces	$\theta_i < \theta_e$	$\theta_i > \theta_e$
	$Q_{T,WB}$	Transmission via thermal bridges	$\theta_i < \theta_e$	$\theta_i > \theta_e$
Q_V Ventilation	$Q_{V,inf}$	Ventilation due to infiltration	$\theta_i < \theta_e$	$\theta_i > \theta_e$
	$Q_{V,win}$	Ventilation due to user action or window	$\theta_i < \theta_e$	$\theta_i > \theta_e$
	$Q_{V,mech}$	Uncontrolled mechanical ventilation	$\theta_i < \theta_{\text{supp}}$	$\theta_i > \theta_{\text{supp}}$
Q_S Solar heat sources/ heat sinks	$Q_{S,opaq}$	Solar heat gains from opaque building	$Q_{S,opaq} > 0$	$Q_{S,opaq} < 0$
	$Q_{S,trans}$	Solar heat gains from transparent building elements	always	—
Q_I Internal heat sources/ heat sinks	$Q_{I,p}$	Internal heat gains from metabolic heat	always	—
	$Q_{I,goods}$	Internal heat gains or losses due to the flow of goods	$\theta_i < \theta_{\text{goods}}$	$\theta_i > \theta_{\text{goods}}$
	$Q_{I,fac}$	Internal heat gains or losses due to appliances, machinery and equipment	$\theta_i < \theta_{\text{fac}}$	$\theta_i > \theta_{\text{fac}}$
	$Q_{I,el}$	Internal heat gains or losses due to other electrical appliances	always	—
	$Q_{I,l}$	Internal heat gains due to lighting	always	—

	$Q_{I,h}$ $Q_{I,h*}$	Internal heat gains and losses from the heating system, including air conditioning	always	—
	$Q_{I,w}$	Internal heat gains from the domestic hot water preparation system	always	—
	$Q_{I,c}$ $Q_{I,c*}$ $Q_{I,rc}$	Internal heat gains or losses from the cooling system, including air conditioning and residential cooling	$\theta_i < \theta_{\text{system}}$	$\theta_i > \theta_{\text{system}}$
	$Q_{I,st}$	Internal heat gains from the generation and distribution of steam for humidification	always	—
	$Q_{I,vh}$ $Q_{I,vc}$ $Q_{I,rv}$	Internal heat gains or losses from the mechanical ventilation system	$\theta_i < \theta_R$	$\theta_i > \theta_R$

2.1.1. Heat sinks

The total amount of heat sinks Q_{sink} is the sum of transmission and ventilation heat sinks (heat losses) and cold gains from ventilation systems, internal sources of cold in the building zone and radiation losses.

$$Q_{\text{sink}} = Q_T + Q_V + Q_{I,\text{sink}} + Q_S + \Delta Q_{C,\text{sink}} \quad (1)$$

where:

Q_{sink} is the total sum of heat sinks in the building zone;

Q_T is the heat flow due to transmission heat sinks

Q_V is the heat flow due to ventilation heat sinks

$Q_{I,\text{sink}}$ is the heat flow due to internal heat sinks in the building zone

Q_S is the heat flow due to radiation, taking into account the solar irradiation

$\Delta Q_{C,\text{sink}}$ is heat stored during periods of normal operation that escapes from the building elements during days with reduced operation. It is only taken into account for the days of use in the heating energy balance

2.1.1.1. Transmission heat sinks

Transmission heat flows act either as heat sources or as heat sinks, depending on the temperatures on both sides of a building element. If a building zone is adjacent to various areas with different temperature levels, it is possible that transmission heat sources and transmission heat sinks may exist at the same time. Transmission heat sinks will occur in all boundaries with adjacent areas in which the mean temperatures are lower than the internal temperature of the building zone being considered. Usually, this mainly includes the transmission of heat to the external environment. Transmission heat sinks are generally calculated using equation (2):

$$Q_T = \sum_j H_{T,j} (\theta_i - \theta_j) t \quad \text{for } \theta_i > \theta_j \quad (2)$$

Where:

$H_{T,j}$ is the transmission heat transfer coefficient between the building zone and an adjacent area;

θ_i is the reference internal temperature of the building zone

θ_j is the average monthly outdoor temperature or the mean temperature of an adjacent zone;

t is the length of the calculation step ($t = 24$ h).

The transmission heat transfer coefficient $H_{T,j}$ is calculated from the thermal transmittance of the individual elements and their areas as specified in SK SSh EN ISO 13789 and EN ISO 13370, taking into account linear and point thermal bridges. For simplification, default values may be assumed for the effects of the thermal bridges.

The coefficient of heat transmission $H_{T,j}$ is calculated based on the heat transfer coefficients of individual elements and their surface areas, as specified in the SK SSH EN ISO 13789 and EN ISO 13370 standards, taking into account linear and point thermal bridges.

For simplification of calculations, the impact of thermal bridges can be considered by increasing the heat transfer coefficient value U [$W/(m^2 \cdot K)$] of each element of the building envelope of the heated/cooled part of the building by ΔU_{UT} [$W/(m^2 \cdot K)$]:

1. If the thermal bridges are insulated according to the recommended best practice solutions, the increase of the heat transfer coefficient value, is: $\Delta U_{UT} = 0.05$ [$W/(m^2 \cdot K)$],
2. If the thermal bridges are not insulated according to the recommended best practice solutions, the increase of the heat transfer coefficient value, is: $\Delta U_{UT} = 0.10$ [$W/(m^2 \cdot K)$],

Wherever the temperature of the adjacent zone is lower than the internal temperature of the building zone being assessed, the following transmission heat flows are taken into account:

Transmission through external building elements

$$Q_{T,e} = (H_{T,D} + H_{T,WB})(\theta_i - Q_e) t$$

Transmission to adjacent unheated building zones or sunspaces

$$Q_{T,u} = H_{T,iu}(\theta_i - Q_u) t$$

Transmission to adjacent heated or cooled building zones

$$Q_{T,z} = H_{T,iz}(\theta_i - Q_z) t$$

Transmission to the ground

$$Q_{T,s} = H_{T,s}(\theta_i - Q_e) t$$

2.1.1.2. Ventilation heat sinks

Ventilation heat flow is caused by infiltration through joints and leaks, window airing or mechanical ventilation systems. In each case, the air entering the building zone needs to be

balanced. Depending on the temperature of the air entering the zone, the heat flow is either a heat sink or a heat source. If the building zone is adjacent to various areas with different temperature levels, the different air streams may cause ventilation heat sinks and ventilation heat sources at the same time. The heat flow due to ventilation heat sinks is generally calculated using equation (3):

$$Q_V = \sum_k H_{V,k} (\theta_i - \theta_j) t \quad \text{for } \theta_i > \theta_j \quad (3)$$

where:

- $H_{V,k}$ is the heat transfer coefficient for ventilation by external air, air from another building zone or via a ventilation system;
- θ_i is the reference internal temperature of the building zone
- θ_k is the average monthly external temperature, or the mean temperature of the air from another building zone or the mean temperature of the air supplied by the ventilation system;
- t is the period to which the calculation step applies ($t = 24$ h).

The heat transfer coefficient $H_{V,k}$ is calculated from the mean volume flow, the specific heat capacity of air and the density of air. The mean volume flow is usually given as the product of the average air exchange rate and the volume of the building zone.

In particular, the following ventilation heat sinks are considered if the mean temperature of the air entering the zone is lower than the internal air temperature of the building zone:

Ventilation heat sinks due to external air infiltration

External air can enter the building zone through gaps, joints and leaks in external building elements (infiltration). Infiltration depends on the construction of the building, in particular its airtightness (e.g., the size of leaks and their distribution in the building envelope). As the internal temperature is generally higher than the mean external air temperature, the infiltration of external air usually has the effect of a heat sink in the building zone.

$$Q_{V,\text{inf}} = H_{V,\text{inf}} (\theta_i - \theta_e) t$$

Ventilation heat sinks due to window airing

The air exchange of the indoor air by external air entering through windows, doors or other envelope elements which can be opened and shut, depends on the usage of the building zone and is generally variable. This air change also constitutes a heat sink:

$$Q_{V,\text{win}} = H_{V,\text{win}} (\theta_i - \theta_e) t$$

Cold gains due to mechanical ventilation

Cold gains due to HVAC systems must be taken into account in the building zone if these occur independently of the current heat or cooling load. This is the case, for example, with residential ventilation systems and ventilation systems with central air conditioning. For demand-oriented variable air volume control (VAV) systems, the minimum volume flow is assumed. When calculating the cold gains due to supply air, the difference between the supply air temperature and the reference internal temperature, as well as the operating time of the ventilation system, is taken

into consideration. The supply air temperature is usually specified for systems with temperature control and for ventilation systems for residential building.

$$Q_{V,mech} = H_{V,mech}(\theta_i - \theta_{V,mech}) t$$

For building zones not equipped with mechanical ventilation, equation (4) applies:

$$Q_{V,mech} = 0 \quad (4)$$

Ventilation heat sinks due to air exchange with other zones

If there is a high rate of air exchange between different spaces or enclosures in the building, they should be combined into one building zone. Thus, the air exchange between building zones is generally assumed to be zero.

If, in individual cases, there are two zones with air exchange between the zones, then the heat sinks due to air entering the zone are calculated for the zone into which the air flows, using equation (3) and inserting the appropriate values. This is necessary, for instance, in zones with extract air systems where the replacement air is drawn in from other zones.

$$Q_{V,z} = H_{V,z}(\theta_i - \theta_z) t$$

2.1.1.3. Internal heat sinks

Internal heat sinks (sources of cold) may exist in the building zone in form of refrigerant piping, cold-water pipes or cold-air ducts located within the zone. "Losses" due to distribution pipelines and air ducts and their proportional impact on the building zone are calculated according to equations in chapter V, sub-chapters 3 and 6.

Cold (i.e., heat losses) can also be due to equipment (e.g., chilled counters with external cold generation, split units) or due to cold materials or objects (e.g., production materials), being regularly brought into the building zones.

It is possible for internal heat sinks and internal heat sources to exist simultaneously within a building zone.

The total internal heat sinks are calculated as follows:

$$Q_{I,sink} = Q_{I,sink,c} + Q_{I,sink,fac} + Q_{I,sink,goods} \quad (5)$$

where:

$Q_{I,sink,c}$ is the input of cold due to cooling systems (due to distribution pipeline and air ducts with temperatures below the internal temperature);

$Q_{I,sink,fac}$ is the input of cold due to appliances, equipment and machinery;

$Q_{I,sink,goods}$ is the input of cold due to materials and goods with temperatures below internal temperature brought into the building zone.

In the initial balance estimates, the value of $Q_{I,sink,c}$ is assumed to be zero.

2.1.1.4. Heat sinks due to radiative heat transfer

Heat gains due to solar radiation on opaque surfaces are balanced against the heat losses due to

long-wave radiative heat transfer from these surfaces. This may cause a heat sink if the solar radiation levels are low and the radiative heat transfer levels are high. The respective heat flows cause each building element to act as either a heat source or a heat sink.

2.1.1.5. Heat storage

When taking into account reduced operation at weekends or during holidays, the heat stored in elements during periods of normal operation that escapes during the period of reduced operation and is stored in days with normal operation are taken into account. For days of non-usage this heat is deducted directly from the energy need for heating. For usage days this heat is treated as a heat sink.

2.1.2. Heat sources

According to equation (6), the total amount of heat sources Q_{source} is the sum of heat flows due to solar radiation, transmission heat sources, ventilation heat sources due to natural and mechanical ventilation and internal heat sources within the building zone.

$$Q_{\text{source}} = Q_S + Q_T + Q_V + Q_{\text{I,source}} \quad (6)$$

where:

- Q_{source} is the sum of heat sources in the building zone;
- Q_S is the sum of heat flows due to solar radiation;
- Q_T is the sum of heat flows due to transmission heat sources;
- Q_V is the sum of heat flows due to ventilation heat sources;
- $Q_{\text{I,source}}$ is the sum of heat flows due to internal heat sources in the building zone.

2.1.2.1. Heat sources due to solar radiation

Solar radiation can be absorbed directly within the building zone if it enters via windows or other transparent building elements, or it can be absorbed on the external envelope by non-transparent (opaque) building elements and then act indirectly as a heat source as a result of heat being conducted into the building zone. Thus, the sum of solar heat gains is calculated for all element surfaces as follows:

$$Q_S = \sum Q_{\text{S,tr}} + \sum Q_{\text{S,opaq}} \quad (7)$$

where:

- $\sum Q_{\text{S,tr}}$ is the sum of heat gains due to solar radiation through transparent building elements;
- $\sum Q_{\text{S,opaq}}$ is the sum of the heat gains due to solar radiation on opaque surfaces.

Heat sources due to solar radiation entering through transparent surfaces

The quantity of heat $Q_{\text{S,tr}}$ gained due to solar radiation entering the heated or cooled building zone via windows, is calculated as follows:

$$Q_{S,tr} = F_F A_{tr} g_{eff} I_S t$$

The solar irradiance I_S is the respective monthly mean intensity of incident solar radiation on the surface as a function of the inclination and orientation of that surface. The area A_{trans} is the area of the transparent element of the building shell. It is reduced by multiplying it by the frame factor F_F to take into account the opaque frames. The effective total energy transmittance g_{eff} of the transparent part of the surface takes into consideration the following factors which reduce the amount of radiation on and through the element:

1. the energy transmittance of the glazing;
2. any solar protection devices installed;
3. mode of the solar protection device control;
4. shading by other buildings or parts of buildings, as well as shading from the horizon.

The effect of solar protection devices which are controlled automatically or manually are calculated in relation to how these are likely to be activated.

Heat sources due to solar radiation on opaque surfaces

In order to determine the heat sources due to solar radiation on non-transparent (opaque) building elements, the radiation absorbed by the element is balanced against the radiative heat transfer from that element. The proportion of absorbed radiation which is effective within the building zone depends on the thermal resistance inwards and outwards from the absorbent layer.

Depending on the type of building element (e.g., external wall, external wall with transparent thermal insulation), different calculation methods apply.

The following heat sources due to solar radiation are specified:

1. $Q_{S,opaq}$ radiation on opaque building elements without transparent thermal insulation;
2. $Q_{S,opaq,TI}$ radiation on opaque building elements with transparent thermal insulation.

Heat sources due to solar radiation passing through or into unheated glazed sunspaces

Solar heat gains due to radiation passing through sunspaces are determined as, whereby the external glazing of the sunspace is also taken into account. To enable calculation of the temperature inside the sunspace (this being required for the calculations of transmission heat flow and ventilation heat flow), the solar heat gains inside the sunspace are determined.

Solar heat gains through glass double façades with divisions at every story are calculated using the methods generally applied to unheated sunspaces but using special boundary conditions.

2.1.2.2. Transmission heat sources

The transmission heat flows through any building element depend on the temperatures on both sides of the element (i.e., they may constitute either heat sources or heat sinks). They act as heat sources if the mean temperature in the adjacent zone is higher than the internal temperature of the building zone being assessed.

If the building zone is adjacent to various areas with differing temperature levels, there may be

both transmission heat sinks and transmission heat sources at the same time.

Equation (8) is generally used to calculate the heat flows due to transmission heat sources:

$$Q_T = \sum_j H_{T,j} (\theta_j - \theta_i) t, \quad \text{for } \theta_i < \theta_j \quad (8)$$

where:

$H_{T,j}$ is the heat transfer coefficient between the building zone and an adjacent area j ;

θ_i is the reference internal temperature of the building zone;

θ_j is the average monthly external temperature or the mean temperature of the adjacent building zone;

t is the period to which the calculation step applies ($t = 24$ h).

The heat transfer coefficient $H_{T,j}$ is calculated from the thermal transmittance of the individual elements and their surface areas as specified in SK SSH EN ISO 13789 and EN ISO 13370, taking into account linear thermal bridges. For simplification, a default value may be assumed for the effect of the thermal bridges.

Wherever the temperature of the adjacent area is higher than the internal temperature of the building zone being evaluated, the following transmission heat flows are taken into consideration:

- Transmission through external building elements

Since the mean external temperature is usually lower than the internal temperature, this source only needs to be considered in exceptional cases.

$$Q_{T,e} = (H_{T,D} + H_{T,WB})(\theta_e - \theta_i) t$$

- Transmission from adjacent unheated building zones or sunspaces

$$Q_{T,u} = H_{T,iu} (\theta_u - \theta_i) t$$

- Transmission from adjacent heated or cooled building zones

$$Q_{T,z} = H_{T,iz} (\theta_z - \theta_i) t$$

- Transmission through the ground

$$Q_{T,s} = H_{T,s} (\theta_e - \theta_i) t$$

2.1.2.3. Ventilation heat sources

Heat sources due to ventilation are caused, for example, by the heated supply air in a ventilation system with air heating. Where, in exceptional cases, the average external temperature is higher than the internal temperature, the infiltration of external air as well as window airing also constitutes a heat source. If a building zone is adjacent to various areas with differing temperature levels, there may be both ventilation heat sources and ventilation heat sinks at the same time.

Heat flows due to ventilation heat sources are generally calculated using equation (9):

$$Q_V = \sum_j H_{V,k} (\theta_k - \theta_i) t, \quad \text{for } \theta_i < \theta_k \quad (9)$$

where:

$H_{V,k}$ is the heat transfer coefficient due to ventilation to external air, the air in another building zone, or via a ventilation system;

θ_i is the reference internal temperature of the building zone;

θ_k is the average monthly external temperature or the mean temperature of the supply air from the ventilation system or from another building zone;

t is the calculation period.

The heat transfer coefficient $H_{V,j}$ is calculated from the mean volume flow, the specific heat capacity of air and the density of air. The mean volume flow is usually given as the product of the mean air change rate and the volume of the building zone.

In particular, the following ventilation heat sources are taken into consideration if the mean temperature of the air entering the zone is higher than the internal air temperature of the zone:

Ventilation heat sources due to external air infiltration

Since the mean external temperature is usually lower than the internal temperature, this source is only considered in exceptional cases.

$$Q_{V,\text{inf}} = H_{V,\text{inf}} (\theta_e - \theta_i) t$$

Ventilation heat sources due to window airing

Since the mean external temperature is usually lower than the inside temperature, this source is only considered in exceptional cases.

$$Q_{V,\text{win}} = H_{V,\text{win}} (\theta_e - \theta_i) t$$

Heat sources due to mechanical ventilation

Heat inputs due to HVAC systems are taken into consideration in the building zone if they occur independently of the current heating or cooling load. This applies, for example, to ventilation systems for residential buildings and to ventilation systems with central air handling. Air heating systems are generally demand-controlled systems and, as such, need not to be included in the calculations described here. For variable air volume (VAV) systems controlled as a function of the heat load, the minimum volume flow is assumed. Calculation of heat input due to supply air from a mechanical ventilation system takes into account the difference between the supply air temperature and the internal temperature, as well as the operating time of the ventilation system. The supply air temperature is generally specified for systems with temperature control and for ventilation systems in residential buildings.

$$Q_{V,\text{mech}} = H_{V,\text{mech}} (\theta_{V,\text{mech}} - \theta_i) t$$

Equation (4) applies to spaces without mechanical ventilation systems:

$$Q_{V,mech} = 0$$

Ventilation heat sources due to air exchange with other zones

Where there is a high rate of air exchange between different spaces or enclosures in a building, these are generally grouped together into a single building zone. Thus, the air exchange between building zones is generally assumed to be zero.

If, in exceptional cases, there are two zones with air exchange between the zones, then equation (9) with the appropriate values is used to calculate the heat source resulting from air entering the zone into which the air flows. This may be necessary, for instance, in zones with extract air systems where the replacement air is drawn in from other zones.

$$Q_{V,z} = H_{V,z} (\theta_z - \theta_i) t$$

2.1.2.4. Internal heat sources

Internal heat sources include persons and animals in the building zone, (electrical) appliances and equipment operated within the zone and, in particular, artificial lighting. Internal heat sources may exist in the building zone in form of central heating distribution pipes, domestic hot water pipes, hot-air ducts and/or heat storage units, heaters or chillers located within the zone, or they may be due to hot materials or objects (e.g., production materials) being regularly brought into the building zones. There may be both internal heat sinks and internal heat sources within a building zone at the same time.

The internal heat sources are summarized as follows:

$$Q_{I,source} = Q_{I,source,p} + Q_{I,source,l} + Q_{I,source,fac} + Q_{I,source,goods} + Q_{I,source,h} \quad (10)$$

where:

- $Q_{I,source,p}$ is the heat input due to persons;
- $Q_{I,source,l}$ is the heat input due to artificial lighting;
- $Q_{I,source,fac}$ is the heat input due to equipment, machinery or other appliances;
- $Q_{I,source,goods}$ is the heat input due to material, goods and objects brought into the building zone and which have temperatures above the reference internal temperature;
- $Q_{I,source,h}$ is the heat input due to heating and cooling systems (due to distribution pipes and air ducts with temperatures higher than the reference internal temperature, as well as heat input due to generation and storage).

In the initial balance estimates the value of $Q_{I,source,h}$ is assumed to be zero.

For residential buildings, an estimated total value for the internal heat sources $Q_{I,source,p}$, $Q_{I,source,l}$, $Q_{I,source,fac}$ and $Q_{I,source,goods}$ is assumed in accordance with boundary data to be specified. However, the heat sources $Q_{I,source,h}$ due to distribution pipes and air ducts are determined separately, even for residential buildings.

2.1.2.5. Utilization of heat sources

Calculation of the usable heat contribution from heat sources on the basis of the utilization factor is an approximate method which takes into account the fact that the losses and gains due to heat sinks and sources vary within the calculation period and, in some cases, are greater or less at different times. Depending on the time constant of the building zone, the heat sources and sinks will compensate each other to a greater or lesser extent. As a result, the utilization factor of heat sources needs to take the following into account:

- the heat capacity and the (specific) transmission heat transfer coefficient and ventilation heat coefficient of the building zone for the respective building time constant;
- the ratio of heat sources to heat sinks during the calculation period;
- the calculation period;
- the internal temperature variations tolerated by the user(s) or permitted by the technical building system (generally a value of 2 K being assumed).

The utilization factor shall first be approximated, neglecting the internal heat and cold gains due to heating and cooling systems. The energy needs for heating and cooling in the building zone thus estimated are then used to quantify these internal heat sources and sinks. Once all internal heat sources and sinks have been fully determined, the value of the utilization factor shall be calculated by iteration.

The utilization factor η greatly depends on the ratio γ of the heat flows due to the heat sources and the heat flows due to the heat sinks in the building zone. Since different boundary conditions generally apply as a function of the heating operation, cooling operation, usage days and non-usage days, the utilization factor shall be determined separately for each of these cases, depending on the respective ratios of heat sources to heat sinks.

$$\gamma = \frac{Q_{source}}{Q_{sink}} \quad (11)$$

A further parameter to be taken into consideration when determining the utilization factor is the time constant τ of the building zone.

The time constant τ is calculated on the basis of the effective heat capacity of the building zone and the sum of the transmission and ventilation heat transfer coefficients of the zone, including the ventilation heat transfer coefficient due to a mechanical ventilation system.

$$\tau = \frac{C_{effect}}{H} \quad (12)$$

where:

C_{effect} is the effective heat capacity

H is the overall transmission and ventilation heat transfer coefficient, including heat transfer from mechanical ventilation

For simplified evaluations, the following blanket values relating to the net floor area A_{NF} are used, as expressed by equations (13) to (15).

For building zones with low thermal mass:

$$C_{\text{effect}} = 50 \text{ Wh}/(\text{m}^2 \cdot \text{K}) A_{\text{NF}} \quad (13)$$

For building zones with medium thermal mass:

$$C_{\text{effect}} = 90 \text{ Wh}/(\text{m}^2 \cdot \text{K}) A_{\text{NF}} \quad (14)$$

For building zones with high thermal mass:

$$C_{\text{effect}} = 130 \text{ Wh}/(\text{m}^2 \cdot \text{K}) A_{\text{NF}} \quad (15)$$

Building zones are classified in respect of thermal mass as follows:

The default value applies to building zones with low thermal mass.

- Building zones with the following characteristics are classified as being of "medium thermal mass":
 1. reinforced concrete ceiling;
 2. solid internal and external building elements (with a density $\geq 600 \text{ kg/m}^3$);
 3. no suspended or covered ceilings;
 4. no internal insulation of external building elements;
 5. no high rooms ($> 4.5 \text{ m}$, e.g., sport halls, museums, etc.)
- Building zones with the following characteristics are classified as being of "heavy thermal mass":
 1. reinforced concrete ceiling;
 2. solid internal and external building elements (with a density $\geq 1600 \text{ kg/m}^3$);
 3. no suspended or covered ceilings;
 4. no internal insulation on the external building elements;
 5. no high rooms ($> 4.5 \text{ m}$, e.g., sport halls, museums, etc.);
 6. hall buildings (if furnishings or stored goods with high heat storage capacity are present), e.g. logistics halls.

The overall heat transfer coefficient is the sum of the transmission and ventilation heat transfer coefficients:

$$H = H_T + H_V = \sum_j H_{T,j} + \sum_k H_{T,k} + H_{V,mech,\theta} \quad (16)$$

where:

$\sum_j H_{T,j}$ is the sum of the transmission heat transfer coefficients for all elements j of the thermal envelope of the building zone to be included in the balance calculations;

1. for direct transmission to the external environment;
2. for transmission through unheated or uncooled spaces to the external environment;
3. for transmission to adjacent zones;
4. for transmission through the ground;

F_x is the temperature correction factor for calculating the time constant;

If the temperature of an adjacent unheated zone is determined with the simplified approach when calculating the energy need for heating, the same value for F_{χ} is used for the component; otherwise, the following applies:

1. $F_{\chi} = 1$ for direct transmission to the external environment (external elements) and transmission through the ground according to EN ISO 13370;
2. $F_{\chi} = 0,5$ for all other elements.

$\sum_k H_{T,k}$ is the sum of all ventilation heat transfer coefficients of the supply air flow with temperatures equal to that of external air:

1. for infiltration;
2. for window airing, with $f_{\text{win,seasonal}} = 1$;

$H_{V,mech,\theta}$ is the temperature-weighted heat transfer coefficient of mechanical ventilation, calculated using equations (17) to (19).

1. For HVAC systems with cooling functions, the air volume flow is calculated on the basis of the given supply air temperature (in relation to a standard temperature difference of 6 K below the internal temperature).

$$H_{V,mech,\theta} = H_{V,mech} \frac{\theta_{V,mech}}{6 \text{ K}} \quad (17)$$

where:

$H_{V,mech}$ is the heat transfer coefficient of mechanical ventilation;

$$H_{V,mech} = n_{mech} V c_{p,a} \rho_{p,a} \quad (17.1)$$

n_{mech} mean number of air change due to mechanical ventilation, according to equation (68);

V net space volume;

$c_{p,a}$ the specific heat capacity of air;

$\rho_{p,a}$ the heat density of air.

$\theta_{i,set}$ for heating: $\theta_{i,set} = \theta_{i,h,set}$; for cooling: $\theta_{i,set} = \theta_{i,c,set} - 2\text{K}$;

$\theta_{V,mech}$ is the minimum supply air temperature of the mechanical ventilation system.

If $\theta_{i,set} < \theta_{V,mech}$ than: $H_{V,mech,\theta} = 0$

1. For HVAC systems without cooling functions and ventilation systems for residential buildings, the uncorrected ventilation heat transfer coefficient of the system-driven air flow is used in equation (12), in which case:

$$H_{V,mech,\theta} = H_{V,mech} \quad (18)$$

2. For an air-heating system which provides supply air temperature equal to or above the internal set- point temperature:

$$H_{V,mech,\theta} = 0 \quad (19)$$

Air-heating systems are usually specifically designed to meet the heating requirements of the building zone and are neglected when calculating the heat source/heat sink balances.

The utilization factor η is determined by approximation on the basis of the ratio γ of heat sources to heat sinks, as follows:

$$\eta = \frac{1-\gamma^a}{1-\gamma^{a+1}} \quad \text{if } \gamma \neq 1 \quad (20)$$

and

$$\eta = \frac{a}{a+1} \quad \text{if } \gamma = 1 \quad (21)$$

Here, a is a numerical parameter that takes into account the time constant of the building zone and is determined by:

$$a = a_0 + \frac{\tau}{\tau_0} = 1 + \frac{\tau}{16 \text{ h}} \quad (22)$$

where:

τ is the (thermal) time constant of the building zone calculated using equation (12)

γ is ratio of heat source to heat sinks calculated using equation (23);

a_0 and τ_0 are numerical parameters, specified as $a_0=1$ and $\tau_0=16 \text{ h}$.

The ratio of heat source to heat sinks, γ , is calculated separately for each month as the ratio of the sum of all heat sources to the sum of all heat sinks in the calculation period.

$$\gamma = \frac{Q_{source}}{Q_{sink}} \quad (23)$$

For $Q_{sink} = 0$, $\eta = 0$.

2.2. Balance equations for calculating the energy need for heating

The energy need for heating is initially determined as a daily value (24-h value) for each month. The sum of all heat sinks is compared with the sum of all heat sources and the balance is calculated by applying equation (24), taking the utilization factor into account. The stored heat that escapes during reduced operation shall be taken into account in the balance for weekends or holiday periods. The monthly energy need for heating is calculated by multiplying the result by the number of days in the month using equation (27), taking into account, where applicable, the days with full usage and days with reduced operation.

$$Q_{h,nd} = Q_{sink} - \eta \cdot Q_{source} - \Delta Q_{c,nd} \quad (24)$$

where:

$Q_{h,nd}$ is the energy need of the building zone for heating: $Q_{h,nd,use}$ for usage days and $Q_{h,nd,we}$ for days of non-usage;

Q_{sink} is the sum of the heat sinks in the building zone under the given boundary conditions;

Q_{source} is the sum of the heat sources in the building zone under the given boundary conditions;

$\Delta Q_{c,nd}$ is the heat escaping from building elements during periods of reduced operation at

weekends and during holiday periods ($\Delta Q_{c,nd}=0$ for continuous operation);

η is the monthly utilization factor of the heat sources (for heating purposes)

2.3. Balance equations for calculating the energy need for cooling

The energy need for cooling is determined as a daily value using equation (25). It is considered as a contribution of the heat sources exceeding the actual energy need (surplus heat). Generally, different boundary conditions (e.g., different reference indoor temperatures) are assumed to apply for heating and for cooling modes. Therefore, heat sources and heat sinks must be determined separately for heating and cooling. Depending on the boundary conditions, the heat sources and sinks may differ considerably from those used in the calculations of the energy need for heating. The monthly energy need for cooling is calculated by multiplying the result by the number of days in the month using equation (28), taking into account, where applicable, the days with full usage and the days with reduced operation.

$$Q_{c,nd} = (1 - \eta) Q_{source} \quad (25)$$

where:

$Q_{c,nd}$ is the energy need of the building zone for cooling: $Q_{c,nd,use}$ for usage days and $Q_{c,nd,we}$ for days of non-usage;

Q_{source} is the sum of the heat sources in the building zone under the given boundary conditions

η is the monthly utilization factor of the heat sources (for heating purposes).

2.4. Accounting for weekend and holiday-period operation

For non-residential buildings, it is necessary to account for days on which usage differs considerably (e.g., in periods of reduced operation at weekends or during holidays). In these cases, the following parameters may differ:

1. set-point temperature;
2. occupancy of the building zone and internal heat sources (or sinks);
3. usage-dependent and mechanical (ventilation-driven) air change rates;
4. daily operating times of heating and/or cooling;
5. operation of solar protection devices.

The balances for the energy need for heating and the energy need for cooling are calculated separately for both workdays and weekends. In some cases, this may mean that heat sources, heat sinks and the utilization factor need to be calculated individually for four different sets of boundary conditions (heating/cooling; workdays/weekends). The obtained values are projected onto a month in relation to their respective share in the total operating time in order to obtain monthly values (see equations (29) and (30)).

2.4.1. Balance of the energy need for heating

When considering reduced heating operation, the average indoor temperature for days of non-

usage is determined using equation (38).

The heat stored in the thermal envelope area during periods of normal usage that escapes during periods of reduced operation is taken into account as follows:

1. In the balance for days with normal usage or continuous usage:

$$\text{in equation (24), } \Delta Q_{c,nd} = \Delta Q_{c,nd,use} = 0 \quad \text{and}$$

$$\text{in equation (1), } \Delta Q_{c,sink} = \Delta Q_{c,sink,use}$$

2. In the balance for days of weekend or holiday operation:

$$\text{in equation (24) } \Delta Q_{c,nd} = \Delta Q_{c,nd,we} \quad \text{and}$$

$$\text{in equation (1) } \Delta Q_{c,sink} = \Delta Q_{c,nd,we} = 0$$

In order to determine the stored heat, the balance for the weekend is calculated first.

2.4.2. Balance of the energy need for cooling

Where ventilation and/or air conditioning cooling systems are turned off at weekends or during holiday periods, the following can be assumed:

$$Q_{c,nd,we} = 0 \tag{26}$$

Transfer of heat between the days of usage and non-usage is not considered in balance of the energy need for cooling.

$$\text{In equation (1): } \Delta Q_{c,sink} = 0$$

2.4.3. Monthly values and annual values

The monthly energy need for heating and the monthly energy need for cooling are calculated by projecting the daily sums onto a full month:

For residential buildings and buildings with continuous operation:

$$Q_{h,nd,mth} = d_{mth} Q_{h,nd} \tag{27}$$

$$Q_{c,nd,mth} = d_{mth} Q_{c,nd} \tag{28}$$

where:

d_{mth} is the number of days in the month;

$Q_{h,nd}$ is the balanced energy need for heating of the building zone;

$Q_{c,nd}$ is the balanced energy need for cooling of the building zone.

For building zones with different operating modes, the values for days with normal usage (e.g., operating days) and the values for days with reduced usage (e.g., holidays or weekends) are calculated according to their share in the month.

$$Q_{h,nd,mth} = d_{use} Q_{h,nd,use} + d_{we} Q_{h,nd,we} \tag{29}$$

$$Q_{c,nd,mth} = d_{use} Q_{c,nd,use} + d_{we} Q_{c,nd,we} \quad (30)$$

where:

d_{use} is the number of days in the month on which the building zone is in normal usage (usually the following applies: $d_{use} = d_{use,a} / 365 d_{mth}$, where $d_{use,a}$ is the number of usage days per year);

$Q_{h,nd,use}$ is the balanced energy need for heating of the building zone under normal conditions of usage;

d_{we} is the number of days in the month with no usage or with reduced usage (e.g. weekends, holidays), taking equation (31) into account;

$Q_{h,nd,we}$ is the balanced energy need for heating of the building zone under conditions of no usage or with reduced usage (e.g. weekends, holidays);

$Q_{c,nd,we}$ is the balanced energy need for cooling of the building zone under conditions of no usage or with reduced usage (e.g. weekends, holidays).

The total number of days in the month is:

$$d_{use} + d_{we} = d_{mth} \quad (31)$$

The annual energy need of the building zone for heating $Q_{h,nd,a}$ is calculated by adding together the values calculated for each month. The annual energy need of the building zone for cooling $Q_{c,nd,a}$ is calculated accordingly.

$$Q_{h,nd,a} = \sum_{mth} Q_{h,nd,mth} \quad (32)$$

$$Q_{c,nd,a} = \sum_{mth} Q_{c,nd,mth} \quad (33)$$

where:

$Q_{h,nd,a}$ is the annual energy need for heating of the building zone;

$Q_{h,nd,mth}$ is the monthly energy need for heating;

$Q_{c,nd,a}$ is the annual energy need for cooling of the building zone;

$Q_{c,nd,mth}$ is the monthly energy need for cooling.

3. Energy need for ventilation and air conditioning

Handling of external air to provide supply air of a desired quality, defined by a certain temperature and humidity range, is ensured by a number of system components (heaters, chillers, humidifiers).

For each component of a HVAC system, the quantity of energy to be transferred to the air is determined on the basis of:

- the existing HVAC system configuration and its operating mode,
- the usage parameters (requirements for supply air temperature, humidification or dehumidification), and

- all other air distribution losses between the building zone and the location of the air handling unit.

For variable air volume systems, the additional air volume flow required to satisfy the energy need for heating or cooling is calculated on the basis of the energy need for heating or cooling of the building zone.

In this way, a specified energy need for air conditioning is calculated for every component (heaters, chillers and humidifiers) of the HVAC system.

3.1. Energy need for the HVAC heating coil

Equation (34) is used to calculate the heating energy needed at the HVAC heating coil. In addition to the energy need of air conditioning system, derived from the usage parameters of the spaces being assessed, the control, emission and distribution losses for the HVAC ventilation system are taken into consideration.

$$Q_{h*,nd} = Q_{vh,nd} + Q_{vh,ce} + Q_{vh,d} \quad (34)$$

where:

- $Q_{h*,nd}$ is the energy need for the heating coil;
- $Q_{vh,nd}$ is the energy need for air conditioning;
- $Q_{vh,ce}$ is the control and emission loss of the HVAC ventilation system;
- $Q_{vh,d}$ is the distribution loss of the HVAC ventilation system.

3.2. Energy need for the HVAC cooling coil

Equation (35) is used to calculate the cooling energy needed at the HVAC cooling coil. In addition to the cooling energy need for air conditioning, derived from the usage parameters of the spaces being assessed, the distribution, control and emission losses for the HVAC ventilation system are taken into consideration.

$$Q_{c*,nd} = Q_{vc,nd} + Q_{vc,ce} + Q_{vc,d} \quad (35)$$

where:

- $Q_{c*,nd}$ is the energy need for the HVAC cooling coil;
- $Q_{vc,nd}$ is the net cooling energy for air conditioning;
- $Q_{vc,ce}$ is the control and emission loss of the HVAC ventilation system;
- $Q_{vc,d}$ is the distribution loss for the HVAC ventilation system

4. Energy need for domestic hot water preparation

The energy need for preparation of domestic hot water $Q_{w,nd}$, is the quantity of energy which is contained in the hot water used (i.e. drawn from the taps) within the building or building zone. The energy need in this case is determined using the cold-water temperature as a reference value, the temperature of the water on tap and the amount of hot water using equation (36).

$$Q_{w,nd} = 0,001 \cdot \rho \cdot c \cdot V_w \cdot (\theta_{w,av} - \theta_K) \quad (36)$$

where:

- $Q_{w,nd}$ is the energy need for domestic hot water preparation (in the respective month), in kWh;
- ρ is the density of water, in kg/m³;
- c is the specific heat capacity of water ($1,163 \cdot 10^{-3}$ kWh/(kg·K));
- V_w is the volume of water (in the respective month), in l;
- $\theta_{w,av}$ is the average temperature at the user outlets, in °C;
- θ_K is the average cold water inlet temperature, in °C.

5. Determination of individual variables for the monthly balance calculation

5.1. Reference internal temperature for calculating the energy need for heating

In the monthly balance calculation of the energy need for heating, the mean monthly value of the internal set-point temperature $\theta_{i,h,set}$ for heating is generally used. To take into consideration reduced heating operation in certain spaces or at certain times, the room temperature is corrected by applying equations (37), (38) or (39). For continuous operation (24-hours usage), the following applies: $\theta_{i,h} = \theta_{i,h,set}$.

5.1.1. Reduced heating during the night

If reduced heating operation during the night is taken into account in the calculations, the equation (37) is used to correct the monthly internal temperature. All time periods during which the room temperature is allowed to be lower than the normal internal set-point temperature, are considered to be periods of reduced heating operation. A distinction is made between the following modes of reduced operation:

- Set-back mode: lowering the heating supply temperature for a pre-specified period at night-time;
- Switch-off mode: shutting down the heating system for a pre-specified period at night-time (this period includes associated lowering and boost mode times).

In both cases, only a temperature reduction up to the specified maximum temperature set-back ($\Delta\theta_{i,NA}$) may be used in the calculations.

The reference internal temperature for days with specified usage times (working days) is calculated monthly as a function of the external temperature. However, at least the time-weighted mean temperature of normal operation and maximum night-time temperature set-back $\Delta\theta_{i,NA}$ have to be used in the balance equations.

$$\theta_{i,h} = \max\left(\theta_{i,h,set} + \Delta\theta_{EMS} - f_{NA}(\theta_{i,h,set} - \theta_e), \theta_{i,h,set} - \Delta\theta_{i,NA} \frac{t_{NA}}{24h}\right) \quad (37)$$

where:

- f_{NA} is the correction factor for reduced night-time heating operation;

- $\theta_{i,h,set}$ is the internal set-point temperature in the normal heating mode;
- θ_e is the monthly average external temperature;
- $\Delta\theta_{i,NA}$ is the permitted internal set-back temperature for reduced heating operation;
- t_{NA} is the daily reduced heating time (i.e., the boost heating period counts as being part of the operating time) ($t_{NA} = 24 \text{ h} - t_{h,op,d}$; where $t_{h,op,d}$ is the daily operating time of the heating system);
- $\Delta\theta_{EMS}$ is the addend for taking into account building automation.

5.1.2. Reduced heating operation at weekends and during holiday periods

In order to take into account reduced heating operation during weekends and holiday periods, additional balance calculations of the monthly energy need for heating are carried out with the boundary conditions relating to weekend and holiday-period operation. The energy need for heating in normal operation and in weekend and holiday operation are then added together.

In the same way as for reduced heating operation at night, a distinction is made between set-back mode (with reduced heating supply temperature) and switch-off mode (with controlled set-back and boost mode periods). The temperature set-back on days on which the building zone is not used is limited by the maximum night-time temperature set-back $\Delta\theta_{i,NA}$.

The monthly internal temperature for calculating the monthly energy need for heating for the days on which the zone is not used or only partially used (i.e., at weekends and during holiday periods) is determined according to equation (38).

$$\theta_{i,h} = \max(\theta_{i,h,set} - f_{we}(\theta_{i,h,set} - \theta_e), \theta_{i,h,set} - \Delta\theta_{i,NA}) \quad (38)$$

where:

- f_{we} is the correction factor for reduced heating operation over a period of more than one day according to equation (34) or (35);
- $\theta_{i,h,set}$ is the internal set-point temperature in the normal heating mode;
- θ_e is the monthly average external temperature;
- $\Delta\theta_{i,NA}$ is the permitted internal set-back temperature for reduced heating operation.

5.1.3. Spatially reduced heating operation (partial heating)

Partial heating of buildings which are only heated and which are calculated as a single zone (mainly residential buildings) is taken into account using the mean internal temperature of the directly heated and indirectly heated areas of the building. Indirectly heated areas are separate spaces which are heated indirectly via the heated area, but in which the temperature is allowed to remain below the internal set- point temperature.

The reference internal temperature is calculated according to equation (36).

$$\theta_{i,h} = \theta_{i,h,set} - f_{tb}(\theta_{i,h,set} - \theta_e) \quad (39)$$

where:

f_{th} is the correction factor for partial heating according to equation (37);

$\theta_{i,h,set}$ is the mean internal temperature in normal heating mode;

θ_e is the monthly average external temperature.

5.2. Reference internal temperature for cooling

Permitted temperature of 2 K above the set-point temperature for heating is taken into account by including the utilization factor of the heat sources in the balance equations. Hence, a value 2 K lower than the internal temperature for cooling is used for calculating the monthly balance:

$$\theta_{i,c} = \theta_{i,c,set} - 2 \text{ K} \quad (40)$$

The daily operating time of the mechanical ventilation system in normal operation (i.e., on working days) is taken into account in the calculation of heat transfer coefficient for mechanical ventilation. Equation (40) remains unchanged when considering intermittent cooling operation.

Usually, ventilation and cooling systems are not operated at weekends or during holiday periods. As there is no energy need for cooling during these periods, no additional balance calculations with corresponding boundary conditions are needed.

5.3. Approximate method using temperature correction factors to determine the mean temperatures in unheated zones (heating case)

In the approximate method, equation (41) is used to calculate the mean temperature in the unheated space (heating operation):

$$\theta_u = \theta_i - F_x(\theta_i - \theta_e) \quad (41)$$

where:

θ_i is the reference internal temperature in the building zone (for heating: $\theta_{i,h}$);

F_x is the temperature correction factor;

The temperature θ_u , calculated by the equation (41) is assumed to be the external temperature for all building element surfaces which do not border on the external air or on heated or cooled parts of the building. These include, for example, surfaces bordering on: unheated basements, non-habitable attics, residual roof spaces, unheated sunspaces, unheated attached staircases, the ground.

5.3.1. Boundary conditions for the determination of heat transfer coefficients of building elements in the ground

For determination of the heat transfer coefficients of opaque building elements, the boundary conditions according to SK SSH EN ISO 6946 are generally applicable. When using the temperature correction factors for building envelope elements adjoining the ground, the heat transfer coefficient U (called constructive U -value) results from the layer sequence of the building element and the heat transfer resistances:

$R_{si} = 0,17 \text{ m}^2\text{K/W}$ for horizontal elements with heat flow downwards;

$R_{si} = 0,10 \text{ m}^2\text{K/W}$ for horizontal elements with heat flow upwards;

$R_{si} = 0,13 \text{ m}^2\text{K/W}$ for vertical elements (with horizontal heat flow); and

$R_{se} = 0,04 \text{ m}^2\text{K/W}$.

$R_{se} = 0 \text{ m}^2\text{K/W}$, for parts of the buildings in contact with ground.

For reasons of standardization, when considering single zone modeled buildings of a building row or multi- zone modelling of a building, the geometric boundary conditions of the considered building area are taken as a basis for determining the characteristic base plate dimension. In the case of interior zones whose perimeter borders exclusively heated areas and therefore cannot be considered, the geometry of the entire building is used. This concerns the determination of the characteristic base plate dimension B' (base area A , perimeter P) as well as, in the case of detailed calculation according to EN ISO 13370, the thickness of the outer walls at ground level w .

5.3.2. Simplified approach for determining the mean temperature in adjacent uncooled zones as well as in the ground (cooling case)

In simplified terms, the temperature in a zone adjoining a cooled zone can be set as follows:

1. Unconditioned basement (basement ceiling), as well as floor slab and outer wall to the ground:
 - Thermal resistance of the separating construction $R \leq 1$: $\theta_u = 21 \text{ }^\circ\text{C}$;
 - Thermal resistance of the separating construction $R > 1$: $\theta_u = 18 \text{ }^\circ\text{C}$;
2. Unconditioned attic, roof sides: $\theta_u = 35 \text{ }^\circ\text{C}$;
3. Walls and ceilings to unconditioned rooms (except basements): $\theta_u = 30 \text{ }^\circ\text{C}$.

5.4. Temperature of an adjacent heated or cooled zone

Heat flows from or to adjacent heated or cooled zones is only taken into account if the internal set-point temperatures of the two zones differ by more than 4 K.

When considering heating, the temperature of the adjacent zone θ_z is the reference internal temperature for heating. When considering cooling, θ_z is the reference internal temperature for the cooling.

$$\theta_z = \theta_{i,h,z} \quad \text{in the balance of the energy need for heating} \quad (42)$$

$$\theta_z = \theta_{i,c,z} \quad \text{in the balance of the energy need for cooling} \quad (43)$$

where:

$\theta_{i,h,z}$ is the reference internal temperature of the adjacent building zone for heating according;

$\theta_{i,c,z}$ is the reference internal temperature of the adjacent building zone for cooling.

5.5. Transmission heat sinks/sources

5.5.1. Calculation of heat sinks and heat sources due to transmission to the external environment

Transmission heat sinks and sources represented by building elements forming the boundary between the building zone and the external environment are calculated using the following equations:

$$Q_{T,e} = (H_{T,D} + H_{T,WB})(\theta_i - \theta_e) t \quad \text{for} \quad \theta_i > \theta_e \quad (44)$$

and

$$Q_{T,e} = (H_{T,D} + H_{T,WB})(\theta_e - \theta_i) t \quad \text{for} \quad \theta_i < \theta_e \quad (45)$$

where:

- $H_{T,D}$ is the transmission heat transfer coefficient between the heated or cooled building zone and the external environment;
- $H_{T,WB}$ is the transmission heat transfer coefficient for two-dimensional thermal bridges;
- θ_i is the reference internal temperature $\theta_{i,h}$ in the building zone for heating according to Chapter V, sub-chapter 5.1, or the reference internal temperature $\theta_{i,c}$ in the building zone for cooling according to Chapter V, sub-chapter 5.2;
- θ_e is the average external temperature for the respective month;
- t is the period to which the calculation step applies ($t = 24$ h).

The heat transfer coefficient $H_{T,D}$ includes the area-related thermal transmittance of the elements between the building zone and external environment. The transmission heat transfer coefficient is calculated according to SK SSH EN ISO 13789 (with $H_{T,D}$ corresponding to H_D), or if simplified method is preferred, using equation (46). The heat transfer coefficient $H_{T,WB}$ is already determined as temperature-weighted, and thus completely assigned to direct transmission to the external environment.

5.5.1.1. Calculation of coefficients of heat transfer to the external environment

The transmission heat transfer coefficient is the sum of the coefficients of the individual building elements forming the boundary between the building zone and the external environment. The influence of thermal bridges is taken into account in accordance with Chapter V, sub-chapter 2. The transmission heat transfer coefficient is thus calculated as follows:

$$H_{T,D} = \sum_j (U_j A_j) \quad (46)$$

where:

- A_j is the area of element j which forms part of the boundary between the building zone and the external environment. The dimensions of windows and doors are taken as the raw building carcass openings (clear internal unfinished dimensions);
- U_j is the thermal transmittance of element j of the building envelope, calculated according to SK SSH EN ISO 6946 for opaque elements, or according to DIN 4108-4, EN ISO 10077-1 or SK SSH EN ISO 12631 for transparent elements. The

thermal transmittance for transparent elements can be further improved by (external and internal) shutters.

j is the element.

5.5.2. Transmission through unheated or uncooled spaces to the external environment

Transmission heat sinks and sources to the external environment due to transmission through unheated or uncooled spaces (e.g., attics and roof sides, basements or small adjacent garages or storage rooms) are calculated in the same way as direct transmission heat sinks and sources using equations (44) and (45), if the U -value according to SK SSH EN ISO 6946 has already taken the unheated spaces into account.

Alternatively, the transmission into the unheated or uncooled space as a function of the internal temperature of this space is calculated using equations (47) and (48), where the U -values between the building zone and the unheated or uncooled space are used. The temperature of the unheated or uncooled space is calculated acc.

$$Q_{T,u} = H_{T,iu} (\theta_i - \theta_u) t \quad \text{for} \quad \theta_i > \theta_u \quad (\text{heat sink}) \quad (47)$$

and

$$Q_{T,u} = H_{T,iu} (\theta_u - \theta_i) t \quad \text{for} \quad \theta_i < \theta_u \quad (\text{heat source}) \quad (48)$$

where:

$H_{T,iu}$ is the transmission heat transfer coefficient between the heated and unheated building zones or between cooled and uncooled building zones, obtained according to the equation (49) or according to SK SSH EN ISO 13789 (corresponding to H_D);

θ_i is the reference internal temperature $\theta_{i,h}$ in the building zone for heating, or the reference internal temperature $\theta_{i,c}$ in the building zone for cooling;

θ_u is the mean temperature of the unheated or uncooled building zone, determined either approximately using equation (41) (for heating mode);

t is the calculation period ($t = 24$ h).

The transmission heat transfer coefficient into the unheated or uncooled spaces are calculated according to equation (49).

$$H_{T,iu} = \sum_j (U_j A_j) \quad (49)$$

where:

A_j is the area of a building element j between the considered building zone and the unheated or uncooled space;

U_j is thermal transmittance of element j as an internal element, calculated according to SK SSH EN ISO 6946 for opaque elements, but without taking into account thermal resistance through unheated spaces, or according to DIN 4108-4 for glazed elements.

If the U -value of the element for the thermal transmittance to the external environment is known, it can be converted to the U -value for internal elements according to equation (50). This particularly applies to glazing.

$$U_{internal\ comp.} = \frac{1}{\frac{1}{U_{external\ comp.}} - R_{se} + R_{si}} \quad (50)$$

where:

R_{se} is the external surface resistance of the element according to SK SSH EN ISO 6946 or EN ISO 10077- 1 (generally 0,04 (K m²)/W);

R_{si} is the internal surface resistance of the element according to SK SSH EN ISO 6946 or EN ISO 10077- 1 (generally 0,13 (K m²)/W for vertically aligned elements).

5.5.3. Transmission to adjacent heated or cooled building zones

Transmission heat sinks and sources represented by building elements forming the boundary between the building zone and adjacent zones with different internal temperatures are taken into account only if the internal set-point temperatures differ by more than 4 K. They are calculated using equation (51):

$$Q_{T,z} = H_{T,iz} (\theta_i - \theta_z) t \quad \text{for} \quad \theta_i > \theta_z \quad (\text{heat sink}) \quad (51)$$

and

$$Q_{T,z} = H_{T,iz} (\theta_z - \theta_i) t \quad \text{for} \quad \theta_i < \theta_z \quad (\text{heat source}) \quad (52)$$

where:

$H_{T,iz}$ is the transmission heat transfer coefficient between the considered building zone i and the adjacent building zone z , according to equation (52) or according to SK SSH EN ISO 13789 (corresponding to H_D);

θ_i is the reference internal temperature $\theta_{i,h}$ in the building zone for heating, or the reference internal temperature $\theta_{i,c}$ in the building zone for cooling;

θ_z is the reference internal temperature of the adjacent building zone;

t is the calculation period ($t = 24$ h).

The heat transfer coefficient is calculated according to equation (53) or according to SK SSH EN ISO 13789, summing up the areas between the building zones. The temperature of the adjacent building zone is the mean temperature over the calculation period.

$$H_{T,iz} = \sum_j (U_j A_j) \quad (53)$$

where:

A_j is the area of a building element j between the building zones;

U_j is thermal transmittance of element j as an internal element, calculated according to SK SSH EN ISO 6946 for opaque elements, or according to DIN 4108-4 for glazed elements.

5.5.4. Transmission through the ground

In building zones which are only heated, the calculation of transmission heat sinks or sources through the ground or basements is carried out according to the transmission through unheated spaces using the simplified approach with temperature correction factors determined according to equation (41).

In other cases, the transmission heat sinks or sources through the ground are calculated using equations (54) or (55), or where applicable, using equation (56).

$$Q_{T,s} = H_{T,ts} (\theta_i - \theta_e) t \quad \text{for} \quad \theta_i > \theta_e \quad (\text{heat sink}) \quad (54)$$

and

$$Q_{T,s} = H_{T,ts} (\theta_e - \theta_i) t \quad \text{for} \quad \theta_i < \theta_e \quad (\text{heat source}) \quad (55)$$

where:

$H_{T,s}$ is the coefficient for heat transfer through the ground (with $H_{T,s}$ corresponding to L_s from EN ISO 13370);

θ_i is the reference internal temperature $\theta_{i,h}$ in the building zone for heating, or the reference internal temperature $\theta_{i,c}$ in the building zone for cooling;

θ_e is the average monthly external temperature;

t is the calculation period ($t = 24$ h).

The transfer coefficient relating to heat flows through the ground is calculated from the steady-state thermal coupling coefficient L_s using the method described in EN ISO 13370. In the absence of information on the characteristics of the ground, its thermal conductivity λ can be assumed to be 2 W/(mK).

In building zones with considerable heat losses through the ground, the steady-state thermal coupling coefficient from EN ISO 13370 can lead to overestimation of the monthly heat losses through the ground in the winter. If loss of heat through the ground constitutes a large part of the total heat sinks, the detailed calculation of the heat flow through the ground as described in EN ISO 13370 should be considered. In this case, the monthly total heat flow calculated using equation (56) must be specified.

$$Q_{T,s} = \Phi_m t \quad (56)$$

where:

Φ_m is the mean daily heat flow through the ground in the respective month, calculated as described in EN ISO 13370;

t is the calculation period ($t = 24$ h).

5.6. Ventilation heat sinks/sources

5.6.1. Infiltration

Heat sources and sinks due to infiltration are calculated using equation (57) and (58).

$$Q_{V,inf} = H_{V,inf} (\theta_i - \theta_e) t \quad \text{for } \theta_i > \theta_e \quad (\text{heat sink}) \quad (57)$$

and

$$Q_{V,inf} = H_{V,inf} (\theta_e - \theta_i) t \quad \text{for } \theta_i < \theta_e \quad (\text{heat source}) \quad (58)$$

where:

$H_{V,inf}$ is the infiltration heat transfer coefficient;

θ_i is the reference internal temperature $\theta_{i,h}$ in the building zone for heating, or the reference internal temperature $\theta_{i,c}$ in the building zone for cooling;

θ_e is the average monthly external temperature;

t is the calculation period ($t = 24$ h).

The infiltration heat transfer coefficient is calculated as follows:

$$H_{V,inf} = n_{inf} V c_{p,a} \rho_a \quad (59)$$

where:

n_{inf} is daily mean infiltration air change rate, calculated using equations (60) or (61);

V is the net volume of the space;

$c_{p,a}$ is the specific heat capacity of air;

ρ_a is the density of air.

A value of 0,34 Wh/(m³·K) is assigned to $c_{p,a} \rho_a$.

For interior building zones (i.e., which have no surfaces bordering on the external environment), external air infiltration is set to zero.

5.6.1.1. Determination of the infiltration air change rate

The infiltration air change rate is determined as a daily mean value calculated on the basis of the airtightness of the building. The airtightness of the building is given in relation to the measured air change rate at pressure difference of 50 Pa (n_{50} -value). Default values are specified for buildings which have not been tested.

If mechanical ventilation without balanced supply and extract air volume flow is used, the infiltration is reduced by the pressure difference caused by the ventilation system.

1. Where no mechanical ventilation is used (because either no system is installed or the ventilation system is switched off at weekends or during holiday periods), the mean daily infiltration air change rate is determined according to equation (60):

$$n_{inf} = n_{50} e f_{ATD} \quad (60)$$

2. Mechanical ventilation reduces the mean daily infiltration air change rate as expressed by equation (61):

$$n_{inf} = n_{50} e f_{ATD} (1 + (f_e - 1) \frac{t_{V,mech}}{24 h}) \quad (61)$$

where:

n_{50} is the air change rate at a pressure difference of 50 Pa;

The value for n_{50} is proposed to be 3.0 1/h for all building categories, despite of the net volume, for the categories:

1. Buildings with airtightness test
2. New buildings or major retrofits without airtightness test
3. Existing buildings (no major retrofit)
4. Buildings with presence of apparent leaks

e is the wind shielding coefficient; a default value of $e_{\text{wind}} = 0,07$ is assumed (corresponds to the shielding coefficient in SK SSH EN ISO 13789 for moderate shielding of buildings with more than one façade exposed to the wind);

$t_{\text{V,mech}}$ is the daily operating time of the ventilation system;

f_e is a factor taking into account an increase or decrease in infiltration due to the mechanical ventilation

f_{ATD} is a factor taking into account the air transfer devices

5.6.2. Determination the air change rate due to window airing

The calculation of the air change rate due to window airing includes all air change flows through windows, doors and other openings to the outside, including air discharge openings for ventilation systems. The air change due to window airing is determined as a mean daily value of the specified usage-related required external air change. Reductions in the air change rate due to window airing as a function of infiltration are taken into account.

Where mechanical ventilation systems supply air to a building zone, the window air change rate is additionally reduced by the air change rate of the ventilation system. However, in case of mechanical ventilation systems in which the extract air flow exceeds the supply air flow, it is necessary to increase the air change rate due to window airing up to a level where the extract air flow is balanced by a combination of window airing, infiltration and supply air from the ventilation system.

Whenever the building zone has openings to the outside (e.g., openable windows or air outlets), a minimum value $n_{\text{win,mth}} = 0,1 \text{ h}^{-1}$ is assumed for window airing, irrespective of the contributions made to air change by infiltration and mechanical ventilation.

Where no mechanical ventilation is used (no ventilation system or ventilation system switched off during weekends or holiday periods; $n_{\text{SUP}} = n_{\text{ETA}} = 0$), the average daily window air exchange is determined according to equation (62):

$$n_{\text{win}} = n_{\text{win,min}} + \Delta n_{\text{win}} \frac{t_{\text{use}}}{24 \text{ h}} \quad (62)$$

where:

$$1. \text{ for } n_{\text{use}} < 1,2 \text{ h}^{-1} \\ \Delta n_{\text{win}} = \max [0; (n_{\text{use}} - (n_{\text{use}} - 0,2 \text{ h}^{-1}))/\text{h}^{-1} \cdot n_{\text{inf}} - 0,1 \text{ h}^{-1}] \quad (63)$$

$$2. \text{ for } n_{\text{use}} \geq 1,2 \text{ h}^{-1} \\ \Delta n_{\text{win}} = \max [0; n_{\text{use}} - n_{\text{inf}} - 0,1 \text{ h}^{-1}] \quad (64)$$

where:

$n_{\text{win,min}}$ is the minimum air change rate due to window airing;

n_{use} is the usage-dependent minimum air change rate, calculated using equation (67);

n_{inf} is the air change rate due to infiltration, calculated using equation (60);

t_{use} is the daily usage time specified.

If a mechanical ventilation system is used, the mean daily air change rate due to window airing is determined according to equation (65), provided that the usage time does not exceed the operating time of the ventilation system (standard case: $t_{\text{V,mech}} = t_{\text{use}}$):

$$n_{\text{win}} = n_{\text{win,min}} + \Delta n_{\text{win,mech}} \frac{t_{\text{V,mech}}}{24 \text{ h}} \quad (65)$$

If a mechanical ventilation system is used and its operating time is shorter than the time of use of the building zone, the mean daily air change rate due to window airing is determined according to equation (66) (special case: $t_{\text{V,mech}} < t_{\text{use}}$):

$$n_{\text{win}} = n_{\text{win,min}} + \Delta n_{\text{win}} \frac{t_{\text{use}} - t_{\text{V,mech}}}{24 \text{ h}} + \Delta n_{\text{win,mech}} \frac{t_{\text{V,mech}}}{24 \text{ h}} \quad (66)$$

where:

$n_{\text{win,min}}$ is the minimum air change rate due to window airing;

Δn_{win} is the additional air change rate due to window airing during the periods when the building is use, but the mechanical ventilation system is not in operation, calculated using equations (63) and (64);

$\Delta n_{\text{win,mech}}$ is the additional air change rate due to window airing during the periods when the mechanical ventilation system is in operation;

t_{use} is the daily usage time;

$t_{\text{V,mech}}$ is the daily operating time of the ventilation system.

If a mechanical ventilation system is operated in an adjacent zone, the air change rate due to air transfer from that zone is taken into account. Equation (65) applies accordingly.

The minimum volume flow of external air into the building zone as a function of the usage of the building or building zone is provided by window airing and/or mechanical ventilation.

$$n_{\text{use}} = \frac{V_A A_{\text{NF}}}{V} \quad (67)$$

where:

$\dot{V}_A$ is the minimum external air volume flow per unit area, in $\text{m}^3/(\text{h} \cdot \text{m}^2)$;

A_{NF} is the net floor area of the building zone, in m^2 ;

V is the net volume of the space, in m^3 .

5.6.3. Determination of the mean air change rate due to mechanical ventilation systems

The air change rate due to ventilation systems is determined as the mean daily value of the supply air brought into the building zone by the ventilation system in relation to the volume of the air that can be replaced in the zone. Where necessary, the value for the minimum external air volume flow specified in boundary conditions of use is increased in relation to the minimum requirements of the system technology or, for constant air volume systems which are designed to completely cover the cooling load, it is increased in relation to the maximum cooling load. In the case of variable air volume systems (VAV) dependent on the cooling load, the minimum volume flow is assumed. Default values are specified for residential ventilation systems and systems that only partially cover the external air change requirements.

The mean daily air change rate due to a ventilation system is calculated using equation (68).

$$n_{\text{mech}} = n_{\text{mech,SUP}} \frac{t_{\text{V,mech}}}{24 \text{ h}} \quad (68)$$

where:

$n_{\text{mech,SUP}}$ is the air change rate due to supply air when the ventilation system is in the operation, calculated using equations (70) and (71);

$t_{\text{V,mech}}$ is the daily operating time of the ventilation system.

For extraction-only ventilation systems, $n_{\text{mech}} = n_{\text{mech,SUP}} = 0 \text{ h}^{-1}$. In these cases, the extract air volume flow is used directly in for calculating the energy required by the fans and, where appropriate, heat recovery. The inflow air required to balance the air extracted by the ventilation system is taken into account in the air change rate values from window airing.

5.6.4. Air change due to supply air from mechanical ventilation

The supply air change rate is applied in the calculations for ventilation systems for residential buildings.

$$n_{\text{mech,SUP}} = n_{\text{mech}} \quad (69)$$

This also applies to other ventilation systems which only provide part of the required minimum air exchange with external air where no detailed information on the systems is available.

In the case of ventilation systems that meet the entire ventilation requirements, the minimum volume flow to be provided by the system, as well as the minimum external air change required depending on the type of usage, must be maintained. The air change rate is determined using the volume flow and the net volume of the building zone:

$$n_{\text{mech,SUP}} = \frac{\dot{V}_{\text{mech,nd}}}{V} \quad (70)$$

where:

$\dot{V}_{\text{mech,nd}}$ is the maximum value of the following parameters: the reference volume flow according to and the minimum volume flow required by the system (designed value, default values);

V is the net volume of the space.

For systems providing only supply air, the air transferred into adjacent zones is treated as inflowing (supply air) from other zones.

For extraction-only ventilation systems:

$$n_{\text{mech,SUP}} = 0 \quad (71)$$

The extract air volume flow must be covered by infiltration, window airing and, if necessary, by air from adjacent zones.

5.6.5. Extract air change due to mechanical ventilation systems

Where no values are available, the extract air volume flow of the HVAC systems is specified in the design phase. The following equation is used to calculate the air change rate:

$$n_{\text{mech,ETA}} = \frac{V_{\text{ETA}}}{V} \quad (72)$$

Where no actual data is available, $n_{\text{mech,ETA}} = n_{\text{mech,SUP}}$ is assumed; or for extraction-only systems, $n_{\text{mech,ETA}} = n_{\text{use}}$.

5.6.6. Air exchange between building zones

When there is a high rate of air exchange between different spaces or enclosures in the building, these are grouped together into a single building zone.

If, in particular cases, the division into two zones with air exchange inbetween is carried out, the resulting heat sources and sinks are determined according to equations (73) and (74). Planned air exchange exists, for example, where mechanical ventilation systems are designed to serve more than one zone. The air volume flows are specified as to ensure a balance between the volume of incoming and outgoing air and an adequate supply of fresh air to the individual zones.

When no mechanical ventilation system is installed, the air exchange between building zones is only taken into consideration if the internal set-point temperatures differ by more than 4 K.

The balance of air flowing into each zone is calculated. In the calculations for the adjacent zone, the volume flow is treated as extract air flow.

The following equation is used to calculate the heat of the air flowing into a zone:

$$Q_{\text{V,z}} = H_{\text{V,z}} (\theta_i - \theta_z) t \quad \text{for } \theta_i > \theta_z \quad (\text{heat sink}) \quad (73)$$

and

$$Q_{\text{V,z}} = H_{\text{V,z}} (\theta_z - \theta_i) t \quad \text{for } \theta_i < \theta_z \quad (\text{heat source}) \quad (74)$$

where:

$H_{\text{V,z}}$ is the ventilation heat transfer coefficient;

θ_i is the reference internal temperature $\theta_{i,h}$ of the building zone for heating, or the reference internal temperature $\theta_{i,c}$ for cooling;

θ_z is the average temperature (reference internal temperature) of the zone from which the air is coming;

t is the duration of the calculation period ($t = 24$ h).

The heat transfer coefficient of the air change is calculated using the following equation:

$$H_{V,z} = V_{z,d} c_{p,a} \rho_a \quad (75)$$

where:

$V_{z,d}$ is the mean volume flow from the adjacent zone over a day;

$c_{p,a}$ is the specific heat capacity of air;

ρ_a is the density of air.

A value of $0,34 \text{ Wh}/(\text{m}^3 \cdot \text{K})$ is assigned to $c_{p,a} \rho_a$.

5.7. Radiant heat sources and sinks

5.7.1. Heat sources due to solar radiation entering through transparent surfaces

Equation (76) is used to calculate solar heat gains $Q_{s,tr}$ entering the heated or cooled building zone through windows and other transparent surfaces.

$$Q_{s,tr} = F_F A_{tr} g_{eff} I_S t \quad (76)$$

where:

F_F is the frame factor, corresponding to the ratio of the transparent area to the total area of the element; in the absence of the precise data, F_F is assumed to be 0,7; for roof skylights and thin conservatory constructions $F_F = 0,9$;

A_{tr} is the total area of the transparent building element determined by the clear unfinished dimensions (i.e., gross area);

g_{eff} is the effective total energy transmittance calculated according to equations (77) to (78);

I_S is the mean solar irradiance for the entire month;

t is the duration of the calculation step ($t = 24$ h).

Hence the following distinction is made, depending on the type of solar protection device:

— no solar protection device

$$g_{eff} = F_S F_W F_V g \quad (77)$$

— fixed solar protection device

$$g_{eff} = F_S F_W F_V g_{tot} \quad (78)$$

where:

F_S is the shading correction factor to account for the shading from the surroundings, other buildings or parts of buildings; A value of 0,9 is assumed for F_S in standard applications;

F_W is the correction factor due to oblique incidence of radiation; $F_W = 0,9$;

- F_V is the dirt depreciation factor ($F_V = 1$ for residential buildings; $F_V = 0,9$ for non-residential buildings);
- g is the total energy transmittance of the glazing (without solar protection) according to EN 410 for perpendicular incidence of radiation;
- g_{eff} is the total energy transmittance taking into consideration the solar protection device either, or calculated according to EN 13363-1, EN 13363-2, or on the basis of reliable, substantiated calorific and luminous product data provided by the manufacturer for identical boundary conditions.

5.7.2. Solar heat gains via opaque building elements

The heat sources and sinks due to solar radiation on opaque building elements and long-wave radiative heat transfer from such elements are calculated using equations (79) and (80), respectively. For building elements with transparent thermal insulation, equation (81) is used.

$$Q_{S,opaq} = R_{se} U A (\alpha I_S - F_f h_r \Delta\theta_{er}) t \quad \text{for } \alpha I_S > F_f h_r \Delta\theta_{er} \quad (\text{heat source}) \quad (79)$$

$$Q_{S,opaq} = R_{se} U A (F_f h_r \Delta\theta_{er} - \alpha I_S) t \quad \text{for } \alpha I_S < F_f h_r \Delta\theta_{er} \quad (\text{heat sink}) \quad (80)$$

where:

- R_{se} is the external surface resistance;
- U is the thermal transmittance of the element;
- A is the total area of the element in a specific orientation;
- α is the solar radiation absorption coefficient of the element.
- I_S is the global solar irradiance for the orientation of the element surface;
- F_f is the form factor considering the relation between the building element and the sky: $F_f = 1$ for horizontal element surfaces and surfaces with a surface angle of up to 45° ; $F_f = 0,5$ for vertical elements and elements with surface angle of more than 45° ;
- h_r is the external radiative heat transfer coefficient obtained using equation (81);
- $\Delta\theta_{er}$ is the mean difference between the temperature of the ambient air and the apparent sky temperature; for simplified calculations $\Delta\theta_{er}$ can be assumed to be 10 K;
- t is the calculation period ($t = 24$ h).

If no precise values are known, a solar radiation absorption coefficient of $\alpha = 0,6$ can be used for opaque surfaces.

A rough approximation of the value is obtained using equation (81).

$$h_r = 5 \varepsilon \quad \text{in W/(m}^2\text{K)} \quad (81)$$

where:

ε is the emissivity for thermal radiation of the external surface. If the values are not known, ε is assumed to be equal to 0,9.

Solar heat gains in opaque building elements with I thermal insulation are calculated as follows:

$$Q_{S,opaq,TI} = R_e U A F_F F_S F_W g_{TI} \propto I_S t \quad (82)$$

where:

- R_e is the external thermal resistance of the building element (calculated in an outward direction, starting from the absorbing layer; thermal resistance of the transparent insulation, including the external surface resistance);
- U is the total thermal transmittance of the building element;
- A is the total area of the element in a specific orientation;
- F_S is the external shading reduction factor;
- F_F is the frame factor for the element;
- F_W is the correction factor for oblique incidence of radiation, $F_W = 0.9$ (in cases where oblique radiation has already been taken into consideration when determining g_{TI} , then $F_W = 1$ is used);
- g_{TI} is the total energy transmittance of the transparent thermal insulation, as certified (if no accurate data are available, $g_{TI} = 0,35$ is assumed);
- α is the solar radiation absorption coefficient of the transparent thermal insulation (in cases where solar radiation absorption has already been taken into consideration when determining g_{TI} , then $\alpha = 1$ is used);
- I_S is the global solar irradiance for the respective orientation;
- T is the calculation period ($t = 24$ h).

Other forms of solar heat gains via ventilated solar walls (Trombe walls) or via ventilated elements forming part of the building envelope (dynamic thermal insulation) are described in EN ISO 52016-1.

5.8. Internal sources of heat and cold

5.8.1. Internal heat sources in residential buildings

In case of residential buildings, the internal heat sources due to persons, machinery, equipment and lighting are combined. Heat sources due to the operation of heating systems are specified separately. Sources of cold are neglected.

$$Q_{I,source,RB} = q_I A_{NF} \quad (83)$$

where:

- q_I is the specific mean daily dissipation of heat by persons, machinery, equipment and lighting in residential buildings in relation to the reference area;
- A_{NF} is the net floor area of the building zone.

5.8.2. Heat sources due to persons

Boundary conditions of use give the area-specific values of the heat dissipated by persons in relation to the respective usage profiles. These are used to determine the mean heat dissipation:

$$Q_{I,source,p} = q_{I,p} A_{NF} \quad (84)$$

where:

$q_{I,p}$ is the specific mean daily heat dissipation by persons in relation to the reference area;

A_{NF} is the net floor area of the building zone.

5.8.3. Heat sources and sinks due to machinery and equipment

Boundary conditions of use give the area-specific values of the heat dissipated in the building zone due to the operation of machinery and equipment. These are used when calculating the actual amount with equation (85). Equipment which generates cooling energy (e.g., refrigerated sales counters) and which extract the heat outside the building zone being assessed are treated as heat sinks (see equation (86)).

$$Q_{I,source,fac} = q_{I,fac} A_{NF} \quad (85)$$

$$Q_{I,sink,fac} = q_{I,sink,fac} A_{NF} \quad (86)$$

where:

$q_{I,fac}$ is the specific mean daily heat dissipation by machinery and equipment, in relation to the net floor area;

A_{NF} is the net floor area of the building zone;

$q_{I,sink,fac}$ is the specific mean daily cooling energy dissipated by refrigeration appliances with refrigeration units outside the building zone, in relation to the net floor area.

5.8.4. Heat sources due to artificial lighting

The electrical energy requirement $Q_{I,source,l}$ of artificial lighting is generally used directly to determine the heat gains due to artificial lighting $Q_{l,del}$.

5.9. Taking into account stored heat between days of usage and non-usage

The heat escaped from the elements at the weekends or during holidays and stored during periods of usage are:

1. deducted from the energy need for heating for the period of non-usage,
2. taken into account as a heat sink in the heating balance for the period of usage.

The quantity of heat is considered the same for the days of usage and non-usage for the month as a whole and is assessed according to the mean number of periods of reduced heating in the month. The quantities are given in relation to one-day period (24 h).

The escaping heat included in the balance is limited by the maximum permitted temperature reduction during reduced heating operation and by the total heat requirement during the period of

reduced heating (without taking into account the escaping heat).

The stored heat to be included in the balance for weekend and holiday periods is calculated according to equation (87):

$$\Delta Q_{C,nd,we} = \min \left(\frac{C_{effect} 2(\theta_{i,h,set} - \theta_{i,h})}{a_{we}}, \frac{C_{effect} \Delta \theta_{i,NA}}{a_{we}}, Q_{sink} - \eta Q_{source} \right) \quad (87)$$

If $\theta_{i,h,set} < \theta_{i,h}$, then: $\Delta Q_{C,nd,we} = 0$.

where:

C_{effect} is the effective heat capacity;

$\theta_{i,h,set}$ is the mean internal temperature in periods of normal heating operation;

$\theta_{i,h}$ is the reference internal temperature for reduced weekend operation;

$\Delta \theta_{i,NA}$ is the permitted reduction of the internal temperature for periods of reduced heating;

a_{we} is the average number of days of non-usage per week (in the absence of specific data, $a_{we} = (1 - d_{use,a}/365) \cdot 7$);

Q_{sink} is the sum of heat sinks in the building zone during weekend or holiday operation;

Q_{source} is the sum of heat sources in the building zone during the weekend or holiday operation;

η is the monthly utilization factor of the heat sources for weekend or holiday operation.

When considering the days of usage, the following applies: $\Delta Q_{C,nd,use} = 0$.

In addition, when considering days of usage, the stored heat from equation (136) is taken as a heat sink in the heating balance:

$$\Delta Q_{C,sink,use} = \frac{\Delta Q_{C,nd,we} d_{we}}{d_{use}} \quad (88)$$

where:

d_{use} is the number of days in the month with normal usage

d_{we} is the number of weekend days or holidays in the month.

For days of non-usage the following applies: $\Delta Q_{C,sink,use} = 0$.

In the balance of energy need for cooling, the following applies: $\Delta Q_{C,sink} = 0$ for days of usage and non-usage.

VI. CALCULATION OF LOSSES FOR CONTROL AND EMISSION, DISTRIBUTION AND STORAGE

After determining the energy needs (i.e., for heating, cooling, domestic hot water, HVAC systems and lighting) required in the zones, the next step in the energy balance calculations is to determine the system losses due to control and emission, distribution and storage. Once these have been determined, they are combined with the already determined energy need to calculate the energy output which the generator or generators is required to provide to the network

(generator heat output or (net) cooling energy output).

1. Lighting

As explained in Chapter V, sub-chapter 1, the determination of lighting energy does not follow the calculation procedure of deriving delivered energy from the energy need added by system and distribution losses, as for heating and cooling. Losses are not calculated separately, and the calculation of the delivered energy for lighting is explained in chapter VII.

2. Heating (heating system and HVAC heating function)

When calculating the energy balance of a heating system, on the one hand the quantities of heat delivered to the building zone or building by conventional space heating (radiator heating, direct electric heating, electrical storage heaters, etc.) are assessed together, and on the other hand, the heat delivered by the heating function of an HVAC system (with one or more heating coils) is assessed together with the additional energy required for supplying this heat.

2.1. Generator heat output to the heating system

Equation (89) is used to calculate the generator heat output (the heat energy to be provided by the generator). In this equation, the losses due to control and emission, heat distribution and storage (where applicable) are added to the energy need for heating (i.e., the heat which is supplied to the heated zone by conventional heating systems and not via the air handling unit).

$$Q_{h,outg} = Q_{h,nd,i} + Q_{h,ce} + Q_{h,d} + Q_{h,s} \quad (89)$$

where:

- $Q_{h,outg}$ is the generator heat output to the heating system;
- $Q_{h,nd,i}$ is the energy need for heating (i.e. the share which is supplied to the space via conventional heating systems);
- $Q_{h,ce}$ are the control and emission losses of the heating system;
- $Q_{h,d}$ are the distribution losses of the heating system;
- $Q_{h,s}$ are the storage losses of the heating system.

If a building or zone is served by several completely separate heating systems, equation (89) is applied separately for each system in order to determine the generator heat output individually for each generator (e.g., a building is partly heated directly by electrical heaters and partly by central heating with pumped hot water circulation).

If there are several types of heat control and emission and/or distribution and/or storage within a heating system, the sums of the energy quantities of the individual process steps are entered in equation (89) respectively.

2.1.1. Determination of energy expenditures

2.1.1.1. Heat control and emission

In the following, the energy characteristics required to determine the losses associated with the transfer of heat to the room are specified. $Q_{h,ce}$ is calculated for each month according to equation (90).

$$Q_{h,ce} = Q_{h,nd} \cdot \left[\frac{\Delta\vartheta_{ce}}{\vartheta_{i,h} - \vartheta_e} \right] \quad (90)$$

where:

- $Q_{h,ce}$ is the additional loss due to control and emission (in the respective month), in kWh;
- $Q_{h,nd}$ is the energy need (in the respective month), in kWh;
- $\Delta\vartheta_{ce}$ is the temperature variation based on all influencing factors, in K;
- $\vartheta_{i,h}$ is the reference internal temperature, in °C;
- ϑ_e is the average external temperature in the balancing period, in °C.

The auxiliary energy that is used to improve heat transfer processes in the room is calculated according to equation (91).

$$W_{h,ce} = W_C + W_{fan,Pu} \quad (91)$$

where:

- $W_{h,ce}$ is the auxiliary energy (in the respective month), in kWh;
- W_C is the auxiliary energy of the control system (in the respective month), in kWh;
- $W_{fan,Pu}$ is the auxiliary energy of fans, blowers and additional pumps (in the respective month), in kWh.

2.1.1.2. Heat distribution

The following general equation applies for losses from central hot water heating pipe system:

$$Q_{h,d,i} = \frac{1}{1000} \cdot U \cdot (\theta_{HK,av} - \theta_I) \cdot L \cdot t_{h,rL} \quad (92)$$

The heat losses of a piping network composed of several different pipe sections are calculated according to equation (93):

$$Q_{h,d} = \sum Q_{h,d,i} \quad (93)$$

where:

- U is the linear heat transfer coefficient, in W/(m·K);
- $\theta_{HK,av}$ is the mean heating medium temperature, in °C;
- θ_I is the ambient temperature, in °C;
- L is the length of the pipeline, in m;
- $t_{h,rL}$ is the monthly design running time, in h.

In the zones through which the pipes pass, the loss corresponds to the uncontrolled heat gains:

$$Q_{I,h,d,i} = Q_{h,d,i} \quad (94)$$

where:

$Q_{I,h,d,i}$ are the uncontrolled losses to the zone via the heating distribution system (in the respective month), in kWh;

$Q_{h,d,i}$ is the heat output from distribution piping (in the respective month), in kWh.

The auxiliary energy expenditure required to operate heating circulation pumps is calculated on the basis of the hydraulic requirement of the distribution system and an expenditure factor describing the operation of the pump.

$$W_{h,d} = W_{h,d,hydr} \cdot e_{h,d,aux} \quad (95)$$

where:

$W_{h,d}$ is the auxiliary energy expenditure (in the respective month), in kWh;

$W_{h,d,hydr}$ is the hydraulic energy requirement (in the respective month), in kWh;

$e_{h,d,aux}$ is the expenditure factor for operation of the pump.

The hydraulic energy requirement of heating distribution is obtained from the hydraulic power at the design point (P_{hydr}) together with the mean distribution part load ($\beta_{h,d}$ and t_h):

$$W_{h,d,hydr} = \frac{P_{hydr}}{1000} \cdot \beta_{h,d} \cdot (t_h \cdot f_{d,PM}) \cdot f_{Sch} \quad (96)$$

where:

P_{hydr} is the hydraulic power of the pump at the design point, in W;

$\beta_{h,d}$ is the mean distribution part load;

t_h is the number of heating hours in the respective month;

f_{Sch} is the correction factor to account for the hydraulic circuit;

$f_{d,PM}$ is the correction factor for heat generators with integrated pump management with the following values:

1. For heat generators without integrated pump management, the factor $f_{d,PM} = 1$
2. For heat generators with integrated pump management and boiler temperature control with external sensors, the factor $f_{d,PM} = 0,75$.
3. For heat generators with integrated pump management and boiler temperature control with internal sensors, the factor $f_{d,PM} = 0,45$.

2.1.1.3. Heat storage

If the heating circuit is provided with a storage tank (e.g. to minimise the cyclical behaviour of the heat generator or to store solar energy), the storage losses are calculated according to equation (97).

$$Q_{h,s} = f_{\text{con}} \cdot \frac{(\theta_{h,s} - \theta_1)}{45} \cdot d_{\text{op,mth}} \cdot Q_{\text{PO,s,day}} \quad (97)$$

Where:

- $Q_{h,s}$ is the heat loss of the storage tank (in the respective month), in kWh;
- f_{con} is the factor taking into account heat loss from the pipe between heat generator and storage tank;
- $\theta_{h,s}$ is the mean temperature of the storage tank, in °C;
- θ_1 is the average ambient temperature, in °C;
- $d_{\text{op,mth}}$ is the monthly operating time, in d;
- $Q_{\text{PO,s,day}}$ is daily stand-by heat loss, in kWh/d

If the storage tank is located in a zone, the loss corresponds to the uncontrolled heat gain:

$$Q_{\text{I,h,s}} = Q_{h,s} \quad (98)$$

Where:

- $Q_{\text{I,h,s}}$ is the uncontrolled heat gain in the zone due to the storage tank (in the respective month), in kWh;
- $Q_{h,s}$ is the loss from the storage tank (in the respective month), in kWh.

If a separate circulation pump is required for operation of the buffer storage tank, then the auxiliary energy is determined using equation (99).

$$W_{h,s} = \frac{P_{\text{Pu}} \cdot t_{\text{Pu}}}{1000} \quad (99)$$

Where:

- $W_{h,s}$ is the auxiliary energy of the pump (in the respective month), in kWh;
- P_{Pu} is the power consumption of the pump, in W;
- t_{Pu} is the operating period of the pump (in the respective month), in h.

2.2. Generator heat output for the HVAC heating function

The generator heat output for the HVAC heating function is the sum of all energy which one or more generators provide to the HVAC system when it is running in heating mode. This includes the energy needed by the heating coil as well as the losses due to control and emission, distribution and storage of heating water occurring between the location where the energy is generated and the location where the heat is transferred to the air stream. This is described by equation (100).

$$Q_{h^*,\text{outg}} = Q_{h^*,\text{nd,i}} + Q_{h^*,\text{ce}} + Q_{h^*,\text{d}} + Q_{h^*,\text{s}} \quad (100)$$

Where:

- $Q_{h^*,\text{outg}}$ is the generator heat output for the HVAC heating function;
- $Q_{h^*,\text{nd,i}}$ is the energy need for the heating coil (see equation (27));

$Q_{h*,ce}$ are the control and emission losses for the HVAC heating function;

$Q_{h*,d}$ are the distribution losses for the HVAC heating function;

$Q_{h*,s}$ are the storage losses for the HVAC heating function.

If there are several heating coils which are all connected to a common hot water network supplied by a common generator (or by a common central heating plant with multiple generators), then equation (100) is applied in a similar manner. The same applies if there are several types of distribution and/or storage. The sums of the energy quantities of the individual process steps are entered in equation (100) respectively.

If several separate heat generation systems are used, equation (100) is applied separately for each system in order to determine the generator heat output individually for each system (e.g., one heating coil is heated by a boiler and there is another one electrically heated heating coil).

As given in Chapter V, sub-chapter 3.1, the heating energy needed at the HVAC heating coil is calculated:

$$Q_{h*,nd} = Q_{vh,nd} + Q_{vh,ce} + Q_{vh,d}$$

Where:

$Q_{h*,nd}$ is the energy need for the heating coil;

$Q_{vh,nd}$ is the energy need for air conditioning;

$Q_{vh,ce}$ are the control and emission losses of the HVAC ventilation system;

$Q_{vh,d}$ are the distribution losses of the HVAC ventilation system.

The control and emission losses for the HVAC ventilation system (air circulation heat losses) are calculated according to equation (101):

$$Q_{vh,ce} = (1 - \eta_{vh,ce}) \cdot Q_{vh,nd} \quad (101)$$

where:

$\eta_{vh,ce}$ is the efficiency of heat control and emission to the room – heating air circulation.

If there are no guidelines for design dimension calculations, the calculations are carried out using the constant factor $\eta_{vh,ce} = 0,9$.

As long as the supply air temperature is only slightly (i.e. not more than 10 K) higher or lower than the indoor set-point temperature, the heating energy demand for air distribution is calculated for as follows.

Air distribution within the thermal envelope (cooled/heated zone) of the building: $Q_{vh,d} = 0$ (from the overall energy balance aspect, the heat is to the benefit of the building).

If parts of the ductwork and equipment are installed outside of the thermal envelope (cooled/heated zone), then these parts are evaluated in relation to the surface area assumed to be outside the envelope. In this case, an insulating layer with a coefficient of thermal conductivity of at least 0,04 W/(m·K) and a thickness of 50 mm are assumed.

$$Q_{vh,d} = f_{vh,d} \cdot A_{K,A} \cdot t_{h*,op,mth} / 1\,000 \quad (102)$$

where:

- $Q_{vh,d}$ are the distribution losses for the HVAC ventilation system, in kWh;
- $f_{vh,d}$ is the heat loss coefficient for air distribution (heating), 16 W/m²;
- $A_{K,A}$ is the surface area outside of the building, in m²;
- $t_{h*,op,mth}$ is the demand time for the HVAC heating system (in the respective month).

Losses in the system due to control and emission, distribution and hot water storage are determined according to the Chapter VI, sub-chapter 2, above in this document.

2.3. Internal heat sources due to the heating system

The contribution of the internal heat sources due to the heating system $Q_{I,h}$ (as well as the fraction of heating energy supply to the HVAC system $Q_{I,h*}$) is calculated from the distribution heat losses $Q_{h,d}$ ($Q_{h*,d}$) and storage losses $Q_{h,s}$ ($Q_{h*,s}$) of the heating system.

3. Cooling (cooling system and HVAC cooling function)

When calculating the energy balance of a cooling system, on the one hand the thermal quantities delivered directly to the building zone or building by room conditioning (e.g., cooled ceilings, decentralized cooling units, etc.) are assessed together, and on the other hand, the thermal quantities delivered by the cooling function of an HVAC system (with one or more cooling coils) are assessed together with the additional expenditure required for supplying this cooling function.

3.1. Generator cooling energy output to the cooling system (room conditioning)

Equation (103) is used to calculate the generator cooling energy output (the cooling energy to be provided by the generator). In this equation, the losses due to control and emission, heat distribution and storage (where applicable) are added to the energy need for cooling (i.e., the part to be provided to the cooled zone by conventional cooling systems and not via the air handling unit).

$$Q_{c,out} = Q_{c,nd,i} + Q_{c,ce} + Q_{c,d} + Q_{c,s} \quad (103)$$

where:

- $Q_{c,outg}$ is the generator cooling energy output to the cooling system;
- $Q_{c,nd,i}$ is the energy need for cooling (i.e. the fraction which is supplied to the space via static cooling surfaces);
- $Q_{c,ce}$ are the control and emission losses of the cooling system;
- $Q_{c,d}$ are the distribution losses of the cooling system;
- $Q_{c,s}$ are the storage losses of the cooling system.

If there are several separate cooling systems, equation (103) is applied separately for each system in order to determine the cooling energy output individually for each generator.

If there are several types of heat control and emission and/or distribution and/or storage within a cooling system, the sums of the energy quantities of the individual process steps are entered in equation (103) respectively.

Losses in the cooling system due to control and emission of energy are calculated according to 104, below:

$$Q_{c,ce} = ((1 - \eta_{c,ce}) + (1 - \eta_{c,ce,sens})) \cdot Q_{c,nd} \quad (104)$$

where:

$Q_{c,ce}$ are the cooling efficiency losses of control and emission for the room conditioning system;

$\eta_{c,ce}$ is the efficiency of control and emission for the room conditioning system;

$\eta_{c,ce,sens}$ is the sensible efficiency of control and emission for the room conditioning system; this takes into account the undesirable dehumidification in actual air-cooling equipment.

$$Q_{c,d} = (1 - \eta_{c,d}) \cdot Q_{c,nd} \quad (105)$$

where:

$Q_{c,d}$ are the cooling efficiency losses of distribution for the room conditioning system;

$\eta_{c,d}$ is the efficiency of the distribution;

Losses in the energy storage system is calculated according to equation (106).

$$Q_{c,s} = Q_{c,s} + \frac{Q_{c,nd}}{Q_{c,nd} + Q_{c*,nd}} \quad (106)$$

where:

$Q_{c,s}$ are the (proportional) cooling energy losses of the storage for the room conditioning system;

$Q_{C,s}$ are the total cooling energy losses of the storage.

The electrical energy required $W_{c,ce}$ for the secondary air fans for room conditioning is calculated in relation to the type of device and the individual device designs. The specified energy demand refers to devices with multi-stage speed control (based on 1000 hours operation of the fan convectors and 500 full utilization hours of cooling system).

$$W_{c,ce} = f_{c,ce,aux} \cdot Q_{c,outg} \cdot t_{C,op} / 1\,000\,h \quad (107)$$

where:

$f_{c,ce,aux}$ is the specific energy demand of the secondary air fans related to the generator cooling energy output (default value 0,04 kWh/kWh);

$Q_{c,outg}$ is the generator cooling energy output for room conditioning;

$t_{C,op}$ is the room conditioning demand time.

3.2. Generator cooling energy output for the HVAC cooling function

The generator cooling energy output for the HVAC cooling function is the sum of all energy

quantities which one or more generators provide to the HVAC system when it is running in cooling mode. This includes the energy need for the cooling coil as well as the losses due to the control and emission, distribution and storage of cold water occurring between the location where the cooling is carried out and the location where the cooling energy is transferred to the air stream. This is described by equation (108).

$$Q_{c^*,outg} = Q_{c^*,nd,i} + Q_{c^*,ce} + Q_{c^*,d} + Q_{c^*,s} \quad (108)$$

where:

$Q_{c^*,outg}$ is the generator cooling energy output for the HVAC cooling function;

$Q_{c^*,nd,i}$ is the energy need for the cooling coil;

$Q_{c^*,ce}$ are the control and emission losses for the HVAC cooling function;

$Q_{c^*,d}$ are the distribution losses for the HVAC cooling function;

$Q_{c^*,s}$ are the storage losses for the HVAC cooling function.

If there are several cooling coils which are all connected to a common cold-water network supplied by a common generator (or by a common central refrigeration plant with multiple units), then equation (108) is applied in a similar manner. The same applies if there are several types of distribution and/or storage. The sums of the energy quantities of the individual process steps are entered in equation (108) respectively.

If individual cooling coils are supplied by several separate systems, equation (108) is applied separately for each system in order to determine the cooling energy output individually for each generator.

As given in Chapter V, sub-chapter 3.2, the cooling energy needed at the HVAC cooling coil is calculated according to equation:

$$Q_{c^*,nd} = Q_{vc,nd} + Q_{vc,ce} + Q_{vc,d}$$

where:

$Q_{c^*,nd}$ is the energy need for the HVAC cooling coil;

$Q_{vc,nd}$ is the net cooling energy of air conditioning;

$Q_{vc,ce}$ are the control and emission losses of the HVAC ventilation system;

$Q_{vc,d}$ are the distribution losses of the HVAC ventilation system.

The control and emission losses for the HVAC ventilation system (air circulation heat losses) are calculated according to equation (109):

$$Q_{vc,ce} = (1 - \eta_{vc,ce}) \cdot Q_{vc,b} \quad (109)$$

where:

$\eta_{vc,ce}$ is the efficiency of heat control and emission to the room (cooling air transport and distribution).

Air distribution within the thermal envelope of the building is: $Q_{vc,d} = 0$.

If parts of the ductwork and equipment are installed outside of the thermal envelope, then these

parts are evaluated in relation to the surface area assumed to be outside the envelope. In this case, an insulating layer with a coefficient of thermal conductivity of at least 0,04 W/(m·K) and a thickness of 50 mm is assumed.

$$Q_{vc,d} = f_{vc,d} \cdot A_{K,A} \cdot t_{C^*,op,mth} / 1\ 000 \quad (110)$$

where:

- $Q_{vc,d}$ are the distribution losses of the HVAC ventilation system, in kWh;
- $f_{vc,d}$ is the factor for cooling, in W/m²;
- $A_{K,A}$ is the air duct surface area outside of the building, in m²;
- $t_{C^*,op,mth}$ is the demand time for HVAC cooling system (in the respective month).

Losses related to the cooling function in the HVAC system due to control and emission, distribution and storage are determined as follows:

$$Q_{C^*,ce} = ((1 - \eta_{C^*,ce}) + (1 - \eta_{C^*,ce,sens})) \cdot Q_{C^*,nd} \quad (111)$$

where:

- $Q_{C^*,ce}$ are the cooling energy losses of control and emission for the HVAC cooling;
- $\eta_{C^*,ce}$ is the efficiency of control and emission for the HVAC cooling (constant);
- $\eta_{C^*,ce,sens}$ is the sensible efficiency of control and emission for the HVAC cooling; this takes into account the undesirable dehumidification in actual air-cooling equipment.

$$Q_{C^*,d} = (1 - \eta_{C^*,d}) \cdot Q_{C^*,nd} \quad (112)$$

where:

- $Q_{C^*,d}$ are the cooling energy losses of distribution for the HVAC cooling;
- $\eta_{C^*,d}$ is the efficiency of distribution for the HVAC cooling.

$$Q_{C^*,s} = Q_{C,s} + \frac{Q_{C^*,nd}}{Q_{C,nd} + Q_{C^*,nd}} \quad (113)$$

where:

- $Q_{C^*,s}$ are the (proportional) cooling energy losses of the storage for the HVAC cooling;
- $Q_{C,s}$ are the total cooling energy losses of the storage.

3.3. Auxiliary energy for cooling-water and chilled water distribution

The auxiliary energy demand for cooling or chilled water distribution is calculated according to the detailed procedure or, in simplified way, according to the procedure presented below.

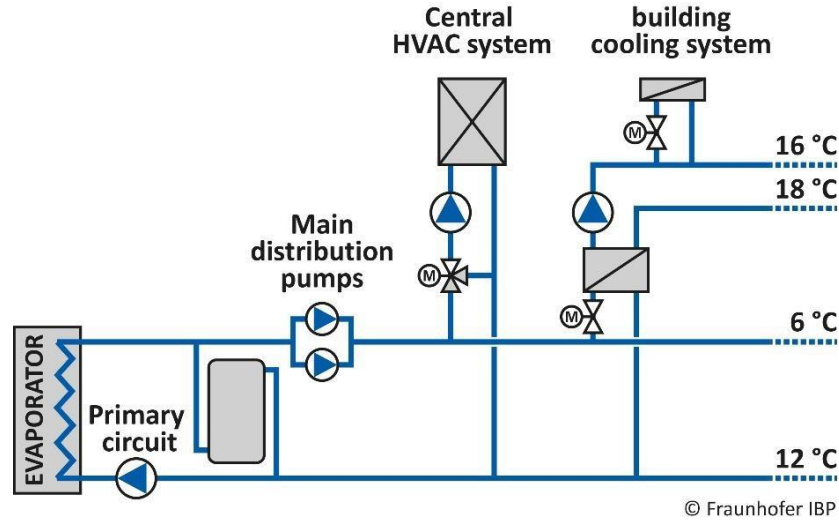


Figure 5. Basic structure of cooling/chilled water distribution

The specific electrical energy consumption for the respective subcircuits is determined based on the values of different system configuration. The specific electrical energy consumption is the annual energy consumption of the pumps in the distribution circuit, related to the respective cooling capacity in (kWh/y)/kW.

The simplified procedure for evaluating hydraulic energy requirement for distribution is based on the conversion to other uses and operating times which is calculated according to equation (114):

$$W_{Z,aux,d,a} = \sum_{i=1}^n \dot{Q}_{Z,i} \cdot f_{z,i} \cdot f_{use} \quad (114)$$

where:

i is the number and type of distribution circuits;

$\dot{Q}_{Z,i}$ is the sum of the cooling capacities in the respective distribution circuit in the design case PRI; HVK; RLT, GEB; RKK

Where: PRI = Primary Circuit, HVK = Main Distributor, RLT = Central air handling unit, GEB = Building cooling, RKK = Recooling

$f_{z,i}$ is the specific electric power consumption of the distribution in the respective distribution circuit PRI; HVK; RLT, GEB, RKK;

f_{use} is the conversion factor for other uses in the respective distribution circuit.

The following applies:

$f_{use,i} = 5100$ for seasonal operation;

$f_{use,i} = 2100$ for intermittent operation (default case);

The monthly values are calculated from the annual energy values in proportion to the cooling energy demand values in the respective distribution circuits.

3.4. Storage systems for cooling energy

Storage systems for cooling energy for room conditioning and HVAC cooling function are often

used for balancing the load and to reduce the installed capacity of chillers, or as a back-up system in case of failure of a chiller. The influence on the energy demand of a building is therefore highly dependent on a wide range of parameters. In a simplified way, storage systems are evaluated using default values for efficiency.

$$Q_{C,s} = Q_{C,nd} \times (1 - \eta_{C,s}) \quad (115)$$

where:

$Q_{C,s}$ is the cooling energy output of the storage;

$Q_{C,nd}$ is the energy need for room conditioning and HVAC cooling;

$\eta_{C,s}$ is the efficiency of storage.

3.5. Internal heat sinks due to the cooling system

The contribution of the internal heat sinks due to the cooling system $Q_{I,c}$ (as well as the fraction of cooling energy supply to the HVAC system $Q_{I,c*}$) is calculated from the losses of the cooling energy distribution system $Q_{c,d}$ ($Q_{c*,d}$) and storage losses $Q_{c,s}$ ($Q_{c*,s}$).

4. Humidification in HVAC systems

4.1. Generator heat output for water vapor supply to the HVAC system

The energy balance of the water vapor supply to the HVAC system is calculated according to the method determined by the type of heating and cooling system. The generator heat output for the supply of water vapor is calculated on the basis of the sum of the water vapor required for humidifying the air in the HVAC system and the energy losses due to the heat control, emission and distribution of the water vapor. The relationships between these quantities are described by equation (116).

$$Q_{st,outg} = Q_{st,nd} + Q_{st,ce} + Q_{st,d} \quad (116)$$

where:

$Q_{st,outg}$ is the generator heat output for humidification;

$Q_{st,nd}$ is the energy need for humidification;

$Q_{st,ce}$ are the control and emission losses for humidification;

$Q_{st,d}$ are the distribution losses for humidification.

4.2. Internal heat sources due to the water vapor supply

The energy contribution of the internal heat sources due to the supply of water vapor $Q_{I,st}$ are calculated from the internal heat losses of the water vapor distribution system $Q_{st,d}$.

5. Ventilation of residential buildings

Calculations for the energy balance of the ventilation system of a residential building take into account the heat quantities which are delivered via the ventilation system, either with or without a heating function, to the building or building zone being heated, as well as the additional energy

requirements for the technical installations supplying this service.

5.1. Generator heat output to the ventilation system for residential buildings

Equation (117) is used to calculate the generator heat output (the heat energy to be provided by the generator). The losses due to the control and emission, distribution and storage of heat (where applicable) are added to the energy need of the residential ventilation system.

$$Q_{rv,outg} = Q_{rv,nd} + Q_{ev,ce} + Q_{rv,d} + Q_{rv,s} \quad (117)$$

where:

- $Q_{rv,outg}$ is the generator heat output to the residential ventilation system;
- $Q_{rv,nd}$ is the energy need of the residential ventilation system;
- $Q_{rv,ce}$ are the control and emission losses of the residential ventilation system;
- $Q_{rv,d}$ are the distribution losses of the residential ventilation system;
- $Q_{rv,s}$ are the storage losses of the residential ventilation system.

If there are several separate systems supplying heat, equation (117) is applied separately for each system in order to determine the generator heat output individually for each system.

If there are several types of heat control and emission and/or distribution and/or storage within a residential ventilation system, the sums of the energy quantities of the individual process steps are entered in equation (117) respectively.

5.1.1. Control and emission losses

The control and emission heat losses $Q_{rv,ce}$ are calculated on a monthly basis, using equation (118).

$$Q_{rv,ce,mth} = Q_{h,nd,mth} \cdot \sum_j \left(f_{rv,part,j} \cdot \frac{\Delta\theta_{ce,j}}{\theta_{i,h,mth} - \theta_{e,mth}} \right) \quad (118)$$

where:

- $Q_{rv,ce,mth}$ are the monthly control and emission heat losses (in the respective month), in kWh;
- $Q_{h,nd,mth}$ is the monthly energy need for heating (in the respective month), in kWh;
- $f_{rv,part,j}$ is the partial ventilation factor of the residential ventilation system j , from equation (119);
- $\Delta\theta_{ce,j}$ is the temperature variation of the residential ventilation system j , in K;
- $\theta_{i,h,mth}$ is the monthly reference indoor temperature for heating in °C;
- $\theta_{e,mth}$ is the monthly average outdoor temperature in the balance period, in °C

If there is only fan-supported ventilation within a zone on a pro-rata basis (e.g. central supply/exhaust air system in most of the rooms and window airing for the remaining rooms) or different fan-supported ventilation systems on a pro-rata basis (e.g. decentralized supply/exhaust air units for individual rooms in combination with an exhaust air system), the heat losses are

calculated on a pro-rata basis using the partial ventilation factor $f_{rv,part,j}$ according to equation (119).

$$f_{rv,part,j} = \frac{A_{N,rv,j}}{A_{NF}} \quad (119)$$

where:

- $f_{rv,part,j}$ is the partial ventilation factor of the residential ventilation system j ;
- $A_{N,rv,j}$ is the usable floor area ventilated with the residential ventilation system j (according to design), in m^2 ;
- A_{NF} is the net floor area, in m^2 .

Equation (120) is used to calculate the auxiliary energy required for improving the heat transfer processes associated with residential ventilation and air heating systems.

$$W_{rv,se,mth} = 0,001 \cdot \sum_j \sum_i (P_{c,i,j} \cdot t_{rv,mech,mth,j}) \quad (120)$$

where:

- $W_{rv,ce,mth}$ is the auxiliary energy for control and emission (in the respective month), in kWh;
- $P_{c,i,j}$ is the nominal power of controller i of the residential ventilation system j dependent on the system design, in W;
- $t_{rv,mech,mth,j}$ is the total monthly operating time of the residential ventilation system j , in h/mth.

5.1.2. Distribution losses

Heat losses in the air ductwork occur when warm supply air is distributed and exhaust air is vented. The following heat losses are identified in this section:

1. heat losses in the supply air ducts between the heat generator and the air terminal devices, and
2. heat losses in the exhaust air ducts located outside the thermal envelope.

The general heat losses in a section k of an air duct are determined per month using equation (121).

$$Q_{rv,d,mth,k} = 0,001 \cdot U_k \cdot L_k \cdot (\theta_{L,av,mth} - \theta_{u,av,mth}) \cdot t_{rv,mech,mth} \quad (121)$$

where:

- $Q_{rv,d,mth,k}$ are the heat losses of the section k of the air duct system (in the respective month), in kWh;
- U_k is the linear thermal transmittance of the section k of the air duct system, in $W/(m \cdot K)$;
- L_k is the length of the respective air duct section k , in m;
- $\theta_{L,av,mth}$ is the mean monthly air temperature in the, in $^{\circ}C$;
- $\theta_{u,av,mth}$ is the average monthly ambient temperature, in $^{\circ}C$;

$t_{rv,mech,mth}$ is the total monthly operating time of the ventilation system, in h/mth.

The monthly and annual heat losses of an entire ventilation air distribution ductwork comprising several different duct sections (e.g. ducts inside and outside the thermal envelope and with different heat insulation) are calculated by adding together the values of the individual duct sections k for the respective periods.

The auxiliary energy required by the fans for distributing the air through the ventilation ductwork is calculated either separately ($W_{rv,d}$) or in conjunction with the auxiliary energy $W_{rv,g}$ for the residential ventilation unit if the fan is an integral component of the ventilation unit and is included in the energy requirement considerations for this unit.

If separate fans are used (e.g. for recirculation), they are taken into account by applying equation (122).

$$W_{rv,se,mth} = 0,001 \cdot \sum_j \sum_i (P_{fan,i,j} \cdot t_{rv,mech,mth,j}) \quad (122)$$

where:

$W_{rv,d,mth}$ is the auxiliary energy for distribution (in the respective month), in kWh;

$P_{fan,i,j}$ is the nominal power of fan i of the residential ventilation system j , including fan controls according to design, in W;

$t_{rv,mech,mth,j}$ is the total monthly operating time of the residential ventilation system j , in h/mth.

5.1.3. Storage losses

If a heat storage tank is used in a residential ventilation unit in conjunction with an exhaust air/water heat pump, the storage heat losses are calculated according to equation (123).

$$Q_{rv,s,mth} = \sum_j \left(f_{rv,part,j} \cdot \left(\frac{\theta_{rv,s} - \theta_{u,av,mth}}{45} \cdot d_{rv,mech,mth} \cdot Q_{P0,s,day} \cdot f_{con} \right)_j \right) \quad (123)$$

where:

$Q_{rv,s,mth}$ are the storage heat losses (in the respective month), in kWh;

$f_{rv,part,j}$ is the partial ventilation factor of the residential ventilation system j ;

$\theta_{rv,s}$ is the mean temperature of the storage tank, in °C

$\theta_{u,av,mth}$ is the mean monthly ambient temperature, in °C;

$d_{rv,mech,mth}$ is the number of operating days of the ventilation unit in the month, in d/mth;

$Q_{P0,s,day}$ are the daily stand-by heat losses, in kWh/d;

f_{con} is the connection heat-loss factor.

If a separate circulation pump is required for operation of the storage tank and the heat transfer does not take place via direct condensation, the auxiliary energy is determined using equation (124).

$$W_{rv,s,mth} = 0,001 \cdot \sum_j (P_{pu,j} \cdot t_{pu,mth,j}) \quad (124)$$

where:

- $W_{rv,s,mth}$ is the auxiliary energy for the pump (in the respective month), in kWh;
- $P_{pu,j}$ is the nominal power of the storage circulation pump of the residential ventilation system j , in W;
- $t_{pu,mth,j}$ is the operating time of the storage circulation pump of the residential ventilation system j (in the respective month), in h.

5.2. Internal heat sources of ventilation systems for residential buildings

The contribution of the internal heat sinks due to the residential ventilation system $Q_{l,rv}$ is calculated on the basis of heat distribution losses $Q_{rv,d}$ and storage losses $Q_{rv,s}$.

6. Cooling of residential buildings

Calculations for the energy balance of the cooling system of a residential building take into account the heat quantities which are delivered via cooling system to the building or building zone being cooled, as well as the additional energy requirements for the technical installations supplying this service.

6.1. Generator cooling energy output to the cooling system for residential buildings

The generator cooling energy output (the cooling energy to be provided by the generator) is calculated according to equation (125). The losses due to the control and emission, distribution and storage of cooling energy are added to the energy need of the residential cooling system.

$$Q_{rc,outg} = Q_{rc,nd} + Q_{rc,ce} + Q_{rc,d} + Q_{rc,s} \quad (125)$$

where:

- $Q_{rc,outg}$ is the generator cooling energy output to the residential cooling system;
- $Q_{rc,nd}$ is the energy need of the residential cooling system;
- $Q_{rc,ce}$ are the control and emission losses of the residential cooling system;
- $Q_{rc,d}$ are the distribution losses of the residential cooling system;
- $Q_{rc,s}$ are the storage losses of the residential cooling system.

If there are several separate systems supplying cooling energy, equation (125) is applied separately for each system in order to determine the generator cooling energy output individually for each system.

If there are several types of control and emission and/or distribution and/or storage of cooling energy within a residential cooling system, the sums of the energy quantities of the individual process steps are entered in equation (125) respectively.

6.2. Control and emission losses

The calculation of monthly control and emission losses of the cooling system in residential buildings $Q_{rc,ce,mth}$ is done according to equation (126):

$$Q_{rc,ce,mth} = ((1 - \eta_{rc,ce}) + (1 - \eta_{rc,ce,sens})) \cdot Q_{c,nd,mth} \cdot f_{c,part} \cdot f_{c,limit} \quad (126)$$

where:

- $Q_{rc,ce,mth}$ are the monthly control and emission losses of the residential cooling system, in kWh;
- $\eta_{rc,ce}$ is the efficiency for the control and emission of cooling energy in the room.
- $\eta_{rc,ce,sens}$ is the sensitive efficiency for the control and emission of cooling energy in the room to take account of unintentional dehumidification in air coolers;
- $Q_{c,nd,mth}$ is the monthly energy need for cooling energy, in kWh;
- $f_{c,part}$ is the partial cooling factor;
- $f_{c,limit}$ is the cooling factor.

The annual control and emission losses $Q_{rc,ce,a}$ of the cooling system in residential buildings are calculated according to equation (127):

$$Q_{rc,ce,a} = \sum Q_{rc,ce,mth} \quad (127)$$

where:

- $Q_{rc,ce,a}$ are the annual control and emission losses of residential cooling system, in kWh/a;
- $Q_{rc,ce,mth}$ are the control and emission losses of residential cooling system (in the respective month) according to equation (126), in kWh.

The auxiliary energy required for secondary air fans of residential cooling system is calculated using the equation (128). The energy requirement refers to units with multistage speed control (on the basis of 1000 operating hours per 500 full hours of use).

$$W_{re,ce,mth} = Q_{re,outg,mth} \cdot f_{c,ce,w} \cdot \frac{t_{rc,limit,mth}}{1000 h} \quad (128)$$

where:

- $W_{rc,ce,mth}$ is the auxiliary energy for control and emission of the cooling energy (in the respective month), in kWh;
- $Q_{rc,outg,mth}$ is the monthly generator cooling output, in kWh;
- $f_{c,ce,w}$ is the specific energy demand of the secondary air fans (default value: $f_{c,ce,w} = 0,04$ kWh/kWh), in kWh/kWh;
- $t_{rc,limit,mth}$ is the monthly operating time of cooling system, in h/mth.

The annual auxiliary energy for control and emission is calculated by adding together the values for the whole year according to equation (129):

$$W_{rc,ce,a} = \sum W_{re,ce,mth} \quad (129)$$

where:

- $W_{rc,ce,a}$ is the annual auxiliary energy for the control and emission of cooling energy, in kWh;
- $W_{rc,ce,mth}$ is the monthly auxiliary energy for the control and emission of cooling

energy according to equation (128), in kWh.

6.3. Distribution losses

The calculation of monthly heat losses due to distribution of cooling energy $Q_{rc,d,mth}$ is done according to equation (130):

$$Q_{rc,d,mth} = (1 - \eta_{rc,d}) \cdot Q_{c,nd,mth} \cdot f_{c,part} \cdot f_{c,limit} + Q_{rc,d,duct,mth} \quad (130)$$

where:

- $Q_{rc,d,mth}$ is the monthly heat losses due to distribution of cooling energy, in kWh;
- $\eta_{rc,d}$ is the efficiency for the distribution of cooling energy;
- $Q_{c,nd,mth}$ is the monthly energy need for cooling, in kWh;
- $f_{c,part}$ is partial cooling factor;
- $f_{c,limit}$ is the cooling factor;
- $Q_{rc,d,duct,mth}$ are the monthly heat losses due to distribution of cooling energy of air ducts outside the thermal envelope, in kWh.

The monthly heat losses of air ducts outside the thermal envelope $Q_{rc,d,duct,mth}$ are calculated according to equation (131). For air ducts inside the thermal envelope and for cold water or refrigerant piping $Q_{rc,d,duct,mth} = 0$.

$$Q_{rc,d,duct,mth} = 0,001 \cdot \sum U_j \cdot L_j \cdot (\theta_{u,av,mth} - \theta_{L,av,mth}) \cdot t_{rc,limit,mth} \quad (131)$$

where:

- U_j is the linear heat transfer coefficient in the air duct section j (design value, in W/(m·K);
- L_j is the length of the air duct section j (design value), in m;
- $\theta_{u,av,mth}$ the average ambient temperature in cooling mode, in °C;
- $\theta_{L,av,mth}$ is the average air temperature in the air duct in cooling mode, in °C;
- $t_{rc,limit,mth}$ is the monthly operating time of residential cooling system, in h/mth.

6.3.1. Storage losses

The use of cold water storage tanks in residential cooling systems is not a standard solution. For this reason, it is generally assumed that residential cooling is carried out without cold water storage tank. Thus, for the cooling heat losses and for the uncontrolled heat gains due to cooling the following applies:

$$Q_{rc,s} = 0 \text{ kWh}$$

$$Q_{I,rc,s} = 0 \text{ kWh}$$

Also, it is assumed that for the auxiliary energy demand the following applies:

$$W_{rc,s} = 0 \text{ kWh}$$

6.4. Internal heat sources of ventilation systems for residential buildings

The contribution of the internal heat sinks due to the residential cooling system $Q_{l,rc}$ is calculated on the basis of cooling energy distribution losses $Q_{rc,d}$ and storage losses $Q_{rc,s}$.

7. Domestic hot water preparation

The calculation of the energy balance of the domestic hot water system takes into account the heat quantities delivered as net energy to the building or building zone being heated and the energy losses of the technical installations supplying this service.

7.1. Generator heat output for domestic hot water preparation

Equation (132) is used to calculate the generator heat output (i.e., heat energy to be provided by the generator) for the domestic hot water preparation. The losses due to the control and emission, distribution and storage of heat (where applicable) are added to the energy need of the domestic hot water system.

$$Q_{w,outg} = Q_{w,nd} + Q_{w,ce} + Q_{w,d} + Q_{w,s} \quad (132)$$

where:

- $Q_{w,outg}$ is the generator heat output to the domestic hot water system;
- $Q_{w,nd}$ is the energy need for heating of the domestic hot water;
- $Q_{w,ce}$ are the control and emission losses of the domestic hot water system;
- $Q_{w,d}$ are the distribution losses of the domestic hot water system;
- $Q_{w,s}$ are the storage losses of the domestic hot water system.

If there are several separate heating systems, equation (132) is applied separately for each system in order to determine the generator heat output individually for each generator (e.g., a building is partly supplied directly by localized electrical water heaters and partly by a central domestic hot water system).

If there are several types of distribution and/or storage within a domestic hot water system, the sums of the energy quantities of the individual process steps are entered in equation (132) respectively.

7.1.1. Boundary conditions

The heat and auxiliary energy requirement are generally determined using the procedure described in this section. In particular, the procedures described allow the use of product-specific values that can be taken from the manufacturers' product data.

The nominal power P_N of the heat generator is determined as described in section 7.2.

7.1.2. Determination of characteristic values

7.1.2.1. Control and emission losses

The heat expenditure as a result of unused hot domestic water running out at the user outlet is already contained in the energy need for domestic hot water $Q_{w,nd}$. Thus, the losses due to control and emission and the auxiliary energy are zero (i.e. $Q_{w,ce} = 0$, $Q_{w,ce,aux} = 0$).

7.1.2.2. Distribution losses

Heat losses from a section i of a domestic hot water pipe system with or without a circulation pipe are calculated as follows:

$$Q_{w,d,i} = \frac{1}{1000} \cdot U_i \cdot L_i \cdot (\theta_{w,av} - \theta_1) \cdot d_{op,th} \cdot t_{op,day} \quad (133)$$

where:

- $Q_{w,d,i}$ are the heat losses of the pipe section (in the respective month), in kWh;
- U_i is the linear heat transfer coefficient, in W/(m·K);
- L_i is the length of the pipe section, in m;
- $\theta_{w,av}$ is the average temperature of the pipe section, in °C;
- θ_1 is the average ambient temperature, in °C;
- $d_{op,mth}$ is the monthly operating time of domestic hot water system, in d;
- $t_{op,day}$ is the daily operating time with the corresponding temperature $\theta_{w,av}$, in h

The heat losses of systems with circulation comprise the losses during the operation of the circulation pump and the losses when the circulation is interrupted.

7.1.2.2.1. Central DHW systems

The auxiliary energy required to operate circulation pumps is calculated on the basis of the hydraulic requirement of the distribution system and an expenditure factor to indicate the pump operation.

$$W_{w,d} = W_{w,d,hydr} \cdot e_{w,d,aux} \quad (134)$$

where:

- $W_{w,d}$ is the electrical energy expenditure (in the respective month), in kWh;
- $W_{w,d,hydr}$ is the hydraulic energy requirement (in the respective month), in kWh;
- $e_{w,d,aux}$ is the expenditure factor for the operation of the circulation pump.

The hydraulic energy requirement of heating systems is obtained from the hydraulic power at the design point (P_{hydr}) and the circulation time:

$$W_{w,d,hydr} = \frac{P_{hydr}}{1000} \cdot d_{op,mth} \cdot z \quad (135)$$

where:

- P_{hydr} is the hydraulic power of the pump at the design point, in W;
- $d_{op,mth}$ is the operating time for domestic hot water system (in the respective month), in d;
- z is the running time of the circulation pump per day, in h.

7.1.2.3. Storage losses

7.1.2.3.1. Indirectly heated DHW storage

The heat loss of an indirectly heated domestic hot water storage tank is calculated according to equation (136), assuming that all heat emitted by the storage tank during the calculation period is considered as a loss.

$$Q_{w,s} = f_{con} \cdot \frac{(\theta_{s,av} - \theta_1)}{45} \cdot d_{op,mth} \cdot Q_{s,PO,day} \quad (136)$$

where:

- $Q_{w,s}$ is the heat loss of the domestic hot water storage tank (in the respective month), in kWh;
- $\theta_{s,av}$ is the average temperature of the storage tank, in °C; for systems without circulation or trace heating, the average temperature of the storage tank is reduced by 5 K;
- θ_1 is the ambient temperature, in °C;
- $d_{op,mth}$ the operating time for hot drinking water (in month), in d;
- $Q_{s,PO,day}$ is the daily stand-by heat loss, in kWh;
- f_{con} the factor considering additional losses from the piping associated with the storage tank.

The auxiliary energy required by the circulating pump for operation of the domestic hot water storage tank is determined from equation (137).

$$W_{w,s} = 0,001 \cdot P_{Pu} \cdot t_{Pu} \quad (137)$$

where:

- $W_{w,s}$ is the auxiliary energy consumption of the pump (in the respective month), in kWh;
- P_{Pu} is the nominal power consumption of the pump, in W;
- t_{Pu} is the operating period of the circulating pump (in the respective month), in h.

7.1.2.3.2. Electrically heated or gas-fired DHW storage

The storage tank loss of an electrically heated domestic hot water storage tank is calculated according to equation (138), whereby this approach assumes that all the heat emitted by the storage tank during the calculation period is considered as loss.

$$Q_{w,s} = \frac{(\theta_{s,av} + 5 - \theta_1)}{45} \cdot d_{op,mth} \cdot Q_{s,PO,day} \quad (138)$$

where:

- $Q_{w,s}$ is the heat loss of the domestic hot water storage tank (in the respective month), in kWh;
- $\theta_{s,av}$ is the mean temperature of the storage tank, in °C; in systems without circulation or trace heating, the mean temperature of the storage tank must be reduced by 5 K;

- θ_1 is the ambient temperature, in °C;
- $d_{\text{op,mth}}$ is the operating period of domestic hot water system (in the respective month), in d;
- $Q_{\text{s,PO,day}}$ is the daily stand-by heat loss, in kWh.

7.2. Internal heat sources due to the domestic hot water supply

The energy contributions by the internal heat sources of the domestic hot water system $Q_{\text{L,w}}$ are calculated on the basis of the heat distribution losses $Q_{\text{w,d}}$ and the storage losses $Q_{\text{w,s}}$.

VII. BALANCING OF DELIVERED ENERGY

The delivered energy Q_{del} is the sum of the energy need, system losses due to control and emission, distribution and storage (sub-total: generator heat output or generator cooling energy output) and heat generation losses. A distinction is made between the delivered energy for lighting, for heating and cooling (including HVAC in non-residential buildings or ventilation and cooling in residential buildings, as well as domestic hot water preparation), for electrical appliances and for auxiliary energy. The delivered energy Q_{del} is calculated separately for each building service and each energy source.

Part of the delivered energy $Q_{\text{del,prod}}$ is generated or made technically usable in the spatial context of the building. These usually refers to regenerative heating (solar heating, geothermal heating, environmental heating energy), regenerative cooling (geothermal cooling, environmental cooling energy) and electricity (photovoltaics, wind power, CHP).

The balancing of the individual sources (heating energy, cooling energy, electricity) provides a result about the amount of energy used by the respective energy carrier, as well as the amount of energy $Q_{\text{del,out}}$, which is delivered from the building outside the balance boundary. Generally, these refers to surpluses of electricity production (photovoltaics, wind power, CHP), but thermal energy can also be delivered to other users.

Similarly, the energy quantities $Q_{\text{del,in}}$ of all energy sources that must be provided to the building from outside via the balance boundary are determined. This includes all fuels as well as electricity, heating and cooling energy supplied from utility grids. A general illustration of the balancing of delivered energy is given in Figure 6.

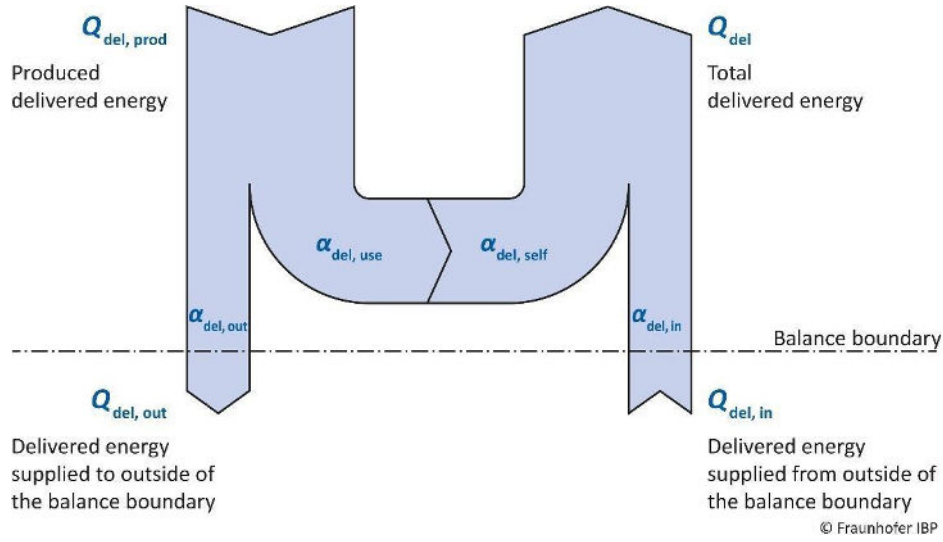


Figure 6. Balancing of delivered energy

The balancing of the delivered energy is carried out separately for each energy carrier. For each energy carrier, the following shares are determined from the energy quantities:

- $\alpha_{del, use}$: share of delivered energy that is produced and used in the building itself (self-use share);
- $\alpha_{del, out}$: share of delivered energy that is produced and supplied out of the balance boundary to other users or fed into the public grid (feed-back share);
- $\alpha_{del, self}$: share of self-produced delivered energy in covering the energy need (self-supply share);
- $\alpha_{del, in}$: share of delivered energy in covering the energy need which is supplied to the balance boundary, e.g. from a public grid or in the form of fuel (external supply share).

1. Balancing of delivered energy from externally supplied energy carriers

All delivered energy flows that are supplied from outside the balance boundary in order to cover energy need of the building are summarized in equation (139). The index j is used to represent different energy carriers. The delivered energy is aggregated in such a way that it can be evaluated with the primary energy factors. Accordingly, energy carriers are electricity, the various fuels and district and local heating.

$$Q_{del, in, j} = (Q_{h, del, in, j} + Q_{h^*, del, in, j} + Q_{c, del, in, j} + Q_{c^*, del, in, j} + Q_{st, del, in, j} + Q_{rv, del, in, j} + Q_{rc, del, in, j} + Q_{w, del, in, j} + Q_{l, del, in, j} + W_{del, in, j} + Q_{el, del, in, j}) \cdot \alpha_{del, in, j} \quad (139)$$

where:

- $Q_{del, in, j}$ is the delivered energy supplied from outside by the energy carrier j ;
- $Q_{h, del, in, j}$ is the delivered energy for the heating system supplied from outside by the energy carrier j ;

$Q_{h^*,del,in,j}$	is the delivered energy for the HVAC heating function supplied from outside by the energy carrier j ;
$Q_{c,del,in,j}$	is the delivered energy for the cooling system supplied from outside by the energy carrier j ;
$Q_{c^*,del,in,j}$	is the delivered energy for the HVAC cooling function supplied from outside by the energy carrier j ;
$Q_{st,del,in,j}$	is the delivered energy for the humidification purposes supplied from outside by the energy carrier j ;
$Q_{rv,del,in,j}$	is the delivered energy for the residential ventilation system supplied from outside by the energy carrier j ;
$Q_{rc,del,in,j}$	is the delivered energy for the residential cooling system supplied from outside by the energy carrier j ;
$Q_{w,del,in,j}$	is the delivered energy for domestic hot water preparation supplied from outside by the energy carrier j ;
$Q_{l,del,in,j}$	is the delivered energy for lighting supplied from outside by the energy carrier j ;
$W_{del,in,j}$	is delivered auxiliary energy supplied from outside by the energy carrier j ;
$Q_{el,del,in,j}$	is delivered energy for electrical applications supplied from outside by the energy carrier j ;
$\alpha_{del,in,j}$	is the share of delivered energy in the coverage of demand which is supplied to the balance area (e.g., from a public grid or in the form of fuel) for the energy source j .

The delivered energy is given in equation (139) in terms of gross calorific value. If delivered energy related to the net calorific value is required, it must be converted using equation (140).

$$Q_{del,in,Hi,j} = \frac{Q_{del,in,j}}{f_{Hs/Hi}} \quad (140)$$

where:

$Q_{del,in,Hi,j}$	is the delivered energy supplied from outside by the energy carrier j , related to the net calorific value H_i ;
$Q_{del,in,j}$	is the delivered energy supplied from outside by the energy carrier j , related to the gross calorific value according to equation (138);
$f_{Hs/Hi}$	is the conversion factor for the delivered energy

2. Balancing of delivered energy by energy carriers exported outside the building boundary

All delivered energy flows that are transferred outside the balance area and thus made usable for processes outside the balance boundary are summarized in equation (141). The index j is used to represent different energy carriers. The delivered energy is aggregated in such a way that it can be evaluated with the primary energy factors. Accordingly, energy carriers are usually electricity, heating and cooling.

$$\begin{aligned}
Q_{\text{del,out},j} = & Q_{\text{h,del,out},j} + Q_{\text{h}^*,\text{del,out},j} + Q_{\text{c,del,out},j} + Q_{\text{c}^*,\text{del,out},j} + Q_{\text{st,del,out},j} + \\
& + Q_{\text{rv,del,out},j} + Q_{\text{rc,del,out},j} + Q_{\text{w,del,out},j} + Q_{\text{del,out,PV},j} + Q_{\text{del,out,WEP},j} + \\
& + Q_{\text{del,out,CHP},j}
\end{aligned} \tag{141}$$

where:

- $Q_{\text{del,out},j}$ is the delivered energy provided for processes outside the balance boundary by the energy carrier j ;
- $Q_{\text{h,del,out},j}$ is the delivered energy provided by the heating system for the processes outside the balance boundary by the energy carrier j ;
- $Q_{\text{h}^*,\text{del,out},j}$ is the delivered energy provided by the HVAC heating function for the processes outside the balance boundary by the energy carrier j ;
- $Q_{\text{c,del,out},j}$ is the delivered energy provided by the cooling system for the processes outside the balance boundary by the energy carrier j ;
- $Q_{\text{c}^*,\text{del,out},j}$ is the delivered energy provided by the HVAC cooling function for the processes outside the balance boundary by the energy carrier j ;
- $Q_{\text{st,del,out},j}$ is the delivered energy provided by the HVAC humidification for the processes outside the balance boundary by the energy carrier j ;
- $Q_{\text{w,del,out},j}$ is the delivered energy provided by the system for domestic hot water preparation for the processes outside the balance boundary by the energy carrier j ;
- $Q_{\text{rv,del,out},j}$ is the delivered energy provided by the residential ventilation system for the processes outside the balance boundary by the energy carrier j ;
- $Q_{\text{rc,del,out},j}$ is the delivered energy provided by the residential cooling system for the processes outside the balance boundary by the energy carrier j ;
- $Q_{\text{del,out,PV},j}$ is the delivered energy provided by the photovoltaic system for the processes outside the balance boundary by the energy carrier j ;
- $Q_{\text{del,out,WEP},j}$ is the delivered energy provided by the wind power plant for the processes outside the balance boundary by the energy carrier j ;
- $Q_{\text{del,out,CHP},j}$ is the delivered energy provided by the cogeneration plant for the processes outside the balance boundary by the energy carrier j .

3. Delivered energy for heating and cooling and generation losses

Once the generator output of heat or cooling energy has been calculated as described in Chapter VI, the delivered energy can be calculated. This is done by adding the heat generation losses to the generator heat or cooling energy output.

First the delivered energy balance is described below for a single building service with a single heat generator (basic version). Then calculation modes are described for systems in which energy is delivered by more than one generator for a single service. Finally, the most frequent situation (i.e., where more than one service is served by one or more generators) is described.

3.1. Systems with a single building service and a single generator

There are various combinations of generators and systems which use a single generator to supply energy for a single service (e.g., heating, cooling energy, domestic hot water etc.).

3.1.1. A single heat generator supplying heat only for heating purposes

$$Q_{h,del} = Q_{h,outg} + Q_{h,g} = Q_{h,del,in} + Q_{h,del,prod} - Q_{h,del,out} \quad (142)$$

where:

- $Q_{h,del}$ is the delivered energy for the heat generator;
- $Q_{h,outg}$ is the generator heat output to the heating system;
- $Q_{h,g}$ are generation losses of the heating system, taking into consideration the building automation system, where applicable;
- $Q_{h,del,in}$ is the delivered energy supplied to the generator from outside the balance boundary;
- $Q_{h,del,prod}$ is the (renewable) delivered energy used for heating by this generator;
- $Q_{h,del,out}$ is the delivered energy provided by this generator for processes outside the balance boundary.

3.1.2. A single heat generator supplying heat only to HVAC heating function

Equation (142) applies analogously but using the balance terms for the HVAC heating function, marked with the subscript "h*".

3.1.3. A single cold generator supplying cooling energy only

$$Q_{c,del} = Q_{c,outg} + Q_{c,g} = Q_{c,del,prod} - Q_{c,del,in} + Q_{c,del,out} \quad (143)$$

where:

- $Q_{c,del}$ is the delivered energy for the cold generator;
- $Q_{c,outg}$ is the net cooling energy output to the cooling system;
- $Q_{c,g}$ are generation losses of the cooling system, taking into consideration the building automation system, where applicable;
- $Q_{c,del,in}$ is the delivered energy supplied to the generator from outside the balance boundary;
- $Q_{c,del,prod}$ is the (renewable) delivered energy used for cooling by this generator;
- $Q_{c,del,out}$ is the delivered energy of re-cooling provided by this generator for processes outside the balance boundary.

3.1.4. A single cold generator supplying cooling energy only to HVAC cooling function

Equation (143) applies analogously but using the balance terms for the HVAC cooling function, marked with the subscript "c*".

3.1.5. A single thermal or electrical generator supplying energy only for water vapor

Equation (142) applies analogously but using the balance terms for the HVAC steam humidification, marked with the subscript "st".

3.1.6. A single heat generator supplying heat only to the ventilation system of a residential building

Equation (142) applies analogously but using the balance terms for the residential ventilation system, marked with the subscript "rv".

3.1.7. A single cold generator supplying cooling energy only to the cooling system of a residential building

Equation (143) applies analogously but using the balance terms for the residential cooling system, marked with the subscript "rc".

3.1.8. A single heat generator supplying heat only for domestic hot water preparation

Equation (142) applies analogously but using the balance terms for domestic hot water preparation, marked with the subscript "w".

3.1.9. Internal heat sources/sinks

In cases where generators are located in thermally conditioned zones, the generation losses Q_g have the effect of internal heat sources or heat sinks. In such cases, the individual contributions Q_i of the internal heat sources/heat sinks (these being identified as $Q_{i,h,g}$, $Q_{i,w,g}$, $Q_{i,rv,g}$, etc., as appropriate) are calculated.

3.2. Systems with a single building service with more than one generator

If a single building service is supplied with energy by more than one generator (e.g., domestic hot water preparation by a fuel oil boiler and by a solar thermal system), then the calculated generator heat/cooling energy output is distributed over the individual generators. The corresponding equation as described in Chapter VII, sub-chapter 3.1 applies to each generator, but in each case with its (proportional) generator heat/cooling energy output to be provided.

In cases where generators are located in thermally conditioned zones, the generation losses Q_g have the effect of internal heat sources or heat sinks. In such cases, the individual contributions Q_i of the internal heat sources/heat sinks (these being identified as $Q_{i,h,g}$, $Q_{i,w,g}$, $Q_{i,rv,g}$, etc., as appropriate) are calculated.

3.3. Several technical building services with one or more generators

Use of one or more generators to supply energy for more than one building service is the most common type of energy supply system (e.g., a boiler used for both space heating and domestic hot water preparation). For each generator the corresponding equation as described in Chapter

VII, sub-chapter 3.1 applies.

In cases where generators are located in thermally conditioned zones, the generation losses Q_g have the effect of internal heat sources or heat sinks. In such cases, the individual contributions Q_i of the internal heat sources/heat sinks (these being identified as $Q_{I,h,g}$, $Q_{I,w,g}$, $Q_{I,rv,g}$, etc., as appropriate) are calculated.

3.4. Heat generation

3.4.1. Heating systems

If there are additional demands for heat generation from other systems (e.g. for HVAC system), these are also taken into account.

On the other hand, in cases where the heat from the other systems is supplied for the heating system (e.g. exhaust air heat pump), these are also taken into account in the demand for heat generation. The remaining heat demand, which is covered by the additional heat generator (e.g. a boiler) is calculated as follows:

$$Q_{h,outg}^* = Q_{h,outg} - Q_{h,sol} - Q_{rv,h,outg}^* \quad (144)$$

where:

$Q_{h,outg}^*$ is the remaining generator heat output (in the respective month), in kWh, (to be used for

$Q_{h,outg}$ in the further calculation);

$Q_{h,outg}$ is the generator heat output to the heating distribution system (in the respective month), in kWh;

$Q_{rv,h,outg}^*$ is the heat output of the domestic ventilation system for space heating (in the respective month), in kWh;

$Q_{h,sol}$ is the energy yield of the solar system for space heating (in the respective month), in kWh.

If the same heat generator is used for heating and domestic hot water heating, the heating operating time is reduced in the further calculation by the operating time for domestic hot water.

The delivered energy for the heat generator is given by equation (145):

$$Q_{h,del} = (Q_{h,outg} + Q_{h,g}) \cdot f_{g,PM} \quad (145)$$

With regard to the different types of delivered energy the following equation applies:

$$Q_{h,del} = Q_{h,del,in} + Q_{h,del,prod} - Q_{h,del,out} \quad (146)$$

where:

$Q_{h,del}$ is the delivered energy for the heat generator, in kWh;

$Q_{h,outg}$ is the generator heat output to the heating system, in kWh;

$Q_{h,g}$ are the generation heat losses of the heating system (in the respective month), in kWh;

$Q_{h,del,in}$	is the delivered energy supplied to the generator from outside the balance boundary (in the respective month), in kWh;
$Q_{h,del,prod}$	the delivered energy provided by the generator and used for heating (in the respective month), in kWh;
$Q_{h,del,out}$	is the delivered energy provided by the generator for processes outside the balance boundary (in the respective month), in kWh;
$f_{g,PM}$	is the correction factor for heat generators with integrated pump management.

For further evaluation of delivered energy values $Q_{h,del,in}$, $Q_{h,del,prod}$ and $Q_{h,del}$, the respective associated energy sources must also be specified.

Heat generator with integrated pump management $f_{g,PM}$:

1. For heat generators without integrated pump management, the factor $f_{g,PM} = 1$.
2. For heat generators with integrated pump management and boiler temperature regulation based on external temperature control, the factor $f_{g,PM} = 1,03$.
3. For heat generators with integrated pump management and boiler temperature regulation based on room temperature control, the factor $f_{g,PM} = 1,06$.

3.4.1.1. Solar systems for back-up heating with or without domestic hot water preparation

Solar systems are considered in this section according to the proportion they contribute to covering the energy demand of the domestic hot water heating system with central heating back-up. The proportion to be considered for back-up heating is calculated from the energy need for heating and the heat losses due to control and emission, distribution and storage.

The heat losses of storage tanks or storage areas that are used exclusively for storing solar heat are already taken into account in the energy requirement $Q_{w,outg}$.

3.4.1.1.1. Determination of the energy yield of solar thermal system

The energy yield of the solar system is calculated by determining the average hourly irradiation on the collector and the average hourly collector efficiency, which are then balanced over the relevant hours of the day to give the average irradiation on the day in the respective month.

By using the solar yield per m^2 of collector area, the required collector area A_C is calculated in m^2 as follows:

$$A_C = \frac{(Q_{w,outg,d} + Q_{h,outg,d}) \cdot e_{sol,ce} \cdot e_{sol,d}}{\max(\bar{q}_{sol,d,mth})} \quad (147)$$

where:

$Q_{w,outg,d}$	is the daily generation heat output for domestic hot water heating, in kWh/($m^2 \cdot d$);
$Q_{h,outg,d}$	is the daily generation heat output for backup space heating, in kWh/d (simplified definition: $Q_{h,outg,d} = Q_{w,outg,d}$);

- $q_{sol,d,mth}$ is the daily area-related solar yield in kWh/d, where the maximum is formed over all months;
- $e_{sol,ce}$ is the expenditure figure for the heat transfer from the solar circuit to the storage tank (default value $e_{sol,ce} = 1,03$);
- $e_{sol,d}$ is the expenditure figure for the heat loss in the solar circuit (default value $e_{sol,d} = 1,03$).

A_C is the aperture area when using default or product-specific values according to EN 12975, and the collector gross area when using default or product-specific values according to SK SSH EN ISO 9806.

For the calculation of the reference storage tank size, $Q_{w,outg,d}$ is determined according to the following equation:

$$Q_{w,outg,d} = (Q_{w,b,d} + Q_{w,ce,d} + Q_{w,d,d}) \cdot e_{w,s} \quad (148)$$

where:

- $Q_{w,b,d}$ is the daily energy need for domestic hot water heating, in kWh/d;
- $Q_{w,ce,d}$ are the daily control and emission losses of the domestic hot water heating system, in kWh/d;
- $Q_{w,d,d}$ are the daily distribution losses of the domestic hot water heating system, in kWh/d;
- $e_{w,s}$ is the expenditure figure for the storage of the domestic hot water (for simplification $e_{w,s} = 1.1$ can be assumed).

The total storage capacity in kWh/d corresponds to the daily energy demand and is divided between the solar and stand-by section:

$$Q_{S,sol} = 0,6 \cdot (Q_{w,outg,d} + Q_{h,outg,d}) \quad (149)$$

$$Q_{S,aux} = 0,4 \cdot (Q_{w,outg,d} + Q_{h,outg,d}) \quad (150)$$

where:

- $Q_{S,sol}$ is the capacity of the solar storage in kWh/d;
- $Q_{S,aux}$ is the capacity of the stand-by storage in kWh/d.

The storage volumes are:

$$V_{S,sol} = \frac{Q_{S,sol}}{1,163 \cdot \Delta Q_{S,sol}} \cdot 1000 \frac{W}{kW} \quad (151)$$

$$V_{S,aux} = \frac{Q_{S,aux} \cdot f_N}{1,163 \cdot \Delta Q_{S,aux}} \cdot 1000 \frac{W}{kW} \quad (152)$$

where:

- $\Delta\theta_{S,sol}$ is the temperature difference in the solar storage tank (25 K);
- $\Delta\theta_{S,aux}$ is the temperature difference in the stand-by storage tank (30 K);
- f_N is the utilization factor $f_N = 1,85 \cdot N^{-0,42}$; with N indicating the number of apartments

The coverage share of a thermal solar system based on the delivered energy is:

1. for back-up space heating (only for $Q_{h,outg} > 0$):

$$\kappa = \frac{Q_{h,sol}}{Q_{h,outg}} \quad (153)$$

2. for domestic hot water heating:

$$\kappa = \frac{Q_{w,sol}}{Q_{w,outg}} \quad (154)$$

Equations (155) and (156) apply to both monthly and annual values.

The monthly shares of the energy contribution of the solar system are as follows:

3. for domestic hot water heating:

$$Q_{w,sol} = \min(Q_{sol}; Q_{h,outg} + Q_{w,outg}) \cdot \frac{Q_{w,outg}}{Q_{w,outg} + Q_{h,outg}} \quad (155)$$

4. for back-up space heating:

$$Q_{h,sol} = \min(Q_{sol}; Q_{h,outg} + Q_{w,outg}) \cdot \frac{Q_{h,outg}}{Q_{w,outg} + Q_{h,outg}} \quad (156)$$

where:

$Q_{w,outg}$ is the monthly energy demand for domestic hot water heating, in kWh/mth;

$Q_{h,outg}$ is the monthly energy demand for back-up space heating, in kWh/mth.

and the monthly solar yield:

$$Q_{sol} = \frac{\bar{q}_{sol,mth} \cdot A_c}{e_{sol,ce} + e_{sol,d}} \quad (157)$$

The average monthly solar yield is calculated as follows:

$$\bar{q}_{sol,mth} = n_d \cdot \bar{q}_{sol,mth,d} \quad (158)$$

where:

$\bar{q}_{sol,mth,d}$ is the average daily energy yield of the solar system in month m , in kWh/d;

n_d is the number of days in the respective month, in d.

The procedure aims to determine both the required collector area and the storage tank volumes according to demand. Corrections are made when assessing existing systems or freely selected collector areas and storage tank sizes. The corrections are only made to the average monthly temperature difference between the average collector temperature and the outdoor temperature.

If the parameters required to calculate a solar system are not known, the solar coverage of a solar system up to $A_{NF} = 3000 \text{ m}^2$ can be determined simply by using the default values. The energy yields of solar systems supplying larger areas ($A_{NF} > 3000 \text{ m}^2$) must always be calculated in detail according to the procedure described in this section. For the use of the solar system for back-up space heating, it is assumed that the heating system is set to 55/45 or 35/28.

3.4.1.1.2. Auxiliary energy for operation of the solar pump

The auxiliary energy for operation of the solar pump is calculated according to equation (159):

$$W_{w,g} = 0,001 \cdot P_{Pu,sol} \cdot t_{Pu,sol} \quad (159)$$

where:

- $W_{w,g}$ is the auxiliary energy of the solar pump (in the respective month), in kWh;
- $P_{Pu,sol}$ is the nominal power consumption of the solar pump, in W;
- $t_{Pu,sol}$ is the operating period of the solar pump (in the respective month), in h.

If the above parameters are not known due to the absence of design calculations, the auxiliary energy of the solar pump can be approximated using the following boundary conditions:

$$W_{w,g} = 0,025 \cdot Q_{w,sol} \quad (160)$$

where:

- $Q_{w,sol}$ is the energy yield of the solar system for domestic hot water heating (in the respective month), in kWh.

3.4.1.2. Heat pumps (electrical and gas-engine)

In the calculation procedure described below the following physical factors which influence the annual performance factor and the energy consumption of the heat pump are taken into account:

1. Type of heat pump (air-to-water, brine-to-water, water-to-water, direct condensing without ventilation function, partially exhaust air-to-water), as electric or gas-engine heat pumps;
2. System configuration (priority switching of domestic hot water heating over space heating, combined operation with simultaneous domestic hot water and space heating);
3. Operating mode in bivalent operation (parallel, partially parallel, alternative);
4. Operating times for space heating, domestic hot water heating and combined operation;
5. Effects of source and sink temperature variation on the output and coefficient of performance (COP) of the heat pump;
6. Effects of part load operation (cyclical, controllable) of single-stage and multistage as well as continuously controlled heat pumps on the output and the coefficient of performance;
7. Auxiliary energy required to operate the heat pump, which is not taken into account in test conditions;
8. System losses due to installed storage tanks.

On the basis of these input data the following output data are calculated:

1. Energy in the form of electricity or fuel $Q_{h,del}$ required to provide the generator heat output;
2. Total heat losses of the heat pump $Q_{h,g}$;
3. Auxiliary energy $W_{h,g}$ required for the operation of the heat pump;

4. Total recoverable heat losses of the heat pump $k_{rd,g} \cdot W_{h,g}$.

The temperature of the outdoor air as a heat source can fluctuate considerably within a month. Therefore, the energy evaluation of heat pumps is not carried out in one step for one month but takes into account the frequency distribution of the heat source temperature in different temperature classes in the respective month. For the heat source ground and groundwater, the fluctuation range of the source temperature is significantly smaller. The energy evaluation for these two heat sources is carried out by correcting the source temperature of the test points to the average monthly source temperature. For exhaust-air heat pumps, a constant exhaust-air temperature is assumed.

The design of the heating system has a great influence on the energy efficiency of the heat pump. A correction factor once determined with respect to the design of the heating system is applied to the coefficient of performance, the bivalence temperature and the heating limit temperature in all temperature classes.

Heat pumps controlled in stages or continuously are characterized by efficiency increases in part load operation. Manufacturers specify a test point for controllable heat pumps as an optimization of heat output and coefficient of performance. The characteristic values at minimum and maximum load are determined from the part load test points. With these support points it is possible to evaluate the actual operating point in the control range between minimum and maximum load in each temperature class. For single-stage (non-controllable) heat pumps, the same calculation method is used as for controllable heat pumps. Their main feature is that the characteristic values at the minimum load are identical to the maximum load and thus the controllable range becomes zero.

Heat pumps can be operated in bivalent mode, which means that a second heat generator takes over part of the heat output of the generator. This share must be deducted in the further evaluation of the heat pump in the corresponding temperature class.

The allocation of the remaining generator heat output in a month among the individual temperature classes i is done via a weighting factor.

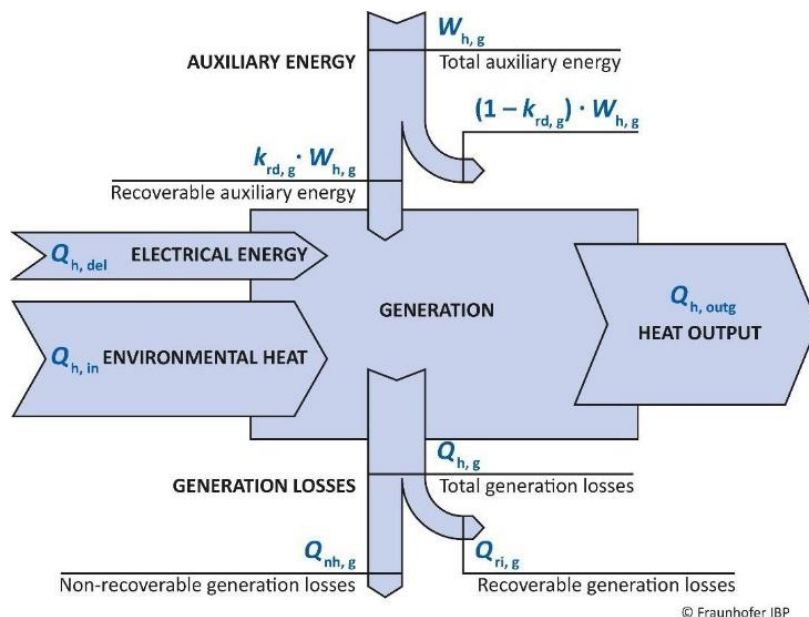


Figure 7. Energy balance of the generator subsystem (electrically driven heat pump)

The energy balance of the heat losses for the generator subsystem (see Figure 7) is according to equation (161):

$$Q_{h,del} = Q_{h,outg} + Q_{h,g} - k_{rd,g} \cdot W_{h,g} - Q_{h,in} \quad (161)$$

where:

- $Q_{h,del}$ is the delivered energy for the heat generator (heat pump) (in the respective month), in kWh;
- $Q_{h,outg}$ is the generator heat output to the heat distribution system (in the respective month), in kWh;
- $Q_{h,g}$ are the losses of the generator subsystem (in the respective month), in kWh;
- $k_{rd,g}$ is the recovered energy fraction of the auxiliary systems;
- $W_{h,g}$ is the auxiliary input energy for the operation of the generator (in the respective month), in kWh;
- $Q_{h,in}$ is the environmental heat (in the respective month), in kWh.

The fractions of recovered energy of the auxiliary systems are not taken into account $k_{rd,g} = 0$.

The energy for operation of the heat pump $Q_{h,del}$ is taken from the test measurements according to EN 14511-3. The auxiliary energy for the source and sink pump (primary and secondary sides), for overcoming the internal pressure drop in the heat pump evaporator (heat source) and condenser (heating) as well as the auxiliary energy for control, for defrosting and any back-up heating equipment are taken into account.

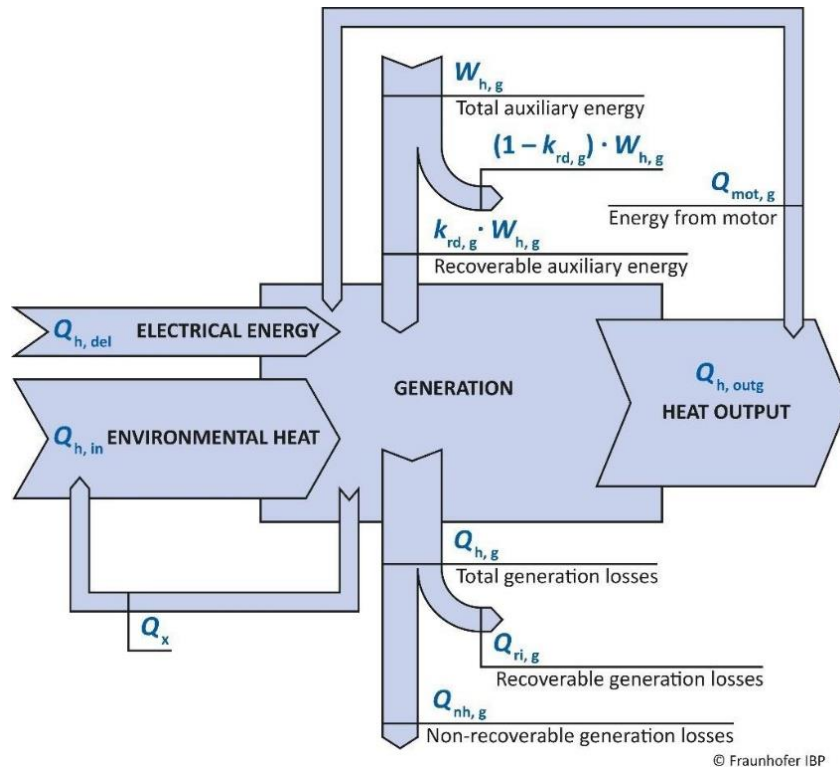


Figure 8. Energy balance of the generator subsystem (gas-engine heat pump)

For gas-engine heat pumps, the energy balance for the generator system related to the heat losses (see Figure 8) is as follows:

$$Q_{h,del} = \frac{Q_{h,outg} + Q_{h,g} - k_{rd,g} \cdot W_{h,g} - Q_{h,in}}{1 + p_{rd,mot}} \quad (162)$$

where:

- $Q_{h,del}$ is the delivered energy for the heat generator (heat pump) (in the respective month), in kWh;
- $Q_{h,outg}$ is the generator heat output to the heat distribution system (in the respective month), in kWh;
- $Q_{h,g}$ are the losses of the generator subsystem (in the respective month), in kWh;
- $k_{rd,g}$ is the fraction of the recovered thermal energy of auxiliary systems;
- $W_{h,g}$ is the auxiliary input energy for the operation of the generator (in the respective month), in kWh;
- $Q_{h,in}$ is the environmental heat (in the respective month), in kWh.
- $p_{rd,mot}$ is the recovered input fuel supplied to the generator.

The fractions of recovered energy of the auxiliary systems are not taken into account $k_{rd,g} = 0$.

3.4.1.2.1. Calculation procedure

The procedure for the energy assessment of heat pumps is divided into the following sub-steps:

1. Evaluation of heat source temperatures;
2. Reduction of the heat output of the heat pump in bivalent operation;
3. Allocation of the generator heat output to the temperature classes;
4. Correction of the test points (monthly source and sink temperature, design value of the spread);
5. Consideration of part load operation;
6. Calculation of running time of the heat pump;
7. Calculation of heat output, heat losses and energy consumption of the generator;
8. Calculation of heat output of the second generator (back-up heating system);
9. Determination of regenerative energy contribution;
10. Determination of the coefficient of performance.

For heat pumps with outdoor air as their heat source (air-to-water and direct condensing heat pumps, such as split units or VRF-systems), the calculation procedure is based on a monthly assessment of the distribution of the outdoor temperature. The hourly frequency with which a particular outdoor temperature occurs in a month is given in intervals of 1 K, and then divided into temperature classes (bins). These temperature classes correspond to the outdoor air temperature conditions of the test points.

The exhaust air as a heat source is considered to have a uniform temperature. For this reason, only one temperature class corresponding to the exhaust air temperature is used in case of exhaust air heat pumps. If test points are only available for one source temperature, the correction is made using exergy efficiency.

Due to their high storage capacity, ground temperatures are subject to significantly smaller fluctuations than the outside air temperatures. For brine-to-water heat pumps, the test standard EN 14511-2 specifies three source temperatures (-5 °C, 0 °C and 5 °C). For further calculation, the test points are corrected to the monthly average brine temperature. If the test points are only available for one source temperature, the correction is made using exergy efficiency.

Groundwater temperatures fluctuate very little seasonally. EN 14511-2 specifies two source temperatures (10 °C and 15 °C) for water-to-water heat pumps. As with brine heat pumps, the test points are corrected to the monthly average groundwater temperature. If the test points are only available for one source temperature, the correction is made by exergy efficiency.

3.4.1.2.1.1. Calculation of the heat output, heat losses and energy consumption of the generator

3.4.1.2.1.1.1. Heat output of the generator

The useful heat produced by the heat pump for space heating is composed of the combined operation and single operation modes across all temperature classes.

$$Q_{h,hp,outg} = \sum_i (Q_{h,outg,combi,i} + Q_{h,outg,sng,i}) \quad (163)$$

where:

- $Q_{h,hp,outg}$ is the heat output of the heat pump for space heating (in a month), in kWh;
- $Q_{h,outg,combi,i}$ is the heat output of the generator in combined operation for space heating in temperature class i (in a month), in kWh;
- $Q_{h,outg,sng,i}$ is the heat output of the generator in individual operation for space heating in temperature class i (in a month), in kWh.

3.4.1.2.1.1.2. Heat generator losses

a) Hot water buffer storage tank

If the buffer storage tank is part of the heat pump, the losses are included in the coefficient of performance. They are presented as heat gains for the room and their allocation to the individual temperature classes is performed according to equation (164):

$$Q_{h,g,s,i} = Q_{h,s} \cdot w_i \quad (164)$$

where:

- $Q_{h,g,s,i}$ is the heat loss of the storage tank to the surrounding environment in class i (in a month), in kWh;
- $Q_{h,s}$ is the heat loss of the buffer storage tank (in a month), in kWh;
- w_i is the weight factor in class i (in a month), in h.

b) Hot water buffer storage tank

For electrically driven heat pumps, no further losses are considered $Q_{h,g,hp,i} = 0$. For heat pumps with combustion drive the data from the test rig results or manufacturer's data are used. These losses are included in the coefficient of performance, and they are presented as heat gains for the room:

$$Q_{h,g,i} = Q_{h,g,s,i} + Q_{h,g,hp,i} \quad (165)$$

where:

- $Q_{h,g,i}$ is the total generator heat loss in class i (in the respective month), in kWh;
- $Q_{h,g,s,i}$ is the heat loss of the storage tank to the surrounding environment in class i (in the respective month) according to equation (164), in kWh;
- $Q_{h,g,hp,i}$ is the heat loss of the heat pump in class i (in the respective month), in kWh.

3.4.1.2.1.1.3. Calculation of total energy consumption

3.4.1.2.1.1.3.1. Electrically driven heat pumps

The electrical energy consumption of the heat pump is calculated by adding together the electrical energy consumption in the individual classes and single operating modes. The energy consumption in combined mode is divided in two halves between the domestic hot water mode and the space heating mode.

The energy consumption includes proportionally the auxiliary energy for pumps and fans, which is included in the test points for overcoming the internal pressure losses.

$$Q_{h,del,1} = \sum_{i=1}^{n_{class}} \frac{Q_{h,outg,sng,i} - (1 - \kappa_{h,combi,i}) \cdot k_{rd,g} \cdot W_{h,g,i}}{COP_{Pint,sng,i}} + \sum_{i=1}^{n_{class}} \frac{\frac{Q_{h,outg,combi,i}}{2} - \kappa_{h,combi,i} \cdot k_{rd,g} \cdot W_{h,g,i}}{COP_{Pint,combi,i}} \quad (166)$$

where:

- $Q_{h,del,1}$ is the delivered energy required for operation of the heat pump in heating mode (in the respective month), in kWh;
- $Q_{h,outg,sng,i}$ is the generator heat output in class i (in the respective month), which is met by the heat pump in single heating mode, in kWh;
- $Q_{h,outg,combi,i}$ is the generator heat output in class i (in the respective month), which is met by the heat pump in combined space heating and domestic hot water heating mode, in kWh;
- $k_{rd,g}$ is the fraction of auxiliary energy recovered as thermal energy (for electrically driven heat pumps: $k_{rd,g} = 0$);
- $W_{h,g,i}$ is the auxiliary energy for operation of the heat pump in heating mode in class i (in the respective month), in kWh;
- $COP_{Pint,sng,i}$ is the coefficient of performance of the heat pump in single heating mode in

class i ;

$COP_{Pint,combi,i}$ is the coefficient of performance of the heat pump in combined space heating and domestic hot water heating mode in class i ;

$\kappa_{h,combi,i}$ is the fraction of combined space heating and domestic hot water heating (simultaneous operation) in class i ;

n_{class} is the number of classes.

The fraction of combined space heating and domestic hot water heating $\kappa_{h,combi,i}$ is calculated using the running time shares according to equation (167):

$$\kappa_{h,combi,i} = \frac{t_{g,op,combi,i}}{t_{g,op,combi,i} + t_{h,g,op,sng,i} + t_{w,g,op,sng,cor,i}} \quad (167)$$

where:

$\kappa_{h,combi,i}$ is the fraction of combined space heating and domestic hot water heating (simultaneous operation) in class i ;

$t_{g,op,combi,i}$ is the running time of the heat pump in combined mode in class i (in the respective month), in h;

$t_{h,g,op,sng,i}$ is the running time of the heat pump in single space heating mode in class i (in the respective month), in h;

$t_{w,g,op,sng,cor,i}$ is the corrected running time of the heat pump in single domestic hot water heating mode in class i (in the respective month), in h;

3.4.1.2.1.3.2. Gas-engine heat pumps

Gas-engine heat pumps can recover part of the losses from the drive via downstream heat exchangers. $Q_{rd,mot,g}$ is a feature of the heat pump and depends on the efficiency and technical configuration of the system to recover heat from cooling and exhaust gas.

If no product-specific values are available, for gas-engine heat pumps with appropriate cooling of the engine, $p_{rd,mot} = 0,4$ is used as the default value.

$$p_{rd,mot} = \frac{Q_{rd,mot,g}}{Q_{h,del}} \quad (168)$$

where:

$p_{rd,mot}$ is the recovered share of input fuel to the generator;

$Q_{rd,mot,g}$ is the energy recovered from the motor (in the respective month), in kWh;

$Q_{h,del}$ is the energy delivered to the generator (in the respective month), in kWh.

The fuel energy consumption of the heat pump is calculated by adding together the energy consumption in the individual classes according to equation (169).

$$Q_{h,del,1} = \sum_{i=1}^{n_{class}} \frac{Q_{h,outg,sng,i} - (1 - \kappa_{h,combi,i}) \cdot k_{rd,g} \cdot W_{h,g,i}}{COP_{Pint,sng,i}} \cdot \frac{\frac{f_{Hs}}{H_i}}{1 + p_{rd,mot}} + \sum_{i=1}^{n_{class}} \frac{\frac{Q_{h,outg,combi,i}}{2} - \kappa_{h,combi,i} \cdot k_{rd,g} \cdot W_{h,g,i}}{COP_{Pint,combi,i}} \cdot \frac{\frac{f_{Hs}}{H_i}}{1 + p_{rd,mot}} \quad (169)$$

where:

$Q_{h,del,l}$	is the delivered energy (gas) required for operation of the heat pump in heating mode (in the month), in kWh;
$Q_{h,outg,sng,i}$	is the generator heat output in class i (in the respective month), which is met by the heat pump in single heating mode, in kWh;
$Q_{h,outg,combi,i}$	is the generator heat output in class i (in the respective month), which is met by the heat pump in combined domestic hot water heating and space heating mode, in kWh
$k_{rd,g}$	is the fraction of auxiliary energy recovered as thermal energy (for electrically driven heat pumps: $k_{rd,g}=0$);
$W_{h,g,i}$	is the auxiliary energy for operation of the heat pump in heating mode in class i (in the respective month), in kWh;
$COP_{Pint,sng,i}$	is the coefficient of performance of the heat pump in single heating mode in class i ;
$COP_{Pint,combi,i}$	is the coefficient of performance of the heat pump in combined space heating and domestic hot water heating mode in class i ;
$\kappa_{h,combi,i}$	is the fraction of combined space heating and domestic hot water heating (simultaneous operation) in class i ;
$f_{Hs/Hi}$	is the ratio of gross calorific value and net calorific value of the fuel used (default value: $f_{Hs/Hi} = 1,11$);
$p_{rd,mot}$	is the recovered share of input fuel to the generator; default value: $p_{rd,mot} = 0,4$;
n_{class}	is the number of classes.

3.4.1.2.1.1.3.3. Auxiliary energy expenditure

$$W_{h,g,i} = (P_{prim,aux} \cdot t_{h,g,op,sng,i} + P_{sek,aux} \cdot t_{g,op,sng,i}) \cdot 0,001 \quad (170)$$

where:

$W_{h,g,i}$	is the total auxiliary energy expenditure for each temperature class (in the respective month), in kWh;
$P_{prim,aux}$	is the power of the primary circuit (external auxiliary power only, if the power takes into account the internal power component; otherwise, the total auxiliary power of the pump(s) or from equation (171)), in W;
$P_{sek,aux}$	is the power of the secondary circuit (external auxiliary power only, if the power takes into account the internal power component; otherwise, the total auxiliary power of the pump(s) or from equation (171)), in W;
$t_{h,g,op,sng,i}$	is the running time of the heat pump in single heating mode in class i (in

the respective month), in h;

$t_{g,op,aux,i}$ is the running time of the respective auxiliary component for each temperature class (in the respective month), in h.

If the power of the auxiliary component is not known, it is calculated according to equation (171):

$$P_{\frac{prim}{sek},aux} = \frac{\Delta p \cdot \dot{V}}{\eta_{aux} \cdot 3600} \quad (171)$$

where:

$P_{prim,aux}$ is the power of the primary circuit, in W;

$P_{sek,aux}$ is the power of the secondary circuit, in W;

Δp is the pressure drop of the primary or secondary side, in Pa;

$\dot{V}$ is the volume flow, in m³/h (this value can be taken from the test rig measurements according to EN 14511-3 or from the product-specific values);

η_{aux} is the efficiency of the circulating pump (set to $\eta_{aux} = 0,3$ according to EN 14511).

For direct exchange heat pump $W_{h,g,i} = 0$, since all generation effort is included in the determination of the coefficient of performance.

3.4.1.2.1.2. Heat output of the second generator (back-up heating system)

$$Q_{h,outg,bu} = \max \left(\sum_i \left(Q_{h,outg,i} \cdot \frac{w_i + \kappa_{bu,h,i}}{w_i} - Q_{h,outg,sng,i} - Q_{h,outg,combi,i} \right); \sum_i \left(\left[\frac{\kappa_{bu,h,i}}{w_i} + 1 - f_{LG} \right] \cdot Q_{h,outg,i} \right) \right) \quad (172)$$

where:

$Q_{h,outg,bu}$ is the generator heat output in temperature class i (in the respective month), in kWh, provided by the second generator (back-up heating);

$Q_{h,outg,sng,i}$ is the heat output of the heat pump in single space heating mode in temperature class i (in the respective month), in kWh;

$Q_{h,outg,combi,i}$ is the heat output of the heat pump for space heating in combined mode in temperature class i (in the respective month), in kWh;

$Q_{h,outg,i}$ is the heat output of the heat pump in temperature class i (in the respective month), in kWh;

w_i is the weight factor in temperature class i (in the respective month);

$\kappa_{bu,h,i}$ is the coverage share of the second generator (back-up heating) in temperature class i (in the respective month), depending on the operation mode.

Based on the heat output of the second generator, the energy consumption $Q_{h,del,bu}$ is calculated according to the type of heat generator. If the back-up heating is a solely electric system, the energy consumption corresponds to the heat output of the generator. For other heat generators, corresponding conversions are made.

3.4.1.2.1.3. Regenerative energy contribution

The regenerative energy used for the heat supply is calculated as follows:

$$Q_{h,in} = Q_{h,outg} - (Q_{h,del,1} + Q_{h,del,bu}) + \sum Q_{h,g,i} \quad (173)$$

where:

- $Q_{h,in}$ is the environmental heat for the heating system (in the respective month), in kWh;
- $Q_{h,outg}$ is the generator heat output to the heating system (in the respective month), in kWh;
- $Q_{h,del,1}$ is the delivered energy required in the space heating mode (in the respective month) for electric heat pumps and for gas-engine heat pumps, in kWh;
- $Q_{h,del,bu}$ is the delivered energy required for the second generator (back-up heating) in heating mode (in the respective month);
- $Q_{h,g,i}$ are the generation heat losses of the heating system in the temperature class (in the respective month), in kWh.

If the electric heat pump is driven by electricity produced in photovoltaic system (PV electricity), the corresponding delivered energy requirement for the PV electricity assessment is as follows:

$$Q_{h,del,g,HP} = Q_{h,del,1} \quad (174)$$

If not all the demand is covered by PV-electricity, the remaining demand is given as follows:

$$Q_{h,del,1} = Q_{h,del,1} - Q_{h,del,g,H} \quad (175)$$

3.4.1.2.1.4. Performance factor to account for the generator subsystem

The annual coefficient of performance can be calculated on the basis of the sum of the monthly energy requirements for heating and the energy expenditures according to equation (176):

$$SPF_{g,t,a} = \frac{\sum_{month} Q_{h,outg}}{\sum_{month} (Q_{h,del,1} + Q_{h,del,bu}) + W_{h,g}} \quad (176)$$

The monthly performance factor can be calculated according to equation (177):

$$SPF_{g,t} = \frac{Q_{h,outg}}{(Q_{h,del,1} + Q_{h,del,bu}) + W_{h,g}} \quad (177)$$

where:

- $SPF_{g,t,a}$ is the annual performance factor of the heat pump;
- $SPF_{g,t}$ is the monthly performance factor of the heat pump;
- $Q_{h,outg}$ is the generator heat output for the heating system (in the respective month), in kWh;
- $Q_{h,del,1}$ is the delivered energy required in the space heating mode (in the respective month) for electric heat pumps according to equation (166) or for gas-engine heat pumps according to equation (169), in kWh;
- $Q_{h,del,bu}$ is the delivered energy required for the second generator (back-up heating) in heating mode (in a respective month), in kWh;

$W_{h,g}$ is the total auxiliary energy expenditure (in the respective month), in kWh.

3.4.1.3. Conventional boilers

The nominal output of the boiler is determined in such a way that load levels $\beta_{h,g,i} \leq 1$ is always obtained. If there is only one boiler, the value β is calculated as follows:

$$\beta_{h,g} = P_{d,in} / P_n \quad (178)$$

where:

$\beta_{h,g}$ is the part load level;

$P_{d,in}$ is the mean heat output to the heat distribution, in kW;

P_n is the nominal output of the boiler, in kW.

3.4.1.3.1. Multivalent heat generation

For the calculation of the different system configurations, these are divided into following cases:

- a) Heat pump and other heat generators (boiler);
- b) Micro-CHP and other heat generators (boilers);
- c) CHP and other heat generators (boilers);
- d) multiple boilers.

All classes can be supplemented with a solar system for backup heating and domestic hot water heating. According to Chapter VI, sub-chapter 3.4.1.1, the energy of the solar system must be deducted from the required heat output of the generator. The energy for domestic hot water heating must be added up accordingly.

The calculation algorithm differs for the different system configurations only by the type of the first heat generator. Apart from the first heat generator, all other heat generators are defined with the index “OHG”.

The calculation algorithm for the further heat generators must be repeated until all other heat generators are included in the system.

$$P_{d,in,OHG} = \frac{Q_{h,outg} - Q_{h,outg,1}}{d_{op,mth} \cdot t_{h,op,day}} \quad (179)$$

where:

$P_{d,in,OHG}$ is the mean heat output of the other heat generators, in kW;

$Q_{h,outg}$ is the generator heat output to the heating system, in kWh;

$Q_{h,outg,1}$ is the heat output of the first heat generator, in kWh;

$t_{h,op,day}$ is the daily duration of heating operation;

$d_{op,mth}$ is the monthly operating time, in d.

The contributions of the other heat generators are calculated as:

1. For $P_{n,OHG,i} < P_{d,in,OHG} - \sum P_{n,OHG,i-1}$ the following applies:

$$Q_{h,outg,OHG,i} = (d_{op,mth} \cdot t_{h,op,day}) \cdot (P_{n,OHG,i}) \quad (180)$$

2. For $P_{n,OHG,i} > P_{d,in,OHG} - \sum P_{n,OHG,i-1}$ the following applies:

$$Q_{h,outg,OHG,i} = Q_{h,outg} - Q_{h,outg,1} - \sum Q_{h,outg,OHG,i-1} \quad (181)$$

where:

$P_{n,OHG,i}$ is the nominal output of the i additional heat generator, in kW;

$Q_{h,outg,OHG,i}$ is the heat output of the i additional heat generator, in kWh.

If the condition $P_{n,OHG,i} > P_{d,in,OHG} - \sum P_{n,OHG,i-1}$ is fulfilled for a heat generator, all other heat generators with higher running index i are not active for the respective month.

The number of heat generators must be such that for the heat generator with the highest running index i , at least in one month the condition $P_{n,OHG,i} > P_{d,in,OHG} - \sum P_{n,OHG,i-1}$ is fulfilled.

The coverage share of each heat generator is calculated from the shares of the energies in the total energy according to equation (182):

$$\kappa_i = \frac{Q_{h,outg,ONG,i}}{Q_{h,outg}} \quad (182)$$

where:

κ_i is the coverage share of the i additional heat generator.

3.4.1.3.1.1. Heat pump and other heat generators (boilers)

The energy for space heating that cannot be supplied by the heat pump in the respective month is calculated in accordance with Chapter VII, sub-chapter 3.4.1.2.1.2. The energy that cannot be supplied by the heat pump for domestic hot water heating is calculated in accordance with Chapter VII, sub-chapter 3.4.2. The sum of the energies not covered by the heat pump must be covered by other heat generators.

$$Q_{h,outg,OHG} = Q_{h,outg,bu} + Q_{w,outg,bu} \quad (183)$$

where:

$Q_{h,outg,OHG}$ is the heat output of the other heat generators, in kWh;

$Q_{h,outg,bu}$ is the generator heat output for space heating that cannot be covered by the heat pump, in kWh;

$Q_{w,outg,bu}$ is the generator heat output for domestic hot water heating that cannot be covered by the heat pump, in kWh

If the first heat generator is a heat pump, $P_{d,in,OHG}$ is calculated as follows:

$$P_{d,in,OHG} = \frac{Q_{h,outg,OHG}}{d_{op,mth} \cdot t_{h,op,day}} \quad (184)$$

where:

$t_{h,op,day}$ is the daily duration of heating operation;

$d_{\text{op,mth}}$ is the monthly operating time, in d.

3.4.1.3.1.2. Multiple boiler systems

In the case of multiple boiler systems, a distinction is made according to the type of operating mode.

In case of parallel operation (without priority switching), all boilers are in operation at the same time to cover the heat demand. In this case, the share of the heat output of the respective boiler corresponds to the ratio of the nominal heat output of the boiler to the mean heat output.

$$\kappa_i = \frac{P_{n,i}}{P_{dE,in}} \quad (185)$$

where:

κ_i is the coverage share of the i heat generator;

$P_{dE,in}$ is the mean heat output, in kW;

$P_{n,i}$ is the nominal heat output of the i boiler, in kW.

The heat output of the respective boiler in this case is calculated as:

$$Q_{h,outg,i} = \kappa_i \cdot Q_{h,outg} \quad (186)$$

In case of sequential operation (with priority switching), the nominal heat outputs of the individual boilers are added step by step in the order of the control-related activation of the individual boilers i . As long as the sum of these outputs is below the demand after each step, the corresponding boilers are loaded to 100%.

The heat output of the first boiler is calculated as follows:

$$Q_{h,outg,1} = (d_{\text{op,mth}} \cdot t_{h,\text{op,day}}) \cdot (P_{n,1}) \quad (187)$$

where:

$P_{n,1}$ is the nominal heat output of the first boiler, in kW;

$t_{h,\text{op,day}}$ is the daily duration of heating operation;

$d_{\text{op,mth}}$ is the monthly operating time, in d.

3.4.1.3.2. Fuel-fired systems (boilers)

The heat loss $Q_{h,g}$ and auxiliary energy $W_{h,g}$ of a boiler are calculated on the basis of the nominal heat output P_n , the efficiencies $\eta_{k,Pn}$, $\eta_{g,Pint}$ according to the Regulation (EU) No. 813/2013, the stand-by loss $q_{P0,70}$ and the electrical power P_{aux} of the auxiliary units of a boiler. These values are either determined as product-specific values according to EN 304, EN 3035, EN 15502-2-2, SK EN 15035 or EN 656 or, through the measurement in the case of existing installations, or if no values are available, using default values.

The total generation loss of the heating system $Q_{h,g}$, referred to the gross calorific value (H_s), is calculated using equation (188):

$$Q_{h,g} = \sum(Q_{h,g,ls,\text{day},i} \cdot d_{h,rB}) \quad (188)$$

where:

- $Q_{h,g}$ is the total generation loss of heating system (in the respective month), in kWh;
- $Q_{h,g,ls,day,i}$ is the daily heat loss of the boiler, in kWh/d;
- $d_{h,rB}$ is the calculated number of operating days (in the respective month), in d.

The daily generation losses of the boiler $Q_{h,g,ls,day}$ are determined as a function of the mean boiler part load $\beta_{h,g,i}$ and the load regimes on which testing of the generator is based, with part loads $\beta_{h,g,Pint}$ and nominal load $\beta_{h,g,Pn}$ ($= 1,0$):

$$Q_{h,g,ls,day,i} = \left(\frac{\beta_{h,g,i}}{\beta_{h,g,Pint}} \cdot (P_{g,Pint} - P_{g,PO}) + P_{g,PO} \right) \cdot (t_{h,rL,day} - t_{w,Pn,day}) \quad (189)$$

If $\beta_{h,g,Pint} < \beta_{h,g,i} < 1,0$:

$$Q_{h,g,ls,day,i} = \left(\frac{\beta_{h,g,i} - \beta_{h,g,Pint}}{1 - \beta_{h,g,Pint}} \cdot (P_{g,Pn} - P_{g,Pint}) + P_{g,Pint} \right) \cdot (t_{h,rL,day} - t_{w,Pn,day}) \quad (190)$$

where:

- $\beta_{h,g,i}$ is the part load level of the boiler;
- $P_{g,Pn}$ is the thermal power loss of the boiler at nominal output, in kW;
- $P_{g,Pint}$ is the thermal power loss of the boiler at partial load, in kW;
- $P_{g,P0}$ is the thermal power loss of the boiler in stand-by mode, in kW;
- $t_{h,rL,day}$ is the daily calculated running time, in h;
- $t_{w,Pn,day}$ is the daily running time of the boiler at nominal output for domestic hot water heating, in h.

3.4.1.3.2.1. Average heat output of the generation process

If the generator only has to meet the heat requirements of the space heating system or the heat requirements of the space heating system combined with domestic hot water heating, then the average heat output is calculated according to equation (191):

$$P_{d,in} = \frac{Q_{h,outg}}{d_{h,rB} \cdot (t_{h,rL,day} - t_{w,Pn,day})} \quad (191)$$

As soon as there is no heating requirement in the particular month and thus $d_{h,rB} = 0$, then $P_{d,in}$ also becomes 0.

If the generator has to meet further heating requirements in addition to space heating and domestic hot water heating (e.g. for air-conditioning), then the average heat output is calculated according to equation (192):

$$P_{d,in} = \frac{\Sigma Q_{h,outg}}{(t_{h,g,op,day} - t_{w,Pn,day}) \cdot d_{op,mth}} \quad (192)$$

where:

$\Sigma Q_{h,outg}$ is the total heat output;

$t_{h,g,op,day}$ is the daily duration of heating operation, taking into account all heat loads to be supplied.

3.4.1.3.2.2. Calculation of the power losses

Thermal power loss of the boiler at stand-by mode $P_{g,P0}$ is calculated as follows:

$$P_{g,P0} = q_{PO,\theta} \cdot \frac{P_n}{\eta_{k,Pn}} \cdot f_{\frac{Hs}{Hi}} \quad (193)$$

where:

$q_{P0,\theta}$ is the stand-by loss at the mean boiler temperature;

P_n is the nominal output of the boiler, in kW;

$\eta_{k,Pn}$ is the boiler efficiency at nominal load;

$f_{\frac{Hs}{Hi}}$ is the ratio of gross calorific value to net calorific value of the fuel used.

The stand-by loss $q_{P0,\theta}$ of the boiler at the mean boiler temperature is calculated as follows:

$$q_{PO,\theta} = q_{PO,70} \cdot \frac{\theta_{HK,av} - \theta_I}{70 - 20} \quad (194)$$

where:

$q_{P0,70}$ is the standby loss at mean boiler temperature of 70 °C;

$\theta_{HK,av}$ is the mean boiler temperature, in °C;

θ_I is the ambient temperature, in °C.

The boiler efficiencies determined under test conditions ($\theta_{g,Test,Pn}$, $\theta_{g,Test,Pint}$) are corrected to take into account the actual operating temperature ($\theta_{HK,av}$ or $\theta_{RL,av}$) as follows:

$$\eta_{g,Pn} = \eta_{k,Pn} + K \cdot (\theta_{g,Test,Pn} - \theta_{HK,av}) \quad (195)$$

$$\eta_{g,Pint} = \eta_{k,Pint} + L \cdot (\theta_{g,Test,Pint} - \theta_{HK,av}) \quad (196)$$

If a number of heating circuits with differing temperatures are connected, then the highest value is used for $\theta_{HK,av}$ or $\theta_{RL,av}$.

For condensing boilers, the mean return temperature $\theta_{RL,av}$ is used instead of the mean boiler temperature $\theta_{HK,av}$.

Factors K and L are given in the Table 8.

Table 7 – Temperature correction factors

Boiler type	Factor K	Factor L
Standard boiler (fossil and biomass)	0	0,0004
Low temperature boiler	0,0004	0,0004
Condensing boiler, gaseous fuels	0,002	0,002
Condensing boiler, liquid fuels	0,0004	0,001

Thermal power loss at partial load is calculated according to equation (197):

$$P_{g,Pint} = \frac{f_{Hs}^{HI} \cdot \eta_{g,Pint}}{\eta_{g,Pint}} \cdot \beta_{h,g,Pint} \cdot P_n \quad (197)$$

Thermal power loss at nominal load is calculated according to equation (198):

$$P_{g,Pn} = \frac{f_{Hs}^{HI} \cdot \eta_{g,Pn}}{\eta_{g,Pn}} \cdot P_n \quad (198)$$

3.4.1.3.2.3. Calculation of recoverable heat losses

Uncontrolled heat gains from generators installed within the heated zone caused by losses via the envelope ($q_{s,\theta}$) of the generator is taken into account as follows:

Special gas boiler according to equation (199):

$$q_{s,\theta} = 0,5 \cdot q_{P0,\theta} \quad (199)$$

All other boilers according to equation (200):

$$q_{s,\theta} = 0,75 \cdot q_{P0,\theta} \quad (200)$$

Thus the total sum of the radiation losses $Q_{I,h,gen}$ in the period under consideration is determined according to equation (201):

$$Q_{I,h,gen} = q_{s,\theta} \cdot \frac{P_n}{\eta_{k,Pn}} \cdot (t_{h,rL,day} - t_{w,Pn,day}) \cdot d_{h,rB} \quad (201)$$

3.4.1.3.2.4. Auxiliary energy

The auxiliary energy for the heat generation $W_{h,g}$ is calculated with the auxiliary power P_{aux} of the boiler (measured at nominal load, at part load and in stand-by mode) on the basis of a volume flow at a difference of 20 K between the supply and return temperature, and the mean boiler part load $\beta_{h,i}$. In set-back mode, the heat generator runs at a reduced temperature and with a reduced running time. These influences are taken into account, as well as a possible period of operational shut down, via the calculated running time according to equation (202):

$$W_{h,g} = \sum P_{h,g,aux,i} \cdot (t_{h,rL} - t_{w,Pn,day} \cdot d_{mth} \cdot d_{op,a}/365) + P_{aux,P0} \cdot (24 \cdot d_{mth} - t_{h,rL}) \quad (202)$$

where:

$W_{h,g}$ is the auxiliary energy for the heat generation, in kWh;

$P_{aux,P0}$ is the electrical power consumption of the boiler at stand-by, in kW;

$t_{h,rL}$ is the monthly calculated running time, in h;
 d_{mth} is the number of days in the respective month, in d.

If $0 < \beta_{h,g,i} \leq \beta_{h,g,Pint}$:

$$P_{h,g,aux,i} = (\beta_{h,g,i} / \beta_{h,g,Pint}) \cdot (P_{aux,Pint,i} - P_{aux,P0}) + P_{aux,P0} \quad (203)$$

where:

$P_{h,g,aux,i}$ is the electrical power consumption of the boiler when in operation, in kW;
 $P_{aux,Pint,i}$ is the electrical power consumption of the boiler at part load, in kW;
 $P_{aux,P0}$ is the electrical power consumption of the boiler at stand-by, in kW.

If $\beta_{h,g,Pint} < \beta_{h,g,i} < 1,0$:

$$P_{h,g,aux,i} = (\beta_{h,g,i} - \beta_{h,g,Pint}) / (1 - \beta_{h,g,Pint}) \cdot (P_{aux,Pn} - P_{aux,Pint}) + P_{aux,Pint} \quad (204)$$

where:

$P_{aux,Pn}$ is the electrical power consumption of the boiler at nominal load, in kW.

3.4.1.4. Decentralized fuel-fired systems

In the case of the decentralized fuel fired systems the energy for net (usable) heat, control and emission, distribution and generation is brought together into one quantity which is then used in the subsequent balance calculation. They thus correspond directly to the final energy demand of the heat generator.

1. Gas space heaters

1.1. Chimney-dependent units

up to 1985 $Q_{h,del} = 1,40 \cdot Q_{h,nd}$ in kWh in the respective month
after 1985 $Q_{h,del} = 1,34 \cdot Q_{h,nd}$ in kWh in the respective month

1.2. Outside wall units

up to 1985 $Q_{h,del} = 1,47 \cdot Q_{h,nd}$ in kWh in the respective month
after 1985 $Q_{h,del} = 1,40 \cdot Q_{h,nd}$ in kWh in the respective month

2. Oil-fired stand-alone stoves with vaporization burner

up to 1985 $Q_{h,del} = 1,40 \cdot Q_{h,nd}$ in kWh in the respective month
after 1985 $Q_{h,del} = 1,34 \cdot Q_{h,nd}$ in kWh in the respective month

3. Tiled stoves

$Q_{h,del} = 1,55 \cdot Q_{h,nd}$ in kWh in the respective month

4. Coal-fired iron stoves

$Q_{h,del} = 1,60 \cdot Q_{h,nd}$ in kWh in the respective month

5. Decentralized systems of hall heating

$$Q_{h,g} = \left(\frac{f_{HS}}{\eta_{h,g}} - 1 \right) \cdot Q_{h,outg} \quad (205)$$

where:

- $Q_{h,g}$ is the monthly loss of heat generation of the decentralized hall heating system, in kWh;
- $f_{HS/Hi}$ is the ratio of gross calorific value and net calorific value of the fuel used;
- $\eta_{h,g}$ is the generator efficiency related to calorific value (luminous radiant heaters with indirect flue gas discharge);
- $Q_{h,outg}$ is the monthly generator heat output, in kWh.

3.4.1.5. Individual fireplaces (as additional heat generators)

In the case of decentralized individual fireplaces fired with biomass, which are operated in addition to central heating system, the energy for net (usable) heat, control and emission, distribution and generation is brought together into one quantity which is then used in the subsequent balance calculation. They thus correspond directly to the final energy demand of the heat generator.

The delivered energy of a decentralized individual fireplace is calculated according to equation (206):

$$Q_{h,del} = 1,55 \cdot \alpha_{h,g,direct} \cdot (Q_{h,nd} + q_{h,ce,direct} \cdot A_{NF}) \quad (206)$$

where:

- $Q_{h,del}$ is the delivered energy for the individual fireplace (in the respective month), in kWh;
- $\alpha_{h,g,direct}$ is the percentage of the energy need for heating covered by the individual fireplace;
- $Q_{h,nd}$ is the energy need for heating (in the respective month), in kWh;
- $q_{h,ce,direct}$ are the specific control and emission losses of an individual fireplace with direct heat emission according to Table 9, in kWh/m²a;
- A_{NF} is the net floor area, in m².

Table 8 – Area-related control and emission losses of individual fireplace with direct heat emission

Building type	Control and emission losses
Residential building with up to two residential units with heated basement	8,50 kWh/m ² a
Other residential buildings	10,10 kWh/m ² a

In the case of hydraulically integrated biomass-fired individual furnaces, which are operated in

addition to the main heat generator, both indirect and direct heat emission takes place. Indirect heat emission refers to the transferring the heat to the heating water via a heat exchanger. The heat is then used for heating of space and domestic hot water. In this section, the direct and indirect heat transfer to the space heating is considered. The indirect heat transfer for domestic hot water heating is taken into account in Chapter VII, sub-chapter 3.4.2. For the calculation of the delivered energy of a hydraulically integrated individual fireplace, the energy for net (usable) heat, control and emission, distribution and generation is brought together into one quantity which is then used in the subsequent balance calculation.

The delivered energy of a hydraulically integrated individual fireplace is calculated as follows:

$$Q_{h,del} = 1,55 \cdot \alpha_{h,g,direct} \cdot (Q_{h,nd} + q_{h,ce,direct} \cdot A_{NF}) + 1,55 \cdot \alpha_{h,g,indirect} \cdot Q_{h,outg} \quad (207)$$

where:

$Q_{h,del}$	is the delivered energy for the individual fireplace (in the respective month) in kWh;
$\alpha_{h,g,direct}$	is the percentage of the energy need for heating covered by the individual fireplace (direct heat transfer);
$Q_{h,nd}$	is the energy need for heating (in the respective month) in kWh;
$q_{h,ce,direct}$	are the specific control and emission losses of an individual fireplace with direct heat transfer, in kWh/(m ² ·a);
A_{NF}	is the net floor area in m ² ;
$\alpha_{h,g,indirect}$	is the percentage of the energy need for heating covered by the individual fireplace (indirect heat transfer);
$Q_{h,outg}$	is the remaining generator heat output (in the respective month) in kWh, according to Chapter VII, sub-chapter 3.4.1 this value corresponds to $Q_{h,outg}^*$.

3.4.1.6. Electrical heat generators

Decentralized electrical systems are considered during the commissioning process.

In the case of centralized electrical heat generation, the losses are calculated as follows:

1. Storage with separate generation: $Q_{h,s} + Q_{h,g} = 0,11 \cdot Q_{h,outg}$ in kWh per month;
2. Storage with integrated generation: $Q_{h,s} + Q_{h,g} = 0,09 \cdot Q_{h,outg}$ in kWh per month.

where:

$Q_{h,outg}$ is the generator heat output (in the respective month), in kWh.

3.4.1.7. District and local heating

For the assessment of district and local heating, the following provisions are made:

1. Heat transfer station for heating and domestic hot water is considered, domestic hot water is produced in priority operation;

2. Determination of the capacity to be applied as usual for priority operation (maximum of heating capacity and domestic hot water heating capacity);
3. All heat losses of the station are allocated to heating (for simplification).

The heat losses $Q_{h,g}$ of the district heating stations and the substations are as calculated according to equation (208):

$$Q_{h,g} = H_{DS} \cdot (\theta_{DS} - \theta_1) \cdot \frac{d_{mth}}{365} \quad (208)$$

with:

$$H_{DS} = B_{DS} \cdot (P_{DS})^{1/3} \quad (209)$$

and

$$\theta_{DS} = D_{DS} \cdot \theta_{prim,DS} + (1 - D_{DS}) \cdot \theta_{sek,DS} \quad (210)$$

where:

- H_{DS} is the annual specific heat loss of the station, in kWh/(K·a);
- B_{DS} is the insulation class coefficient (see Table 11);
- P_{DS} is the nominal capacity of the district heating station, in kW;
- D_{DS} is the primary temperature factor (see Table 10);
- $\theta_{prim,DS}$ is the mean temperature on the primary side, in °C;
- $\theta_{sek,DS}$ is the mean temperature on the secondary side, in °C;
- d_{mth} is the number of days per month, in d.

For $\theta_{prim,DS}$ and $\theta_{sek,DS}$ the average temperatures on the primary and secondary sides of the district heating station are used respectively. In this case $\theta_{sek,DS} = \theta_{HK,av}$

The equations are numerical equations. The nominal power PDS of the district heating station in kW and the numerical values from Tables 10 and 11 are used, thus giving the heat losses $Q_{h,g}$ in kWh per year.

Table 9 – D_{DS} as a function of primary temperature and the type of district heating station

Type of district heating station	Primary temperature (design)	D_{DS}
Hot water, low temperature	105	0,6
Hot water, high temperature	150	0,4
Low pressure steam	110	0,5
High pressure steam	180	0,4

Table 10 – Coefficient B_{DS} as a function of insulation class and type of district heating station

Type of station	Insulation class of the components of the district heating station according to SK EN 12828			
Insulation of the secondary side	4	3	2	1
Insulation of the primary side	5	4	3	2
Type of supply	Coefficient B_{DS}			
Hot water, low temperature	3,5	4,0	4,4	4,9
Hot water, high temperature	3,1	3,5	3,9	4,3
Low pressure steam	2,8	3,2	3,5	3,9
High pressure steam	2,6	3,0	3,3	3,7

As consideration of this system on a monthly basis is too complex, it is recommended that a year is selected as the calculation period, and that in the ensuing calculations the unmodified heat losses in the course of the year are taken into account. In some cases, it is useful to calculate separate values for summer and winter.

The auxiliary energy expenditure of the district heating station is neglected. If the supply temperature for the heating system of the building is controlled by a central control system, a value of $W_{h,gen} = 10$ kWh in the respective month is assumed.

3.4.2. Domestic hot water systems

For heating of the domestic water, a number of generators (e.g. solar, boiler, heat pump, or additional electric heating) may be available. The total heat requirement for all consumers correspond to the total heat output of all heat generators:

$$\sum_j Q_{w,outg,j} = \sum_k Q_{in,d,k} \quad (211)$$

were:

$Q_{w,outg,j}$ is the output energy of generator j (in the respective month), in kWh;

$Q_{in,d,k}$ is the input energy of the distribution system k (in the respective month), in kWh.

If there are multiple generators the total heat requirement of the distribution system $Q_{in,d,k}$ is distributed among the available generators. The calculations are performed separately for each heat generator j on the basis of $Q_{w,outg,j}$.

If heat is supplied to the heating system from other systems or services (e.g. by an extract air heat pump, solar heat, etc.), then this shall also be taken into account when considering the heat generation requirement. The remaining heat requirement that is met by the additional heat generator (e.g. a boiler), is given by:

$$Q_{w,outg}^* = Q_{w,outg} - Q_{w,sol} - Q_{rv,w,outg}^* \quad (212)$$

were:

- $Q_{w,outg}^*$ is the remaining generator heat output (in the respective month), in kWh;
- $Q_{w,outg}$ is the generator heat output to the domestic hot water system (in the respective month), in kWh;
- $Q_{rv,w,outg}^*$ is the heat output of the domestic ventilation unit for the domestic hot water system (in the respective month), in kWh;
- $Q_{w,sol}$ is the energy yield of the solar system for domestic hot water production (in the respective month), in kWh;

3.4.2.1. Solar systems for domestic hot water heating and, if necessary, back-up heating

Determination of the energy yield of solar thermal system, as well as the default values for parameters required to calculate solar systems are covered in the Chapter VII, sub-chapter 3.4.1.1.

3.4.2.2. Heat pumps (electric and gas-engine) for domestic hot water

In the calculation procedure described below the following physical factors which influence the annual performance factor and the energy consumption of the heat pump are taken into account:

1. Type of heat pump (air-to-water, brine-to-water, water-to-water, partially exhaust air-to-water with and without upstream heat exchanger, basement air-to-water), as electric or gas-engine heat pumps;
2. System configuration (domestic hot water heating, combined operation (simultaneous DHW and space heating) and operating mode);
3. Operating times for domestic hot water heating;
4. Effects of source and sink temperature variation on the output and coefficient of performance (COP) of the heat pump;
5. Auxiliary energy required to operate the heat pump, which is not taken into account in test conditions according to EN 16147 or EN 14511-2;
6. System losses due to installed storage tanks.

On the basis of these input data the following output are calculated:

1. Energy in the form of electricity or fuel $Q_{w,del}$ required to provide the generator heat output;
2. Total heat losses of the heat pump $Q_{w,g}$;
3. Auxiliary energy $W_{w,g}$ required for the operation of the heat pump;
4. Total recoverable heat losses of the heat pump $Q_{rl,g}$;
5. Heat pump running time in priority mode $t_{w,g,op,sng}$ and in combined mode $t_{w,g,op,combi}$.
6. If the heat pump is operated in combined mode, a single iteration is necessary.

3.4.2.2.1. Calculation procedure

The procedure for the energy assessment of heat pumps is divided into the following steps:

1. Evaluation of heat source temperatures;
2. Correction of the test points (to the source and sink temperatures);
3. Calculation of running time of the heat pump;
4. Calculation of generator heat output, heat losses, the auxiliary energy expenditure and the total energy consumption;
5. Calculation of heat output of the second generator (back-up heating system);
6. Determination of regenerative energy yield;
7. Determination of the coefficient of performance.

The energy efficiency of a heat pump depends strongly on the operating conditions, especially on the temperatures of the heat source and heat sink. The temperature of the outdoor air as a heat source can fluctuate considerably within a month. As the standard EN 16147 provides test point only for one outdoor temperature (7 °C) and the standard EN 14511-3 provides test points for four different temperature classes (-15 °C, -7 °C, 2 °C and 7 °C), the average monthly outdoor temperature is calculated with sufficient accuracy.

For the heat source ground and groundwater, the fluctuation range of the source temperature is significantly smaller. The energy evaluation for these two heat sources is carried out by correcting the source temperature of the test points to the average monthly source temperature. For exhaust-air and basement- air heat pumps, a constant source temperature is assumed.

The temperature of the heat sink side may differ from the test points. The characteristic values of the test points are corrected to the average monthly flow temperature, which is 5 K above the set-point temperature of the domestic hot water storage tank (when tested according to EN 14511), or to the set-point temperature of the domestic hot water storage tank (when tested according to EN 16147).

3.4.2.2.2. Calculation of the heat output, heat losses and energy consumption of the generator

3.4.2.2.2.1. Heat output of the second generator (back-up heating)

The heat output of the second generator due to the running time limitation of the heat pump is calculated according to equation (213).

$$Q_{w,outg,bu,t} = \max\left(0; Q_{w,outg}^* - Q_{w,outg,bu} - \Phi_{g,sng,corr} \cdot t_{w,g,op,sng} - \Phi_{g,combi,corr} \cdot t_{w,g,op,combi}\right) \quad (213)$$

were:

$Q_{w,outg,bu,t}$ is the energy demand for the back-up heating due to the running time limitation of the heat pump (in the respective month), in kWh;

$Q_{w,outg,bu}$	is the generator heat output to the domestic hot water system (in the respective month) covered by the back-up heating (second heat generator), in kWh;
$Q_{w,outg}^*$	is the remaining generator heat output to the domestic hot water system (in the respective month) from equation (212), in kWh;
$\Phi_{g,sng,corr}$	is the heat output of the heat pump in single operation mode corrected to the average monthly source and sink temperature, in kW;
$t_{w,g,op,sng}$	is the running time of the heat pump in single operation mode (in the respective month), in h;
$\Phi_{g,combi,corr}$	is the heat output of the heat pump in combined operation mode corrected to the average monthly source and sink temperature, in kW;
$t_{w,g,op,combi}$	is the running time of the heat pump in combined operation mode (in the respective month), in h.

3.4.2.2.2.2. Generator heat losses

Any external hot water storage tank that may be installed is considered in Chapter VI, subchapter 7.1.2.3. The losses are calculated using $Q_{w,g,s} = Q_{w,s}$. This case occurs when the test points of the heat pump have been determined according to EN 14511. When using the test points according to EN 16147, $Q_{w,g,s} = 0$.

For heat pumps with combustion drive, the data from the test bench results or product values are used.

3.4.2.2.2.3. Total energy consumption for domestic hot water operation

The electrical energy consumption for domestic hot water operation is calculated using equation (214). In combined operation mode, the electrical energy consumption is divided equally between space heating and domestic hot water heating. This is only applicable when in the coefficient of performance, the heating capacity of the domestic hot water heating is related to the total power consumption. Otherwise:

$$Q_{w,del,1} = \frac{\Phi_{g,sng,corr} \cdot t_{w,g,op,sng}}{COP_{w,sng,corr}} + \frac{\frac{\Phi_{g,combi,corr}}{n} \cdot t_{w,g,op,combi}}{COP_{w,combi,corr}} \quad (214)$$

were:

$Q_{w,del,1}$	is the delivered energy for the heat pump operation in domestic hot water heating mode (in the respective month), in kWh;
$\Phi_{g,sng,corr}$	is the heat output of the heat pump in single operation mode corrected to the average monthly source and sink temperature, in kW;
$t_{w,g,op,sng}$	is the running time of the heat pump in single operation mode (in the respective month), in h;

$\Phi_{g,combi,corr}$	is the heat output of the heat pump in combined operation mode corrected to the average monthly source and sink temperature, in kW;
n	is the factor taking into account the electrical power consumption in the standard test; $n = 1$ if $COP_{w,combi}$ contains only the power consumption of the part related to the domestic hot water heating, $n = 2$ if $COP_{w,combi}$ contains the power consumption of both domestic hot water heating and the space heating;
$t_{w,g,op,combi}$	is the running time of the heat pump in combined operation mode (in the respective month) , in h;
$COP_{w,sng,corr}$	is the coefficient of performance of the heat pump in single domestic hot water heating operation (the coefficient of performance corresponds to the coefficient of performance at averaged operating conditions); if no manufacturer's data is available, a default value of 2,7 is assumed;
$COP_{w,combi,corr}$	is the coefficient of performance of the heat pump in combined space heating and domestic hot water heating operation (the coefficient of performance corresponds to the coefficient of performance at averaged operating conditions); if no manufacturer's data is available, a default value of 2,7 is assumed.

If the electric heat pump is driven by electricity generated in photovoltaics, the corresponding delivered energy for the photovoltaics electricity evaluation is given according to Chapter VII, sub-chapter 7.2.

$$Q_{w,del,Hp} = Q_{w,del,1}$$

If not the entire demand is covered by electricity from photovoltaics, the remaining demand is covered according to:

$$Q_{w,del,1}^* = Q_{w,del,1} - Q_{w,del,Hp}$$

The fuel input energy of the gas engine driven heat pump is calculated according to equation (215):

$$Q_{w,del,1} = \frac{(1-\kappa_w) \cdot Q_{w,outg}^* - k_{rd,g} \cdot W_{w,g}}{COP} \cdot f_{\frac{Hs}{Hi}} \quad (215)$$

where:

$Q_{w,del,1}$	is the delivered energy to the gas engine heat pump in heating mode (in the respective month), in kWh;
κ_w	is the share of energy for domestic hot water preparation that is recovered from the engine exhaust heat;
$Q_{w,outg}^*$	is the remaining generator heat output for the heating system (in the respective month) from equation (212), in kWh;
$k_{rd,g}$	is the share of auxiliary energy that is recovered as thermal energy (default value:

$$k_{rd,g} = 0);$$

- $W_{w,g}$ is the auxiliary energy of the heat pump in heating mode (in the respective month) from equation (216), in kWh;
- COP is the coefficient of performance of the heat pump in space heating operation (this corresponds to the coefficient of performance under averaged operating conditions);
- $f_{Hs/Hi}$ is the ratio of gross calorific value to net calorific of the fuel used (default value: 1,11).

3.4.2.2.2.4. Auxiliary energy expenditure

Only the drive energy for the primary circuit is taken into consideration. The auxiliary energy for the secondary circuit is already included in the results from EN 16147 and EN 14511. Any additional pressure loss of an external domestic hot water storage tank is not taken into account.

The auxiliary energy is given by:

$$W_{w,g} = P_{prim,aux} \cdot 0,001 \cdot t_{w,op,aux} \quad (216)$$

where:

- $W_{w,g}$ is the total auxiliary energy expenditure (in the respective month), in kWh;
- $P_{prim,aux}$ is the power requirement of the primary circuit from equation (217), in W;
- $t_{w,op,aux}$ is the running time of the respective auxiliary component (in the respective month), in h.

The running time of the heat pump $t_{w,g,op,sng} + t_{w,g,op,combi}$ is used for the auxiliary component running time $t_{w,op,aux}$.

If the power consumption of the auxiliary component is not known, it is calculated by equation (217):

$$P_{prim,aux} = \frac{\Delta p_{ext} \cdot \dot{V}}{\eta_{aux} \cdot 3600} \quad (217)$$

where:

- $P_{prim,aux}$ is the power requirement of the primary circuit, in W;
- Δp_{ext} is the external pressure drop in the primary circuit, in Pa;
- $\dot{V}$ is the volume flow, in m³/h; this value is taken from test bench measurements according to EN 14511-3, or from product-specific value data;
- η_{aux} is the efficiency of the circulating pump; $\eta_{aux} = 0,3$ according to EN 14511-3.

3.4.2.2.2.5. Energy consumption of the second generator (back-up heating)

If the back-up heating (second heat generator) consists of an electric direct heating, the delivered energy (energy absorption) is calculated according to equation (218). Here it is assumed that the

electric direct heating (heating element) works without loss.

$$Q_{w,del,bu} = Q_{w,outg}^* \cdot k_{bu,w} \quad (218)$$

where:

- $Q_{w,del,bu}$ is the delivered energy for the domestic hot water heating by the second heat generator (back-up heating) (in the respective month), in kWh;
- $Q_{w,outg}^*$ is the remaining generator heat output to the domestic hot water system (in the respective month) from equation (212), in kWh;
- $k_{bu,w}$ is the share of energy for domestic hot water preparation covered by the second heat generator (back-up heating).

3.4.2.2.2.6. Energy yield from environmental heat

The environmental heat used for heat supply is calculated as follows:

$$Q_{w,in} = Q_{w,outg}^* - (Q_{w,del,1} + Q_{w,del,bu}) + Q_{w,g,s} \quad (219)$$

where:

- $Q_{w,in}$ is the environmental heat (in the respective month), in kWh;
- $Q_{w,outg}^*$ is the remaining generator heat output to the heating system (in the respective month) from equation (212), in kWh;
- $Q_{w,del,1}$ is the delivered energy for the domestic hot water heating operation of the heat pump (in the respective month) from equation (215), in kWh;
- $Q_{w,del,bu}$ is the delivered energy to the second heat generator (back-up heating) for the domestic hot water heating operation mode (in the respective month) from equation (218), in kWh;
- $Q_{w,g,s}$ are the generator heat losses of the domestic hot water system to the installation space (in the respective month), in kWh.

3.4.2.2.2.7. Annual performance factor of the generator subsystem

For the individual modes of operation (e.g. space heating and domestic hot water heating), the seasonal performance factor can be combined into a total annual performance factor by weighting with the respective fractions of energy provided.

The annual performance factor is calculated separately for the individual operating modes (e.g. space heating and domestic hot water heating) and combined into an overall performance factor by weighting the respective energy shares.

The annual performance factor of the domestic hot water heating is calculated as follows:

$$SPF_{w,g,t,a} = \frac{\sum_{mth}(Q_{w,outg}^*)}{\sum_{mth}(Q_{w,del,1} + Q_{w,del,bu}) + \sum_{mth}(W_{w,g})} \quad (220)$$

where:

- $SPF_{w,g,t,a}$ is the annual performance factor of the heat pump for domestic hot water heating;
- $Q_{w,outg}^*$ is the remaining generator heat output to the domestic hot water system (in the respective month), in kWh;
- $Q_{w,del,l}$ is the delivered energy for the domestic hot water heating operation of the heat pump (in the respective month), in kWh;
- $Q_{w,del,bu}$ is the delivered energy to the second heat generator (back-up heating) for the domestic hot water preparation (in the respective month), in kWh;
- $W_{w,g}$ is the total auxiliary energy expenditure (in the respective month), in kWh.

The monthly performance factor for domestic hot water heating is calculated as follows:

$$SPF_{w,g,t} = \frac{Q_{w,outg}^*}{Q_{w,del,l} + Q_{w,del,bu} + W_{w,g}} \quad (221)$$

where:

- $SPF_{w,g,t}$ is the monthly performance factor of the heat pump for domestic hot water heating;
- $Q_{w,outg}^*$ is the remaining generator heat output to the domestic hot water system (in the respective month), in kWh;
- $Q_{w,del,l}$ is the delivered energy for the domestic hot water heating operation of the heat pump (in the respective month), in kWh;
- $Q_{w,del,bu}$ is the delivered energy to the second heat generator (back-up heating) for the domestic hot water preparation (in the respective month), in kWh;
- $W_{w,g}$ is the total auxiliary energy expenditure (in the respective month), in kWh.

3.4.2.3. Electric water heaters (instantaneous)

The heat loss is determined depending on the control of the electric instantaneous water heater. Auxiliary energy is not balanced separately ($Q_{w,g,aux} = 0$ kWh per month).

Hydraulic control $Q_{w,del} = 1,01 \cdot Q_{w,outg}$ in the respective month, in kWh (222)

Electronic control $Q_{w,del} = 1,0 \cdot Q_{w,outg}$ in the respective month, in kWh (223)

where:

- $Q_{w,del}$ is the delivered energy for the domestic hot water heating (in the respective month), in kWh;
- $Q_{w,outg}$ is the generator heat output to the domestic hot water system (in the respective month), in kWh;

3.4.2.4. Gas water heaters (instantaneous)

The heat loss of instantaneous gas water heaters is determined in the same way as for fuel-fired systems (boilers). In addition, a constantly burning pilot flame is taken into account:

$$Q_{w,del} = Q_{w,outg} + Q_{w,ign} + Q_{w,g} - Q_{w,reg} \quad \text{in respective month, in kWh} \quad (224)$$

where:

- $Q_{w,del}$ is the delivered energy for the domestic hot water heating (in the respective month), in kWh;
- $Q_{w,outg}$ is the generator heat output to the domestic hot water system (in the respective month), in kWh;
- $Q_{w,ign}$ are the heat losses due to ignition (in the respective month), in kWh;
- $Q_{w,g}$ are the heat losses of the gas-fired instantaneous water heater (in the respective month), in kWh;
- $Q_{w,reg}$ is the regenerative energy yield (in the respective month), in kWh.

The heat losses due to ignition are given by: $Q_{w,ign} = 40 \text{ kWh} \cdot n$, where n is the number of installed devices.

If the number of installed devices is unknown, it is assumed that it corresponds to the number of residential units in the building. In case that the number of residential units in the building is not known, one device per $A_{NF} = 80 \text{ m}^2$ is assumed.

3.4.2.5. Boilers for domestic hot water heating

The heat losses and the auxiliary energy of a boiler are determined on the basis of the nominal heat output P_n , the efficiency $\eta_{K,Pn}$ at nominal output according to EU Directive 92/42/EEC, the stand-by heat loss $q_{P0,70}$ and the electrical power P_{aux} of the auxiliary units of a boiler. These values are determined either from measurements (e.g. in accordance with EN 304, EN 303-5, EN 656, SK EN 15035, EN 15502-2-1 or EN 15502-2- 2) or, if no product- specific values are available, default values can be used.

The heat loss $Q_{w,g}$ of the boiler in the calculation period is composed of two components: the heat loss $Q_{w,g,Pn}$, occurring during generation of the heat $Q_{w,outg}$ to be provided under nominal load operation, and the stand-by heat loss $Q_{w,gen,P0}$.

$$Q_{w,g} = Q_{w,g,Pn,day} \cdot t_{w,Pn,day} \cdot d_{op,mth} + Q_{w,g,P0,day} \cdot (d_{op,mth} - d_{h,rB}) \quad (225)$$

The difference $(d_{op,mth} - d_{h,rB})$ is set to zero if $d_{h,rB} > d_{op,mth}$.

$$Q_{w,g,Pn,day} = \frac{f_{Hs}}{H_i} \eta_{k,Pn,w} \cdot \frac{Q_{w,outg}}{24 \cdot d_{op,mth}} \quad (226)$$

$$Q_{w,g,Pn,day} = q_{P0,\theta} \cdot \frac{P_n}{\eta_{k,Pn,w}} \cdot (t_{op,day} - t_{w,Pn,day}) \cdot f_{Hs} \quad (227)$$

$$\eta_{k,Pn,w} = \eta_{k,Pn} + K \cdot (50 - \theta_{s,av}) \quad (228)$$

where:

$Q_{w,g}$	is the heat loss of the boiler (in the respective month), in kWh;
$Q_{w,g,Pn,day}$	is the daily heat loss of the boiler at nominal heat output, in kWh;
$Q_{w,outg}$	is the generator heat output to be provided for domestic hot water preparation (in the respective month), in kWh;
$Q_{w,g,P0,day}$	is the daily heat loss of the boiler at stand-by, in kWh;
P_n	is the nominal output of the boiler, in kW;
$\eta_{k,Pn}$	is the boiler efficiency;
$\eta_{k,Pn,w}$	is the boiler efficiency for domestic hot water heating;
$\frac{f_{Hs}}{H_i}$	is the ratio of gross calorific value and net calorific value of the fuel used;
$t_{w,Pn,day}$	is the daily operating time of the boiler for domestic hot water heating at nominal output, in h;
$d_{op,mth}$	is the operating time for domestic hot water system (in the respective month), in d;
$d_{h,rB}$	is the monthly designed operating time, in d;
$t_{op,day}$	is the daily usage period, in h;
$\theta_{s,av}$	is the average storage tank temperature in °C (for systems without circulation or trace heating, the average temperature of the storage tank must be reduced by 5 K).

The auxiliary energy for operation of the boiler is calculated on the basis of the auxiliary power consumption P_{aux} of the boiler (measured at 100 % full load in accordance with EU Council Directive 92/42/EEC at mode of operation 2 and with the volume flow dependent on the nominal output and a flow/return temperature difference of 20 K).

$$W_{w,g} = P_{aux,Pn} \cdot t_{w,Pn,day} \cdot d_{op,mth} + P_{aux,P0} \cdot (24 - t_{w,Pn,day}) \cdot (d_{op,mth} - d_{h,rB}) \quad (229)$$

were:

$W_{w,g}$	is the auxiliary energy expenditure of the boiler at nominal output (in the respective month), in kWh;
$P_{aux,Pn}$	is the electrical power consumption of the boiler at nominal load, in kW;
$P_{aux,P0}$	is the electrical power consumption in stand-by operation, in kW;
$t_{w,Pn,day}$	is daily operating time of the boiler for domestic hot water heating at nominal output, in h;
$d_{op,mth}$	is the operating time for domestic hot water (in the respective month), in d;
$d_{h,rB}$	is the designed operating time (in the respective month), in d.

3.4.2.6. Electrically heated domestic hot water storage tanks

In the case of a domestic hot water storage tank heated directly with electricity, the heat loss to be taken into account is calculated in the same way as for the boiler, whereby the stand-by losses have already been considered in Chapter VI, sub-chapter 7. Auxiliary energy is not balanced separately ($Q_{w,g,aux} = 0$ kWh per month).

$$Q_{w,g} = Q_{w,g,Pn} \cdot d_{op,mth} \quad (\text{in the respective month}), \text{ in kWh} \quad (230)$$

$$Q_{w,g,Pn} = \frac{\left(\frac{f_{Hs} - \eta_{k,Pn}}{H_i} \right)}{\eta_{k,Pn}} \cdot \frac{Q_{w,outg}}{d_{op,mth}} \quad (\text{in the respective month}), \text{ in kWh} \quad (231)$$

were:

- $Q_{w,g}$ are the heat losses of the directly heated storage tank in boost mode (in the respective month), in kWh;
- $Q_{w,g,Pn}$ are the daily heat losses of the directly heated storage tank in boost mode, in kWh;
- $Q_{w,outg}$ is the generator heat output to the domestic hot water system (in the respective month), in kWh;
- $f_{Hs/Hi}$ is the ratio of gross calorific value and net calorific value of the fuel used;
- $d_{op,mth}$ is the operating time for domestic hot water preparation (in the respective month), in d.

The generator efficiency $\eta_{k,Pn}$ is assumed to be 84 % in accordance with SK EN 89.

If no other data are available, the nominal power is assumed to be:

$$P_n = 0,82 \cdot (0,027 \cdot V_S + 2,5) \quad \text{in kW} \quad (232)$$

where:

V_S is the storage tank volume, in l.

For simplification, the auxiliary energy requirement $W_{w,g}$ is assumed to be zero.

3.4.3. Residential ventilation systems and air heating systems

This section specifies the parameters required in the calculation method for determining the energy needed for heat generation in residential ventilation systems and air heating systems, on the basis of which the delivered energy and generator heat output can be calculated.

The delivered energy $Q_{rv,del}$ for heat generators integrated in the ventilation system is determined taking into consideration the generator heat output, generation heat losses and heat input due to heat recovered from extract air.

3.4.3.1. Heat losses and uncontrolled heat gains

The generation heat losses $Q_{rv,g}$ are calculated separately for the individual components of a residential ventilation system or an air heating system and are then used for determining the delivered energy.

For exhaust-air heat pumps, the monthly heat losses for generation are determined according to equation (233).

$$Q_{rv,g,hp,mth} = \sum_j \left[f_{rv,part,j} \cdot \left(f_{g,hp,mth} \cdot (Q_{rv,outg,w,hp,mth} + Q_{rv,outg,h,hp,mth}) \right)_j \right] \quad (233)$$

where:

- $Q_{rv,g,hp,mth}$ are the generation heat losses of the heat pump (in the respective month), in kWh;
- $f_{rv,part,j}$ is the partial ventilation factor of the residential ventilation system j , from;
- $f_{g,hp,mth}$ is the heat loss factor of the heat pump (in the respective month);
- $Q_{rv,outg,w,hp,mth}$ is the generator heat output for domestic hot water heating (in the respective month), in kWh;
- $Q_{rv,outg,h,hp,mth}$ is the generator heat output for heating (in the respective month), in kWh.

Equation (234) is used to calculate the monthly generation heat losses of reheating coils:

$$Q_{rv,g,re-h,mth} = \sum_j \left[f_{rv,part,j} \cdot (f_{g,re-h,mth} \cdot Q_{rv,outg,re-h,mth})_j \right] \quad (234)$$

where:

- $Q_{rv,g,re-h,mth}$ are the heat losses of the heating coil (in the respective month), in kWh;
- $f_{rv,part,j}$ is the partial ventilation factor of the residential ventilation system j ;
- $f_{g,re-h,mth}$ is the heat loss factor of the heating coil (in the respective month);
- $Q_{rv,outg,re-h,mth}$ is the generator heat output of the heating coil (in the respective month), in kWh.

The annual generation heat losses for reheating coils are calculated by adding together the values for the whole year according to equation (235).

$$Q_{rv,g,re-h,a} = \sum Q_{rv,g,re-h,mth} \quad (235)$$

where:

- $Q_{rv,g,re-h,a}$ are the annual generation heat losses of the reheating coil, in kWh;
- $Q_{rv,g,re-h,mth}$ are the generation heat losses of the reheating coil (in the respective month), in kWh.

The heat losses $Q_{rv,g,mth}$ of the generators correspond to the uncontrolled heat gain $Q_{l,rv,g,mth}$ due to generation.

$$Q_{l,rv,g,mth} = Q_{rv,g,hp,mth} + Q_{rv,g,re-h,mth} \quad (236)$$

where:

- $Q_{l,rv,g,mth}$ is the uncontrolled heat gain due to generation (in the respective month), in

- kWh;
- $Q_{rv,g,hp,mth}$ are the generation heat losses of the heat pump (in the respective month), in kWh;
- $Q_{rv,g,re-h,mth}$ are the heat losses of the heating coil (in the respective month), in kWh.

3.4.3.2. Auxiliary energy

The auxiliary energy for heat generation $W_{rv,g}$ for residential ventilation systems and air heating systems comprises the auxiliary energy required by the fans and control devices as well as the auxiliary energy for preheating the air in defrost mode and reheating the supply air, where applicable. A clear distinction is made between the auxiliary energy and heat. The monthly auxiliary energy for heat generation is calculated according to equation (237).

$$W_{rv,g,mth} = W_{fan,mth} + W_{c,mth} + W_{pre-h,mth} + W_{re-h,mth} + W_{pu,mth} \quad (237)$$

where:

- $W_{rv,g,mth}$ is the auxiliary energy for generation (in the respective month), in kWh;
- $W_{fan,mth}$ is the auxiliary energy for the fans (in the respective month), in kWh;
- $W_{c,mth}$ is the auxiliary energy for the controls (in the respective month), in kWh;
- $W_{pre-h,mth}$ is the auxiliary energy for preheating the air (frost-prevention operation) (in the respective month), in kWh;
- $W_{re-h,mth}$ is the auxiliary energy for reheating (heating coil) (in the respective month), in kWh;
- $W_{pu,mth}$ is the auxiliary energy for the brine pump of a ground brine-supply air heat exchanger (in the respective month), in kWh.

The auxiliary energy consumption of the fans for transporting the air through the ventilation ductwork can be considered separately ($W_{rv,d}$, see Chapter VI, sub-chapter 5.1.2) or together with the auxiliary energy consumption of the residential ventilation unit $W_{rv,g}$, if the fan is an integral part of the ventilation unit.

The auxiliary energy for the fans $W_{fan,mth}$ is calculated according to equation (238), taking into account the power consumption of the fans (as a function of the respective volume flow), the mean ventilation system- driven air change rate, the operating time of the residential ventilation system and the existence of a ground/supply air heat exchanger, as well as taking into account different residential ventilation systems j . In the case of air heating systems, any auxiliary energy for recirculation is taken into account.

$$W_{fan,mth} = 0,001 \sum \{ (1 + f_{gr-exch,mth,j} + f_{sol-pan,mth,j} - f_{sup-decr,j}) \cdot SPI_j \cdot n_{mech,mth,j} \cdot V \cdot t_{rv,mech,mth,j} \} \quad (238)$$

where:

$W_{\text{fan,mth}}$	is the auxiliary energy for the fans (in the respective month), in kWh;
$f_{\text{gr-exch,mth},j}$	is the allowance for ground/supply air heat exchangers of the residential ventilation system j : 1. without ground-supply air heat exchanger: $f_{\text{gr-exch,mth}} = 0$; 2. with ground-supply air heat exchanger without bypass: $f_{\text{gr-exch,mth}} = 0,2$; 3. with ground-supply air heat exchanger with bypass: 3.1.in months with air preheating: $f_{\text{gr-exch,mth}} = 0,2$; 3.2.in months without air preheating: $f_{\text{gr-exch,mth}} = 0$;
$f_{\text{sol-pan,mth},j}$	is the allowance for solar air collector of the residential ventilation system j : 1. without solar air collector: $f_{\text{sol-pan,mth}} = 0$; 2. with solar air collector without bypass: $f_{\text{sol-pan,mth}} = 0,2$; 3. with solar air collector with bypass: 3.1.in months with air preheating: $f_{\text{sol-pan,mth}} = 0,2$; 3.2.in months without air preheating: $f_{\text{sol-pan,mth}} = 0$;
$f_{\text{sup-decr},j}$	is the allowance for frost-prevention operation by switching-off/reducing the supply air volume flow of the residential ventilation system j , to be accounted for only in November, December, January, February and March (in all other months, $f_{\text{sup-decr}} = 0$): 1. without by switching-off or reducing: $f_{\text{sup-decr}} = 0$ 2. on switch-off or setback at $\theta_e < -9 \text{ }^{\circ}\text{C}$: $f_{\text{sup-decr}} = 0$ 3. on switch-off at $\theta_e < -6 \text{ }^{\circ}\text{C}$: $f_{\text{sup-decr}} = 0.010$ 4. on setback at $\theta_e < -6 \text{ }^{\circ}\text{C}$: $f_{\text{sup-decr}} = 0.005$ 5. on switch-off at $\theta_e \geq -6 \text{ }^{\circ}\text{C}$: $f_{\text{sup-decr}} = 0.152$ 6. on setback at $\theta_e \geq -6 \text{ }^{\circ}\text{C}$: $f_{\text{sup-decr}} = 0.076$
SPI_j	is the specific power consumption of the fans of the residential ventilation system j according to SK EN 13142, manufacturer's specifications, in $\text{W}/(\text{m}^3/\text{h})$;
$n_{\text{mech,mth},j}$	is the mean air change rate of the residential ventilation system j (related to the net volume V of the entire zone), in $1/\text{h}^{-1}$;
V	is the net volume, in m^3 ;
$t_{\text{rv,mech,mth},j}$	is the total monthly operating time of the residential ventilation system j , in h/mth ;

Supply and exhaust ventilation systems/supply ventilation systems/air heating systems

The mean monthly ventilation system-driven air change rate $n_{\text{mech,mth}}$ of supply and exhaust ventilation systems is calculated on the basis of the supply air change rate. The auxiliary energy of the control devices $W_{\text{c,mth}}$ is calculated using equation (239). Depending on the test method used, the power consumption of the controls can already be taken into account in the volume flow-related power consumption of the fans. In this case, the auxiliary energy for the controls is considered to be zero, i.e. $P_{\text{el,c}} = 0$.

$$W_{\text{c,mth}} = 0,001 \cdot \sum_j \left(P_{\text{el,c},j} \cdot t_{\text{rv,mech,mth},j} + P_{\text{el,c,PO},j} \cdot (t_d \cdot d_{\text{mth}} - t_{\text{rv,mech,mth},j}) \right) \quad (239)$$

where:

$W_{\text{c,mth}}$	is the auxiliary energy for the controls (in the respective month), in kWh;
$P_{\text{el,c},j}$	is the power consumption of the controls of the residential ventilation system j in the ventilation operating time (according to manufacturer's specifications), in W;
$t_{\text{rv,mech,mth},j}$	is the total monthly operating time of the residential ventilation system j , in h/mth;
$P_{\text{el,c,PO},j}$	is the power consumption of the controls of the residential ventilation system j in stand-by mode out of the ventilation operating time (according to manufacturer's specifications), in W;
d_{mth}	is the number of days in the month, in d/mth;
t_d	is the number of hours per day.

Residential ventilation systems can be protected from frost by preheating the incoming external air with the aid of an electric heating coil. The auxiliary energy $W_{\text{pre-h,mth}}$ for preheating the air in the frost-prevention mode of such system configurations can be calculated using equation (240). In the case of water-filled heating coils, the energy for preheating the air is taken into account in Chapter VII, sub-chapter 3.4.1.

The auxiliary energy consumption of the brine pump of a ground brine/supply air heat exchanger for regenerative air preheating is taken into account according to equation (240).

$$W_{\text{pre-h,mth}} = 0,001 \cdot \sum_j (n_{\text{mech,mth},j} \cdot V \cdot F_{\text{ddh,pre-h},j} \cdot c_{p,a} \cdot \rho_a) \quad (240)$$

where:

$W_{\text{pre-h,mth}}$	is the auxiliary energy for preheating the air (frost-preventing operating mode) (in the respective month), in kWh;
$n_{\text{mech,mth},j}$	is the mean ventilation system-driven air change rate of the residential ventilation system j (related to the net volume V of the entire zone), in h ⁻¹ ;
V	is the net room volume, in m ³ ;
$F_{\text{ddh,pre-h},j}$	is the degree day value for preheating the air of the residential ventilation system j (in the respective month), in Kh;

$c_{p,a}$ is the specific heat capacity of air, in kJ/(kg·K);

ρ_a is the density of air, in kg/m³.

Here, $c_{p,a} \cdot \rho_a = 1,22 \text{ kJ}/(\text{m}^3 \cdot \text{K}) = 0,34 \text{ Wh}/(\text{m}^3 \cdot \text{K})$ is used.

In air heating systems, the supply air is reheated in order to satisfy the total energy need for heating $Q_{h,nd}$. No auxiliary energy for reheating $W_{re-h,mth}$ is required if electric reheating coils are used. In the case of waterfilled reheating coils, any separate circulation pumps which may need to be installed for the reheating coils are taken into account in Chapter VII, sub-chapter 3.4.1.

The auxiliary energy consumption of the brine pump of a ground brine/supply air heat exchanger for regenerative air preheating is taken into account according to equation (241).

$$W_{pu,mth} = 0,001 \cdot \sum_j (P_{u,j} \cdot t_{pu,mth,j}) \quad (241)$$

where:

$W_{pu,mth}$ is the auxiliary energy consumption of the brine pump of the ground brine/supply air heat exchanger (in the respective month), in kWh;

$P_{pu,j}$ is the nominal power of the brine pump of the residential ventilation system j (according to design), in W;

$t_{pu,mth,j}$ is the operating time of the brine pump of the residential ventilation system j (in the respective month), in h.

3.4.3.3. Generator heat output

The generator heat output $Q_{rv,outg}$ of the residential ventilation system is determined in relation to the respective type of ventilation system and is then accounted for either in domestic hot water heating and/or space heating, depending on the system configuration.

3.4.3.3.1. Ventilation systems without heat recovery

In residential ventilation systems without heat recovery there is no generator heat output ($Q_{rv,outg} = 0$).

3.4.3.3.2. Ventilation systems with exhaust air/supply air heat exchanger and/or regenerative air preheating

Exhaust air/supply air heat exchangers and regenerative air preheating are taken into account when calculating the energy need for heating $Q_{h,nd}$. They are not treated as heat generators ($Q_{rv,outg} = 0$).

3.4.3.3.3. Exhaust air heat pumps

Systems and operating modes

The energy evaluation of controllable and single-stage electric exhaust air heat pumps is carried out with the general approach for the usual configurations, e.g.: with and without upstream heat exchanger, air or water as a heat sink, use for domestic hot water heating or space heating in

alternative or parallel operation, and use of an outdoor air mixing with the exhaust air with the aim of increasing the performance.

To apply the method, the specific power consumption and coefficient of performance are first corrected to the source (air inlet) and sink (air inlet or water outlet) temperatures for the test points determined according to various test standards. Subsequently, a case distinction is made as to whether the exhaust air heat pump can cover the required generator heat output or whether a second heat generator must take over a share. If the exhaust air heat pump can cover the generator heat output, it must be calculated whether it operates below the cycle limit or in the controllable range. For this purpose, it is necessary to calculate minimum and maximum heat outputs and running times.

If outdoor air is added to the exhaust air to increase the performance, a temperature criterion must be taken into account. The temperature criterion specifies the (outdoor) temperature at which the operating mode switches from exhaust air mode to mixed exhaust air/outdoor air mode. For the purpose of simplification, it is specified that in systems with outdoor air admixture, the outdoor temperature class in which the switchover temperature occurs and any lower temperature classes are operated completely in mixed exhaust air/outdoor air mode. For all higher outdoor temperature classes, the heat pump is always calculated in pure exhaust air operation. The temperature criterion can vary in the following operating modes, but is constant in the respective operating mode in the year.

For the application of the procedure, a distinction is made between the operating modes:

1. Domestic hot water heating (water-based systems only),
2. Ventilation (exhaust air/supply air without heating) and
3. Heating (exhaust air/supply air or exhaust air/water).

Delivered energy

The delivered energy supplied from outside by the exhaust air heat pumps in the respective month is determined as follows:

$$Q_{rv,x,del,in,hp,mth} = \sum_j \sum_i \frac{(Q_{rv,x,outg,mth,i} + Q_{rv,g,hp,mth})}{COP_{x,\vartheta,Pint,i}} \quad (242)$$

where:

$Q_{rv,x,del,in,hp,mth}$ is the delivered energy supplied from outside the for the heat pump(s) for space heating ($x = h$ or $x = ho$), domestic hot water heating ($x = w$ or $x = wo$) or supply air heating ($x = s$ or $x = so$) (in the respective month), in kWh/mth;

$Q_{rv,x,outg,mth,i}$ is the generator heat output of the heat pump for space heating ($x = h$ or $x = ho$), domestic hot water heating ($x = w$ or $x = wo$) or supply air heating ($x = s$ or $x = so$) (in the respective month and temperature class i), in kWh/mth;

$Q_{rv,g,hp,mth}$ are the heat losses generated by the heat pump (in the respective month) according to equation (486), in kWh;

$COP_{x,9,Pint,i}$ is the mean (source and sink side) temperature-corrected and part load-corrected coefficient of performance for space heating ($x = h$ or $x = ho$), domestic hot water heating ($x = w$ or $x = wo$) or supply air heating ($x = s$ or $x = so$) (in the respective month and in temperature class i).

3.4.3.3.4. Air heating systems

Air heating systems are heating systems which supply heat to a zone using only air as the heat carrier. Air heating systems have at least one heat generator (e.g. an exhaust air heat pump). They may also be provided with a heat exchanger.

If the air heating system includes heat exchangers and/or heat pumps, the assessment is initially carried out using the method described in 8.2.5.3.4.3.

Equation (243) is used for the reheating coil:

$$Q_{rv,h,del,in,re-h,mth} = (Q_{h,nd} + Q_{h,ce} + Q_{hd} + Q_{h,s} + Q_{rv,ce} + Q_{rv,d} + Q_{rv,s} + Q_{rv,g,re-h}) - (\sum Q_{h,del,prod} + Q_{rv,h,del,in,hp}) \quad (243)$$

where:

$Q_{rv,h,del,in,re-h,mth}$ is the delivered energy supplied from outside to the reheating coil for heating (in the respective month), in kWh;

$Q_{h,nd}$ is the energy need for heating of the zone (in the respective month), in kWh;

$Q_{h,ce}$ are the control and emission heat losses of the heating system (in the respective month), in kWh;

Q_{hd} are the distribution heat losses of the heating system (in the respective month), in kWh;

$Q_{h,s}$ are the storage heat losses of the heating system (in the respective month), in kWh;

$Q_{rv,ce}$ are the control and emission heat losses of the residential ventilation system (in the respective month), in kWh;

$Q_{rv,d}$ are the distribution heat losses of the residential ventilation system (in the respective month), in kWh;

$Q_{rv,s}$ are the storage heat losses of the residential ventilation system (in the respective month), in kWh;

$Q_{rv,g,re-h}$ are the heat losses of the heating register (in the month), in kWh;

$\sum Q_{h,del,prod}$ is the sum of the (regenerative) delivered energy (in the respective month) used in the residential ventilation system, in kWh;

$Q_{rv,h,del,in,hp}$ is the delivered energy supplied from outside to an exhaust air heat pump for heating the supply air (in the respective month), in kWh

3.4.3.4. Heat input due to heat recovery and regenerative air preheating

For residential ventilation systems and air heating systems, the heat input $Q_{rv,del,prod}$ to the ventilation system due to heat recovery from exhaust air and regenerative air preheating is calculated as described in this chapter, taking into consideration the type of ventilation system and the installed components.

3.4.3.4.1. Ventilation systems without heat recovery

In residential ventilation systems without heat recovery there is no heat input to the ventilation system due to heat recovered from the exhaust air ($Q_{rv,del,prod} = 0$).

3.4.3.4.2. Ventilation systems with exhaust air/supply air heat exchanger and/or regenerative air preheating

Exhaust air/supply air heat exchangers and regenerative air preheating are taken into account when calculating the energy need for heating $Q_{h,nd}$. The heat input of the exhaust air/supply air heat exchanger from the exhaust air and the heat input from the environment by regenerative air preheating are determined from equation (244), taking into account various residential ventilation systems j .

$$Q_{rv,del,prod,mth} = \sum_l \left(n_{mech,mth,j} \cdot V \cdot t_{rv,mech,mth,j} \cdot c_{p,a} \cdot \rho_a \cdot (\theta_{V,mech,mth,j} - \theta_{e,mth}) \right) \quad (244)$$

where:

- $Q_{rv,del,prod,mth}$ is the heat input due to heat recovery from exhaust air with exhaust air/supply air heat exchanger and/or due to regenerative air preheating (in the respective month), in kWh/mth;
- $n_{mech,mth,j}$ is the mean ventilation system-driven air change rate of the residential ventilation system (in the respective month) j , in h^{-1} ;
- V is the net room volume, in m^3 ;
- $t_{rv,mech,mth,j}$ is the total monthly operating time of the residential ventilation system j , in h/mth;
- $c_{p,a}$ is the specific heat capacity of air, in $kJ/(kg \cdot K)$;
- ρ_a is the density of air, in kg/m^3 ;
- $\theta_{V,mech,mth,j}$ is the mean supply air temperature (in the respective month) of the residential ventilation system j , in $^{\circ}C$;
- $\theta_{e,mth}$ is the monthly mean value of the outdoor air temperature, in $^{\circ}C$.

3.4.3.4.3. Exhaust air heat pumps

If there are different fan-assisted ventilation systems with exhaust air heat pumps within a zone on a pro rata basis, the regenerative heat consumption is calculated by adding the values for the individual residential ventilation systems j .

$$Q_{rv,x,del,prod,mth} = \sum_j \sum_i (Q_{rv,x,outg,mth,i} - Q_{rv,x,del,in,hp,mth}) \quad (245)$$

where:

- $Q_{rv,x,del,prod,mth}$ is the heat input due to heat recovery from the exhaust air with exhaust air heat pump for space heating ($x = h$ or $x = ho$), TWE ($x = w$ or $x = wo$) or supply air heating ($x = s$ or $x = so$) (in the respective month), in kWh/mth;
- $Q_{rv,x,outg,mth,i}$ is the generator heat output of the heat pump for space heating ($x = h$ or $x = ho$), TWE ($x = w$ or $x = wo$) or supply air heating ($x = s$ or $x = so$) (in the respective month and temperature class i), in kWh/mth;
- $Q_{rv,x,del,in,hp,mth}$ is the delivered energy supplied from outside to the heat pump for space heating ($x = h$ or $x = ho$), TWE ($x = w$ or $x = wo$) or supply air heating ($x = s$ or $x = so$) (in the respective month), in kWh/mth.

3.5. Cooling energy generation

3.5.1. Cooling energy and steam generators in non-residential buildings

The calculation of the delivered energy for cooling is based on specific characteristic values which depend on both the technology used and the usage of the system. These characteristic values as calculated on the basis of hourly values of energy need are summarized in tabular form. The basis for this procedure is the climatic conditions determined for the test reference year. The following parameters need to be known in order to be able to calculate the delivered energy for the cooling system:

1. cooling energy output for air-conditioning in connection with HVAC system/room conditioning system as described in chapter 7;
2. type of cooling generator;
3. type of refrigerant used;
4. type of compressor used and the associated partial load controls;
5. net temperature level;
6. type of re-cooling used and the associated partial load controls;
7. type of building usage.

Using the characteristic value method, it is possible to calculate the delivered auxiliary energy for compressor-type cooling units and the delivered thermal energy for absorption chillers, including the use of auxiliary energy for recooling.

In general, the delivered energy for cooling is the sum of the energy use of the cooling unit and the energy use of the recooling process.

In these calculations, the energy use of the cooling unit is distinguished either as the delivered electrical energy for compressor-type systems or delivered thermal energy for absorption refrigeration systems. Only electrical energy is required as the delivered energy for recooling equipment.

The annual cooling energy output of the generator is calculated individually for each type of usage n . It results from the annual sum of the monthly cooling energy output for HVAC cooling function and the annual sum of the monthly cooling energy output for room conditioning, corresponding to the number j of building zones served, calculated by the equation:

$$\begin{aligned} Q_{C,outg,a,n} &= Q_{c,outg,a,n} + Q_{c,outg,a,n}^* + Q_{C,S} = \\ &= \sum_1^j (\sum_1^{12} Q_{c,outg,mth,j} + \sum_1^{12} Q_{c,outg,mth,j}^*) + Q_{C,S} \end{aligned} \quad (246)$$

were:

- $Q_{C,outg,a,n}$ is the annual cooling energy output per type of usage n , in kWh;
- $Q_{c,outg,a,n}$ is the annual cooling energy output for room conditioning per type of usage n , in kWh;
- $Q_{c,outg,a,n}^*$ is the annual cooling energy output for HVAC cooling function per type of usage n , in kWh;
- $Q_{c,outg,mth,j}$ is the cooling energy output for room conditioning per month, per zone j , in kWh;
- $Q_{c,outg,mth,j}^*$ is the cooling energy output for HVAC cooling function per month, per zone j , in kWh;
- $Q_{C,S}$ is the cooling energy output of the storage.

3.5.1.1. Delivered energy for compression cooling units

Cold-vapour compression cooling unit energy demands are evaluated on the basis of the nominal energy efficiency ratio of cooling EER and an average part load factor PLV_{av} according to equations (247) and (248). For cooling units with a cooling capacity above 12 kW, the nominal energy efficiency ratio of cooling EER is calculated according to equation (248) by multiplying the factor related to the year of construction. For room air conditioners up to 12 kW cooling capacity, the $SEER$ value is calculated according to equation (247) or it can be used in accordance with EN 14825 (Regulation (EU) No. 206/2012 and Regulation (EU) No. 626/2011).

$$EER \cdot PLV_{av} = SEER = \frac{Q_{C,outg,a}}{Q_{C,del}} \quad (247)$$

$$EER = EER_B \cdot f_{C,B} \quad (\text{for cooling units above 12 kW}) \quad (248)$$

were:

- EER is the nominal energy efficiency ratio of cooling, in kW/kW;

EER_B is the nominal energy efficiency ratio of cooling related to the year of construction factor $f_{C,B} = 1$;

PLV_{av} is the average part load value;

$SEER$ is the seasonal energy efficiency ratio, in kWh/kWh;

$Q_{C,del}$ is the energy use of the compression cooling unit (electrical), in kWh;

$f_{C,B}$ is the construction year factor for the cooling units > 12 kW.

From this, the delivered energy for the compression cooling unit is calculated according to equation (249):

$$Q_{C,del} = \frac{Q_{C,outg,a}}{EER \cdot PLV_{av}} \quad (249)$$

The nominal energy efficiency ratio of cooling EER as used in this equation represents the ratio of the nominal cooling output (benefit) to the electrical drive power demand (effort) under design operating conditions:

$$EER = \frac{\dot{Q}_{C,outg}}{P_{C,elektr}} \quad (250)$$

were:

$\dot{Q}_{C,outg}$ is the nominal cooling output of the compressor-type cooling unit, in kW;

$P_{C,elektr}$ is the nominal electrical power demand of the drive, in kW.

The energy efficiency ratio of cooling units varies under partial load conditions. The variable conditions are represented by the technology-dependent average part load value PLV_{av} . This accounts for the real partial load characteristics of the cooling unit, the influence of the cooling-water or external air temperature and of the heat exchangers which may be incorrectly dimensioned in partial load conditions.

If only one room conditioning system or one HVAC system is supplied with cooling energy within one and the same type of usage, PLV_{av} can be used directly for the energy evaluation calculations. Where cooling is achieved in parallel by room conditioning systems and HVAC systems, PLV_{av} shall be weighted according to the percentage proportions of the respective room conditioning and HVAC cooling systems:

$$PLV_{av,n} = \frac{Q_{C,outg,a,n} \cdot PLV_{C,av} + Q_{a,outg,a,n}^* \cdot PLV_{C,av}^*}{Q_{C,outg,a,n}} \quad (251)$$

were:

PLV_{av} is the average part load value, depending on the type of usage.

If only one type of usage occurs in a particular cooled sector, the part load value PLV_{av} can be used directly in the energy-related evaluation calculations. Where several types of usage occur in a specific cooled sector, PLV_{av} shall be weighted according to the percentage proportions of the respective types of usage:

$$PLV_{av} = \frac{\sum_1^n Q_{C,outg,a,n} \cdot PLV_{av,n}}{Q_{C,outg,a}} \quad (252)$$

3.5.1.2. Net generator energy for heating of absorption chillers

Absorption chillers are evaluated on the basis of the nominal heat ratio ζ and an average part load value PLV_{av} , using the following equation:

$$\zeta \cdot PLV_{av} = \zeta_{av} = \frac{Q_{C,outg,a}}{Q_{C,del}} \quad (253)$$

where:

ζ is the nominal heat ratio, in kW/kW;

PLV_{av} is the average part load value (i.e. factor);

ζ_{av} is the average annual heat ratio, in kWh/kWh;

$Q_{C,del}$ is the delivered energy of the absorption chiller (thermal), in kWh;

These values are used to calculate the energy need of the heat generator for supplying heat to the absorption chiller as follows:

$$Q_{C,del} = \frac{Q_{C,outg,a}}{\zeta \cdot PLV_{av}} \quad (254)$$

The nominal heat ratio ζ as used in this equation represents the ratio of the nominal cooling output (benefit) to the thermal power (effort) at the design operating conditions:

$$\zeta = \frac{\dot{Q}_{C,outg}}{\dot{Q}_{C,therm}} \quad (255)$$

where:

$\dot{Q}_{C,outg}$ is the nominal cooling output of the sorption chiller, in kW;

$\dot{Q}_{C,therm}$ is the nominal heating output, in kW.

The energy efficiency ratio of sorption chiller varies under partial load conditions. These variable conditions are represented by the part load value PLV_{av} , which is dependent on the technology. This accounts for the real partial load characteristics of the cooling unit, the influence of the cooling-water temperature and of the heat exchangers, which may be incorrectly dimensioned in partial load conditions.

The monthly auxiliary energy consumption for the auxiliary drives of thermal chillers is added:

$$W_{C,del,therm} = \frac{\dot{Q}_{C,outg} \times P_{el,C,therm} \times \max_{i=C^*,C} t_{i,op,mth}}{1000} \quad (256)$$

where:

$W_{C,del,therm}$ is the monthly auxiliary energy consumption for the auxiliary drives of thermal cooling units, in kWh;

$\dot{Q}_{C,outg}$ is the thermal cooling capacity of the chiller, in kW;

$P_{el,C,therm}$ is the specific internal auxiliary energy consumption for pumps of the cooling unit, in W_{el}/kW_{cold} ;

$\max_{i=c^*,c} t_{i,op,mth}$ is the maximum of cooling time of room conditioning and HVAC cooling.

3.5.1.3. Delivered energy for recooling

The energy balance evaluation of recooling is carried out on the basis of the specific design-related electrical energy demand $q_{R,electr}$ of the recooling equipment and a mean utilization factor $f_{R,av}$ of the recooling system. If the rated recooling power and the mean operating time are taken into account, the delivered energy for the recooling system is expressed by the following equation:

$$W_{C,del,R} = \dot{Q}_{R,outg} \cdot q_{R,electr} \cdot f_{R,av} \cdot t_{R,op} \cdot f_{R,FC} \quad (257)$$

where:

$W_{C,del,R}$ is the delivered energy for the recooling system (electrical), in kWh;
 $\dot{Q}_{R,outg}$ is the nominal re-cooling power, in kW;
 $q_{R,electr}$ is the electrical energy demand of the recooling system in relation to the recooling capacity, in kW/kW; default value 0,03 kW/kW;
 $f_{R,av}$ is the mean utilization factor for recooling;
 $t_{R,op}$ is the recooling operating time, in h;
 $f_{R,FC}$ is the utilization factor for free cooling; without free cooling $f_{R,FC} = 1$, with free cooling.

with:

$$\dot{Q}_{R,outg} = \dot{Q}_{c,outg} \cdot \left(1 + \frac{1}{EER}\right) \quad \text{for compressor-type refrigeration units} \quad (258)$$

or

$$\dot{Q}_{R,outg} = \dot{Q}_{c,outg} \cdot \left(1 + \frac{1}{\zeta}\right) \quad \text{for sorption chillers} \quad (259)$$

were:

$\dot{Q}_{c,outg}$ is the nominal cooling output of the chiller, in kW;
 EER is the nominal energy efficiency ratio, in kW/kW;
 ζ is the nominal heat ratio, in kW/kW.

3.5.1.4. Geothermal cooling

For the simplified evaluation of geothermal heat sinks, the following general conditions apply:

1. The sole use of geothermal heat sinks (no bivalent operation with cooling units);
2. Groundwater use;

3. Geothermal probe fields (no ground collectors).

3.5.1.4.1. Cooling with groundwater

The electrical expenditure for the operation of groundwater utilization systems for cooling are calculated in a simplified way:

$$W_{c,GW} = \frac{Q_{C,Outg}}{EER_{GW} \cdot PLV_{GW}} \quad (260)$$

were:

- $Q_{C,Outg}$ is the useful cooling output of the geothermal heat sink, in kWh;
- EER_{GW} is the energy efficiency ratio for cooling of groundwater utilization systems;
- PLV_{GW} are the part load values of groundwater utilization systems.

The performance of groundwater utilization systems is calculated using equation (261):

$$\dot{Q}_{GW} = \dot{m}_{GW} \cdot c_{p,W} \cdot (\theta_{W,Return} - \theta_{W,Ent}) / 1000 \quad (261)$$

were:

- $\dot{Q}_{GW}$ is the capacity of the groundwater utilization system, in kW;
- $\dot{m}_{GW}$ is the permitted groundwater extraction rate, in kg per hour;
- $\theta_{W,Return}$ is the permitted return temperature of the water, in °C;
- $\theta_{W,Ent}$ is the source temperature of groundwater, in °C.

3.5.1.4.2. Cooling via a geothermal probe field

The electrical expenditure for the operation of geothermal probes for cooling are calculated in a simplified way according to equation (262):

$$W_{c,GS} = \frac{Q_{c,outg}}{EER_{GS,i} \cdot PLV_{GS}} \quad (262)$$

were:

- $Q_{c,outg}$ is the useful cooling output of the geothermal heat sink, in kWh;
- $EER_{GS,i}$ is the energy efficiency ratio for cooling of the geothermal probe field; The ratio is interpolated linearly according to the number of probes and the drilling depth. Larger fields are divided into equal fields with a maximum of 24 probes.
- PLV_{GS} are the partial load values of geothermal probe systems.

The required number of geothermal probes is determined by the required cooling capacity according to equation (263):

$$\eta_{ES} = \frac{\dot{Q}_{c,outg}}{lt_{ES} \cdot q_{ES}} \cdot 1000 \quad (263)$$

were:

- n_{ES} is the number of geothermal probes;
- $\dot{Q}_{C,outg}$ is the useful cooling capacity of the geothermal heat sink, in kW;
- lt_{ES} is the drilling depth of the geothermal probe field;
- q_{ES} is the specific extraction rate per probe and per linear meter.

3.5.1.5. Multiple-generator systems

If several chillers are operated in parallel or in sequence in a common cooled sector, the resulting seasonal energy efficiency ratio for cooling is calculated as follows:

$$SEER_{Par} = SEER \cdot f_{Par} \quad (264)$$

$$SEER_{Seq} = SEER \cdot f_{Seq} \quad (265)$$

were:

- $SEER_{Par}$ is the resulting seasonal energy efficiency ratio for cooling in case of multiple-generation units in parallel operation;
- $SEER_{Seq}$ is the resulting seasonal energy efficiency ratio for cooling in case of multiple-generation units in sequential operation;
- f_{Par} is the factor influenced by parallel operation;
- f_{Seq} is the factor influenced by sequence operation.

3.5.1.6. Auxiliary energy for HVAC and air-conditioning

The annual total auxiliary energy for HVAC, chillers and room conditioning systems is the sum of the auxiliary energy used for all HVAC systems and chillers for room conditioning and HVAC cooling, for all utilization units and cooled sectors. If it is necessary to calculate the auxiliary energy on a monthly basis, and this is not possible according to the methods described (e.g. pumps for water humidifiers, auxiliary drives for heat exchangers), it is permitted to distribute the thermal energy proportionately for the HVAC system.

$$W_C = \sum W_{c*,a} + \sum W_{c,a} = \sum W_{c,ce,a} + \sum W_{Z,d,a} + \sum W_{hr,del,a} + \sum W_{evs,del,a} + \sum W_{eve,del,a} + \sum W_{C,del,R} \quad (266)$$

were:

- $\sum W_{c,ce,a}$ the electrical energy required for the secondary air fans for room conditioning, in kWh;
- $\sum W_{Z,d,a}$ is the annual electrical energy consumption of the distribution system per refrigeration supply unit, in kWh;
- $\sum W_{hr,del,a}$ is the annual auxiliary energy demand for heat recovery, in kWh;
- $\sum W_{evs,del,a}$ is the annual auxiliary energy expenditure for the pumps of the water humidifiers (supply humidifier), in kWh;

$\sum W_{\text{eve,del,a}}$ is the annual auxiliary energy expenditure for the pumps of the water humidifiers (exhaust humidifier), in kWh;

$\sum W_{\text{C,del,R}}$ is the delivered energy for the recooling system (electrical), in kWh;

The auxiliary energy for steam supply is not taken into account in the simplified evaluation method:

$$W_{\text{st}} = 0$$

3.5.2. Residential cooling systems

The delivered energy $Q_{\text{rc,del}}$ for cooling units integrated in the residential cooling system is determined taking into consideration the generator cooling energy output and cooling energy generation losses.

3.5.2.1. Cooling energy generation losses and uncontrolled heat inputs

The cooling energy generation losses $Q_{\text{rc,g}}$ are calculated for active cooling systems and applied for determination of the delivered energy.

The monthly cooling energy generation losses are determined according to equation (267).

$$Q_{\text{rc,g,mth}} = f_{\text{g,cu,mth}} \cdot Q_{\text{rc,outg,mth}} \quad (267)$$

were:

$Q_{\text{rc,g,mth}}$ are cooling energy generation losses of the cooling unit (in the respective month), in kWh;

$f_{\text{g,cu,mth}}$ is the factor for cooling energy losses of the cooling unit (in the respective month);

$Q_{\text{rc,outg,mth}}$ is the generator cooling energy output (per month), in kWh.

For systems without active cooling, there are no cooling energy generation losses ($Q_{\text{rc,g}} = 0$).

For the uncontrolled heat inputs during cooling energy generation $Q_{\text{l,rc,g}}$, a simplification independently of the system applies: $Q_{\text{l,rc,g}} = 0$.

3.5.2.2. Auxiliary energy

The auxiliary energy consumption for residential cooling $W_{\text{rc,g}}$ comprises the auxiliary energy consumption of the fans or pumps as well as the control system. The monthly auxiliary energy demand for cooling is:

$$W_{\text{rc,g,mth}} = W_{\text{fan,mth}} + W_{\text{pu,mth}} + W_{\text{c,mth}} + W_{\text{therm,mth}} \quad (268)$$

were:

$W_{\text{rc,g,mth}}$ is the auxiliary energy consumption for the cooling energy generation (in the respective month), in kWh;

$W_{fan,mth}$	is the auxiliary energy consumption of the fans for cooling (in the respective month), in kWh;
$W_{pu,mth}$	is the auxiliary energy consumption of the pumps for cooling (in the respective month), in kWh;
$W_{c,mth}$	is the auxiliary energy consumption of the cooling control system (in the respective month), in kWh;
$W_{therm,mth}$	is the auxiliary energy consumption of the auxiliary drives of absorption and adsorption chillers (in the respective month), in kWh.

The auxiliary energy consumption of the fans in cooling mode $W_{fan,mth}$ is calculated according to equation (269), taking into account the volume flow-related power consumption of the fans, the mean system air change rate, the operating time of the cooling system for the residential ventilation system and the presence of a ground/supply air heat exchangers:

$$W_{fan,mth} = 0,001 \cdot (1 + f_{gr-exch}) \cdot p_{el,fan} \cdot n_{mech,mth} \cdot V \cdot t_{rc,limit,mth} \quad (269)$$

were:

$W_{fan,mth}$	is the auxiliary energy consumption of the fans (in the respective month), in kWh;
$f_{gr-exch}$	is the allowance for ground/supply air heat exchangers (without heat exchanger: $f_{gr-exch} = 0$; with heat exchanger: $f_{gr-exch} = 0,2$);
$p_{el,fan}$	is the power consumption of the fans, in W/(m ³ /h);
$n_{mech,mth}$	is the mean air change rate of the system (in the respective month), in 1/h ⁻¹ ;
V	is the net room volume, in m ³ ;
$t_{rc,limit,mth}$	is the monthly cooling operating time, in h/mth.

The auxiliary energy consumption of the pumps in cooling mode $W_{pu,mth}$ is calculated according to equation (270), taking into account the power consumption of the pumps and the cooling operating time.

$$W_{pu,mth} = 0,001 \cdot \sum_i P_{pu,i} \cdot t_{rc,limit,mth} \quad (270)$$

were:

$W_{pu,mth}$	is the auxiliary energy consumption of the distribution (in the respective month), in kWh;
$P_{pu,i}$	is the nominal power of pump i according to the design, in W;
$t_{rc,limit,mth}$	is the monthly cooling operating time, in h/mth.

The nominal power of pumps in heat pump heating systems (primary and secondary circuit) operated in an integrated system is calculated for summer cooling operation based on pressure drop, volume flow and efficiency as follows:

$$P_{prim/sek,aux} = \frac{\Delta p \cdot \dot{V}}{\eta_{aux} \cdot 3600} \quad (271)$$

The determination of the auxiliary energy consumption of the cooling control system $W_{c,mth}$ is performed according to equation (272). Depending on the test procedure, the power consumption of the fans or pumps may already take the control system into account. In this case, it must be ensured that the auxiliary energy consumption of the control system is not doubled during the operating time of the cooling system.

$$W_{c,mth} = 0,001 \cdot (P_{el,c} \cdot t_{rc,limit,mth} + P_{el,c,P0} \cdot (h_{day} \cdot d_{mth} - t_{rc,limit,mth})) \quad (272)$$

were:

- $W_{c,mth}$ is the auxiliary energy consumption of the cooling control (in the respective month), in kWh;
- $P_{el,c}$ is the power consumption of the controller during cooling operating time (according to manufacturer's specifications), in W;
- $t_{rc,limit,mth}$ is the monthly cooling operating time, in h/mth;
- $P_{el,c,P0}$ is the power consumption of the controller in stand-by mode out of the cooling operating time (according to manufacturer's specifications), in W;
- h_{day} is the number of hours per day, $h_{day} = 24$ h/d;
- d_{mth} is the number of days in the month, in d/mth.

For absorption and adsorption chillers, the auxiliary energy consumption of the auxiliary drives is determined according to equation (273). For compression chillers and compression heat pumps in cooling mode, as well as for passive cooling systems, the following generally applies: $W_{therm,mth} = 0$.

$$W_{therm,mth} = \dot{Q}_{rc,outg} \cdot p_{el,c,therm} \cdot t_{rc,limit,mth} \quad (273)$$

were:

- $W_{therm,mth}$ is the auxiliary energy consumption of the auxiliary drives of absorption and adsorption chillers (in the respective month), in kWh;
- $\dot{Q}_{rc,outg}$ is the thermal cooling capacity of the chiller (according to manufacturer's specifications), in kW;
- $p_{el,c,therm}$ is the related electrical power consumption of the chiller, in kW/kW;
- $t_{rc,limit,mth}$ is the monthly cooling operating time, in h/mth.

3.5.2.3. Generator cooling energy output

The monthly generator cooling energy output of the residential cooling system $Q_{rc,outg}$ is determined depending on the cooling system and taking into account partial cooling and cooling effects according to equation (274).

$$Q_{rc,outg,mth} = Q_{c,nd,mth} \cdot f_{c,part} \cdot f_{c,limit} + Q_{rc,ce,mth} + Q_{rc,d,mth} + Q_{rc,s,mth} \quad (274)$$

were:

- $Q_{rc,outg,mth}$ is the monthly generator cooling energy output, in kWh;
- $Q_{c,nd,mth}$ is the monthly energy need for cooling, in kWh;
- $f_{c,part}$ is the partial cooling factor;
- $f_{c,limit}$ is the limitation cooling factor;
- $Q_{rc,ce,mth}$ are the control and emission heat losses of cooling system (in the respective month), in kWh;
- $Q_{rc,d,mth}$ are the distribution heat losses of cooling system (in the respective month), in kWh;
- $Q_{rc,s,mth}$ are the storage heat losses of cooling system (in the respective month), in kWh.

The partial cooling factor $f_{c,part}$ takes into account that residential buildings are only partially cooled. The partial cooling factor is calculated according to equation (275).

$$f_{c,part} = \frac{A_{N,c}}{A_{NF}} \quad (275)$$

were:

- $f_{c,part}$ is the partial cooling factor;
- $A_{N,c}$ is the cooled useful area (according to design), in m²;
- A_{NF} is the net floor area, in m².

The cooling factor $f_{c,limit}$ takes into account the fact that not all residential cooling systems are designed to completely cover the monthly energy need for cooling $Q_{c,nd,mth}$. The cooling factor $f_{c,limit}$ is calculated according to equation (276).

$$f_{c,limit} = \min(f_{c,limit,g}; f_{c,limit,ced}) \quad (276)$$

were:

- $f_{c,limit}$ is the limitation cooling factor;
- $f_{c,limit,g}$ is the cooling factor due to power limitation in cooling energy generation;
- $f_{c,limit,ced}$ is the cooling factor due to power limitation in control, emission and distribution of cooling energy.

3.5.2.4. Delivered energy for cooling

3.5.2.4.1. Delivered energy supplied from outside for compression cooling units

The annual delivered (electrical) energy supplied from outside for active cooling energy generation based on cold steam-compression cooling units $Q_{rc,del,in,a}$ is determined by equation (277). Equation (277) is also used for compression heat pumps in cooling mode and for split/multi-split units.

$$Q_{rc,del,in,a} = \frac{Q_{rc,out,g,a}}{EER_B \cdot f_{C,B} \cdot PLV_{av}} \quad (277)$$

were:

- $Q_{rc,del,in,a}$ is the delivered (electrical) energy supplied annually from outside for compression cooling units, in kWh/a;
- $Q_{rc,out,g,a}$ is the annual generator cooling energy output, in kWh/a;
- EER_B is the energy efficiency ratio related to the year of construction factor, in kW/kW;
- $f_{C,B}$ is the year of construction factor;
- PLV_{av} is the average partial load factor.

3.5.2.4.2. Delivered energy supplied from outside for absorption and adsorption chillers

The (thermal) delivered energy supplied annually from outside for active cooling generation based on absorption chillers $Q_{rc,out,g,a}$ is determined by equation (278).

$$Q_{rc,del,in,a} = \frac{Q_{rc,out,g,a}}{\zeta \cdot PLV_{av}} \quad (278)$$

where:

- $Q_{rc,del,in,a}$ is the delivered (thermal) energy supplied annually from outside for the absorption chiller, in kWh/a;
- $Q_{rc,out,g,a}$ is the annual generator cooling energy output, in kWh/a;
- ζ is the nominal heat ratio, in kW/kW;
- PLV_{av} is the average partial load factor.

Cooling systems commonly used for residential cooling work with system-integrated recooling, and a separate energy balancing of the recooling is not necessary for these systems. If cooling systems with separate recooling are used for residential cooling, the energy balance of the recooling is carried out according to Chapter VII, sub-chapter 3.5.1.

3.5.2.4.3. Annual delivered energy for cooling

The delivered energy $Q_{rc,del,prod,a}$ used for residential cooling is obtained from equation (279):

$$Q_{rc,del,prod,a} = Q_{rc,out,g,a} + Q_{rc,g,a} - Q_{rc,del,in,a} \quad (279)$$

were:

- $Q_{rc,del,prod,a}$ is the annual delivered energy for residential cooling, in kWh/a;
- $Q_{rc,out,g,a}$ is the annual generator cooling energy output, in kWh/a;
- $Q_{rc,g,a}$ are the annual generation losses of the cooling unit, in kWh/a;

$Q_{rc,del,in,a}$ is the annual delivered energy for generation of cooling energy supplied from outside in kWh/a from equation (277) for compression chillers (electrical), and from equation (278) for absorption/absorption chillers (thermal).

4. Delivered energy for lighting

The delivered energy for lighting $Q_{l,del}$ corresponds to the calculated demand for the energy carrier, i.e., electricity, to cover the energy need for lighting according to Chapter VII, subchapter 1.

Additional energy use which is not directly associated with the actual lighting function, such as energy used by control equipment, is not considered to be part of the lighting energy.

The delivered energy of lighting is usually fully effective as an internal heat source $Q_{I,1}$.

4.1. Calculation approach

The lighting energy is summed up over all relevant areas within one zone and over all zones of one building respectively. To account for the operating time of the lighting systems during the building's operating time, the factor F_t (partial-operation factor to account for lighting related to the building operating time) is included. This factor depends on the type of usage and is to be specified as part of the usage profile.

$$Q_{l,del} = \sum_{n=1}^N F_{t,n} \cdot \sum_{j=1}^J Q_{l,del,n,j} \quad (280)$$

For each calculation area j , the energy required for lighting is determined by the following equation:

$$Q_{l,del,n,j} = p_j \cdot [A_{D,j} \cdot (t_{eff,Day,D,j} + t_{eff,Night,j}) + A_{ND,j} \cdot (t_{eff,Day,ND,j} + t_{eff,Night,j})] \quad (281)$$

with the total area of the calculation space being:

$$A_j = A_{D,j} + A_{ND,j} \quad (282)$$

were:

- $Q_{l,del}$ is the delivered energy for lighting, in kWh;
- n is the number of zones;
- j is the number of areas;
- p_j is the power density of the area j , in W/m²;
- $A_{D,j}$ is the partial area j which is lit by daylight, in m²;
- $A_{ND,j}$ is the partial area j not lit by daylight, in m²;
- $t_{eff,Day,D,j}$ is the effective operating time of the lighting system for the area lit by daylight

during daytime;

$t_{eff,Day,ND,j}$ is the effective operating time of the lighting system for the area not lit by daylight during daytime;

$t_{eff,Night,j}$ is the effective operating time of the lighting system for the area during nighttime.

The effective operating time of the lighting system for the area lit by daylight during daytime is determined as follows:

$$t_{eff,Day,D,j} = t_{Day,n} \cdot F_{D,j} \cdot F_{O,j} \cdot F_{C,j} \quad (283)$$

The effective operating time of the lighting system for the area not lit by daylight during daytime is determined as follows:

$$t_{eff,Day,ND,j} = t_{Day,n} \cdot F_{D,j} \cdot F_{C,j} \quad (284)$$

were:

$t_{Day,n}$ is the operating time of the zone n during daytime, in h;

$F_{D,j}$ is the daylight dependency factor;

$F_{O,j}$ is the occupancy dependency factor;

$F_{C,j}$ is the constant illuminance dependency factor.

The effective operating time of the lighting system for the area during nighttime is determined as follows:

$$t_{eff,Night,j} = t_{Night,n} \cdot F_{O,j} \cdot F_{C,j} \quad (285)$$

were:

$t_{Night,n}$ is the operating time of the zone n during nighttime, in h.

5. Delivered auxiliary energy

The entire energy supply of a building for heating, cooling, domestic hot water, etc. is linked to a variety of auxiliary processes which consume additional quantities of electrical energy (e.g., electrical actuators, controls, etc.). Auxiliary energy quantities of all subsystems (control and emission, distribution, storage, generation) are determined individually and added to the auxiliary energy of a system. The individual components are then added according to equation (286):

$$W_{del,in} = W_h + W_c + W_v + W_{h^*} + W_{c^*} + W_{st} + W_{rv} + W_{rc} + W_w + W_l + W_{out} \quad (286)$$

were:

$W_{del,in}$ is the delivered auxiliary energy;

W_h is the auxiliary energy for the heating system;

W_c is the auxiliary energy for the cooling system;

W_v is the auxiliary energy for air distribution;

W_{h^*} is the auxiliary energy for heating in the HVAC system;

- $W_{c,*}$ is the auxiliary energy for cooling in the HVAC system;
- W_{st} is the auxiliary energy for humidification in the HVAC system;
- W_{rv} is the auxiliary energy for residential ventilation;
- W_{rc} is the auxiliary energy for residential cooling;
- W_w is the auxiliary energy for the domestic hot water preparation;
- W_l is the auxiliary energy for lighting;
- W_{aut} is the auxiliary energy for automation.

6. Delivered energy for electrical applications

The delivered energy for electrical applications $Q_{el,nd}$ summarizes the other expenditures of the building, e.g., the household electricity demand for residential buildings.

In the context of the balancing presented herein, this amount of energy is named analogously to the other delivered energy quantities with the symbol $Q_{el,del,in}$ ($Q_{el,nd} = Q_{el,del,in}$).

The resulting internal heat sources are reflected in the balance.

7. Delivered energy for generated electricity

Electricity generated in the spatial context of the building includes:

1. electricity from wind turbines
2. photovoltaic electricity

If the electricity is not used within the balance boundary, it is fed back into the public grid or delivered outside the balance area:

$$Q_{del,prod} = Q_{del,out} \quad (287)$$

were:

$Q_{del,prod}$ is the net electricity production;

$Q_{del,out}$ is the delivered energy provided for processes outside the balance boundary.

The electricity used within the building is balanced as $Q_{del,use}$.

7.1. Wind energy plants

Generation of the electricity from the wind energy plants is calculated through the following equation:

$$Q_{del,prod,WEP,i} = \sum P_{WEP,WK,n} \cdot t_{WK,n} \quad (288)$$

where:

$Q_{del,prod,WEP,i}$ is the monthly net electricity production from wind energy plants, in kWh;

$P_{WEP,WK,n}$ is the wind energy plant output in the respective wind speed class n, in W;
 $t_{WK,n}$ is the average frequency duration in the respective wind speed class n, in the month in h.

Wind power for the individual wind speed classes:

$$P_{wind,WK} = \frac{1}{2} \cdot \rho \cdot A_{Rotor} \cdot v_{WK}^3 \quad \text{in W} \quad (289)$$

where:

ρ is the air density, in kg/m³;
 A_{Rotor} is the rotor area, in m²;
 v_{WK} is the wind speed at hub height, in m/s.

The output of the wind energy plant in the respective wind speed class then results in:

$$P_{WEP,WK} = 0,2 \cdot P_{wind,WK} \quad \text{in W} \quad (290)$$

where:

$P_{wind,WK}$ is the wind power in the respective wind speed class, in W.

The factor 0,2 is an average power coefficient that refers to the entire wind speed spectrum and can be taken if no detailed information on the wind energy plant is available in the form of the product power curve.

7.2. Photovoltaic systems

The electrical energy $Q_{del,prod,PV,i}$ generated by the photovoltaic system is calculated according to equation (291):

$$Q_{del,prod,PV,j} = \frac{E_{sol} \cdot P_{pk,m} \cdot f_{perf}}{I_{ref}} \quad (291)$$

were:

$Q_{del,prod,PV,i}$ is the monthly net electricity production from the photovoltaic system, in kWh;
 E_{sol} is the monthly solar irradiation energy to the photovoltaic system; in kWh/(m²);
 $P_{pk,m}$ is the average peak power over a period of 25 years delivered by the photovoltaic system under standard test conditions and taking into account degradation, in kW;
 f_{perf} is the system performance factor;
 I_{ref} is the reference solar irradiance = 1 kW/m².

The solar irradiation energy E_{sol} acting on the photovoltaic modules is calculated according to equation (292):

$$E_{sol} = I_{sol} \cdot d_{mth} \cdot \frac{24 \frac{h}{d}}{1000 \frac{W}{kW}} \quad (292)$$

were:

E_{sol} is the monthly solar irradiation energy of a horizontal surface (PV generator)

in a specific geographical region, in kWh/(m²);

I_{sol} is the average monthly irradiance as a function of inclination and orientation in a specific geographical region (in the month), in W/m²;

d_{mth} is the number of days per month, in d.

VIII. EVALUATION OF PRIMARY ENERGY AND EMISSIONS OF CO₂

1. Primary energy evaluation for externally supplied energy

The primary energy, based on the net calorific value, of the energy sources supplied from outside the system boundary is determined according to equation (293). For this, the delivered energy, which is summed up separately according to energy sources, is additionally evaluated with primary energy factors. Since the evaluation of delivered energy is based on the gross calorific value for all fuels, the delivered energy is simultaneously converted to the net calorific value. Primary energy factors should be defined on national level.

$$Q_{p,in} = \sum_j \left(Q_{del,in,j} \cdot \frac{f_{p,j}}{f_{\frac{Hs}{Hi,j}}} \right) \quad (293)$$

where:

$Q_{p,in}$ is the net calorific value related to primary energy of the energy sources supplied from outside the system boundary;

$Q_{del,in,j}$ is the delivered energy supplied from outside the system boundary for each energy carrier j , related to the gross calorific value;

$f_{p,j}$ is the primary energy factor;

$f_{Hs/Hi,j}$ is the conversion factor for the delivered energy.

If the primary energy is required based on the gross calorific value (and not on the net calorific value), the conversion factor can be deleted from the equation above, leading to the following equation:

$$Q_{p,in,Hs} = \sum_j (Q_{del,in,j} \cdot f_{p,j}) \quad (294)$$

where:

$Q_{p,in}$ is the net calorific value related to primary energy of the energy sources supplied from outside the system boundary;

$Q_{del,in,j}$ is the delivered energy supplied from outside the system boundary for each energy carrier j , related to the gross calorific value;

$f_{p,j}$ is the primary energy factor.

2. Primary energy evaluation for energy emitted outside the system boundary

The primary energy of energy carrier provided for processes outside the system boundary is determined according to equation (295). For this, the delivered energy, which is summed up

separately according to energy carrier, is additionally evaluated with primary energy factors. Since no fuels are emitted to the outside, there is no need for conversion of the delivered energy depending on net or gross calorific value, as both primary energies are equal.

$$Q_{p,out} = \sum_j (Q_{del,out,j} \cdot f_{p,j}) \quad (295)$$

where:

$Q_{p,out}$ is the primary energy of the energy sources provided for processes outside the system boundary;

$Q_{del,out,j}$ is the delivered energy of each energy carrier j provided for processes outside the system boundary;

$f_{p,j}$ is the primary energy factor.

3. Summarized primary energy evaluation

For comparing the primary energy fed into the system with that provided for processes outside the system boundary, the outgoing primary energy is subtracted from the incoming-one. (see equations (296) and (297):

$$Q_p = Q_{p,in} - Q_{p,out} \quad (296)$$

$$Q_{p,Hs} = Q_{p,in,Hs} - Q_{p,out} \quad (297)$$

where:

Q_p is the primary energy related to the net calorific value;

$Q_{p,Hs}$ is the primary energy related to the gross calorific value;

$Q_{p,in}$ is the net calorific value-related primary energy of the externally supplied energy carriers;

$Q_{p,in,Hs}$ is the gross calorific value-related primary energy of the externally supplied energy sources;

$Q_{p,out}$ is the primary energy of the energy sources provided for processes outside the system boundary.

4. Assessment of CO₂ equivalent emissions

If the energy balance is to be transformed into a balance of CO₂ equivalent emissions, the equations in Chapter VIII, sub-chapters 1-3 apply analogously. Instead of the primary energy factors f_p , CO₂ equivalents x_{CO_2} must be used. The final result is then the total mass of CO₂ equivalent emissions m_{CO_2} .

CO₂ equivalents should be defined on national level.

IX. CALCULATION PROTOCOL FOR DETERMINATION OF THE ENERGY CLASS OF THE BUILDINGS

1. Introduction

This part of the Methodology defines the specific protocols that should be used to calculate the energy consumption of the building (and the resulting use of primary energy) for purposes of:

1. Generating the Energy Performance Certificate (EPC) and
2. Compliance check with the Minimum Energy Performance Requirements (MEPR).

The purpose of the calculation methodology in this regard is to create a virtual or imaginary model of the reference building, regarding the size, shape and the same design as the building under review (the current building), which contains the same combination of activities and is subject to the same climatic conditions and demand parameters.

However, the details of construction and servicing systems of the reference building should be specified in a detailed "recipe" on how to define the standards whereby all other buildings are compared. The energy performance of these imaginary buildings is then calculated using the actual calculation methodology, and the resulting energy use determines the target against which the actual building performance is compared.

This methodology serves for the calculation of energy consumption for heating, cooling, ventilation, lighting and hot water systems of a particular building. These calculations are produced for the current building and also for the reference building as defined below. The current methodology enables the calculation of the following:

1. **Energy Performance (EP)** of the assessed building – the calculated primary energy demand of the building is transformed into equivalent indicator of the annual primary energy demand per area, in kWh/(m²a).
2. **Target energy class (TEC)** – derived from the primary energy consumption of the reference building per m², in kWh/(m²a).

2. Assessment and energy class of the building

The method of determining energy performance should use the actual performance report of the current building with the performance of the standardized reference building where the reference building has the same shape and size and activity parameters as the current building but standardized efficiency and performance values.

2.1. Reference comparative buildings

Reference building specifications are defined as a good current practice in construction. This represents the basis for the determination of Target Energy Class (TEC).

This part of the methodology defines the reference building which is the basis for determining the energy assessment scale for the Energy Performance Certificate (EPC) and Minimum Energy Performance Requirements (MEPR). Asset valuation assesses primary energy from the current building compared to the primary energy of the reference building.

EPCs are intended to send market signals for relative performance of comparable buildings. In

order to provide this stability, the reference building should be the same regardless:

1. whether the current building is naturally ventilated or has air conditioning,
2. choice of fuel.

The reference building must have the same size, form and zoning configuration as the current building with the same conventions that relate to the measurement of dimensions.

Each space of the buildings must carry out the same activity (and therefore the parameter values of the same activity) as proposed for the equivalent space in the current building. Reference and current buildings should be given the same orientation and be exposed to the same climatic data.

2.2. Energy performance certificates (EPC)

Pursuant to the procedure set out in the Regulation defining the Energy Performance Certification, the software implementing the calculation methodology should use the calculation results to generate EPC through the following process:

1. Calculate the assessment of the actual building assets as a ratio between EP and TEC,
2. Convert into an energy band on the scale on an A⁺ to G scale,
3. Sets out recommendations for cost-effective improvements to the energy performance of the current building.

2.3. Minimum Energy Performance Requirements (MEPR)

Minimum energy performance requirements for new buildings and existing buildings being renovated (major renovations) has to be used for calculation of the energy performance of the buildings. The approach defined here serves to determine the value of the EPC scale that all buildings must fulfil or improve in order to meet the minimum performance requirements.

2.4. Consideration of the cost-optimal level

The methodology for calculation of the integrated energy performance of buildings enables the calculation of the cost optimum levels of the energy performance requirements of the buildings, building units and the elements of the buildings.

The cost-optimal level during the determination of minimum energy performance requirements of buildings leads to the lowest cost during the estimated economic lifecycle.

Minimum requirements specifications with considerations of the cost optimal levels for minimum energy performance requirements, at any time will be assigned through the Regulation on minimal requirements of the energy performance of buildings.

2.5. Calculation of energy class of the building

Buildings are ranked into eight energy classes, from A⁺ to G, where A⁺ represents the most favorable class, while G represents the least favorable energy class.

The building's energy class is determined by comparing the calculated energy performance indicator, EP kWh/(m²·a), for the assessed building under reference conditions, with the

corresponding energy performance indicator of the comparative reference state, EP_{Ref} kWh/(m²·a), for the same building, in accordance with the table below.

Energy class	
A+	$EP < 0$
A	$0 < EP \leq 0,35 * EP_{Ref}$
B	$0,35 * EP_{Ref} < EP \leq 0,50 * EP_{Ref}$
C	$0,50 * EP_{Ref} < EP \leq 0,71 * EP_{Ref}$
D	$0,71 * EP_{Ref} < EP \leq 1,00 * EP_{Ref}$
E	$1,00 * EP_{Ref} < EP \leq 1,41 * EP_{Ref}$
F	$1,41 * EP_{Ref} < EP \leq 2,00 * EP_{Ref}$
G	$2,00 * EP_{Ref} < EP$

The energy performance (EP) for determining the energy class is calculated according to the following formula:

$$EP = \frac{\text{Primary energy demand of the assessed building}}{\text{Correction factor} * \text{Primary energy demand of the reference building}}$$

The calculated indicator of the Energy Performance (EP) of the building is expressed as the ratio between the primary energy demand of the building being assessed and the primary energy demand of the comparative reference building, adjusted by the correction factor.

The primary energy demand for the building to be assessed is compared with the calculated primary energy demand of the corresponding comparative referent building, using the description of the comparative reference building. With this approach, compliance with the minimum requirements will always result in Class D. In this way, the classes above D can always be used to indicate more energy-efficient buildings.

The energy class of the building is indicated graphically with an arrow on the energy scale in the Energy Performance Certificate (EPC), together with the data for the building's energy performance indicator (EP).

ANNEX 2

CLIMATE DATA

The Climate data for the zone

Climatic zone data												Template version:	1.2	
<u>ID</u>		ClimateZone1												
<u>Name</u>		Pristina												
<u>Description</u>		Climate data for Pristina taken from Meteonorm												
<u>Average monthly temperature</u>														
		Jan °C	Feb °C	Mar °C	Apr °C	May °C	Jun °C	Jul °C	Aug °C	Sep °C	Oct °C	Nov °C	Dec °C	Average °C
Average monthly temperature		-0,3	1,6	6,7	11,1	16,4	19,7	22,5	22,3	16,1	11,9	5,8	1,2	11,3
<u>Average solar radiation intensity</u>														
		Average monthly radiation intensity [W/m²]												Total kWh/m²a
Orientation	Incline	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan-Dec
horizontal	0°	55	80	120	175	221	252	260	221	157	107	64	54	1292
south	30°	84	114	145	184	218	242	254	233	178	137	93	90	1443
	45°	93	122	146	176	200	218	231	219	175	142	100	100	1405
	60°	96	123	140	159	175	186	199	196	163	140	101	106	1304
	90°	87	106	108	108	110	107	117	125	119	114	89	98	941
south-east	30°	73	99	139	182	218	241	251	227	169	124	80	76	1374
	45°	76	101	139	173	205	222	232	215	163	124	82	81	1326
	60°	76	98	133	159	185	196	206	195	152	118	80	82	1229
	90°	64	80	104	116	132	132	142	138	113	93	65	71	915
south-west	30°	76	106	132	177	215	244	257	228	169	130	86	80	1390
	45°	81	110	130	168	200	225	238	216	163	131	91	87	1347
	60°	82	110	122	153	180	200	213	196	152	127	91	90	1253
	90°	71	92	93	111	128	135	147	140	113	103	78	80	943
east	30°	51	73	119	167	210	234	242	209	148	99	59	50	1215
	45°	48	68	114	156	196	215	223	194	137	92	56	48	1132
	60°	44	63	105	143	180	192	201	175	125	85	51	44	1031
	90°	34	49	82	108	136	141	149	133	93	65	40	36	781
west	30°	54	81	110	162	206	240	250	209	148	105	67	55	1235
	45°	52	78	102	150	191	222	233	195	138	100	65	54	1157
	60°	49	73	93	136	174	200	212	177	125	93	62	51	1058
	90°	39	59	72	102	133	150	161	134	93	73	50	42	811
north-west	30°	33	54	87	143	191	226	233	183	123	78	45	31	1045

	45°	28	45	73	123	166	197	205	156	104	66	38	26	897
	60°	24	38	62	105	144	169	177	132	88	57	33	23	770
	90°	19	29	48	77	107	122	130	96	64	43	25	18	570
north-east	30°	32	50	93	147	193	220	226	183	123	74	42	30	1033
	45°	26	41	79	127	170	190	195	155	104	62	35	25	886
	60°	23	35	68	110	147	160	166	132	88	53	31	22	759
	90°	18	28	51	81	107	114	118	97	65	40	24	18	557
north	30°	25	38	76	136	186	219	224	172	111	61	33	24	955
	45°	23	32	54	108	155	184	188	134	80	46	30	22	774
	60°	21	29	46	79	120	143	145	93	63	42	27	20	608
	90°	18	25	38	59	77	85	89	65	50	35	22	17	424
<u>Dimensioning for max heating/cooling load</u>														
Dimension	Radiation hor W/m²	S W/ m²	S-E W/ m²	S-W W/ m²	E W/ m²	W W/ m²	N- W W/ m²	N-E W/ m²	N W/m²	min/ max daily temp °C				
Max for cooling load in July	948	514	657	657	755	755	552	552	168	28,6				
Max for cooling load in Sept	760	760	798	798	680	680	341	341	123	23,1				
Max for heating load in Jan	0	0	0	0	0	0	0	0	0	-10,6				

ANNEX 3

ENERGY FACTORS AND EMISSION FACTORS OF FUELS

Table of the energy sources to be used for calculations in National Calculation Methodology (NCM)

Energy source	Name of energy carrier	Unit	Lower Heating Value (LHV), (kWh/kg)	Upper to lower calorific value ¹	Total primary energy factor	CO ₂ factor (gr/kWh) (gr/kWh)
Factors for the energy sources supplied from the long distances or from the grid						
Anthracite (Hard Coal)	Anthracite (Hard Coal)	kg	(4.778 – 8.528) ²	1,04 ³	1,0 ⁴	394,00 ⁵
Biogas	Landfill gas, Sludge gas, other biogas	m ³	14,00 ⁶	1,11 ⁷	1,1 ⁸	98,00 ⁹
Gas	Natural gas	kg	13.10 ¹⁰	1,11 ¹¹	1,22 ¹²	201.00 ¹³
LPG	LPG (Liquefied Petroleum Gas)	kg	12.778 ¹⁴	1,09 ¹⁵	1,1 ¹⁶	225,00 ¹⁷
Light fuel oil (Diesel)	Fuel oil (diesel)	l	11.750 ¹⁸	1,06 ¹⁹	1,1 ²⁰	272,00 ²¹
Heavy fuel oil	Heavy fuel oil, or Residual Fuel Oil (mazut), ≤ 1010 kg/m ³ at 15 °C	kg	11,22 ²²	1,06 ²³	1,1 ²⁴	278,64 ²⁵
Gasoline	Gasoline	l	12.222 ²⁶	1,06 ²⁷	1,1 ²⁸	249,48 ²⁹
Lignite / Coal	Lignite	kg	2,163 ³⁰	1,08 ³¹	1,2 ³²	353,00 ³³
Electricity	Electricity	kWh	1,00	1,00	3,07 ³⁴	1438 ³⁵
Waste	Waste heat (Municipal waste heat)	kWh	(2.056-2.972) ₃₆	1,00	1,34 ³⁷	58,00 ³⁸

¹ DIN V 18599-1

² According to AI Nr.04/2021

³ EN ISO 52000 (page 98)

⁴ Regulation 02/2018 for NCM, table 29

⁵ Regulation 02/2018 for NCM, table 29

⁶ IPCC 2006

⁷ EN ISO 52000 (page 97)

⁸ Regulation 02/2018 for NCM, table 29

⁹ Regulation 02/2018 for NCM, table 29

¹⁰ According AI Nr.04/2021

¹¹ EN ISO 52000 (page 97)

¹² Regulation 02/2018 for NCM, table 29

¹³ Regulation 02/2018 for NCM, table 29

¹⁴ According AI Nr.04/2021

¹⁵ EN ISO 52000 (page 97)

¹⁶ Regulation 02/2018 for NCM, table 29

¹⁷ Regulation 02/2018 for NCM, table 29

¹⁸ According AI Nr.04/2021

¹⁹ EN ISO 52000 (page 97)

²⁰ Regulation 02/2018 for NCM, table 29

²¹ Regulation 02/2018 for NCM, table 29

²² IPCC 2006

²³ EN ISO 52000 (page 97)

²⁴ EN ISO 52000 (page 94, per Fossil fuels Liquid. This standard puts in one category values for Light Fuel Oil (Diesel) and Heavy Fuel Oil

²⁵ IPCC 2006

²⁶ According AI Nr.04/2021

²⁷ EN ISO 52000 (page 97)

²⁸ EN ISO 52000 (page 94, per Fossil fuels Liquid. This standard puts in one category values for Light Fuel Oil (Diesel) and Heavy Fuel Oil

²⁹ IPCC 2006

³⁰ According AI Nr.04/2021

³¹ EN ISO 52000 (page 98)

³² Regulation 02/2018 for NCM, table 29

³³ Regulation 02/2018 for NCM, table 29

³⁴ Regulation 02/2018 for NCM, table 29

³⁵ Regulation 02/2018 for NCM, table 29

Bio fuels (liquid)	Biogasoline, Biodiesels (liquid)	l	7,50 ³⁹	1,06	1,50 ⁴⁰	70,00 ⁴¹
Biomass	Firewood (Dry)	kg	4,33 ⁴²	1,08 ⁴³	1,01 ⁴⁴	31 ⁴⁵
Biomass	Wood chips	kg	(2.0 – 3.2) ⁴⁶	1,08	1,01 ⁴⁷	31 ⁴⁸
Biomass	Pellets	kg	4.667 ⁴⁹	1,08	1,01 ⁵⁰	31 ⁵¹
District Heating (CHP, fossil)	District Heating (CHP, fossil)	kWh	1.0	1,0 ⁵²	0.47 ⁵³	175 ⁵⁴
District Heating (CHP, renewable)	District Heating (CHP, renewable Wood Chips)	kWh	1.0	1,0 ⁵⁵	0.7 ⁵⁶	45,0 ⁵⁷
Factors for the energy sources produced in the location⁵⁸						
Energy source	Name of energy carrier	Unit	Lower Heating Value (LHV), (kWh/kg)	Upper to lower calorific value ⁵⁹	Total primary energy factor	CO ₂ factor (gr/kWh) (gr/kWh)
Solar electric energy					1	0
Solar thermal energy					1	0
Wind electric energy					1	0
Geothermal, erothermal, hydrothermal					1	0
Energy delivered to the grid⁶⁰						
Electric energy					2,5	

³⁶ According AI Nr.04/2021

³⁷ Regulation 02/2018 for NCM, table 29

³⁸ Regulation 02/2018 for NCM, table 29

³⁹ IPCC 2006

⁴⁰ EN ISO 52000, page 94

⁴¹ EN ISO 52000, page 94

⁴² According to IPCC 2006. This value also was used by JICA in projects in Kosova.

⁴³ EN ISO 52000 (page 98)

⁴⁴ Regulation 02/2018 for NCM, table 29

⁴⁵ Regulation 02/2018 for NCM, table 29

⁴⁶ Sipas Ngrohtores në Gjakovë për Dendësia e bruto 160 deri 300 kg/m³, Përmbajtja e ujit (W) 30 deri 55 % me peshë në mesatare, Vlera e nxehtës Hu min. 2.0 kWh/kg deri në maks. 3.2 kWh/kg, vlera kalorifike është marrë nga mesatarja e vlerave

⁴⁷ Regulation 02/2018 for NCM, table 29

⁴⁸ Regulation 02/2018 for NCM, table 29

⁴⁹ According AI Nr.04/2021

⁵⁰ Regulation 02/2018 for NCM, table 29

⁵¹ Regulation 02/2018 for NCM, table 29

⁵² According DIN V 18599-1:2007-02, faqe 62

⁵³ According to calculations based on the data provided by the NP "Termokos" SH.A.

⁵⁴ According NP "Termokos" SH.A.

⁵⁵ According DIN V 18599-1:2007-02, faqe 62

⁵⁶ According DIN V 18599-1:2007-02, faqe 59

⁵⁷ According to own calculations based on the ERO Report 2023 and the IPA Study for investment in District Heating in Gjakova

⁵⁸ According to EN ISO 52000

⁵⁹ DIN V 18599-1

⁶⁰ According EN ISO 52000

ANNEX 4

LIST OF NORMATIVE REFERENCES

For dated references listed below, only the cited edition applies. For undated references, the latest edition of the referenced document applies, including any amendments or revisions.

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18. EN ISO 10211, Thermal bridges in building construction — Heat flows and surface temperatures — Detailed calculations
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21. EN 215-1:1988-03, Thermostatic radiator valves - Part 1: Requirements and test methods
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24. EN 419-2, Non-domestic gas-fired overhead luminous radiant heaters - Part 2: Rational use of energy
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26. EN 1196, Domestic and non-domestic gas-fired air heaters - Supplementary requirements for condensing air heaters
27. EN 1264, Water based surface embedded heating and cooling systems
28. SK EN 12828, Heating systems in buildings - Design for water-based heating systems
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30. EN 12897, Water supply - Specification for indirectly heated unvented (closed) storage water heaters
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32. EN 13410, Gas-fired overhead radiant heaters - Ventilation requirements for non-domestic

premises

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50. SK EN ISO 9806, Solar energy — Solar thermal collectors — Test methods,
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53. SK EN 12976-2, Thermal solar systems and components - Factory made systems - Part 2: Test methods
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ANNEX 5

USER PROFILES OF THE BUILDINGS

The building user profile represents a structured description of how a building or parts of it are used by occupants over time. It reflects the actual behavior of people within the space and includes information on occupancy, usage schedules, indoor conditions, types of activities, as well as the use of lighting, equipment, and technical systems. The usage profile is a key element in the assessment of a building's energy performance, as it directly affects the energy required for heating, cooling, ventilation, domestic hot water, and lighting.

In practice, a building may have one or several different usage profiles within it, particularly in cases of mixed-use functions. For example, a school building may include classrooms, administrative offices, and sports facilities, each of which has different usage characteristics. In such cases, the building is divided into zones, and an appropriate user profile is defined for each zone in accordance with the actual function of the space.

The use of clearly defined profiles, and where necessary, multiple profiles within the same building, enables more realistic and comparable calculations of energy consumption and the building's energy balance during the assessment process for Energy Performance Certification (EPC). The following section of this annex presents tables with data for different usage profiles, which are used in calculations for the preparation of EPCs

1. Family house

User profile for a non-residential zone		-	[Yes/No]	No			
Can be used as main use		-	[Yes/No]	Yes			
Can be low heated		-	[Yes/No]	No			
Usage times	Daily usage times	-	time of day	0:00	24:00		
	Annual usage days	d _{nutz,a}	d/a	365			
	Daily operating hours of heating system	-	time of day	6:00	22:00		
	Daily operating hours of ventilation, air-conditioning and cooling systems	-	time of day	6:00	22:00		
	Annual operating days of HVAC systems	d _{op,a}	d/a	365			
Indoor space conditions	Set-point temperature heating	θ _{i,h,soll}	°C	19.0			
	Set-point temperature cooling	θ _{i,c,soll}	°C	26.0			
	Minimum temperature heating for design rating	θ _{i,h,min}	°C	19.0			
	Maximum temperature cooling for design rating	θ _{i,c,max}	°C	26.0			
	Temperature reduction for set-back operation	Δθ _{i,NA}	k	3.0			
	DHW Demand	-	l/(person day)	35.0			
	Partial heating factor	a _{TB}	-	0.25			
Minimum outdoor-air volume flow	Area-related minimum air volume flow (usually from hygienic aspects)	V _A	m³/(h m²)	1.2			
	Minimum air volume flow for the building (building-related air volume flow)	V _{A,Geb}	m³/(hm²)	0.8			
	Relative absence ventilation systems (for presence detection or gas sensors)	C _{RLT}	-	0.50			
	Partial operating factor for ventilation systems (presence in the zone)	F _{RLT}	-	0.50			
Lighting	Maintained illuminance	E _m	lx	200.0			
	Height of the work plane	h _{Ne}	m	0.80			
	Reduction factor for area that needs to have the full illuminance level	k _A	-	0.60			
	Relative absence (within operating time)	C _A	-	0.20			
	Room index (dimensionless geometric value used in split flux method)	k	-	1.30			
	Reduction factor for lighting related to the building usage	F _t	-	0.20			
	Reduction factor for lighting of vertical areas	k _{VB}	-	1.00			
Internal heat gains	Occupation density	-	m² per person	30.00			
	Full operating hours persons	-	h/d	16.00			
	Heat flux of one person	-	W per person	70.00			
	Full operating hours equipment and devices	-	h/d	13.00			
	Simultaneous power	-	W/m²	2.40			
Building automation		Automation Class		D	C	B	A
	Summand for consideration of building automation	Δθ _{EMS}	K	0.0	0.0	-0.5	-1.0
	Factor for adaptive temperature control	f _{adap}	-	1.00	1.00	1.35	1.35

2. Residential building

User profile for a non-residential zone		-	[Yes/No]	No			
Can be used as main use		-	[Yes/No]	Yes			
Can be low heated		-	[Yes/No]	No			
Usage times	Daily usage times	-	time of day	0:00	24:00		
	Annual usage days	$d_{nutz,a}$	d/a	365			
	Daily operating hours of heating system	-	time of day	6:00	22:00		
	Daily operating hours of ventilation, air-conditioning and cooling systems	-	time of day	6:00	22:00		
	Annual operating days of HVAC systems	$d_{op,a}$	d/a	365.0			
Indoor space conditions	Set-point temperature heating	$\theta_{i,h,sol}$	°C	19.0			
	Set-point temperature cooling	$\theta_{i,c,sol}$	°C	26.0			
	Minimum temperature heating for design rating	$\theta_{i,h,mi}$	°C	19.0			
	Maximum temperature cooling for design rating	$\theta_{i,c,ma}$	°C	26.0			
	Temperature reduction for set-back operation	$\Delta\theta_{i,N}$	k	3.0			
	DHW Demand	-	l/(person day)	30.0			
	Partial heating factor	a_{TB}	-	0.15			
Minimum outdoor-air volume flow	Area-related minimum air volume flow (usually from hygienic aspects)	V_A	m³/(h m²)	1.4			
	Minimum air volume flow for the building (building-related air volume flow)	$V_{A,G_{eb}}$	m³/(hm²)	0.9			
	Relative absence ventilation systems (for presence detection or gas sensors)	c_{RLT}	-	0.50			
	Partial operating factor for ventilation systems (presence in the zone)	F_{RLT}	-	0.50			
Lighting	Maintained illuminance	E_m	lx	200.0			
	Height of the work plane	h_{Ne}	m	0.80			
	Reduction factor for area that needs to have the full illuminance level	k_A	-	0.60			
	Relative absence (within operating time)	C_A	-	0.20			
	Room index (dimensionless geometric value used in split flux method)	k	-	1.30			
	Reduction factor for lighting related to the building usage	F_i	-	0.20			
	Reduction factor for lighting of vertical areas	k_{VB}	-	1.00			
Internal heat gains	Occupation density	-	m² per person	20.00			
	Full operating hours persons	-	h/d	16.00			
	Heat flux of one person	-	W per person	70.00			
	Full operating hours equipment and devices	-	h/d	13.00			
	Simultaneous power	-	W/m²	2.40			
Building automation	Automation Class			D	C	B	A
	Summand for consideration of building automation	$\Delta\theta_{E_{MS}}$	K	0.0	0.0	-0.5	-1.0
	Factor for adaptive temperature control	f_{adap}	-	1.00	1.00	1.35	1.35

3. Personal office (single occupant)

Operating times	Start and end of building use	-	o'clock	7:00	18:00				
	Annual days of use	d _{nutz,a}	d/a	250.0					
	Total hours with daylight while operating hours	t _{day}	h/a	2543.0					
	Total hours without daylight while operating hours	t _{night}	h/a	207.0					
	Start and end of operation for ventilation and cooling system	-	o'clock	5:00	18:00				
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	250.0					
	Start and end of operation for heating system	-	-	5:00	18:00				
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0					
	Set temperature cooling	Q _{i,c,soll}	°C	24.0					
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0					
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0					
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0					
	Humidification requirement	-	-	mit Toleranz					
	Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)				40.0	
Minimum area-related ventilation (fresh air) volume flow		V _A	m³/(h m²)	4.0					
Minimum external air-supply volume flow for buildings		V _{A,Geb}	m³/(hm²)	2.5					
Relative absence HVAC		c _{RLT}	-	0.3					
Partial operation factor to account for HVAC related to the building operating time		F _{RLT}	-	0.7					
Lighting		Maintained illumination	E _m	lx	500.0				
	Working height	h _{Ne}	m	0.8					
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	0.8					
	Relative absence (1-simultaneity factor)	C _A	-	0.3					
	Room index	k	-	0.9					
	Reduction factor occupation lighting	F _t	-	0.7					
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0					
Occupant density	Occupant density	-	-	low	medium	high			
		-	m² per person	18.0	14.0	10.0			
Internal heat sources	max specific power			full operating hours h/d	low	medium	high		
	pue to person (70W per person)		W/m²	6.0	3.9	5.0	7.0		
	Appliances		W/m²	6.0	2.8	7.1	15.0		
	Heat gain per day		Wh/(m²d)		40.0	73.0	132.0		
Building automation				D	C	B	A		
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0		
	Factor for adative temperature control			1.00	1.00	1.35	1.35		

4. Workgroup office (two to six workplaces)

Operating times	Start and end of building use	-	o'clock	7:00	18:00		
	Annual days of use	d _{nutz,a}	d/a	250.0			
	Total hours with daylight while operating hours	t _{day}	h/a	2543.0			
	Total hours without daylight while operating hours	t _{night}	h/a	207.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	5:00	18:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	250.0			
	Start and end of operation for heating system	-	-	5:00	18:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	40.0			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	4.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	2.5			
	Relative absence HVAC	c _{RLT}	-	0.3			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	0.7			
Lighting	Maintained illumination	E _m	lx	500.0			
	Working height	h _{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	0.9			
	Relative absence (1-simultaneity factor)	C _A	-	0.3			
	Room index	k	-	1.3			
	Reduction factor occupation lighting	F _t	-	0.7			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	18.0	14.0	10.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	6.0	3.9	5.0	7.0
	Appliances		W/m²	6.0	2.8	7.1	15.0
	Heat gain per day		Wh/(m²d)		40.0	73.0	132.0
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

5. Landscaped office (seven or more workplaces)

Operating times	Start and end of building use	-	o'clock	7:00	18:00		
	Annual days of use	$d_{nutz,a}$	d/a	250.0			
	Total hours with daylight while operating hours	t_{day}	h/a	2543.0			
	Total hours without daylight while operating hours	t_{night}	h/a	207.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	5:00	18:00		
	Annual days of use ventilation, cooling systemand heating system	$d_{nutz,a}$	d/a	250.0			
	Start and end of operation for heating system	-	-	5:00	18:00		
Temperatures	Set temperature heating	$Q_{i,h,soll}$	°C	21.0			
	Set temperature cooling	$Q_{i,c,soll}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,min}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,max}$	°C	26.0			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
	Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)			
Minimum area-related ventilation (fresh air) volume flow		V_A	m³/(h m²)	6.0			
Minimum external air-supply volume flow for buildings		$V_{A,Geb}$	m³/(hm²)	2.5			
Relative absence HVAC		c_{RLT}	-	0.2			
Partial operation factor to account for HVAC related to the building operating time		F_{RLT}	-	1.0			
Lighting		Maintained illumination	E_m	lx	500.0		
	Working height	h_{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	0.9			
	Relative absence (1-simultaneity factor)	C_A	-	0.0			
	Room index	k	-	2.5			
	Reduction factor occupation lighting	F_t	-	1.0			
	Reduction factor for lighting of vertikal areas	k_{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	12.0	10.0	8.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	6.0	5.8	7.0	8.8
	Appliances		W/m²	6.0	4.2	10.0	18.8
	Heat gain per day		Wh/(m²d)		60.0	102.0	166.0
Building automation				D	C	B	A
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

6. Meeting, conference and seminar room

Operating times	Start and end of building use	-	o'clock	7:00	18:00			
	Annual days of use	d _{nutz,a}	d/a	250.0				
	Total hours with daylight while operating hours	t _{day}	h/a	2543.0				
	Total hours without daylight while operating hours	t _{night}	h/a	207.0				
	Start and end of operation for ventilation and cooling system	-	o'clock	5:00	18:00			
	Annual days of use ventilation, cooling system and heating system	d _{nutz,a}	d/a	250.0				
	Start and end of operation for heating system	-	-	5:00	18:00			
	Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0			
Set temperature cooling		Q _{i,c,soll}	°C	24.0				
Minimum design temperature heating		Q _{i,h,min}	°C	20.0				
Maximum design temperature cooling		Q _{i,c,max}	°C	26.0				
Temperature reduction for reduced operation		DQ _{i,NA}	k	4.0				
Humidification requirement		-	-	mit Toleranz				
Ventilation		Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	20.0			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	15.0				
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	2.5				
	Relative absence HVAC	c _{RLT}	-	0.5				
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	0.5				
	Lighting	Maintained illumination	E _m	lx	500.0			
Working height		h _{Ne}	m	0.8				
Reduction factor (percentage of area that needs to have the full illumination level)		k _A	-	0.9				
Relative absence (1-simultaneity factor)		C _A	-	0.5				
Room index		k	-	1.3				
Reduction factor occupation lighting		F _t	-	1.0				
Reduction factor for lighting of vertikal areas		k _{VB}	-	1.0				
Occupant density		Occupant density	-	-	low	medium	high	
		-	m² per person	4.0	3.0	2.0		
Internal heat sources	max specific power			full operating hours h/d	low	medium	high	
	pue to person (70W per person)		W/m²	4.0	17.5	23.3	35.0	
	Appliances		W/m²	4.0	1.0	2.0	3.0	
	Heat gain per day		Wh/(m²d)		74.0	101.0	152.0	
Building automation				D	C	B	A	
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0	
	Factor for adative temperature control			1.00	1.00	1.35	1.35	

7. Booking hall

Operating times	Start and end of building use	-	o'clock	7:00	18:00				
	Annual days of use	$d_{nutz,a}$	d/a	250.0					
	Total hours with daylight while operating hours	t_{day}	h/a	2543.0					
	Total hours without daylight while operating hours	t_{night}	h/a	207.0					
	Start and end of operation for ventilation and cooling system	-	o'clock	5:00	18:00				
	Annual days of use ventilation, cooling system and heating system	$d_{nutz,a}$	d/a	250.0					
	Start and end of operation for heating system	-	-	5:00	18:00				
Temperatures	Set temperature heating	$Q_{i,h,soll}$	°C	21.0					
	Set temperature cooling	$Q_{i,c,soll}$	°C	24.0					
	Minimum design temperature heating	$Q_{i,h,min}$	°C	20.0					
	Maximum design temperature cooling	$Q_{i,c,max}$	°C	26.0					
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0					
	Humidification requirement	-	-	mit Toleranz					
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	20.0					
	Minimum area-related ventilation (fresh air) volume flow	V_A	m³/(h m²)	2.0					
	Minimum external air-supply volume flow for buildings	$V_{A,Geb}$	m³/(hm²)	1.3					
	Relative absence HVAC	c_{RLT}	-	0.5					
	Partial operation factor to account for HVAC related to the building operating time	F_{RLT}	-	1.0					
Lighting	Maintained illumination	E_m	lx	200.0					
	Working height	h_{Ne}	m	0.8					
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	0.9					
	Relative absence (1-simultaneity factor)	C_A	-	0.0					
	Room index	k	-	1.5					
	Reduction factor occupation lighting	F_i	-	1.0					
	Reduction factor for lighting of vertical areas	k_{VB}	-	1.0					
Occupant density	Occupant density	-	-	low	medium	high			
		-	m² per person	16.0	12.0	8.0			
Internal heat sources	max specific power			full operating hours h/d	low	medium	high		
	pue to person (70W per person)		W/m²	6.0	4.4	5.8	8.8		
	Appliances		W/m²	6.0	1.5	4.0	9.5		
	Heat gain per day		Wh/(m²d)		35.0	59.0	110.0		
Building automation				D	C	B	A		
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0		
	Factor for adative temperature control			1.00	1.00	1.35	1.35		

8. Retail shop / department store (without refrigerated products)

Operating times	Start and end of building use	-	o'clock	8:00	20:00		
	Annual days of use	d _{nutz,a}	d/a	300.0			
	Total hours with daylight while operating hours	t _{day}	h/a	3009.0			
	Total hours without daylight while operating hours	t _{night}	h/a	591.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	6:00	20:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	300.0	20:00		
	Start and end of operation for heating system	-	-	6:00			
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
	Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)			
Minimum area-related ventilation (fresh air) volume flow		V _A	m³/(h m²)	4.0			
Minimum external air-supply volume flow for buildings		V _{A,Geb}	m³/(hm²)	2.5			
Relative absence HVAC		c _{RLT}	-	0.5			
Partial operation factor to account for HVAC related to the building operating time		F _{RLT}	-	1.0			
Lighting		Maintained illumination	E _m	lx	300.0		
	Working height	h _{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	0.9			
	Relative absence (1-simultaneity factor)	C _A	-	0.0			
	Room index	k	-	2.5			
	Reduction factor occupation lighting	F _t	-	1.0			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.5			
	Occupant density	Occupant density	-	-	low		
		-	m² per person	6.0	5.0	4.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)			6.0	11.7	14.0	17.5
	Appliances			12.0	1.0	2.0	3.0
	Heat gain per day				82.0	108.0	141.0
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

9. Retail shop / department store (with refrigerated products)

Operating times	Start and end of building use	-	o'clock	8:00	20:00				
	Annual days of use	d _{nutz,a}	d/a	300.0					
	Total hours with daylight while operating hours	t _{day}	h/a	3009.0					
	Total hours without daylight while operating hours	t _{night}	h/a	591.0					
	Start and end of operation for ventilation and cooling system	-	o'clock	6:00				20:00	
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	300.0					
	Start and end of operation for heating system	-	-	6:00	20:00				
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0					
	Set temperature cooling	Q _{i,c,soll}	°C	24.0					
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0					
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0					
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0					
	Humidification requirement	-	-	mit Toleranz					
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	20.0					
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	4.0					
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	2.5					
	Relative absence HVAC	c _{RLT}	-	0.5					
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	1.0					
Lighting	Maintained illumination	E _m	lx	300.0					
	Working height	h _{Ne}	m	0.8					
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	0.9					
	Relative absence (1-simultaneity factor)	C _A	-	0.0					
	Room index	k	-	2.5					
	Reduction factor occupation lighting	F _l	-	1.0					
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0					
Occupant density	Occupant density	-	-	low	medium			high	
		-	m² per person	6.0	5.0	4.0			
Internal heat sources	max specific power			full operating hours h/d	low	medium	high		
	pue to person (70W per person)		W/m²	6.0	11.7	14.0	17.5		
	Appliances		W/m²	17.0	−12	−10	−8		
	Heat gain per day		Wh/(m²d)		−134	−86	−31		
Building automation				D	C	B	A		
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0		
	Factor for adative temperature control			1.00	1.00	1.35	1.35		

10. Classroom (schools)

Operating times	Start and end of building use	-	o'clock	8:00	15:00		
	Annual days of use	d _{nutz,a}	d/a	200.0			
	Total hours with daylight while operating hours	t _{day}	h/a	1400.0			
	Total hours without daylight while operating hours	t _{night}	h/a	0.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	6:00	15:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	200.0			
	Start and end of operation for heating system	-	-	6:00	15:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	30.0			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	10.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	2.5			
	Relative absence HVAC	c _{RLT}	-	0.3			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	0.9			
Lighting	Maintained illumination	E _m	lx	300.0			
	Working height	h _{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	0.3			
	Room index	k	-	2.0			
	Reduction factor occupation lighting	F _t	-	0.9			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	-	-	low	medium	high		
	-	m² per person	3.5	3.0	2.5		
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (60W per person)		W/m²	5.0	17.1	20.0	24.0
	Appliances		W/m²	5.0	2.0	4.0	6.0
	Heat gain per day		Wh/(m²d)		96.0	120.0	150.0
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

11. Lecture room, auditorium

Operating times	Start and end of building use	-	o'clock	8:00	18:00		
	Annual days of use	$d_{nutz,a}$	d/a	150.0			
	Total hours with daylight while operating hours	t_{day}	h/a	1408.0			
	Total hours without daylight while operating hours	t_{night}	h/a	92.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	6:00	18:00		
	Annual days of use ventilation, cooling systemand heating system	$d_{nutz,a}$	d/a	150.0			
	Start and end of operation for heating system	-	-	6:00	18:00		
Temperatures	Set temperature heating	$Q_{i,h,soll}$	°C	21.0			
	Set temperature cooling	$Q_{i,c,soll}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,min}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,max}$	°C	26.0			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	30.0			
	Minimum area-related ventilation (fresh air) volume flow	V_A	m³/(h m²)	30.0			
	Minimum external air-supply volume flow for buildings	$V_{A,Geb}$	m³/(hm²)	2.5			
	Relative absence HVAC	c_{RLT}	-	0.5			
	Partial operation factor to account for HVAC related to the building operating time	F_{RLT}	-	0.6			
Lighting	Maintained illumination	E_m	lx	500.0			
	Working height	h_{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	0.9			
	Relative absence (1-simultaneity factor)	C_A	-	0.3			
	Room index	k	-	2.5			
	Reduction factor occupation lighting	F_t	-	0.7			
	Reduction factor for lighting of vertikal areas	k_{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	1.2	1.0	0.8	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	6.0	58.3	70.0	87.5
	Appliances		W/m²	6.0	2.0	4.0	6.0
	Heat gain per day		Wh/(m²d)		362.0	444.0	561.0
Building automation				D	C	B	A
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

12. Hospital ward or dormitory

Operating times	Start and end of building use	-	o'clock	0:00	24:00		
	Annual days of use	d _{nutz,a}	d/a	365.0			
	Total hours with daylight while operating hours	t _{day}	h/a	4407.0			
	Total hours without daylight while operating hours	t _{night}	h/a	4353.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	0:00	24:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	365.0			
	Start and end of operation for heating system	-	-	0:00	24:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	22.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	0.0			
	Humidification requirement	-	-	keine			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	-			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	5.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	2.5			
	Relative absence HVAC	C _{RLT}	-	0.0			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	0.8			
Lighting	Maintained illumination	E _m	lx	300.0			
	Working height	h _{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	0.0			
	Room index	k	-	1.5			
	Reduction factor occupation lighting	F _t	-	0.5			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	19.0	14.0	10.0	
Internal heat sources	max specific power	pue to person (70W per person)	W/m²	full operating hours h/d	low	medium	high
				24.0	3.7	5.0	7.0
				6.0	2.0	4.0	6.0
Building automation	Summand Automation	DQ _{EMS}		D	C	B	A
			0.0	0.0	-0.5	-1.0	
			1.00	1.00	1.35	1.35	

13. Hotel bedroom

Operating times	Start and end of building use	-	o'clock	21:00	8:00		
	Annual days of use	d _{nutz,a}	d/a	365.0			
	Total hours with daylight while operating hours	t _{day}	h/a	743.0			
	Total hours without daylight while operating hours	t _{night}	h/a	3272.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	0:00	24:00		
	Annual days of use ventilation, cooling system and heating system	d _{nutz,a}	d/a	365.0			
	Start and end of operation for heating system	-	-	0:00	24:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	–			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	30.0			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	3.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	2.0			
	Relative absence HVAC	c _{RLT}	-	0.5			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	0.5			
Lighting	Maintained illumination	E _m	lx	200.0			
	Working height	h _{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	0.6			
	Room index	k	-	1.3			
	Reduction factor occupation lighting	F _i	-	0.3			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	12.0	10.0	8.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	10.0	5.8	7.0	8.8
	Appliances		W/m²	11.0	2.0	4.0	6.0
	Heat gain per day		Wh/(m²d)		80.0	114.0	154.0
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

14. Canteen

Operating times	Start and end of building use	-	o'clock	8:00	15:00		
	Annual days of use	$d_{nutz,a}$	d/a	250.0			
	Total hours with daylight while operating hours	t_{day}	h/a	1750.0			
	Total hours without daylight while operating hours	t_{night}	h/a	0.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	6:00	15:00		
	Annual days of use ventilation, cooling systemand heating system	$d_{nutz,a}$	d/a	250.0			
	Start and end of operation for heating system	-	-	6:00	15:00		
Temperatures	Set temperature heating	$Q_{i,h,soll}$	°C	21.0			
	Set temperature cooling	$Q_{i,c,soll}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,min}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,max}$	°C	26.0			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	30.0			
	Minimum area-related ventilation (fresh air) volume flow	V_A	m³/(h m²)	18.0			
	Minimum external air-supply volume flow for buildings	$V_{A,Geb}$	m³/(hm²)	2.5			
	Relative absence HVAC	c_{RLT}	-	0.7			
	Partial operation factor to account for HVAC related to the building operating time	F_{RLT}	-	1.0			
Lighting	Maintained illumination	E_m	lx	200.0			
	Working height	h_{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	1.0			
	Relative absence (1-simultaneity factor)	C_A	-	0.0			
	Room index	k	-	2.5			
	Reduction factor occupation lighting	F_t	-	1.0			
	Reduction factor for lighting of vertikal areas	k_{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	1.4	1.2	0.8	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	3.0	50.0	58.3	87.5
	Appliances		W/m²	5.0	1.0	2.0	3.0
	Heat gain per day		Wh/(m²d)		155.0	185.0	278.0
Building automation				D	C	B	A
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

15. Restaurant

Operating times	Start and end of building use	-	o'clock	10:00	24:00		
	Annual days of use	$d_{nutz,a}$	d/a	300.0			
	Total hours with daylight while operating hours	t_{day}	h/a	2411.0			
	Total hours without daylight while operating hours	t_{night}	h/a	1789.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	8:00	24:00		
	Annual days of use ventilation, cooling system and heating system	$d_{nutz,a}$	d/a	300.0			
	Start and end of operation for heating system	-	-	8:00	24:00		
Temperatures	Set temperature heating	$Q_{i,h,soll}$	°C	21.0			
	Set temperature cooling	$Q_{i,c,soll}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,min}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,max}$	°C	26.0			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	30.0			
	Minimum area-related ventilation (fresh air) volume flow	V_A	m³/(h m²)	18.0			
	Minimum external air-supply volume flow for buildings	$V_{A,Geb}$	m³/(hm²)	2.5			
	Relative absence HVAC	c_{RLT}	-	0.6			
	Partial operation factor to account for HVAC related to the building operating time	F_{RLT}	-	0.7			
Lighting	Maintained illumination	E_m	lx	200.0			
	Working height	h_{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	1.0			
	Relative absence (1-simultaneity factor)	C_A	-	0.0			
	Room index	k	-	2.5			
	Reduction factor occupation lighting	F_t	-	1.0			
	Reduction factor for lighting of vertical areas	k_{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	1.6	1.2	0.8	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	4.0	43.8	58.3	87.5
	Appliances		W/m²	7.0	1.0	2.0	3.0
	Heat gain per day		Wh/(m²d)		182.0	247.0	371.0
Building automation				D	C	B	A
	Summand Automation	DQ_{EMS}		D	C	B	A
	Factor for adative temperature control			0.00	0.00	-0.50	-1.00

1 1 1.35 1.35

16. Kitchen in non-residential building

Operating times	Start and end of building use	-	o'clock	10:00	23:00		
	Annual days of use	d _{nutz,a}	d/a	300.0			
	Total hours with daylight while operating hours	t _{day}	h/a	2411.0			
	Total hours without daylight while operating hours	t _{night}	h/a	1489.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	8:00	23:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	300.0			
	Start and end of operation for heating system	-	-	8:00	23:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	–			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	90.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	–			
	Relative absence HVAC	c _{RLT}	-	–			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	–			
Lighting	Maintained illumination	E _m	lx	500.0			
	Working height	h _{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	0.0			
	Room index	k	-	1.5			
	Reduction factor occupation lighting	F _t	-	1.0			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	10.0	10.0	10.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (80W per person)		W/m²	7.0	8.0	8.0	8.0
	Appliances		W/m²	6.0	200.0	300.0	400.0
	Heat geain per day		Wh/(m²d)		1256.0	1856.0	2456.0
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

17. Kitchen - preparation room or storeroom

Operating times	Start and end of building use	-	o'clock	10:00	23:00		
	Annual days of use	$d_{nutz,a}$	d/a	300.0			
	Total hours with daylight while operating hours	t_{day}	h/a	2411.0			
	Total hours without daylight while operating hours	t_{night}	h/a	1489.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	8:00	23:00		
	Annual days of use ventilation, cooling systemand heating system	$d_{nutz,a}$	d/a	300.0			
	Start and end of operation for heating system	-	-	8:00	23:00		
Temperatures	Set temperature heating	$Q_{i,h,soll}$	°C	21.0			
	Set temperature cooling	$Q_{i,c,soll}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,min}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,max}$	°C	26.0			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	-			
	Minimum area-related ventilation (fresh air) volume flow	V_A	m³/(h m²)	15.0			
	Minimum external air-supply volume flow for buildings	$V_{A,Geb}$	m³/(hm²)	-			
	Relative absence HVAC	c_{RLT}	-	-			
	Partial operation factor to account for HVAC related to the building operating time	F_{RLT}	-	-			
Lighting	Maintained illumination	E_m	lx	300.0			
	Working height	h_{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	1.0			
	Relative absence (1-simultaneity factor)	C_A	-	0.5			
	Room index	k	-	1.5			
	Reduction factor occupation lighting	F_t	-	1.0			
	Reduction factor for lighting of vertikal areas	k_{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	15.0	10.0	5.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (80W per person)		W/m²	7.0	5.3	8.0	16.0
	Appliances		W/m²	6.0	20.0	30.0	40.0
	Heat gain per day		Wh/(m²d)		157.0	236.0	352.0
Building automation				D	C	B	A
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

18. Toilets and sanitary facilities in non-residential buildings

Operating times	Start and end of building use	-	o'clock	7:00	18:00		
	Annual days of use	d _{nutz,a}	d/a	250.0			
	Total hours with daylight while operating hours	t _{day}	h/a	2543.0			
	Total hours without daylight while operating hours	t _{night}	h/a	207.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	5:00	18:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	250.0			
	Start and end of operation for heating system	-	-	5:00	18:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0			
	Humidification requirement	-	-	keine			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	-			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	15.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	5.0			
	Relative absence HVAC	c _{RLT}	-	0.7			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	1.0			
Lighting	Maintained illumination	E _m	lx	200.0			
	Working height	h _{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	0.9			
	Room index	k	-	0.8			
	Reduction factor occupation lighting	F _l	-	1.0			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	-	-	-	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)			-	-	-	-
	Appliances			-	-	-	-
	Heat gain per day				-	-	-
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

19. Other habitable rooms

Operating times	Start and end of building use	-	o'clock	7:00	18:00		
	Annual days of use	d _{nutz,a}	d/a	250.0			
	Total hours with daylight while operating hours	t _{day}	h/a	2543.0			
	Total hours without daylight while operating hours	t _{night}	h/a	207.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	5:00	18:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	250.0			
	Start and end of operation for heating system	-	-	5:00 18:00	18:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	–			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	7.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	2.5			
	Relative absence HVAC	c _{RLT}	-	0.5			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	0.8			
Lighting	Maintained illumination	E _m	lx	300.0			
	Working height	h _{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	0.9			
	Relative absence (1-simultaneity factor)	C _A	-	0.5			
	Room index	k	-	1.3			
	Reduction factor occupation lighting	F _t	-	1.0			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	4.0	3.0	2.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	4.0	17.5	23.3	35.0
	Appliances		W/m²	4.0	1.0	2.0	3.0
	Heat gain per day		Wh/(m²d)		76.0	101.0	152.0
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

20. Auxiliary spaces (wardrobe, archive, etc.)

Operating times	Start and end of building use	-	o'clock	7:00	18:00		
	Annual days of use	d _{nutz,a}	d/a	250.0			
	Total hours with daylight while operating hours	t _{day}	h/a	2543.0			
	Total hours without daylight while operating hours	t _{night}	h/a	207.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	5:00	18:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	250.0			
	Start and end of operation for heating system	-	-	5:00	18:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0			
	Humidification requirement	-	-	keine			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	–			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	0.2			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	–			
	Relative absence HVAC	c _{RLT}	-	–			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	–			
Lighting	Maintained illumination	E _m	lx	100.0			
	Working height	h _{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	0.9			
	Room index	k	-	1.5			
	Reduction factor occupation lighting	F _t	-	1.0			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	-	-	-	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	-	-	-	-
	Appliances		W/m²	-	-	-	-
	Heat gain per day		Wh/(m²d)		-	-	-
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

21. Traffic / circulation areas (that are heated)

Operating times	Start and end of building use	-	o'clock	7:00	18:00			
	Annual days of use	d _{nutz,a}	d/a	250.0				
	Total hours with daylight while operating hours	t _{day}	h/a	2543.0				
	Total hours without daylight while operating hours	t _{night}	h/a	207.0				
	Start and end of operation for ventilation and cooling system	-	o'clock	5:00	18:00			
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	250.0				
	Start and end of operation for heating system	-	-	5:00	18:00			
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0				
	Set temperature cooling	Q _{i,c,soll}	°C	24.0				
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0				
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0				
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0				
	Humidification requirement	-	-	keine				
	Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)				
Minimum area-related ventilation (fresh air) volume flow		V _A	m³/(h m²)	0.0				
Minimum external air-supply volume flow for buildings		V _{A,Geb}	m³/(hm²)	-				
Relative absence HVAC		c _{RLT}	-	-				
Partial operation factor to account for HVAC related to the building operating time		F _{RLT}	-	-				
Lighting	Maintained illumination	E _m	lx	100.0				
	Working height	h _{Ne}	m	0.2				
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0				
	Relative absence (1-simultaneity factor)	C _A	-	0.8				
	Room index	k	-	0.8				
	Reduction factor occupation lighting	F _t	-	1.0				
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0				
Occupant density	Occupant density	-	-	low	medium	high		
		-	m² per person	-	-	-		
Internal heat sources	max specific power			full operating hours h/d	low	medium	high	
	pue to person (70W per person)		W/m²	-	-	-	-	
	Appliances		W/m²	-	-	-	-	
	Heat gain per day		Wh/(m²d)		-	-	-	
Building automation				D	C	B	A	
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0	
	Factor for adative temperature control			1.00	1.00	1.35	1.35	

22. Storeroom, technical equipment room

Operating times	Start and end of building use	-	o'clock	7:00	18:00		
	Annual days of use	d _{nutz,a}	d/a	250.0			
	Total hours with daylight while operating hours	t _{day}	h/a	2543.0			
	Total hours without daylight while operating hours	t _{night}	h/a	207.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	5:00	18:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	250.0			
	Start and end of operation for heating system	-	-	5:00	18:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0			
	Humidification requirement	-	-	keine			
	Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	–		
Minimum area-related ventilation (fresh air) volume flow		V _A	m³/(h m²)	0.2			
Minimum external air-supply volume flow for buildings		V _{A,Geb}	m³/(hm²)	-			
Relative absence HVAC		c _{RLT}	-	-			
Partial operation factor to account for HVAC related to the building operating time		F _{RLT}	-	-			
Lighting	Maintained illumination	E _m	lx	100.0			
	Working height	h _{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	1.0			
	Room index	k	-	1.5			
	Reduction factor occupation lighting	F _t	-	1.0			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	2.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	-	-	-	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	-	-	-	-
	Appliances		W/m²	-	-	-	-
	Heat gain per day		Wh/(m²d)		-	-	-
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

23. Server room, computer centre

Operating times	Start and end of building use	-	o'clock	0:00	24:00		
	Annual days of use	$d_{\text{nutz,a}}$	d/a	365.0			
	Total hours with daylight while operating hours	t_{day}	h/a	4407.0			
	Total hours without daylight while operating hours	t_{night}	h/a	4353.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	0:00	24:00		
	Annual days of use ventilation, cooling system and heating system	$d_{\text{nutz,a}}$	d/a	365.0			
	Start and end of operation for heating system	-	-	0:00	24:00		
Temperatures	Set temperature heating	$Q_{i,h,\text{soll}}$	°C	21.0			
	Set temperature cooling	$Q_{i,c,\text{soll}}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,\text{min}}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,\text{max}}$	°C	26b			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	keine			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	40.0			
	Minimum area-related ventilation (fresh air) volume flow	V_A	m³/(h m²)	1.3			
	Minimum external air-supply volume flow for buildings	$V_{A,\text{Geb}}$	m³/(hm²)	—			
	Relative absence HVAC	C_{RLT}	-	—			
	Partial operation factor to account for HVAC related to the building operating time	F_{RLT}	-	—			
Lighting	Maintained illumination	E_m	lx	500.0			
	Working height	h_{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	1.0			
	Relative absence (1-simultaneity factor)	C_A	-	0.5			
	Room index	k	-	1.5			
	Reduction factor occupation lighting	F_t	-	0.5			
	Reduction factor for lighting of vertical areas	k_{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	40.0	30.0	20.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	per person (70W per person)	W/m²		6.0	1.8	2.3	3.5
	Appliances	W/m²		12.0	50.0	150.0	500.0
	Heat gain per day	Wh/(m²d)			611.0	1814.0	6021.0
Building automation				D	C	B	A
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adaptive temperature control			1.00	1.00	1.35	1.35

24. Workshop, assembly shop, production facility - heavy work

Operating times	Start and end of building use	-	o'clock	7:00	16:00			
	Annual days of use	d _{nutz,a}	d/a	230.0				
	Total hours with daylight while operating hours	t _{day}	h/a	2018.0				
	Total hours without daylight while operating hours	t _{night}	h/a	52.0				
	Start and end of operation for ventilation and cooling system	-	o'clock	6:00	16:00			
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	230.0				
	Start and end of operation for heating system	-	-	6:00	16:00			
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	15.0				
	Set temperature cooling	Q _{i,c,soll}	°C	28.0				
	Minimum design temperature heating	Q _{i,h,min}	°C	15.0				
	Maximum design temperature cooling	Q _{i,c,max}	°C	30.0				
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0				
	Humidification requirement	-	-	keine				
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	70.0				
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	3.5				
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	tbd				
	Relative absence HVAC	c _{RLT}	-	tbd				
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	tbd				
Lighting	Maintained illumination	E _m	lx	300.0				
	Working height	h _{Ne}	m	0.8				
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	0.9				
	Relative absence (1-simultaneity factor)	C _A	-	0.1				
	Room index	k	-	2.5				
	Reduction factor occupation lighting	F _t	-	0.9				
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0				
Occupant density	Occupant density	-	-	low	medium	high		
		-	m² per person	25.0	20.0	15.0		
Internal heat sources	max specific power			full operating hours h/d	low	medium	high	
	pue to person (120W per person)			W/m²	8.0	4.8	6.0	8.0
	Appliances			W/m²	8.0	25.0	35.0	45.0
	Heat gain per day			Wh/(m²d)		38.0	328.0	424.0
Building automation				D	C	B	A	
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0	
	Factor for adative temperature control			1.00	1.00	1.35	1.35	

25. Workshop, assembly shop, production facility - medium work

Operating times	Start and end of building use	-	o'clock	7:00	16:00			
	Annual days of use	$d_{nutz,a}$	d/a	230.0				
	Total hours with daylight while operating hours	t_{day}	h/a	2018.0				
	Total hours without daylight while operating hours	t_{night}	h/a	52.0				
	Start and end of operation for ventilation and cooling system	-	o'clock	6:00	16:00			
	Annual days of use ventilation, cooling systemand heating system	$d_{nutz,a}$	d/a	230.0				
	Start and end of operation for heating system	-	-	6:00	16:00			
Temperatures	Set temperature heating	$Q_{i,h,soll}$	°C	17.0				
	Set temperature cooling	$Q_{i,c,soll}$	°C	26.0				
	Minimum design temperature heating	$Q_{i,h,min}$	°C	15.0				
	Maximum design temperature cooling	$Q_{i,c,max}$	°C	28.0				
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0				
	Humidification requirement	-	-	keine				
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	50.0				
	Minimum area-related ventilation (fresh air) volume flow	V_A	m³/(h m²)	2.5				
	Minimum external air-supply volume flow for buildings	$V_{A,Geb}$	m³/(hm²)	tbd				
	Relative absence HVAC	c_{RLT}	-	tbd				
	Partial operation factor to account for HVAC related to the building operating time	F_{RLT}	-	tbd				
Lighting	Maintained illumination	E_m	lx	400.0				
	Working height	h_{Ne}	m	0.8				
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	0.9				
	Relative absence (1-simultaneity factor)	C_A	-	0.1				
	Room index	k	-	2.5				
	Reduction factor occupation lighting	F_t	-	0.9				
	Reduction factor for lighting of vertikal areas	k_{VB}	-	1.0				
Occupant density	Occupant density	-	-	low	medium	high		
		-	m² per person	25.0	20.0	15.0		
Internal heat sources	max specific power			full operating hours h/d	low	medium	high	
	pue to person (100W per person)		W/m²	8.0	4.0	5.0	6.7	
	Appliances		W/m²	8.0	25.0	35.0	45.0	
	Heat gain per day		Wh/(m²d)		232.0	320.0	413.0	
Building automation				D	C	B	A	
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0	
	Factor for adative temperature control			1.00	1.00	1.35	1.35	

26. Workshop, assembly shop, production facility - light work

Operating times	Start and end of building use	-	o'clock	7:00	16:00			
	Annual days of use	d _{nutz,a}	d/a	230.0				
	Total hours with daylight while operating hours	t _{day}	h/a	2018.0				
	Total hours without daylight while operating hours	t _{night}	h/a	52.0				
	Start and end of operation for ventilation and cooling system	-	o'clock	6:00	16:00			
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	230.0				
	Start and end of operation for heating system	-	-	6:00	16:00			
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	20.0				
	Set temperature cooling	Q _{i,c,soll}	°C	24.0				
	Minimum design temperature heating	Q _{i,h,min}	°C	18.0				
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0				
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0				
	Humidification requirement	-	-	keine				
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	30.0				
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	1.5				
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	tbd				
	Relative absence HVAC	c _{RLT}	-	tbd				
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	tbd				
Lighting	Maintained illumination	E _m	lx	500.0				
	Working height	h _{Ne}	m	0.8				
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	0.9				
	Relative absence (1-simultaneity factor)	C _A	-	0.1				
	Room index	k	-	2.5				
	Reduction factor occupation lighting	F _i	-	0.9				
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0				
Occupant density	Occupant density	-	-	low	medium	high		
		-	m² per person	25.0	20.0	15.0		
Internal heat sources	max specific power			full operating hours h/d	low	medium	high	
	pue to person (80W per person)			W/m²	8.0	3.2	4.0	5.3
	Appliances			W/m²	8.0	25.0	35.0	45.0
	Heat gain per day			Wh/(m²d)		224.0	312.0	403.0
Building automation				D	C	B	A	
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0	
	Factor for adative temperature control			1.00	1.00	1.35	1.35	

27. Spectator and audience areas (theatres and event locations)

Operating times	Start and end of building use	-	o'clock	19:00	23:00		
	Annual days of use	$d_{nutz,a}$	d/a	250.0			
	Total hours with daylight while operating hours	t_{day}	h/a	59.0			
	Total hours without daylight while operating hours	t_{night}	h/a	941.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	17:00	23:00		
	Annual days of use ventilation, cooling systemand heating system	$d_{nutz,a}$	d/a	250.0			
	Start and end of operation for heating system	-	-	17:00	23:00		
Temperatures	Set temperature heating	$Q_{i,h,soll}$	°C	21.0			
	Set temperature cooling	$Q_{i,c,soll}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,min}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,max}$	°C	26.0			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	30.0			
	Minimum area-related ventilation (fresh air) volume flow	V_A	m³/(h m²)	40.0			
	Minimum external air-supply volume flow for buildings	$V_{A,Geb}$	m³/(hm²)	5.0			
	Relative absence HVAC	c_{RLT}	-	0.7			
	Partial operation factor to account for HVAC related to the building operating time	F_{RLT}	-	1.0			
Lighting	Maintained illumination	E_m	lx	200.0			
	Working height	h_{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	1.0			
	Relative absence (1-simultaneity factor)	C_A	-	0.0			
	Room index	k	-	4.0			
	Reduction factor occupation lighting	F_t	-	1.0			
	Reduction factor for lighting of vertikal areas	k_{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	1.5	0.8	0.5	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	2.0	47.0	93.0	140.0
	Appliances		W/m²	-	-	-	-
	Heat gain per day		Wh/(m²d)		93.0	187.0	280.0
Building automation				D	C	B	A
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

28. Foyer (theatres and event locations)

Operating times	Start and end of building use	-	o'clock	19:00	23:00		
	Annual days of use	$d_{nutz,a}$	d/a	250.0			
	Total hours with daylight while operating hours	t_{day}	h/a	59.0			
	Total hours without daylight while operating hours	t_{night}	h/a	941.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	17:00	23:00		
	Annual days of use ventilation, cooling system and heating system	$d_{nutz,a}$	d/a	250.0			
	Start and end of operation for heating system	-	-	17:00	23:00		
Temperatures	Set temperature heating	$Q_{i,h,soll}$	°C	21.0			
	Set temperature cooling	$Q_{i,c,soll}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,min}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,max}$	°C	26.0			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	20.0			
	Minimum area-related ventilation (fresh air) volume flow	V_A	m³/(h m²)	25.0			
	Minimum external air-supply volume flow for buildings	$V_{A,Geb}$	m³/(hm²)	5.0			
	Relative absence HVAC	c_{RLT}	-	0.5			
	Partial operation factor to account for HVAC related to the building operating time	F_{RLT}	-	1.0			
Lighting	Maintained illumination	E_m	lx	300.0			
	Working height	h_{Ne}	m	0.0			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	1.0			
	Relative absence (1-simultaneity factor)	C_A	-	0.5			
	Room index	k	-	4.0			
	Reduction factor occupation lighting	F_t	-	1.0			
	Reduction factor for lighting of vertical areas	k_{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	1.5	0.8	0.5	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	1.0	46.7	87.5	140.0
	Appliances		W/m²	0.0	0.0	0.0	0.0
	Heat gain per day		Wh/(m²d)		47.0	88.0	140.0
Building automation				D	C	B	A
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00		1.35

29. Stage (theatres and event locations)

Operating times	Start and end of building use	-	o'clock	13:00	23:00		
	Annual days of use	$d_{\text{nutz,a}}$	d/a	250.0			
	Total hours with daylight while operating hours	t_{day}	h/a	1259.0			
	Total hours without daylight while operating hours	t_{night}	h/a	1241.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	11:00	23:00		
	Annual days of use ventilation, cooling system and heating system	$d_{\text{nutz,a}}$	d/a	250.0			
	Start and end of operation for heating system	-	-	11:00	23:00		
Temperatures	Set temperature heating	$Q_{i,h,\text{soll}}$	°C	21.0			
	Set temperature cooling	$Q_{i,c,\text{soll}}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,\text{min}}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,\text{max}}$	°C	26.0			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	–			
	Minimum area-related ventilation (fresh air) volume flow	V_A	m³/(h m²)	0.3			
	Minimum external air-supply volume flow for buildings	$V_{A,\text{Geb}}$	m³/(hm²)	-			
	Relative absence HVAC	C_{RLT}	-	-			
	Partial operation factor to account for HVAC related to the building operating time	F_{RLT}	-	-			
Lighting	Maintained illumination	E_m	lx	1000.0			
	Working height	h_{Ne}	m	0.0			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	0.9			
	Relative absence (1-simultaneity factor)	C_A	-	0.0			
	Room index	k	-	2.5			
	Reduction factor occupation lighting	F_t	-	0.6			
	Reduction factor for lighting of vertikal areas	k_{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	–	–	–	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	–	–	–	–
	Appliances		W/m²	–	–	–	–
	Heat gain per day		Wh/(m²d)		–	–	–
Building automation				D	C	B	A
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

30. Exhibition / congress building

Operating times	Start and end of building use	-	o'clock	9:00	18:00		
	Annual days of use	$d_{nutz,a}$	d/a	150.0			
	Total hours with daylight while operating hours	t_{day}	h/a	1258.0			
	Total hours without daylight while operating hours	t_{night}	h/a	92.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	7:00	18:00		
	Annual days of use ventilation, cooling systemand heating system	$d_{nutz,a}$	d/a	150.0			
	Start and end of operation for heating system	-	-	7:00	18:00		
Temperatures	Set temperature heating	$Q_{i,h,soll}$	°C	21.0			
	Set temperature cooling	$Q_{i,c,soll}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,min}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,max}$	°C	26.0			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
	Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	20.0		
Minimum area-related ventilation (fresh air) volume flow		V_A	m³/(h m²)	7.0			
Minimum external air-supply volume flow for buildings		$V_{A,Geb}$	m³/(hm²)	2.5			
Relative absence HVAC		c_{RLT}	-	0.7			
Partial operation factor to account for HVAC related to the building operating time		F_{RLT}	-	1.0			
Lighting		Maintained illumination	E_m	lx	300.0		
	Working height	h_{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	0.9			
	Relative absence (1-simultaneity factor)	C_A	-	0.5			
	Room index	k	-	5.0			
	Reduction factor occupation lighting	F_t	-	1.0			
	Reduction factor for lighting of vertikal areas	k_{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	6.0	3.0	2.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	6.0	11.7	23.3	35.0
	Appliances		W/m²	6.0	1.0	2.0	3.0
	Heat gain per day		Wh/(m²d)		76.0	152.0	228.0
Building automation				D	C	B	A
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

31. Exhibition rooms and museums with conservation requirements

Operating times	Start and end of building use	-	o'clock	10:00	18:00		
	Annual days of use	$d_{\text{nutz,a}}$	d/a	250.0			
	Total hours with daylight while operating hours	t_{day}	h/a	1846.0			
	Total hours without daylight while operating hours	t_{night}	h/a	154.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	0:00	24:00		
	Annual days of use ventilation, cooling systemand heating system	$d_{\text{nutz,a}}$	d/a	365.0			
	Start and end of operation for heating system	-	-	0:00	24:00		
Temperatures	Set temperature heating	$Q_{i,h,\text{soll}}$	°C	21.0			
	Set temperature cooling	$Q_{i,c,\text{soll}}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,\text{min}}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,\text{max}}$	°C	26.0			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	ohne Toleranz			
	Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	20.0		
Minimum area-related ventilation (fresh air) volume flow		V_A	m³/(h m²)	2.0			
Minimum external air-supply volume flow for buildings		$V_{A,\text{Geb}}$	m³/(hm²)	2.0			
Relative absence HVAC		c_{RLT}	-	0.5			
Partial operation factor to account for HVAC related to the building operating time		F_{RLT}	-	1.0			
Lighting		Maintained illumination	E_m	lx	200.0		
	Working height	h_{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	0.9			
	Relative absence (1-simultaneity factor)	C_A	-	0.0			
	Room index	k	-	2.0			
	Reduction factor occupation lighting	F_l	-	1.0			
	Reduction factor for lighting of vertikal areas	k_{VB}	-	1.0			
	Occupant density	Occupant density	-	-	low	medium	high
		-	m² per person	20.0	10.0	5.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	4.0	3.5	7.0	14.0
	Appliances		W/m²	-	-	-	-
	Heat gain per day		Wh/(m²d)		14.0	28.0	56.0
Building automation				D	C	B	A
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

32. Library – reading rooms

Operating times	Start and end of building use	-	o'clock	8:00	20:00		
	Annual days of use	d _{nutz,a}	d/a	300.0			
	Total hours with daylight while operating hours	t _{day}	h/a	3009.0			
	Total hours without daylight while operating hours	t _{night}	h/a	591.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	6:00	20:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	300.0			
	Start and end of operation for heating system	-	-	6:00	20:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	20.0			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	8.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	2.5			
	Relative absence HVAC	c _{RLT}	-	0.5			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	1.0			
Lighting	Maintained illumination	E _m	lx	500.0			
	Working height	h _{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	0.9			
	Relative absence (1-simultaneity factor)	C _A	-	0.0			
	Room index	k	-	1.5			
	Reduction factor occupation lighting	F _l	-	1.0			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
	Occupant density	Occupant density	-	-			
		-	m² per person	5.0	2.5	1.5	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)			6.0	14.0	28.0	46.7
	Appliances			-	-	-	-
	Heat gain per day						
Building automation					84	168	280
	Summand Automation	DQ _{EMS}		D	C	B	A
	Factor for adative temperature control			0.00	0.00	-0.50	-1.00

1 1 1.35 1.35

33. Library – open stacks area

Operating times	Start and end of building use	-	o'clock	8:00	20:00		
	Annual days of use	$d_{nutz,a}$	d/a	300.0			
	Total hours with daylight while operating hours	t_{day}	h/a	3009.0			
	Total hours without daylight while operating hours	t_{night}	h/a	591.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	6:00	20:00		
	Annual days of use ventilation, cooling system and heating system	$d_{nutz,a}$	d/a	300.0			
	Start and end of operation for heating system	-	-	6:00	20:00		
Temperatures	Set temperature heating	$Q_{i,h,soll}$	°C	21.0			
	Set temperature cooling	$Q_{i,c,soll}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,min}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,max}$	°C	26.0			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	20.0			
	Minimum area-related ventilation (fresh air) volume flow	V_A	m³/(h m²)	2.0			
	Minimum external air-supply volume flow for buildings	$V_{A,Geb}$	m³/(hm²)	2.0			
	Relative absence HVAC	c_{RLT}	-	-			
	Partial operation factor to account for HVAC related to the building operating time	F_{RLT}	-	-			
Lighting	Maintained illumination	E_m	lx	200.0			
	Working height	h_{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	1.0			
	Relative absence (1-simultaneity factor)	C_A	-	0.0			
	Room index	k	-	1.5			
	Reduction factor occupation lighting	F_t	-	1.0			
	Reduction factor for lighting of vertikal areas	k_{VB}	-	1.7			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	20.0	10.0	5.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	6.0	3.5	7.0	14.0
	Appliances		W/m²	-	-	-	-
	Heat gain per day		Wh/(m²d)				
Building automation					21	42	84
	Summand Automation	DQ_{EMS}		D	C	B	A
	Factor for adative temperature control			0.00	0.00	-0.50	-1.00

1 1 1.35 1.35

34. Library – magazine and stores

Operating times	Start and end of building use	-	o'clock	8:00	20:00		
	Annual days of use	$d_{\text{nutz,a}}$	d/a	300.0			
	Total hours with daylight while operating hours	t_{day}	h/a	3009.0			
	Total hours without daylight while operating hours	t_{night}	h/a	591.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	6:00	20:00		
	Annual days of use ventilation, cooling systemand heating system	$d_{\text{nutz,a}}$	d/a	300.0			
	Start and end of operation for heating system	-	-	0:00			
Temperatures	Set temperature heating	$Q_{i,h,\text{soll}}$	°C	21.0			
	Set temperature cooling	$Q_{i,c,\text{soll}}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,\text{min}}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,\text{max}}$	°C	26.0			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	–			
	Minimum area-related ventilation (fresh air) volume flow	V_A	m³/(h m²)	3.0			
	Minimum external air-supply volume flow for buildings	$V_{A,\text{Geb}}$	m³/(hm²)	2.0			
	Relative absence HVAC	c_{RLT}	-	0.5			
	Partial operation factor to account for HVAC related to the building operating time	F_{RLT}	-	1.0			
Lighting	Maintained illumination	E_m	lx	100.0			
	Working height	h_{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	1.0			
	Relative absence (1-simultaneity factor)	C_A	-	0.9			
	Room index	k	-	1.5			
	Reduction factor occupation lighting	F_t	-	1.0			
	Reduction factor for lighting of vertikal areas	k_{VB}	-	2.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	–	–	–	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	–	–	–	–
	Appliances		W/m²	–	–	–	–
	Heat gain per day		Wh/(m²d)		–	–	–
Building automation				D	C	B	A
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

35. Gymnasium

Operating times	Start and end of building use	-	o'clock	8:00	23:00		
	Annual days of use	$d_{nutz,a}$	d/a	250.0			
	Total hours with daylight while operating hours	t_{day}	h/a	2509.0			
	Total hours without daylight while operating hours	t_{night}	h/a	1241.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	6:00	23:00		
	Annual days of use ventilation, cooling systemand heating system	$d_{nutz,a}$	d/a	250.0			
	Start and end of operation for heating system	-	-	6:00	23:00		
Temperatures	Set temperature heating	$Q_{i,h,soll}$	°C	19.0			
	Set temperature cooling	$Q_{i,c,soll}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,min}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,max}$	°C	26.0			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	keine			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)	60.0			
	Minimum area-related ventilation (fresh air) volume flow	V_A	m³/(h m²)	3.0			
	Minimum external air-supply volume flow for buildings	$V_{A,Geb}$	m³/(hm²)	1.3			
	Relative absence HVAC	c_{RLT}	-	0.5			
	Partial operation factor to account for HVAC related to the building operating time	F_{RLT}	-	0.9			
Lighting	Maintained illumination	E_m	lx	300.0			
	Working height	h_{Ne}	m	1.0			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	1.0			
	Relative absence (1-simultaneity factor)	C_A	-	0.3			
	Room index	k	-	2.0			
	Reduction factor occupation lighting	F_t	-	1.0			
	Reduction factor for lighting of vertikal areas	k_{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	30.0	20.0	10.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (125W per person)		W/m²	10.0	4.2	6.3	12.5
	Appliances		W/m²	-	-	-	-
	Heat gain per day		Wh/(m²d)		42.0	63.0	125.0
Building automation				D	C	B	A
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

36. Garage buildings (for offices and private use)

Operating times	Start and end of building use	-	o'clock	7:00	18:00		
	Annual days of use	d _{nutz,a}	d/a	250.0			
	Total hours with daylight while operating hours	t _{day}	h/a	2543.0			
	Total hours without daylight while operating hours	t _{night}	h/a	207.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	5:00	18:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	250.0			
	Start and end of operation for heating system	-	-	-	-		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0			
	Humidification requirement	-	-	keine			
	Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	–		
Minimum area-related ventilation (fresh air) volume flow		V _A	m³/(h m²)	8.0			
Minimum external air-supply volume flow for buildings		V _{A,Geb}	m³/(hm²)	-			
Relative absence HVAC		c _{RLT}	-	-			
Partial operation factor to account for HVAC related to the building operating time		F _{RLT}	-	-			
Lighting	Maintained illumination	E _m	lx	75.0			
	Working height	h _{Ne}	m	0.2			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	1.0			
	Room index	k	-	2.0			
	Reduction factor occupation lighting	F _i	-	1.0			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	-	-	-	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	-	-	-	-
	Appliances		W/m²	-	-	-	-
	Heat gain per day		Wh/(m²d)		-	-	-
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

37. Garage buildings (for public use)

Operating times	Start and end of building use	-	o'clock	7:00	18:00		
	Annual days of use	d _{nutz,a}	d/a	250.0			
	Total hours with daylight while operating hours	t _{day}	h/a	2543.0			
	Total hours without daylight while operating hours	t _{night}	h/a	207.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	5:00	18:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	250.0			
	Start and end of operation for heating system	-	-	-	-		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	21.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0			
	Humidification requirement	-	-	keine			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	–			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	8.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	-			
	Relative absence HVAC	c _{RLT}	-	-			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	-			
Lighting	Maintained illumination	E _m	lx	75.0			
	Working height	h _{Ne}	m	0.2			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	1.0			
	Room index	k	-	2.0			
	Reduction factor occupation lighting	F _t	-	1.0			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	-	-	-	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	-	-	-	-
	Appliances		W/m²	-	-	-	-
	Heat gain per day		Wh/(m²d)		-	-	-
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

38. Sauna

Operating times	Start and end of building use	-	o'clock	10:00	22:00		
	Annual days of use	d _{nutz,a}	d/a	365.0			
	Total hours with daylight while operating hours	t _{day}	h/a	2933.0			
	Total hours without daylight while operating hours	t _{night}	h/a	1447.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	8:00	22:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	365.0			
	Start and end of operation for heating system	-	-	8:00	22:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	24.0			
	Set temperature cooling	Q _{i,c,soll}	°C	—			
	Minimum design temperature heating	Q _{i,h,min}	°C	23.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	—			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	—			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	15.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	-			
	Relative absence HVAC	c _{RLT}	-	-			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	-			
Lighting	Maintained illumination	E _m	lx	200.0			
	Working height	h _{Ne}	m	0.0			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	0.0			
	Room index	k	-	1.0			
	Reduction factor occupation lighting	F _t	-	1.0			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	18.0	12.0	6.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	10.0	3.9	5.8	11.7
	Appliances		W/m²	10.0	40.0	50.0	60.0
	Heat gain per day		Wh/(m²d)		439.0	558.0	717.0
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

39. Fitness room

Operating times	Start and end of building use	-	o'clock	8:00	23:00		
	Annual days of use	d _{nutz,a}	d/a	365.0			
	Total hours with daylight while operating hours	t _{day}	h/a	3663.0			
	Total hours without daylight while operating hours	t _{night}	h/a	1812.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	6:00	23:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	365.0			
	Start and end of operation for heating system	-	-	6:00	23:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	20.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	18.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	60.0			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	12.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	2.5			
	Relative absence HVAC	c _{RLT}	-	0.5			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	0.9			
Lighting	Maintained illumination	E _m	lx	300.0			
	Working height	h _{Ne}	m	0.0			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	0.0			
	Room index	k	-	2.0			
	Reduction factor occupation lighting	F _t	-	1.0			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	6.0	5.0	4.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (110W per person)		W/m²	12.0	18.3	22.0	27.5
	Appliances		W/m²	12.0	1.0	2.0	3.0
	Heat gain per day		Wh/(m²d)		232.0	288.0	366.0
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

40. Laboratory

Operating times	Start and end of building use	-	o'clock	7:00	18:00		
	Annual days of use	$d_{nutz,a}$	d/a	250.0			
	Total hours with daylight while operating hours	t_{day}	h/a	2543.0			
	Total hours without daylight while operating hours	t_{night}	h/a	207.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	0:00	24:00		
	Annual days of use ventilation, cooling systemand heating system	$d_{nutz,a}$	d/a	250.0			
	Start and end of operation for heating system	-	-	0:00	24:00		
Temperatures	Set temperature heating	$Q_{i,h,soll}$	°C	22.0			
	Set temperature cooling	$Q_{i,c,soll}$	°C	24.0			
	Minimum design temperature heating	$Q_{i,h,min}$	°C	20.0			
	Maximum design temperature cooling	$Q_{i,c,max}$	°C	26.0			
	Temperature reduction for reduced operation	$DQ_{i,NA}$	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
	Ventilation	Minimum person-related ventilation (fresh air) volume flow	V_A	m³/(h person)			
Minimum area-related ventilation (fresh air) volume flow		V_A	m³/(h m²)	25.0			
Minimum external air-supply volume flow for buildings		$V_{A,Geb}$	m³/(hm²)	tbd			
Relative absence HVAC		c_{RLT}	-	tbd			
Partial operation factor to account for HVAC related to the building operating time		F_{RLT}	-	tbd			
Lighting	Maintained illumination	E_m	lx	500.0			
	Working height	h_{Ne}	m	1.0			
	Reduction factor (percentage of area that needs to have the full illumination level)	k_A	-	0.9			
	Relative absence (1-simultaneity factor)	C_A	-	0.3			
	Room index	k	-	1.3			
	Reduction factor occupation lighting	F_t	-	1.0			
	Reduction factor for lighting of vertikal areas	k_{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	18.0	14.0	10.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (90W per person)		W/m²	6.0	5.0	6.4	9.0
	Appliances		W/m²	6.0	6.0	18.0	63.0
	Heat gain per day		Wh/(m²d)		66.0	147.0	432.0
Building automation				D	C	B	A
	Summand Automation	DQ_{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

41. Examination and treatment rooms

Operating times	Start and end of building use	-	o'clock	7:00	18:00		
	Annual days of use	d _{nutz,a}	d/a	250.0			
	Total hours with daylight while operating hours	t _{day}	h/a	2543.0			
	Total hours without daylight while operating hours	t _{night}	h/a	207.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	5:00	18:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	250.0			
	Start and end of operation for heating system	-	-	5:00	18:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	22.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	-			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	–			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	10.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	2.5			
	Relative absence HVAC	c _{RLT}	-	0.3			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	0.7			
Lighting	Maintained illumination	E _m	lx	500.0			
	Working height	h _{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	0.0			
	Room index	k	-	1.2			
	Reduction factor occupation lighting	F _t	-	1.0			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	8.0	6.0	4.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	7.0	8.8	11.7	17.5
	Appliances		W/m²	5.0	4.0	7.0	10.0
	Heat gain per day		Wh/(m²d)		81.0	117.0	173.0
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

42. Special Care

Operating times	Start and end of building use	-	o'clock	0:00	24:00		
	Annual days of use	d _{nutz,a}	d/a	365.0			
	Total hours with daylight while operating hours	t _{day}	h/a	4407.0			
	Total hours without daylight while operating hours	t _{night}	h/a	4353.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	0:00	24:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	365.0			
	Start and end of operation for heating system	-	-	0:00	24:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	24.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	22.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	-			
	Humidification requirement	-	-	mit Toleranz			
	Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)			
Minimum area-related ventilation (fresh air) volume flow		V _A	m³/(h m²)	30.0			
Minimum external air-supply volume flow for buildings		V _{A,Geb}	m³/(hm²)	-			
Relative absence HVAC		c _{RLT}	-	-			
Partial operation factor to account for HVAC related to the building operating time		F _{RLT}	-	-			
Lighting		Maintained illumination	E _m	lx	300.0		
	Working height	h _{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	0.0			
	Room index	k	-	1.2			
	Reduction factor occupation lighting	F _t	-	0.8			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	17.0	15.0	13.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	24.0	4.1	4.7	5.4
	Appliances		W/m²	24.0	6.0	9.5	13.0
	Heat gain per day		Wh/(m²d)		243.0	340.0	441.0
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

43. Corridors of the general care area

Operating times	Start and end of building use	-	o'clock	0:00	24:00		
	Annual days of use	d _{nutz,a}	d/a	365.0			
	Total hours with daylight while operating hours	t _{day}	h/a	4407.0			
	Total hours without daylight while operating hours	t _{night}	h/a	4353.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	0:00	24:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	365.0			
	Start and end of operation for heating system	-	-	0:00	24:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	22.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	0.0			
	Humidification requirement	-	-	keine			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	–			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	10.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	-			
	Relative absence HVAC	c _{RLT}	-	-			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	-			
Lighting	Maintained illumination	E _m	lx	125.0			
	Working height	h _{Ne}	m	0.2			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	0.8			
	Room index	k	-	1.0			
	Reduction factor occupation lighting	F _t	-	1.0			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	–	–	–	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	–	–	–	–
	Appliances		W/m²	–	–	–	–
	Heat gain per day		Wh/(m²d)		–	–	–
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

44. Medical practices and therapeutic practices

Operating times	Start and end of building use	-	o'clock	8:00	18:00		
	Annual days of use	d _{nutz,a}	d/a	250.0			
	Total hours with daylight while operating hours	t _{day}	h/a	2346.0			
	Total hours without daylight while operating hours	t _{night}	h/a	154.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	6:00	18:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	250.0			
	Start and end of operation for heating system	-	-	6:00	18:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	22.0			
	Set temperature cooling	Q _{i,c,soll}	°C	24.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	20.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	26.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	4.0			
	Humidification requirement	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	–			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	10.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	2.5			
	Relative absence HVAC	c _{RLT}	-	0.3			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	0.7			
Lighting	Maintained illumination	E _m	lx	500.0			
	Working height	h _{Ne}	m	0.8			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	0.0			
	Room index	k	-	1.2			
	Reduction factor occupation lighting	F _t	-	1.0			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.0			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	16.0	12.0	7.0	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (70W per person)		W/m²	9.0	4.4	5.8	10.0
	Appliances		W/m²	5.0	3.0	5.0	7.0
	Heat gain per day		Wh/(m²d)		54.0	78.0	125.0
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35

45. Warehouses, logistics halls

Operating times	Start and end of building use	-	o'clock	0:00	24:00		
	Annual days of use	d _{nutz,a}	d/a	365.0			
	Total hours with daylight while operating hours	t _{day}	h/a	4407.0			
	Total hours without daylight while operating hours	t _{night}	h/a	4353.0			
	Start and end of operation for ventilation and cooling system	-	o'clock	0:00	24:00		
	Annual days of use ventilation, cooling systemand heating system	d _{nutz,a}	d/a	365.0			
	Start and end of operation for heating system	-	-	0:00	24:00		
Temperatures	Set temperature heating	Q _{i,h,soll}	°C	12.0			
	Set temperature cooling	Q _{i,c,soll}	°C	26.0			
	Minimum design temperature heating	Q _{i,h,min}	°C	12.0			
	Maximum design temperature cooling	Q _{i,c,max}	°C	28.0			
	Temperature reduction for reduced operation	DQ _{i,NA}	k	-			
	Humidification requirement	-	-	keine			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	V _A	m³/(h person)	36.0			
	Minimum area-related ventilation (fresh air) volume flow	V _A	m³/(h m²)	1.0			
	Minimum external air-supply volume flow for buildings	V _{A,Geb}	m³/(hm²)	-			
	Relative absence HVAC	c _{RLT}	-	-			
	Partial operation factor to account for HVAC related to the building operating time	F _{RLT}	-	-			
Lighting	Maintained illumination	E _m	lx	150.0			
	Working height	h _{Ne}	m	0.0			
	Reduction factor (percentage of area that needs to have the full illumination level)	k _A	-	1.0			
	Relative absence (1-simultaneity factor)	C _A	-	0.6			
	Room index	k	-	2.4			
	Reduction factor occupation lighting	F _t	-	0.4			
	Reduction factor for lighting of vertikal areas	k _{VB}	-	1.8			
Occupant density	Occupant density	-	-	low	medium	high	
		-	m² per person	—	—	—	
Internal heat sources	max specific power			full operating hours h/d	low	medium	high
	pue to person (90W per person)			W/m²	—	—	—
	Appliances			W/m²	—	—	—
	Heat gain per day			Wh/(m²d)	—	—	—
Building automation				D	C	B	A
	Summand Automation	DQ _{EMS}		0.0	0.0	-0.5	-1.0
	Factor for adative temperature control			1.00	1.00	1.35	1.35



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*Ministria e Mjedisit, Planifikimit Hapësinor
Ministarstvo Sredine, Prostornog Planiranja
Ministry of Environment, Spatial and Planning*

Zyra e Sekretarit të Përgjithshëm / Kancelarija Generalnog Sekretara / Office of the General Secretary

No. 8913/25

Date: 11.12.25

The General Secretary of the Ministry of Environment *and* Spatial Planning based on Article 18 of Law No. 06/L-113 on the Organization and Functioning of State Administration and Independent Agencies (Official Gazette No. 7, 1 March 2019), Article 7, paragraph 1 of Law No. 08/L-242 on the Energy Performance of Buildings, Article 18 of Government Regulation (GRK) No. 17/2024 on the Rules of Procedure of the Government of the Republic of Kosovo, as well as the National Development Plan for the years 2025-2027, approved by the Government of the Republic of Kosovo through Decision No. 03/247 dated 31.01.2025, issues the following:

DECISION

1. A Working Group is appointed for the drafting of the National Building Renovation Strategy 2026-2035, composed as follows:

- 1.1. Arben Ajazi, DSPHC/MESP - chairperson;
- 1.2. Adelina Vatovci, DSPHC/MESP - member;
- 1.3. Xhemail Metolli, DSPHC/MESP - member;
- 1.4. Ramë Hamzaj, DSPHC/MESP - member;
- 1.5. Florije Kika, LD /MESP - member;
- 1.6. Teuta Haxhiu, FD/MESP - member;
- 1.7. Bujar Sekiraqa, ED/ME - member;
- 1.8. Mimoza Kurteshi, DPSIMNO / MIA- member;
- 1.1. Miradije Asllanaj, DEIPC/ MESP -member;
- 1.2. Shpresa Sheremeti, OGE/ MESP - anëtarë;
- 1.3. Venhar Nushi, Office of Strategic Planning (OSP) / PMO -member;
- 1.4. Xhavit Bulliqi, LO/PMO -member;
- 1.5. Fellanza Mekuli, MFLT - member;
- 1.6. Petrit Ahmeti, KEEF - member;
- 1.7. Naim Demiri, MEST - member;
- 1.8. Shqipe Arifaj, Association of Kosovo Municipalities - member;
- 1.9. Bajram Kadriu, DPC/MESP - member.

2. The Working Group from paragraph 1 of this Decision has special authority and responsibility for drafting and finalization of the Strategy, in accordance with the legal

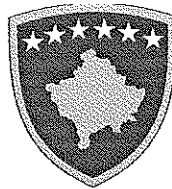
provisions of Law No. 08/L-242 on the Energy Performance of Buildings, as well as other relevant legal provisions in force.

3. The Head of the Working Group, in cooperation with other relevant units, manages the process of preliminary consultation and public consultation in accordance with the standards and procedures set out in Government Regulation (GRK) No. 17/2024 on the Rules of Procedure of the Government of the Republic of Kosovo and applicable legislation.
4. The Working Group prepares all documents and requirements as stipulated by Government Regulation (GRK) No. 17/2024 on the Rules of Procedure of the Government of the Republic of Kosovo.
5. The deadline for completing the initial draft of the Strategy by the Working Group is 21 December 2026.
6. This Decision enters into force on the day of its signature.


Bajram Kafexholli
Acting General Secretary of MESP

Decision shall be sent to:

- Cabinet of the Minister;
- Office of the Secretary General;
- Members of the Working Group;
- Archives of MESP.



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Ministria e Mjedisit, Planifikimit Hapësinor dhe Infrastrukturës
Ministarstvo Životne Sredine, Prostornog Planiranja i Infrastrukture
Ministry of Environment, Spatial Planning and Infrastructure

Zyra e Sekretarit të Përgjithshëm/Kancelarija Generalnog Sekretara/Office of the General Secretary

No. 7757/24
Date: 25.11.24

The General Secretary of the Ministry of Environment and Spatial Planning pursuant to Article 18 of Law No. 06/L-113 on the Organization and Functioning of State Administration and Independent Agencies (Official Gazette of the Republic of Kosovo No. 7, 1 March 2019), Article 31 of Government Regulation (GRK) No. 17/2024 on the Rules of Procedure of the Government of the Republic of Kosovo, as well as the Legislative Plan for Secondary Legislation of the Ministry of Environment, Spatial Planning and Infrastructure (MESPI) for 2024, approved by the Minister through Decision No. 35/24 dated 04.01.2024, as amended and supplemented by Decision No. 35-3 dated 15.02.2024 and Decision No. 35-4/24 dated 19.09.2024, hereby issues the following:

DECISION

1. A Working Group is established for the drafting of the Regulation on the National Methodology for the Calculation of the Energy Performance of Buildings, composed of the following members::

- 1.1. Arben Ajazi, DPHNB - chairperson;
- 1.2. Ardian Reçica, Legal Department – member;
- 1.3. Naime Pakashtica, DSPHC - member;
- 1.4. Xhavit Bulliqi - Legal Office of the PMO - member;
- 1.5. Labinota Kashtanjeva, Department for Policy Coordination and European Integration- member;
- 1.6. Representative from the Ministry of Economy;
- 1.7. Dardan Abazi, Civil society - member.

2. The working group has the following responsibilities:

- 2.1. Develops the process of drafting the initial version of the Draft Regulation on the National Methodology for the Calculation of the Energy Performance of Buildings;
- 2.2. Ensures that the Draft Regulation is prepared in accordance with the Constitution, applicable legislation, the EU Acquis, and the standards and techniques of legislative drafting;
- 2.3. When necessary, coordinates the process with all other units within the proposing authority, as well as with other units of the state administration that are obliged to provide assistance upon its request;

- 2.4. When necessary, cooperates with partner projects supporting the Department of Housing and Building Energy Efficiency (DSPHC) in the field of energy performance of buildings;
- 2.5. Ensures that all procedures and principles established by Government Regulation (GRK) No. 17/2024 on the Rules of Procedure of the Government of the Republic of Kosovo, as well as other applicable legislation, are implemented.
3. The Head of the Working Group, in cooperation with other relevant units, manages the process of preliminary consultation and public consultation in accordance with the standards and procedures set out in the Government Regulation (GRK) No. 17/2024 on the Rules of Procedure of the Government of the Republic of Kosovo and applicable legislation.
4. The Working Group prepares all documents and requirements as stipulated by Government Regulation (GRK) No. 17/2024 on the Rules of Procedure of the Government of the Republic of Kosovo.
5. Upon completion of drafting the Draft Administrative Instruction and other accompanying documentation, the Head of the Working Group submits the Draft Regulation on the National Methodology for the Calculation of the Energy Performance of Buildings to the Director of the Legal Department, who, if there are no remarks, immediately forwards the draft to the General Secretary of the Ministry, who then, if there are no remarks, promptly submits it to the Minister for signature.
6. All relevant units of the Ministry and officials are obliged to cooperate in providing the data requested by the Working Group.
7. This Decision enters into force on the day of its signature.


Bajram Kafexholli
Acting General Secretary in the Ministry of Environment and
Spatial Planning

Decision shall be sent to:

- Cabinet of the Minister;
- Office of the General Secretary;
- Legal Department;
- Members of the Working Group;
- Archives Office of MESP.



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Ministria e Mjedisit dhe Planifikimit Hapësinor
Ministarstvo Sredine i Prostornog Planiranja
Ministry of Environment and Spatial Planning

**PROJEKT RREGULLORE (MMPH) Nr. ____/2026 PËR METODOLOGJINË KOMBËTARE PËR KALKULIMIN E
PERFORMANCËS ENERGJETIKE TË NDËRTESAVE**

**DRAFT REGULATION (MESP) No. ____/2026 ON NATIONAL CALCULATION METHODOLOGY FOR ENERGY
PERFORMANCE OF BUILDINGS**

**NACRT PRAVILNIKA (MŽSPP) Br. ____/2026 O NACIONALNOJ METODOLOGIJI ZA PRORAČUN ENERGETSKE
PERFORMANSE ZGRADA**

Ministrja e Ministrisë së Mjedisit dhe Planifikimit Hapësinor, Në mbështetje të nenit 5, paragrafit 2, të Ligjit Nr. 08/L-242 për Performancën Energjetike të Ndërtesave (Gazeta Zyrtare e Republikës së Kosovës, Nr. 10/12.06 2024), nenit 11, paragrafi 1, nën-paragrafi 1.5, të Ligjit 08/L-117 për Qeverinë e Republikës së Kosovës (Gazeta Zyrtare, Nr. 34/22 dt. 18.11.2022), si dhe nenit 9, paragrafi 2, të Rregullores (QRK) – Nr. 17/2024 për Punën e Qeverisë së Republikës së Kosovës, Nxjerr: RREGULLORE (MMPH) Nr. ____/2026 PËR METODOLOGJINË KOMBËTARE PËR KALKULIMIN E PERFORMANCËS ENERGJETIKE TË NDËRTESAVE KAPITULLI I DISPOZITAT E PËRGJITHSHME Neni 1 Qëllimi 1. Kjo Rregullore përcakton Metodologjinë Kombëtare të Kalkulimit për vlerësimin e performancës së integruar energjetike të ndërtesave, duke siguruar një qasje të	The Minister of the Ministry of Environment and Spatial Planning, Pursuant to Article 5, paragraph 1, of Law No. 08/L-242 on Energy Performance of Buildings (Official Gazette of the Republic of Kosovo, No. 10/12.06.2024); Article 11, paragraph 1, sub-paragraph 1.5, of Law No. 08/L-117 on the Government of the Republic of Kosovo (Official Gazette, No. 34/22 dated 18.11.2022), and Article 9, paragraph 2, of Regulation (GRK) – No. 17/2024 on the Work of the Government of the Republic of Kosovo, Issues: REGULATION (MESP) No. ____/2026 ON NATIONAL CALCULATION METHODOLOGY FOR ENERGY PERFORMANCE OF BUILDINGS CHAPTER I GENERAL PROVISIONS Article 1 Purpose 1. The purpose of this Regulation is to establish the National Calculation Methodology (NCM) for assessing the integrated energy performance of buildings,	Ministar Ministarstva Životne Sredine i Prostornog Planiranja, Na osnovu člana 5, stava 2, Zakona Br. 08/L-242 o Energetskoj Performansi Zgrada (Službeni list Republike Kosova, Br. 10/12.06.2024), člana 11, stav 1, podstav 1.5, Zakona Br. 08/L-117 o Vladi Republike Kosova (Službeni list, Br. 34/22 od 18.11.2022), kao i člana 9, stava 2, Pravilnika (VRK) – Br. 17/2024 o radu Vlade Republike Kosova, Donosi: PRAVILNIKA (MŽSPP) Br. ____/2026 O NACIONALNOJ METODOLOGIJI ZA PRORAČUN ENERGETSKE PERFORMANSE ZGRADA POGLAVLJE I OPŠTE ODREDBE Član 1 Svrha 1. Ovaj pravilnik propisuje Nacionalnu metodologiju proračuna za ocenu integrisane energetske performanse zgrada, obezbeđujući standardizovan pristup u
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standardizuar me kërkesat teknike dhe normat evropiane. 2. Kjo rregullore është pjesërisht në përputhje me Direktivës 2018/844/EU të Parlamentit Evropian dhe të Këshillit të 30 majit 2018 që ndryshon Direktivën 2010/31/EU mbi performancën energjetike të ndërtesave dhe Direktivën 2012/27/EU mbi efikasitetin e energjisë. Neni 2 Fushëveprimi Dispozitat e kësaj Rregullore zbatohet për vlerësimin e performancës së integruar energjetike për të gjitha ndërtesat, njësitë dhe elementet e ndërtesave. Neni 3 Përkufizimet 1. Shprehjet e përdorura në këtë Rregullore kanë kuptimin si në vijim: 1.1. Profili i përdorimit – një grup i të dhënave që karakterizojnë hapësira të caktuara, varësisht nga përdorimi i tyre sipas të njëjtit lloj të përdorimit dhe të njëjtit lloj të kushteve të kondicionimit;	ensuring a standardized approach with applicable technical requirements and European norms. 2. This Regulation is compliant with the Directive 2018/844/EU of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of the buildings and Directive 2012/27/EU on energy efficiency. Article 2 Scope Articles of this Regulation apply to the assessment of the integrated energy performance of buildings and building units and elements. Article 3 Definitions 1. The terms used in this Regulation shall have the following meanings: 1.1. User profile – means a set of data that characterize certain spaces depending on their use by equal type of usage and same type of conditioning.	skladu sa tehničkim zahtevima i evropskim normama. 2. Ovaj pravilnik je delimično usklađen sa Direktivom 2018/844/EU Evropskog parlamenta i Saveta od 30. maja 2018. godine, kojom se menja Direktiva 2010/31/EU o energetske performansi zgrada i Direktiva 2012/27/EU o energetske efikasnosti. Član 2 Delokrug Odredbe ovog pravilnika primenjuju se za ocenu integrisane energetske performanse za sve zgrade, jedinice i elemente zgrada. Član 3 Definicije 1. Pojmovi koji se koriste u ovaj Pravilnik imaju sledeća značenja: 1.1. Korisnički profil – je skup podataka koji karakterišu određene prostore u zavisnosti od njihove upotrebe jednakim tipom korišćenja i istim tipom uslova klimatizacija.
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1.2. Energjia e nevojshme – kërkesa e llogaritur për energji për të përmbushur nevojat për një (1) ose më shumë përdorues përfundimtarë (ngrohje, ftohje, ventilim, ndriçim dhe ngrohje të ujit sanitar); 1.3. Energjia e furnizuar – sasia e përgjithshme e energjisë me të cilën furnizohet ndërtesa nga burime, si: energjia elektrike, gazi, ngrohja qendrore, ose energjia e ripërtëritshme nga jashtë kufijve të ndërtesës, për t’u dorëzuar në ndërtesë me qëllim përmbushjen e nevojave energjetike të saj, duke marrë parasysh eficiencën e pajisjeve; 1.4. Energjia ndihmëse – energjia elektrike e konsumuar nga disa sensorë kontrollues për monitorimin e kushteve të hapësirës; 1.5. Bilanc i energjisë së ndërtesës - ekuilibri sasior midis gjithë energjisë që hyn në një ndërtesë dhe gjithë energjisë që del prej saj gjatë një periudhe të caktuar (zakonisht një vit), duke marrë parasysh fitimet e energjisë (si rrezatimi diellor dhe fitimet e brendshme nga nxehtësia që lirohet nga njerëzit dhe pajisjet) dhe humbjet e energjisë (si transmetimi i nxehtësisë përmes	1.2. Energy need – means calculated energy demands for meeting the need for one or more end users (heating, cooling, ventilation, lighting and sanitary water heating) 1.3. Delivered energy - means the total amount of energy supplied from sources, such as electricity, gas, district heating, or renewable energy from outside the building boundaries delivered to the building in order to meet its energy needs, taking into account the efficiency of the equipments. 1.4. Auxiliary energy - means the electricity consumed by some control sensors for monitoring conditions in a space; 1.5. Energy balance of building – the quantitative equilibrium between all the energy entering a building and all the energy leaving it over a defined period (typically one year), accounting for energy gains (such as solar radiation, and the internal heat gains released by occupants and equipments) and energy losses (such as heat transfer through the building envelope), and energy exported	1.2. Potrebna energija – izračunata potreba za energijom za zadovoljavanje potreba jednog (1) ili više krajnjih korisnika (grejanje, hlađenje, ventilacija, osvetljenje i grejanje sanitarne tople vode); 1.3. Isporučena energija – ukupna količina energije kojom se snabdeva zgrada iz izvora kao što su: električna energija, gas, centralno grejanje ili obnovljiva energija izvan granica zgrade, koja se isporučuje u zgradu radi zadovoljenja njenih energetske potreba, uzimajući u obzir efikasnost opreme; 1.4. Pomoćna energija – električna energija koju troše neki kontrolni senzori za praćenje uslova u prostoru; 1.5. Energetski bilans zgrade – količinska ravnoteža između cele energije koja ulazi u zgradu i celu energiju koja izlazi iz nje tokom određenog perioda (obično jedne godine), uzimajući u obzir dobitke energije (kao što su sunčevo zračenje i unutrašnji izvori od toplote koju oslobađaju ljudi i oprema) i gubitke energije (kao što je prenos toplote kroz ovojnicu zgrade), kao i energija izvezena
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mbështjellësit të ndërtesës), si dhe energjia e eksportuar në rrjet; 1.6. Zona – njësia bazë e hapësirës për llogaritjen e bilanceve të energjisë të ndërtesës. Një (1) zonë përfshin sipërfaqen neto të një (1) ose më shumë hapësirave me të njëjtin lloj përdorimi dhe kondicionim të ajrit, dhe pa ndërhyrje në lidhje me kritere shtesë të zonimit; 1.7 NVKA - ngrohja, ventilimi dhe kondicionimi i ajrit; 1.8. Sipërfaqja e shfrytëzueshme e dyshemesë – sipërfaqe neto e dyshemesë brenda vëllimit të kondicionuar të ndërtesës; 2. Shprehjet e përdorura në këtë Rregullore, kanë kuptimin e njëjtë ashtu siç janë përcaktuar në Ligjin Nr. 08/L-242 për Performancë Energjetike të Ndërtesave dhe Ligjin përkatës për Eficiencë të Energjisë. KAPITULLI II METODOLOGJIA KOMBËTARE E KALKULIMIT Neni 4	to the grid; 1.6. Zone - means the basic unit of space for calculating energy balances of the building. A zone comprises the (net floor) area of a group of rooms with equal type of usage and conditioning and with no interferences regarding additional zoning criteria. 1.7. HVAC - heating, ventilation and air conditioning. 1.8. Useful floor area – means the net floor area within the conditioned volume of the building. 2. The terms and expressions used in this Regulation shall have the same meaning as defined in the Law on Energy Performance of Buildings and the Law on Energy Efficiency. CHAPTER II NATIONAL CALCULATION METHODOLOGY Article 4	u mrežu; 1.6. Zona – znači osnovna jedinica prostora za izračunavanje energetske bilansa zgrade. Jedna (1) zona obuhvata (neto podnu) površinu jednog (1) ili više prostora sa jednakim tipom korišćenja i klimatizacije i bez ikakvih ometanja u vezi sa dodatnim kriterijumima zoniranja. 1.7 HVAC - grejanje, ventilacija i klimatizacija. 1.8. Korisna podna površina – znači neto površina unutar klimatizovane zapremine zgrade. 2. Pojmovi i izrazi koji se koriste u ovaj Pravilnik imaju isto značenje kao što je utvrđeno u Zakonu br. 08/L-242 o energetske performansi zgrada i odgovarajućem Zakonu o energetske efikasnosti. POGLAVLJE II NACIONALNA METODOLOGIJA PRORAČUNA (NMP) Član 4
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Metodologjia Kombëtare e Kalkulimit	National Calculation Methodology	Nacionalna Metodologija Proračuna
1. Metodologjia Kombëtare e Kalkulimit tani e tutje MKK, aplikohet për: 1.1. Kalkulimin e energjisë vjetore të nevojshme për të plotësuar kërkesat e ndryshme të ndërtesës lidhur me përdorimin e zakonshëm të saj; 1.2. Përcaktimin e indikatorit të performancës energjetike të ndërtesës si vlerë numerike e energjisë primare; 1.3. Kalkulimin e niveleve me kosto-optimale të kërkesave për performancë energjetike për ndërtesat, njësitë e ndërtesave dhe elementet e ndërtesave; 1.4. Përgatitjen dhe lëshimin e Certifikatës së Performancës Energjetike (CPE). 2. MKK zbatohet në pajtim me procedurat dhe parametrat e përcaktuar në Shtojcën 1 të kësaj Rregullore.	1. The National Calculation Methodology henceforth NCM, is applied for: 1.1. Calculating of the annual energy demand to meet the various demands of the building related to its normal use; 1.2. Determining the building's energy performance indicator as a numerical value of primary energy; 1.3. Calculating the cost-optimal levels of energy performance demands for buildings, building units and building elements; 1.4. Preparing and issuing the Energy Performance Certificate (EPC). 2. NCM is implemented in accordance with the procedures and parameters defined in Annex 1 of this Regulation	1. Nacionalna metodologija proračuna, u daljem tekstu NMP, primenjuje se za: 1.1. izračunavanje godišnje potrebe za energijom za zadovoljavanje različitih potreba zgrade u vezi sa njenom normalnom korišćenju; 1.2. određivanje indikatora energetske performanse zgrade kao numeričku vrednost primarne energije; 1.3. izračunavanje isplativih optimalnih nivoa za zahteva energetske performanse za zgrade, jedinica zgrada i elemenata zgrada; 1.4. pripremu i izdavanje sertifikata energetske performanse (SEP). 2. NMP se primenjuje u skladu sa procedurama i parametrima utvrđenim u Prilogu 1 ovog Pravilnika.
Neni 5 Kategoritë e përfshira të ndërtesave 1. MKK i mbulon, së paku, kategoritë e mëposhtme të ndërtesave:	Article 5 Categories of included buildings 1. NCM includes at least the following categories of buildings:	Član 5 Kategorije obuhvaćenih zgrada 1. NMP obuhvata najmanje sledeće kategorije zgrada:

1.1. Shtëpitë individuale të tipeve të ndryshme; 1.2. Ndërtesat e banimit me shumë njësi; 1.3. Ndërtesat afariste; 1.4. Ndërtesat administrative; 1.5. Ndërtesat arsimore/edukative; 1.6. Spitalet dhe ndërtesat e kujdesit shëndetësor; 1.7. Hotelet; 1.8. Restorantet; 19. Ndërtesat sportive; 1.10. Ndërtesat për shërbime publike; 1.11. Ndërtesat për aktivitete kulturore. 2. Për kategoritë e ndërtesave të listuara në paragrafin 1 të këtij neni, janë paraqitur profilet e përdorimit të hapësirave të ndërtesave në Shtojcën 5 të kësaj Rregullore. Neni 6	1.1. single-family houses of various types; 1.2. multi-apartment blocks; 1.3. office buildings; 1.4. administrative buildings; 1.5. educational buildings; 1.6. hospitals and health care buildings; 1.7. hotels; 1.8. restaurants; 1.9. sports facilities; 1.10. public service buildings; 1.11. buildings for cultural activities. 2. For the categories of buildings listed in paragraph 1 of this Article, the space usage profiles of buildings are presented in Annex 5 of this Regulation. Article 6	1.1. porodične kuće različitih tipova; 1.2. višestambene zgrade; 1.3. poslovne zgrade; 1.4. administrativne zgrade; 1.5. obrazovne zgrade; 1.6. bolnice i zdravstvene zgrade; 1.7. hotele; 1.8. restorane; 1.9. sportske objekte; 1.10. zgrade javnih službi; 1.11. zgrade za kulturne aktivnosti. 2. Za kategorije zgrada navedene u stavu 1 ovog člana, prikazani su profili korišćenja prostora zgrada u Prilogu 5 ovog Pravilnika. Član 6
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Përcaktimi i bilancit energjetik të ndërtesave	Determination of the energy balance of buildings	Određivanje energetskeg bilansa zgrada
1. MKK përdoret për të kalkuluar bilancin e përgjithshëm energjetik të ndërtesave përmes modelimit të performancës energjetike për të mundësuar llogaritjen e energjisë vjetore të nevojshme që parashikohet të përdoret në ndërtesë, që përfshijnë: 1.1. Ngrohjen e hapësirës; 1.2. Ftohjen e hapësirës; 1.3. Ventilimin; 1.4. Ngrohjen e ujit sanitar; 1.5. Ndriçimin. 2. MKK merr parasysh edhe mundësitë për përdorimin e burimeve të ripërtëritshme të energjisë dhe teknologjive të avancuara, siç janë: 2.1. Sistemet diellore termike; 2.2. Sistemet diellore fotovoltaike; 2.3. Energjia e erës;	1. The NCM is used to calculate the overall energy balance of buildings through the modelling of energy performance to enable the calculation of the annual energy required that is foreseen to be used in the building, which includes: 1.1. space heating; 1.2. space cooling; 1.3. ventilation; 1.4. sanitary hot water; 1.5. lighting. 2. The NCM also takes into account the possibilities for using renewable energy sources and advanced technologies, such as: 2.1. solar thermal systems, 2.2. solar photovoltaic systems, 2.3. wind energy,	1. NMP se koristi za izračunavanje ukupnog energetskeg bilansa zgrada putem modeliranja energetske performanse kako bi se omogućilo izračunavanje godišnje potrebne energije koja se predviđa za upotrebu u zgradi, što uključuje: 1.1. grejanje prostora; 1.2. hlađenje prostora; 1.3. ventilaciju; 1.4. sanitarnu toplu vodu; 1.5. osvetljenje; 2. NMP uzima u obzir i mogućnosti za korišćenje obnovljivih izvora energije i naprednih tehnologija, kao što su: 2.1. Solarni termički sistemi; 2.2. Solarni fotonaponski sistemi; 2.3. Energija vetra;

2.4. Sistemet gjeotermike; 2.5. Sistemet aerotermike; dhe 2.6. Pajisjet për prodhimin e kombinuar të energjisë (ngrohjes dhe energjisë elektrike) në ndërtesë ose në afërsi të saj. 3. Të dhënat klimatike të përcaktuara në Shtojcën 2 të kësaj Rregullore, si dhe të dhënat e profileve të përdorimit të ndërtesave të përcaktuara në Shtojcën 5 të kësaj Rregullore përdoren për kalkulimin e bilancit energjetik të ndërtesës. Neni 7 Standardet MKK është në pajtim me standardet përkatëse të miratuara dhe publikuara nga Agjencia Kosovare e Standardizimit (AKS) dhe me standardet relevante evropiane, të cilat janë janë të përcaktuara në Shtojcën 4 të kësaj Rregullore. KAPITULLI III SOFTUERI Neni 8	2.4. geothermal systems, 2.5. aerothermal systems, and 2.6. equipments for combined production of energy (heating and electricity) in the building of near by. 3. The climatic data specified in Annex 2 of this Regulation, as well as the building use profile data specified in Annex 5 of this Regulation, are used for the calculation of the building's energy balance. Article 7 Standards The NCM is in compliance with the relevant standards approved and published by the Kosovo Standardization Agency (KSA), as well as with the relevant European standards, as specified in Annex 4 of this Regulation. CHAPTER III THE SOFTWARE Article 8	2.4. Geotermalni sistemi; 2.5. Aerotermalni sistemi; i 2.6. Postrojenja za kombinovanu proizvodnju energije (toplotne i električne energije) u zgradi ili u njenoj blizini. 3. Klimatski podaci utvrđeni u Prilogu 2 ovog Pravilnika, kao i podaci o profilima korišćenja zgrada utvrđeni u Prilogu 5 ovog Pravilnika, koriste se za proračun energetskeg bilansa zgrade. Član 7 Standardi NMP je u skladu sa odgovarajućim standardima usvojenim i objavljenim od strane Agencije za standardizaciju Kosova (ASK), kao i sa relevantnim evropskim standardima koji su utvrđeni u Prilogu 4 ovog Pravilnika. POGLAVLJE III SOFTVER Član 8
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Miratimi i softuerit	Approval of software	Odobrovanje softvera
1. Kalkulimi i performancës energjetike të ndërtesave sipas kësaj Rregulloreje bëhet përmes softuerëve të miratuar nga Ministria. 2. Ministria miraton softuerin, përmes vendimit, i cili duhet të jetë në pajtim me kriteret dhe kushtet e parapara në këtë Rregullore. 3. Përdoruesit e softuerit dhe vlerësuesit e licencuar të energjisë që lëshojnë CPE-në janë përgjegjës për përdorimin e softuerit dhe për rezultatet e nxjerrura për CPE-në. 4. Çdo përditësim i softuerit duhet të publikohet në ueb faqen e Ministrisë duke përfshirë historikun e versioneve.	1. Calculation of the energy performance of buildings under this Regulation is carried out using softwares approved by the Ministry. 2. The Ministry approves the software by decision, based on objective and transparent criteria, which should be in compliance with criteria and conditions set in this Regulation. 3. Software users and licensed energy evaluators issuing CPE are responsible for the use of the software and for the results obtained for the CPE. 4. Any software update must be published on the Ministry's website, including the version history.	1. Proračun energetske performanse zgrada u skladu sa ovom Pravilnikom vrši se putem softvera odobrenih od strane Ministarstva. 2. Ministarstvo odobrava softver putem odluke, koji mora biti u skladu sa kriterijumima i uslovima propisanim ovim Pravilnikom. 3. Korisnici softvera i licencirani energetski ocenjivači koji izdaju SEP, odgovorni su za korišćenje softvera i za rezultate dobijene za SEP. 4. Svako ažuriranje softvera mora biti objavljeno na veb stranici Ministarstva, uključujući istorijat verzija.
Neni 9 Pasqyra e kalkulimit	Article 9 Calculation overview	Član 9 Pregled proračuna
1. Softueri pranon të dhëna nga përdoruesi dhe nga baza e të dhënave të paracaktuara, dhe përmes kalkulimeve, paraqet rezultatin me tregues numerik të konsumit të energjisë primare në kWh/(m²v), për nxjerrjen e CPE-së. 2. Softueri kalkulon: energjinë e nevojshme,	1. The software shall receive data from user and databases and by means of calculation shall express the result by a numeric indicator of primary energy use in kWh/(m²a) for the purpose of issuing EPC. 2. The software shall calculate: the energy	1. Softver prihvata podatke od korisnika i iz definisane baze podataka, i putem proračuna prikazuje rezultat sa numeričkim pokazateljem potrošnje primarne energije u kWh/(m²g), za izdavanje SEP-a. 2. Softver izračunava: potrebnu energiju,

energjinë e furnizuar dhe energjinë primare për sistemet teknike për ngrohje, ftohje, ventilim, prodhim të ujit të ngrohtë sanitar dhe ndriçim të ndërtesës, bazuar në zonimin e hapësirave dhe profilin e përdorimit të përcaktuar në këtë Rregullore. 3. Pas vendosjes së të dhënave nga përdoruesi, softueri: 3.1. Përcakton fitimet e nxehtësisë për secilën zonë të ndërtesës; 3.2. Kalkulon transmetimin e nxehtësisë ndërmjet çdo zone të ndërtesës kur ato janë të ngjitura njëra me tjetrën apo të kufizuara me mjedisin e jashtëm, duke përdorur algoritmet standarde; 3.3. Merr parasysh eficiencën përkatëse të sistemit të ngrohjes, ventilimit, ftohjes dhe ngrohjes së ujit sanitar për të përcaktuar energjinë e furnizuar për ruajtjen e komfortit termik; 3.4. Kalkulon nevojat e energjisë për ndriçim, bazuar në procedurën e standardizuar duke marrë parasysh sipërfaqet e xhamëzuara, hijezimin, burimin e dritës dhe sistemet e kontrollimit të ndriçimit.	needs, delivered energy and primary energy for the technical systems for heating, cooling, ventilation, domestic hot water generation and lighting of the building based on user profiles and the buiding zones, defined in this regulation. 3. After data input from the user, the software shall: 3.1. determine the heat gains for each zone of building; 3.2. calculate heat transmission between each building zone when these sides are adjacent or bounded with the external environment, using standard algorithms. 3.3. apply the relevant efficiency of the heating, ventilation, cooling and sanitary water heating to determine the delivered energy to maintain thermal comfort; 3.4. calculate the energy needs for lighting, based on a standardized procedure taking into account glazed surfaces, shading, light sources, and lighting control systems;	isporučenu energiju i primarnu energiju za tehničke sisteme za grejanje, hlađenje, ventilaciju, pripremu sanitarnu potrošnu toplu vodu i osvetljenje zgrade, na osnovu zoniranja prostora i profila korišćenja utvrđenog u ovaj Pravilnik. 3. Nakon unosa podataka od korisnika, softver: 3.1. odredi toplotne dobitke za svaku zonu zgrade; 3.2. izračunava prenos toplote između svake zone zgrade kada su one međusobno susedne ili ograničene spoljnim okruženjem, koristeći standardne algoritme; 3.3. uzima u obzir odgovarajuću efikasnost sistema za grejanje, ventilaciju, hlađenje i pripremu sanitarne potrošne tople vode kako bi se odredila isporučena energija za održavanje toplotnog komfora; 3.4. izračunava potrebe za energijom za osvetljenje, na osnovu standardizovane procedure, uzimajući u obzir zastakljene površine, zasenčenje, izvor svetlosti i sisteme upravljanja osvetljenjem.
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4. Procedurat e rrjedhës së kalkulimeve me të dhënat e paracaktuara të nevojshme për kalkulim, janë të përcaktuara në Shtojcën 1 të kësaj Rregullore. 5. Faktorët energjetik dhe faktorët e emetimeve të lëndëve djegëse përdoren sipas Shtojcës 3 të kësaj Rregullore.	4. The procedures of the calculation workflow using the predefined data required for calculation are set out in Annex 1 of this Regulation. 5. Energy factors and fuels emission factors are applied in accordance with Annex 3 of this Regulation.	4. Postupci toka proračuna sa unapred definisanim podacima potrebnim za proračun utvrđeni su u Prilogu 1 ovog Pravilnika. 5. Energetski faktori i faktori emisija goriva koriste se u skladu sa Prilogom 3 ovog Pravilnika.
Neni 10 Të dhënat dhe burimet e informatave 1. Softueri ofron modulën për vendosjen e të dhënave i cili shërben si mjet përmes të cilit përdoruesi, zgjedh opsionet nga bazat e të dhënave në dispozicion dhe vendos të dhënat në mënyrë manuale. 2. Baza e të dhënave në dispozicion në softuer përbëhet nga të dhënat: 2.1. teknike bazuar në standardet e sistemeve teknike që përdoren në ndërtesë, të cilat janë të definuara në Shtojcën 1 të kësaj Rregullore; 2.2. klimatike të cilat janë të definuara në Shtojcën 2 të kësaj Rregullore; 2.3. për lëndët djegëse, të cilat janë të definuara në Shtojcën 3 të kësaj Rregullore;	Article 10 Inputs and information sources 1. The software provides a data entry module that serves as a tool through which the user selects options from the available databases and enters data manually 2. The database available in the software consists of: 2.1. Technical data based on the standards of the technical systems used in the building, which are defined in Annex 1 of this Regulation; 2.2. Climatic data, which are defined in Annex 2 of this Regulation; 2.3. Fuels, which are defined in Annex 3 of this Regulation;	Član 10 Ulazni podaci i izvori informacija 1. Softver nudi modul za unos podataka koji služi kao alat putem kojeg korisnik bira opcije iz dostupnih baza podataka i unosi podatke ručno. 2. Baza podataka dostupna u softveru sastoji se od podataka: 2.1. tehničke, zasnovane na standardima tehničkih sistema koji se koriste u zgradi, a koje su definisane u Prilogu 1 ovog Pravilnika; 2.2. klimatske, koje su definisane u Prilogu 2 ovog Pravilnika; 2.3. za goriva, koje su definisane u Prilogu 3 ovog Pravilnika;

2.4. për profilet e përdorimit të hapësirave të ndërtesave të cilat janë të definuara në Shtojcën 5 të kësaj Rregullore. 3. Hapat e procesit të vendosjes manuale të të dhënave janë: 3.1. Përcaktimi i sipërfaqes gjeometrike (në m²) të hapësirave të ndryshme të ndërtesës; 3.2. Përcaktimi i aktiviteteve që zhvillohen në çdo pjesë të ndërtesës me qëllim që të definohen kushtet për secilën nga këto aktivitete dhe kohëzgjatja e tyre bazuar në vlerat e marra nga baza e të dhënave standarde; 3.3. Regjistrimi i hapësirave dhe elementeve ndërtimore që rrethojnë çdo hapësirë ku zhvillohen aktivitetet; 3.4. Definimi i sistemeve të NVKA, ngrohjes së ujit sanitar dhe të ndriçimit, duke përfshirë sistemet e tyre të kontrollit, si dhe përcaktimi i zonës që shërbejnë; 3.5. Përcaktimi kurdo që është e	2.4. The profiles of use of building spaces, as defined in Annex 5 of this Regulation; 3.The steps of the manual data entry process are: 3.1. Determination of the area (in m²) of the different spaces of the building; 3.2. Determination of the activities carried out in each part of the building in order to define the conditions for each of these activities and their duration, based on the values obtained from the standard database; 3.3. Recording the spaces and the building elements surrounding each space where the activities take place; 3.4. Definition of the HVAC systems, domestic hot water heating, and lighting, including their control systems, as well as the determination of the zones they serve; 3.5. Determination, whenever appropriate,	2.4. za profile korišćenja prostora u zgradama, koje su definisane u Prilogu 5 ovog Pravilnika. 3. Koraci procesa ručnog unosa podataka su: 3.1. određivanje geometrijske površine (u m²) različitih prostorija u zgradi; 3.2. određivanje aktivnosti koje se odvijaju u svakoj prostoriji radi definisanja uslova za svaku od tih aktivnosti i njihovog trajanja, zasnovano na vrednostima iz standardne baze podataka; 3.3. evidentiranje prostorija i građevinskih elemenata koji okružuju svaku prostoriju u kojoj se odvijaju aktivnosti; 3.4. Definisanje sistema HVAC, pripreme potrošne tople vode i osvetljenja, uključujući njihove sisteme kontrole, kao i određivanje zone koju služe; 3.5. određivanje, kad god je prikladno,
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përshtatshme i përdorimit të cilitdo sistem të energjisë së ripërtëritshme në ndërtesë si: sistemet diellore fotovoltaike, ngrohja e ujit sanitar nga kolektorët diellorë, prodhimi i kombinuar i nxehtësisë dhe energjisë elektrike, etj.	of the use of any renewable energy system in the building, such as: photovoltaic solar systems, domestic hot water heating from solar collectors, combined heat and power generation, etc.	korišćenja bilo kog sistema obnovljive energije u zgradi, kao što su: fotonaponski solarni sistemi, priprema potrošne tople vode pomoću solarnih kolektora, kombinovana proizvodnja toplote i električne energije itd.
4. Përdoruesi i softuerit, për qëllimet e kalkulimit përdor të dhënat përkatëse për elementet e ndërtesës dhe sistemet teknike, duke përfshirë:	4. For the purposes of calculation according to NCM, the software user utilizes the relevant data for the building elements and technical systems, including:	4. Korisnik softvera, za potrebe proračuna, koristi odgovarajuće podatke za elemente zgrade i tehničke sisteme, uključujući:
4.1. Vlerën e koeficientit të tejkalimit të nxehtësisë (vlerën U);	4.1. The value of the heat transfer coefficient (U-value),	4.1. vrednost koeficijenta prenosa toplote (U-vrednost);
4.2. Kapacitetin termik;	4.2. Thermal capacity,	4.2. termički kapacitet;
4.3. Eficiencën e sistemeve të ngrohjes, ventilimit dhe kondicionimit të ajrit;	4.3. The efficiency of heating, ventilation, and air conditioning systems,	4.3. efikasnost sistema grejanja, ventilacije i klimatizacije;
4.4. Të dhënat për ujin e ngrohtë sanitar;	4.4. Data for domestic hot water,	4.4. podatke o potrošnoj sanitarne toplotne vode;
4.5. Të dhënat për ndriçim dhe sistemet e kontrollit.	4.5. Data for lighting and control systems.	4.5. podatke o osvetljenju i sistemima kontrole.
5. Të dhënat nga paragrafi 4 i këtij neni, merren nga baza e brendshme e të dhënave të softuerit, ose kur është e arsyeshme, vendosen në mënyrë manuale nga përdoruesi.	5. The data from paragraph 4 of this article, are taken from the software's internal database, or when reasonable, are entered manually by the user.	5. Podaci iz stava 4 ovog člana, preuzimaju se iz interne baze podataka softvera, ili kada je prikladno, unose se ručno od strane korisnika.

6. Gjatë përdorimit të softuerit, përdoruesi i qaset bazës së të dhënave të softuerit për detaje të standardizuara të elementeve të ndërtesës dhe për të dhënat e përcaktuara lidhur me performancën për ngrohje, ventilim, dhe sisteme të ajrit të kondicionuar, ujë të ngrohtë sanitar dhe ndriçim. Kjo bazë e të dhënave duhet të jetë e qasshme me qëllim që përdoruesi të mund t'i shmanget disa parametrave të zgjedhur automatikisht nga softueri duke i vendosur të dhënat e veta. 7. Softueri përmban një bazë të të dhënave “të mbyllura” që lidhen me parametrat e profileve të përdorimit të ndërtesës dhe të dhënat mbi kushtet klimatike. Kjo bazë e të dhënave quhet “të mbyllura” sepse përdoruesit e softuerit nuk mund të kenë mundësi t'i ndryshojnë parametrat e caktuar nga Ministria, me qëllim që këta parametra të jenë të njëjtë për ndërtesa referente dhe të mundësojnë krahasimin e drejtë dhe të qëndrueshëm. 8. Përdoruesi, sipas nevojës, vendos rekomandimet për masat e propozuara për përmirësimin e performancës energjetike të ndërtesës dhe të njësisve të ndërtesës. KAPITULLI IV DISPOZITAT PËRFUNDIMTARE	6. During the use of the software, the user accesses the database for standardized details of building elements and for the specified data related to the performance of heating, ventilation, and air conditioning systems, domestic hot water, and lighting. This database must be accessible so that the user can override certain parameters automatically selected by the software by entering their own data. 7. The software contains a “closed” database related to the parameters of building use profiles and climatic data. This database is called “closed” because software users cannot modify the parameters set by the Ministry, ensuring that these parameters are the same for reference buildings and allowing for fair and consistent comparisons. 8. The user, as needed, enters the recommendations for the proposed measures to improve the energy performance of the building and its units. CHAPTER IV FINAL PROVISIONS	6. Tokom korišćenja softvera, korisnik pristupa bazi podataka softvera radi detalja standardizovanih elemenata zgrade i podataka vezanih za performanse sistema grejanja, ventilacije, klimatizacije, potrošne tople vode i osvetljenja. Ova baza podataka mora biti dostupna kako bi korisnik mogao da izbegne neke parametre koje softver automatski bira, unoseći sopstvene podatke. 7. Softver sadrži jednu “zatvorenu” bazu podataka koja se odnosi na parametre profila korišćenja zgrade i podatke o klimatskim uslovima. Ova baza podataka naziva se “zatvorena” jer korisnici softvera ne mogu menjati parametre koje je odredilo Ministarstvo, kako bi ti parametri bili isti za referentne zgrade i omogućili pravično i dosledno poređenje. 8. Korisnik, po potrebi, unosi preporuke za predložene mere za poboljšanje energetske efikasnosti zgrade i njenih jedinica. POGLAVLJE IV ZAVRŠNE ODREDBE
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Neni 11 Dispozitat shfuqizuese Me hyrjen në fuqi të kësaj Rregulloreje, shfuqizohet Rregullorja (MMPHI) Nr. 02/18 për Metodologjinë Kombëtare për Kalkulimin e Përformacës së Integruar Energjetike të Ndërtesave. Neni 12 Shtojcat 1. Pjesë përbërëse e kësaj Rregullore janë Shtojcat: 1.1. Shtojca 1 - Kushtet dhe Kriteret Teknike të Metodologjisë Kombëtare të Kalkulimit; 1.2. Shtojca 2 – Të Dhënat Klimatike; 1.3. Shtojca 3 - Faktorët e Energjisë dhe Faktorët e Emetimeve të Lëndëve Djegëse; 1.4. Shtojca 4 - Lista e Referencave të Standardeve; 1.5. Shtojca 5 – Profilet e Përdorimit të Ndërtesave.	Article 11 Repealing provisions Upon the entry into force of this Regulation, Regulation (MESPI) No. 02/18 on the National Methodology for Calculating the Integrated Energy Performance of Buildings is repealed. Article 12 Annexes 1. The integral part of this Regulation are the Annexes: 1.1. Annex 1 - The Technical Conditions and Criteria of the National Calculation Methodology; 1.2. Annex 2 – Climatic Data; 1.3. Annex 3 - Energetic Factors and Emission Factors of Fuels; 1.4. Annex 4 – List of Applicable Standards; 1.5. Annex 5 – User Profiles of buildings.	Član 11 Ukinute odredbe Stupanjem na snagu ovog Pravilnika, ukida se Pravilnik (MŽSPPI) br. 02/18 o Nacionalnoj metodologiji za izračunavanje integrisane energetske performanse zgrada i njeni prilozi. Član 12 Prilozi 1. Sastavni deo ovog Pravilnika su prilozi: 1.1. Prilog 1 – Uslovi i tehnički kriterijumi Nacionalne metodologije za proračun; 1.2. Prilog 2 – Klimatski podaci; 1.3. Prilog 3 – Energetski faktori i faktori emisija goriva; 1.4. Prilog 4 – Lista referenci standarda; 1.5. Prilog 5 – Profili korišćenja zgrada.
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Neni 13 Hyrja në fuqi Kjo Rregullore hyn në fuqi shtatë (7) ditë pas publikimit në Gazetën Zyrtare të Republikës së Kosovës. Fitore Pacolli Dalipi Ministre e Ministrisë së Mjedisit dhe Planifikimit Hapësinor Prishtinë, ____2026	Article 13 Entry into force This Regulation shall enter into force seven (7) days after its publication in the Official Gazette of the Republic of Kosovo. Fitore Pacolli Dalipi Minister of the Ministry of Environment and Spatial Planning Pristina, ____2026	Član 13 Stupanje na snagu Ovaj Pravilnik stupa na snagu sedam (7) dana nakon objavljivanja u Službenom listu Republike Kosovo. Fitore Pacolli Dalipi Ministar Ministarstva Životne Sredine i Prostornog Planiranja Priština, ____2026
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Republika e Kosovës
Republika Kosova-Republic of Kosovo
Qeveria - Vlada - Government

Ministria e Mjedisit, Planifikimit Hapësinor
Ministarstvo Sredine i Prostornog Planiranja
Ministry of Environment and Spatial Planning

Zyra e Sekretarit të Përgjithshëm/Kancelarija Generalnog Sekretara/Office of the General Secretary

No. 7758/24

Date: 25.11.24

The General Secretary of the Ministry of Environment, Spatial Planning, pursuant to Article 18 of Law No. 06/L-113 on the Organization and Functioning of State Administration and Independent Agencies (Official Gazette of the Republic of Kosovo No. 7/01, 1 March 2019), Article 31 of Government Regulation (GRK) No. 17/2024 on the Rules of Procedure of the Government of the Republic of Kosovo, as well as the Legislative Plan for Secondary Legislation of the Ministry of Environment, Spatial Planning (MESP) for 2024, approved by the Minister through Decision No. 35/24 dated 04.01.2024, as amended and supplemented by Decision No. 35-3 dated 15.02.2024 and Decision No. 35-4/24 dated 19.09.2024, issues the following:

DECISION

1. A Working Group is established for the drafting of the Regulation on the Determination of Minimum Requirements for the Energy Performance of Buildings, composed as follows:

- 1.1. Arben Ajazi, DPHNB - chairperson;
- 1.2. Ardian Reçica Legal Department-member;
- 1.3. Naime Pakashtica, DSPHC - member;
- 1.4. Xhavit Bulliqi - Legal Office of the PMO - member;
- 1.5. Labinota Kashtanjeva, Department for Policy Coordination and European Integration - member;
- 1.6. Representative from the Ministry of Economy;
- 1.7. Dardan Abazi, Civil society - member.

2. The Working Group has the following responsibilities:

- 2.1. Develops the process of drafting the initial version of the Draft Regulation of the Regulation on Determination of Minimum Requirements for the Energy Performance of Buildings;
- 2.2. Ensures that the Draft Regulation is prepared in accordance with the Constitution, applicable legislation, the EU Acquis, and the standards and techniques of legislative drafting;
- 2.3. When necessary, coordinates the process with all other units within the proposing authority, as well as with other units of the state administration that are obliged to provide assistance upon its request;

- 2.4. When necessary, cooperates with partner projects supporting the Department of Housing and Building Energy Efficiency (DSPHC) in the field of energy performance of buildings;
- 2.5. Ensures that all procedures and principles set out in Government Regulation (GRK) No. 17/2024 on the Rules of Procedure of the Government of the Republic of Kosovo, as well as other applicable legislation, are implemented.
3. The Head of the Working Group, in cooperation with other relevant units, manages the process of preliminary and public consultation in accordance with the standards and procedures set out in Government Regulation (GRK) No. 17/2024 on the Rules of Procedure of the Government of the Republic of Kosovo and applicable legislation.
4. The Working Group prepares all documents and requirements as required by Government Regulation (GRK) No. 17/2024 on the Rules of Procedure of the Government of the Republic of Kosovo.
5. The deadline for completing the initial draft of the Draft Regulation on the Determination of Minimum Requirements for the Energy Performance of Buildings by the Working Group is 26.12.2026.
6. Upon completion of the drafting of the Draft Administrative Instruction and other accompanying documentation, the Head of the Working Group submits the Draft Regulation on Determination of Minimum Requirements for the Energy Performance of Buildings to the Director of the Legal Department, who, if there are no remarks, immediately forwards the draft to the General Secretary of the Ministry, who then, if there are no remarks, submits it to the Minister for signature.
7. All relevant units of the Ministry and officials are obliged to cooperate in providing the data requested by the Working Group.
8. This Decision enters into force on the day of its signature.

Bajram Kafexholli

Acting General Secretary of MESP



Decision shall be sent to:

- Cabinet of the Minister;
- Office of the General Secretary;
- Legal Department;
- Members of the Working Group;
- Archive Office of MESP.



Republika e Kosovës
Republika Kosova-Republic of Kosovo
Qeveria –Vlada-Government

Ministria e Mjedisit dhe Planifikimit Hapësinor
Ministarstvo Životne Sredine i Prostornog Planiranja
Ministry of Environment and Spatial Planning

**PROJEKT RREGULLORE (MMPH) Nr. ____/2026 PËR KËRKESAT MINIMALE PËR PËRFORMANCËN ENERGJETIKE TË
NDËRTESAVE**

**DRAFT REGULATION (MESP) No. ____/2026 ON MINIMAL REQUIREMENT OF THE ENERGY PERFORMANCE OF
BUILDINGS**

**NACRT UREDBE (MŽSPP) Br. ____/2026 O MINIMALNIM ZAHTEVIMA ZA ENERGETSKE PERFORMANSE
ZGRADA**

Ministrja e Ministrisë së Mjedisit dhe Planifikimit Hapësinor, Në mbështetje të nenit 6 paragrafit 5 të Ligjit Nr. 08/L-242 për Përformancën Energjetike të Ndërtesave (Gazeta Zyrtare e Republikës së Kosovës, Nr. 10/12.06.2024), nenit 11 paragrafi 1, nën-paragrafi 1.5, të Ligjit 08/L-117 për Qeverinë e Republikës së Kosovës (Gazeta Zyrtare, Nr. 34/22 dt. 18.11.2022), si dhe nenit 9, paragrafi 2, të Rregullores (QRK) – Nr. 17/2024 për Punën e Qeverisë së Republikës së Kosovës, Nxjerr: RREGULLORE (MMPH) NR. ____/2026 PËR KËRKESAT MINIMALE PËR PËRFORMANCËN ENERGETIKE TË NDËRTESAVE KAPITULLI I DISPOZITAT E PËRGJITHSHME Neni 1 Qëllimi Qëllimi i kësaj Rregulloreje është të përcaktojë kërkesat minimale për vlerësimin e performancës energjetike të ndërtesave, në pajtim me Metodologjinë Kombëtare të	The Minister of the Ministry of Environment and Spatial Planning, Pursuant to Article 6, paragraph 5, of Law No. 08/L-242 on Energy Performance of Buildings (Official Gazette of the Republic of Kosovo, No. 10/12.06.2024); Article 11, paragraph 1, sub-paragraph 1.5, of Law No. 08/L-117 on the Government of the Republic of Kosovo (Official Gazette, No. 34/22 dated 18.11.2022), and Article 9, paragraph 2, of Regulation (GRK) – No. 17/2024 on the Work of the Government of the Republic of Kosovo, Issues: REGULATION (MESP) NO. ____/2026 ON MINIMUM ENERGY PERFORMANCE REQUIREMENTS FOR BUILDINGS CHAPTER I GENERAL PROVISIONS Article 1 Purpose The purpose of this Regulation is to define the minimum requirements for assessing the energy performance of buildings, in accordance with the National Calculation	Ministar Ministarstva Životne Sredine i Prostornog Planiranja, Na osnovu člana 6, stava 5, Zakona Br. 08/L-242 o energetske performansi zgrada (Službeni list Republike Kosova, br. 10/12.06.2024), člana 11, stav 1, podstav 1.5, Zakona br. 08/L-117 o Vladi Republike Kosova (Službeni list, br. 34/22 od 18.11.2022), kao i člana 9, stava 2, Pravilnika (VRK) – br. 17/2024 o radu Vlade Republike Kosova, Donosi: UREDBA (MŽSPP) BR. ____/2026 O MINIMALNIM ZAHTEVIMA ZA ENERGETSKE PERFORMANSE ZGRADA POGLAVLJE I OPŠTE ODREDBE Član 1 Svrha Svrha ove uredbe je da se utvrde minimalni zahtevi za procenu energetske karakteristika zgrada, u skladu sa Nacionalnom metodologijom proračuna, sa ciljem poboljšanja energetske
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Kalkulimit, me synim përmirësimin e efijencës së energjisë, reduktimin e konsumit të energjisë dhe emetimeve të CO₂, si dhe sigurimin e kushteve të përshtatshme të klimës së brendshme.	Methodology, with the aim of improving energy efficiency, reducing energy consumption and CO₂ emissions, as well as ensuring suitable indoor climate conditions.	efikasnosti, smanjenja potrošnje energije i emisije CO₂ i obezbeđivanja odgovarajućih klimatskih uslova u zatvorenom prostoru.
Neni 2 Fushëveprimi Dispozitat e kësaj Rregullore zbatohen në vlerësimin e performancës energjetike të ndërtesave të reja ndërtesave ekzistuese dhe njësive të tyre, që i nënshtrohen rinovimit të madh, përfshirë elementet e mbështjellësit të ndërtesës dhe sistemet teknike.	Article 2 Scope The provisions of this Regulation shall apply to the assessment of the energy performance of new buildings, existing buildings and their units, which are subject to major renovation, including the elements of the building envelope and technical systems.	Član 2 Delokrug Odredbe ovog Pravilnikaprimenjuju se na procenu energetske karakteristike novih zgrada, postojećih zgrada i njihovih jedinica, koje su predmet veće renovacije, uključujući elemente omotača zgrade i tehničke sisteme.
Neni 3 Përkufizimet 1. Shprehjet e përdorura në këtë Rregullore kanë kuptimin si në vijim: 1.1. Dritarja - një hapësirë e hapur në muret e një ndërtese, që shërben për të lejuar hyrjen e dritës dhe ajrit; 1.2. Metodologjia Kombëtare e Kalkulimit (MKK) - metodologjia për kalkulimin e performancës energjetike të ndërtesës, cila përdoret në kalkulimin e niveleve të kostos optimale për kërkesat e performancës energjetike të ndërtesave,	Article 3 Definitions 1. The expressions used in this Regulation shall have the following meaning: 1.1. Window - an open space in the walls of a building, which serves to allow the entry of light and air; 1.2. National Calculation Methodology (NCM) - the methodology for calculating the energy performance of a building, defined by the Regulation on the NCM, which is used in calculating cost-optimal levels for the energy performance	Član 3 Definicije 1. Termini koji se koriste u ovoj uredbi imaju sledeća značenja: 1.1. Prozor - otvoreni prostor u zidovima zgrade, koji služi za ulazak svetlosti i vazduha; 1.2. Nacionalna metodologija proračuna (NMP) - metodologija za proračun energetske performansi zgrade, definisana Uredbom o NMP, koja se koristi pri izračunavanju optimalnih nivoa troškova za zahteve energetske performansi zgrade,

njësive të ndërtesave dhe elementeve të ndërtesave për përgatitjen dhe lëshimin e certifikatave të performancës energjetike; 1.3. Ndërtesa referente – një ndërtesë krahasuese me të njëjtin destinim, me karakteristikat identike të gjeometrisë, ndarjes të pjesëve jo-transparente dhe transparente të mbështjellësit, si dhe orientimin, e vendosur në të njëjtat kushte klimatike si ndërtesa reale, por me karakteristikat e mbështjellësit dhe të sistemeve teknike sipas Shtojcës 1 dhe Shtojcës 2 të kësaj Rregulloreje. 2. Termet dhe shprehjet e përdorura në këtë Rregullore, kanë kuptimin e njëjtë ashtu siç janë përcaktuar në Ligjin Nr. 08/L-242 për Performancë Energjetike të Ndërtesave. KAPITULLI II KËRKESAT E PËRGJITHSHME Neni 4 Kushtet e përgjithshme të përcaktimit të kërkesave minimale 1.Kërkesat minimale të performancës energjetike të elementeve të mbështjellësit të	requirements of buildings, building units and building elements for the preparation and issuance of energy performance certificates; 1.3. Reference building – a comparative building with the same purpose, with identical characteristics of geometry, the division of opaque and transparent parts of the envelope, as well as orientation, located in the same climatic conditions as the actual building, but with the characteristics of the envelope and technical systems according to Annex 1 and Annex 2 to this Regulation. 2. The terms and expressions used in this Regulation shall have the same meaning as defined in Law No. 08/L-242 on Energy Performance of Buildings. CHAPTER II GENERAL REQUIREMENTS Article 4 General conditions for defining minimum requirements 1.The minimum energy performance requirements for elements of the building	građevinskih jedinica i građevinskih elemenata za pripremu i izdavanje sertifikata o energetskim performansama; 1.3. Referentna zgrada – uporedna zgrada iste namene, sa identičnim karakteristikama geometrije, razdvajanjem ne-transparentnih i transparentnih delova omotača, kao i orijentacijom, smeštena u istim klimatskim uslovima kao i stvarna zgrada, ali sa karakteristikama omotača i tehničkih sistema prema Prilogu 1 i Prilogu 2 ovog pravilnika. 2. Termini i izrazi koji se koriste u ovoj uredbi imaju isto značenje kao što je definisano u Zakonu br. 08/L-242 o Energetskim Performansama Zgrada. POGLAVLJE II OPŠTI ZAHTEVI Član 4 Opšti uslovi za određivanje minimalnih zahteva 1.Minimalni zahtevi za energetske performanse elemenata omotača zgrade i tehničkih sistema
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ndërtesave dhe sistemeve teknike të ndërtesave për ndërtimin e ndërtesave të reja, ekzistuese dhe njërive të tyre që i nënshtrohen rinovimit të madh, përcaktohen në bazë të parimit të kosto-optimumit. 2. Gjatë përcaktimit të kërkesave minimale merret parasysh ndikimi mjedisor dhe reduktimi i emetimeve të CO₂. 3. Në bazë të objektivave për arritjen e ngritjes së efikasitetit të energjisë në ndërtesa, Ministria në bazë të Ligjit Nr. 08/L-242 për Performancë Energjetike të Ndërtesave, rishikon kërkesat minimale në intervale të rregullta dhe sipas nevojës, përditëson kërkesat minimale për ta pasqyruar zhvillimin teknik në sektorin e ndërtesave.	envelope and technical building systems for the construction of new and existing buildings and their units that are subject to major renovation shall be defined on the basis of the cost-optimality principle. 2. In defining the minimum requirements, the environmental impact and reduction of CO₂ emissions shall be taken into account. 3. Based on the objectives for achieving increased energy efficiency in buildings, the Ministry, pursuant to Law No. 08/L-242 on Energy Performance of Buildings, shall review the minimum requirements at regular intervals and, as necessary, update the minimum requirements to reflect technical development in the building sector.	zgrade za izgradnju novih, postojećih zgrada i njihovih jedinica koje su predmet velike renovacije, utvrđuju se na osnovu principa optimalnih troškova. 2. Prilikom određivanja minimalnih zahteva, uzimaju se u obzir uticaj na životnu sredinu i smanjenje emisije CO₂. 3. Na osnovu ciljeva za postizanje povećane energetske efikasnosti u zgradama, Ministarstvo, u skladu sa Zakonom br. 08/L-242 o energetskim performansama zgrada, redovno preispituje minimalne zahteve i, gde je potrebno, ažurira ih kako bi odražavali tehnički razvoj u građevinskom sektoru.
Neni 5 Kërkesat e përgjithshme në projektimin e ndërtesave 1. Gjatë fazës së projektimit të ndërtesave të reja dhe ekzistuese si dhe njërive të tyre, që i nënshtrohen rinovimit të madh, sipas rasteve dhe kur kërkesat janë teknikisht të zbatueshme, duhet të merren parasysh kushtet e mëposhtme:	Article 5 General requirements in building design 1. During the design phase of new and existing buildings as well as their units that are subject to major renovation, as applicable and where the requirements are technically feasible, the following conditions shall be taken into account:	Član 5 Opšti zahtevi u projektovanju zgrada 1. Tokom faze projektovanja novih i postojećih zgrada i njihovih jedinica, koje su predmet veće renovacije, po potrebi i kada su zahtevi tehnički izvodljivi, moraju se uzeti u obzir sledeći uslovi:

1.1. Vendndodhja dhe orientimi i përshtatshëm i ndërtesës për shfrytëzimin maksimal të kushteve klimatike lokale; 1.2. Planifikimi dhe rregullimi i peizazhit për të përmirësuar mikroklimën; 1.3. Projektimi, vendndodhja dhe orientimi i përshtatshëm i hapjeve sipas kërkesave për rrezatim diellor, dritë natyrale dhe ajrosje; 1.4. Funksionet brenda ndërtesës duhet të vendosen sipas përdorimit të tyre, duke siguruar komfortin, organizimin e duhur të hapësirave dhe ndriçimin e përshtatshëm; 1.5. Përfshirja e të paktën një prej mënyrave të përfitimit diellor pasiv, si: përfitimi i drejtpërdrejtë diellor përmes xhamëzimit, muret masive, muret trombe, etj.; 1.6. Mbrojtja nga dielli; 1.7. Integrimi i teknikave të ventilimit natyror; dhe 1.8. Sigurimi i rehatisë vizuale përmes teknikave dhe sistemeve të ndriçimit natyror.	1.1. The appropriate location and orientation of the building for maximum use of local climatic conditions; 1.2. Planning and landscaping to improve the microclimate; 1.3. The appropriate design, location and orientation of openings according to the requirements for solar radiation, natural light and ventilation; 1.4. The functions within the building shall be arranged according to their use, ensuring comfort, proper organisation of spaces and appropriate lighting; 1.5. Inclusion of at least one of the passive solar gain methods, such as: direct solar gain through glazing, massive walls, Trombe walls, etc.; 1.6. Solar protection; 1.7. Integration of natural ventilation techniques; and 1.8. Ensuring visual comfort through natural lighting techniques and systems.	1.1. Pogodna lokacija i orijentacija zgrade za maksimalno korišćenje lokalnih klimatskih uslova; 1.2. Planiranje i uređenje pejzaža radi poboljšanja mikroklimе; 1.3. Dizajn, lokacija i odgovarajuća orijentacija otvora prema zahtevima za sunčevo zračenje, prirodno svetlo i ventilaciju; 1.4. Funkcije unutar zgrade moraju biti raspoređene prema njihovoj nameni, obezbeđujući udobnost, pravilnu organizaciju prostora i adekvatno osvetljenje; 1.5. Uključivanje najmanje jedne od metoda pasivnog solarnog dobitka, kao što su: direktan solarni dobitak kroz zastakljivanje, masivne zidove, trombe zidove itd.; 1.6. Zaštita od sunca; 1.7. Integracija tehnika prirodne ventilacije; i 1.8. Obezbeđivanje vizuelne udobnosti kroz tehnike i sisteme prirodnog osvetljenja.
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Neni 6 Kërkesat e përgjithshme për elementet e mbështjellësit të ndërtesave	Article 6 General requirements for elements of the building envelope	Član 6 Opšti zahtevi za elemente omotača zgrade
1. Kalkulimi i koeficientit të tejkalimit të nxehtësisë U, duhet të bëhet duke përdorur formulën përkatëse në MKK-në dhe të dhënat e përcjellshmërisë termike të materialeve e shprehur në λ me njësinë $W/(m \cdot K)$, të përcaktuara në Shtojcën 3 të kësaj Rregulloreje. 2. Humbjet gjatë kalimit të nxehtësisë përmes urave termike zvogëlohen duke përdorur praktikat e standardizuar të ndërtimit, duke përfshirë por duke mos u kufizuar në trajtimin e këndeve, lidhjeve të hapjeve, ballkoneve dhe çatave. Humbjet përcaktohen me metoda të llogaritjeve analitike. 3. Për ndërtesat ku termoizolimi i jashtëm është i vazhdueshëm dhe i pandërprerë, ndikimi i urave termike kompensohet duke rritur vlerën U të ndërtesës për $\Delta U_{UT} = 0.05 [W/(m^2 \cdot K)]$. 4. Për ndërtimet në të cilat izolimi i jashtëm termik është i ndërprerë (si në konzollat e ballkonit) ose në ndërtimet me izolim në mes ose nga brenda, ndikimi i urave termike kompensohet duke rritur vlerën U të	1.The calculation of the heat transmission coefficient U shall be performed using the relevant formula in the NCM and the data on thermal conductivity of materials expressed as λ in the unit $W/(m \cdot K)$, defined in Annex 3 to this Regulation. 2.Losses during heat transmission through thermal bridges shall be reduced by using standard construction practices, including but not limited to the treatment of corners, opening connections, balconies and roofs. Losses shall be determined by analytical calculation methods. 3.For buildings where the external thermal insulation is continuous and uninterrupted, the impact of thermal bridges shall be compensated by increasing the U-value of the building by $\Delta U_{UT} = 0.05 [W/(m^2 \cdot K)]$. 4. For constructions in which the external thermal insulation is interrupted (as in balcony cantilevers) or in constructions with insulation in the middle or from the inside, the impact of thermal bridges shall be	1. Izračunavanje koeficijenta prenosa toplote U mora se izvršiti korišćenjem relevantne formule u MCR i podataka o toplotnoj provodljivosti materijala izraženih u λ sa jedinicom $W/(m \cdot K)$, navedenih u Prilogu 3 ovog pravilnika. 2. Gubici toplote usled prolaza kroz toplotne mostove smanjuju se primenom standardizovanih građevinskih praksi, uključujući, ali ne ograničavajući se na obradu uglova, spojeva otvora, balkona i krovova. Gubici se određuju metodama analitičkog proračuna. 3. Za zgrade gde je spoljašnja toplotna izolacija kontinuirana i neprekinuta, uticaj toplotnih mostova se kompenzuje povećanjem U-vrednosti zgrade za $\Delta U_{UT} = 0.05 [W/(m^2 \cdot K)]$. 4. Kod zgrada kod kojih je spoljašnja toplotna izolacija prekinuta (kao što su konzole balkona) ili kod zgrada sa izolacijom u sredini ili sa unutrašnje strane, uticaj toplotnih mostova se kompenzuje povećanjem U-vrednosti

strukturës së ndërtesës për $\Delta U_{UT} = 0.10$ [W/(m²·K)]. 5. Pjesët transparente të ndërtesës me orientim kah jugu, në shtrirje prej njëqind e tridhjetë e pesë (135°) nga jug-lindja deri në dyqind e njëzet e pesë (225°) në jug-perëndim, me përjashtim të ndërtesave ose njësive të ndërtesave që janë nën hije me mbrojtje natyrale ose artificiale, duhet të mbrohen nga rrezatimi diellor me elemente hijezuese të jashtme. Veshjet e përshtatshme për absorbimin ose reflektimin e rrezatimit diellor mund të aplikohen në mënyrë alternative. Elementet hijezuese nga rrezatimi diellor duhet të plotësojnë kushtin sipas formulës: $f_g \times g < 0,25$ ku: $f_g = A_g/A_f$ A_g – sipërfaqja e pjesëve transparente të mbështjellësit të ndërtesës A_f – sipërfaqja e përgjithshme e mbështjellësit (fasadës) së ndërtesës g - faktori total i rrezatimit diellorë siç parashihet në Shtojcën 2 të kësaj Rregulloreje.	compensated by increasing the U-value of the building structure by $\Delta U_{UT} = 0.10$ [W/(m²·K)]. 5. The transparent parts of the building with a southern orientation, within the range from one hundred and thirty-five (135°) from the south-east to two hundred and twenty-five (225°) to the south-west, with the exception of buildings or building units that are shaded by natural or artificial protection, shall be protected from solar radiation by external shading elements. Suitable coatings for absorbing or reflecting solar radiation may be applied alternatively. Shading elements against solar radiation shall meet the condition according to the formula: $f_g \times g < 0,25$ where: $f_g = A_g/A_f$ A_g – the area of the transparent parts of the building envelope A_f – the total area of the building envelope (facade) g - the total solar radiation factor as provided for in Annex 2 to this Regulation.	građevinske konstrukcije za $\Delta U_{UT} = 0.10$ [W/(m²·K)]. 5. Providni delovi zgrade okrenuti ka jugu, koji se protežu od sto trideset pet (135°) jugoistočno do dvesta dvadeset pet (225°) jugozapadno, Osim zgrada ili građevinskih jedinica koje su zaklonjene prirodnom ili veštačkom zaštitom, one moraju biti zaštićene od sunčevog zračenja spoljnim elementima za senčenje. Premazi pogodni za apsorpciju ili refleksiju sunčevog zračenja mogu se alternativno primeniti. Elementi za senčenje od sunčevog zračenja moraju ispunjavati uslov prema formuli: $f_g \times g < 0,25$ Gde: $f_g = A_g/A_f$ A_g – površina providnih delova omotača zgrade A_f – ukupna površina omotača zgrade (fasade) g - ukupni faktor sunčevog zračenja kako je predviđeno u Prilogu 2 ovog pravilnika.
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6. Faktori total i rrezatimit diellor “g” dhe parametrat shoqërues merren parasysh vetëm nëse pajisjet hijezuese janë të : 6.1. Përcaktuara në projektin arkitektonik; dhe 6.2. Përfshira në llogaritjet energjetike. Neni 7 Kërkesat e përgjithshme për sistemet teknike të ndërtesave 1. Gjatë instalimit të elementeve të reja dhe zëvendësimit ose përmirësimit të elementeve ose sistemeve ekzistuese nëse ato janë të arsyetuara teknikisht, funksionalisht dhe me kosto optimale, në pajtim me tabelat 2 dhe 3 të Shtojcës 1 të kësaj Rregulloreje, duhet të merren parasysh kushtet e mëposhtme: 1.1. Sistemet e ngrohjes; 1.2. Sistemet e kondicionimit të ajrit (sistemet e ftohjes së hapësirës); 1.3. Sistemet e ventilimit; 1.4. Sistemet e ndriçimit;	6. The total solar radiation factor “g” and the accompanying parameters shall be taken into account only if the shading devices are: 6.1. Defined in the architectural design; and 6.2. Included in the energy calculations. Article 7 General requirements for technical building systems 1. During the installation of new elements and the replacement or improvement of existing elements or systems, where these are technically, functionally, and cost-optimal justified, in accordance with Tables 2 and 3 of Annex 1 to this Regulation, the following conditions shall be taken into account: 1.1. Heating systems; 1.2. Air-conditioning systems (space cooling systems); 1.3. Ventilation systems; 1.4. Lighting systems;	6. Ukupni faktor sunčevog zračenja „g“ i povezani parametri uzimaju se u obzir samo ako su uređaji za zasjenjivanje: 6.1. Definisani u arhitektonskom projektu; i 6.2. Uključeni u energetske proračune. Član 7 Opšti zahtevi za tehničke sisteme zgrada 1. Prilikom ugradnje novih elemenata, kao i zamene ili unapređenja postojećih elemenata ili sistema, ukoliko su oni tehnički, funkcionalno i ekonomski opravdani, u skladu sa tabelama 2 i 3 Priloga 1 ove Uredbe, moraju se uzeti u obzir sledeći uslovi: 1.1. Sisteme grejanja; 1.2. Sisteme za klimatizaciju (sistemi za hlađenje prostora); 1.3. Sisteme za ventilaciju; 1.4. Sisteme rasvete;
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1.5. Sisteme për përgatitjen e ujit të ngrohtë sanitar; dhe 1.6. Çdo kombinim i atyre të përmendura më lartë duke marrë parasysh mundësinë e përdorimit të burimeve të ripërtëritshme të energjisë me teknologji efikase. 2. Të gjitha sistemet teknike duhet të përfshijnë mundësinë për rregullim automatik, për të optimizuar përdorimin e energjisë dhe për të mundësuar integrimin me burime të ripërtëritshme të energjisë kur është e mundur. KAPITULLI III NDËRTESTAT E REJA, EKZISTUES DHE NJËSITË E TYRE Neni 8 Kërkesat minimale për ndërtesat e reja dhe njësitë e ndërtesave të reja 1. Ndërtesat e reja dhe njësitë e ndërtesave të reja, përveç kërkesave të përgjithshme të përcaktuara në Kapitullin II të kësaj Rregulloreje, duhet t'i plotësojnë edhe këto kërkesa minimale të performancës energjetike: 1.1. Koeficienti i kalimit të nxehtësisë U ($W/m^2 \cdot K$), për çdo element të	1.5. Systems for the preparation of domestic hot water; and 1.6. Any combination of those mentioned above, taking into account the possibility of using renewable energy sources with efficient technology. 2. All technical systems shall include the possibility of automatic regulation, in order to optimise energy use and enable integration with renewable energy sources where possible. CHAPTER III NEW AND EXISTING BUILDINGS AND THEIR UNITS Article 8 Minimum requirements for new buildings and new building units 1. New buildings and new building units, in addition to the general requirements defined in Chapter II of this Regulation, shall also meet the following minimum energy performance requirements: 1.1. The heat transmission coefficient U ($W/m^2 \cdot K$), for each element of the	1.5. Sisteme za pripremu tople sanitarne vode; i 1.6. Bilo koja kombinacija gore navedenih, uzimajući u obzir mogućnost korišćenja obnovljivih izvora energije sa efikasnim tehnologijama. 2. Svi tehnički sistemi moraju da uključuju mogućnost automatskog podešavanja, kako bi se optimizovala upotreba energije i omogućila integracija sa obnovljivim izvorima energije kada je to moguće. POGLAVLJE III NOVE, POSTOJEĆE ZGRADE I NJIHOVE JEDINICE Član 8 Minimalni zahtevi za nove zgrade i nove građevinske jedinice 1. Nove zgrade i nove građevinske jedinice, pored opštih zahteva utvrđenih u Poglavlju II ovog pravilnika, moraju da ispunjavaju i sledeće minimalne zahteve za energetske performanse: 1.1. Koeficijent prenosa toplote U ($W/m^2 \cdot K$), za svaki element omotača zgrade, kao što su
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mbështjellësit të ndërtesës, siç janë muret, dyshemetë, çatitë dhe dritaret, nuk duhet të jetë më i madh se vlera 'maksimale e lejuar' e përcaktuar në tabelën 1 të Shtojcës 1 të kësaj Rregulloreje. 1.2. Të gjitha sistemet teknike të ndërtesës të instaluar duhet të jenë efikiente dhe në pajtim me kërkesat minimale të përcaktuara sipas tabelave 2 dhe 3 të Shtojcës 1 të kësaj Rregulloreje. Neni 9 Kërkesat minimale për ndërtesat ekzistuese dhe njësitë e tyre që i nënshtrohen rinovimit të madh 1. Ndërtesat ekzistuese dhe njësitë e tyre që i nënshtrohen rinovimit të madh, përveç kërkesave të përgjithshme të përcaktuara në Kapitullin II të kësaj Rregulloreje, duhet t'i plotësojnë edhe këto kërkesa të performancës energjetike: 1.1. Koeficienti i kalimit të nxehtësisë U ($W/m^2 \cdot K$), për çdo element të mbështjellësit të ndërtesës, siç janë muret, dyshemetë, çatitë dhe dritaret, nuk duhet të jetë më i madh se vlera 'maksimale e lejuar' e përcaktuar në tabelën 1 të Shtojcës 1 të kësaj Rregulloreje.	building envelope, such as walls, floors, roofs and windows, shall not be greater than the “maximum permitted” value defined in Table 1 of Annex 1 to this Regulation. 1.2. All installed technical building systems shall be efficient and in accordance with the minimum requirements defined according to Tables 2 and 3 of Annex 1 to this Regulation. Article 9 Minimum requirements for existing buildings and their units subject to major renovation 1. Existing buildings and their units subject to major renovation, in addition to the general requirements defined in Chapter II of this Regulation, shall also meet the following energy performance requirements: 1.1. The heat transmission coefficient U ($W/m^2 \cdot K$), for each element of the building envelope, such as walls, floors, roofs and windows, shall not be greater than the “maximum permitted” value defined in Table 1 of Annex 1 to this Regulation.	zidovi, podovi, krovovi i prozori, ne sme biti veći od „maksimalno dozvoljene“ vrednosti navedene u Tabeli 1 Priloga 1 ovog pravilnika. 1.2. Svi instalirani tehnički sistemi zgrade moraju biti efikasni i u skladu sa minimalnim zahtevima navedenim u tabelama 2 i 3 Priloga 1 ovog pravilnika. Član 9 Minimalni zahtevi za postojeće zgrade i njihove jedinice koje se podvrgavaju velikoj renovaciji 1. Postojeće zgrade i njihove jedinice koje se renoviraju u velikoj meri, pored opštih zahteva utvrđenih u Poglavlju II ovog pravilnika, moraju da ispunjavaju i sledeće zahteve za energetske performanse: 1.1. Koeficijent prenosa toplote U ($W/m^2 \cdot K$), za svaki element omotača zgrade, kao što su zidovi, podovi, krovovi i prozori, ne sme biti veći od „maksimalno dozvoljene“ vrednosti navedene u Tabeli 1 Priloga 1 ovog pravilnika.
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1.2. Për atë që është e zbatueshme teknikisht, ekonomikisht dhe funksionalisht, të gjitha sistemet teknike të ndërtesës të instaluar duhet të jenë efikase dhe në përputhje me kërkesat minimale të përcaktuara sipas tabelave 2 dhe 3 në Shtojcën 1 të kësaj Rregulloreje. 2. Kur i gjithë sistemi ose njëra pjesë e sistemit teknik të ndërtesës është instaluar ose zëvendësuar në ndërtesën ekzistuese, sistemi i zëvendësuar duhet të jetë me efikasitet të përmirësuar, por jo më e vogël se kriteret e përcaktuar sipas paragrafit 1.2 të këtij neni. 3. Prioritet gjatë rinovimit të madh duhet t'i jepet përmirësimit të elementëve të mbështjellës të ndërtesës që kanë humbje më të larta të energjisë, si muret, çatitë, dritaret dhe dyshemetë në kontakt me tokën apo ajrin e jashtëm. 4. Kërkesat minimale për performancë energjetike për ndërtesat e rinovuara nuk zbatohen kur zbatimi i tyre është teknikisht i pamundur, ekonomikisht i pajustificueshëm ose bie ndesh me kërkesat për mbrojtje të trashëgimisë kulturore, sipas legjislacionit në fuqi.	1.2. To the extent technically, economically and functionally feasible, all installed technical building systems shall be efficient and in compliance with the minimum requirements defined according to Tables 2 and 3 in Annex 1 to this Regulation. 2. When the entire system or one part of the technical building system is installed or replaced in the existing building, the replaced system shall have improved efficiency, but not lower than the criteria defined under paragraph 1.2 of this Article. 3. Priority during major renovation shall be given to improving the elements of the building envelope that have higher energy losses, such as walls, roofs, windows and floors in contact with the ground or outside air. 4. The minimum energy performance requirements for renovated buildings shall not apply where their implementation is technically impossible, economically unjustifiable or conflicts with cultural heritage protection requirements, according to the legislation in force.	1.2. U meri u kojoj je to tehnički, ekonomski i funkcionalno izvodljivo, svi instalirani tehnički sistemi zgrade moraju biti efikasni i ispunjavati minimalne zahteve navedene u tabelama 2 i 3 u Prilogu 1 ovog pravilnika. 2. Kada se ceo sistem ili deo tehničkog sistema zgrade instalira ili zamenjuje u postojećoj zgradi, zamenjeni sistem mora imati poboljšanu efikasnost, ali ne manje od kriterijuma utvrđenih u stavu 1.2 ovog člana. 3. Prioritet tokom velikih renoviranja treba dati poboljšanju elemenata omotača zgrade koji imaju najveće gubitke energije, kao što su zidovi, krovovi, prozori i podovi u kontaktu sa zemljom ili spoljašnjim vazduhom. 4. Minimalni zahtevi za energetske performanse renoviranih zgrada se ne primenjuju kada je njihova primena tehnički nemoguća, ekonomski neopravdana ili je u suprotnosti sa zahtevima zaštite kulturnog nasleđa, prema važećem zakonodavstvu.
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5. Kur gjatë rinovimit të ndërtesës ekzistuese përfshihet edhe zgjerimi i ndërtesës ekzistuese e cila e rritë sipërfaqen e dyshemesë prej pesëdhjetë (50) % ose më shumë, atëherë e tërë ndërtesa ekzistuese bashkë me shtesën, do të trajtohet si ndërtesë e re dhe do t'i nënshtrohet kërkesave të përcaktuara në nenin 8 të kësaj Rregulloreje. Neni 10 Tipologjia e ndërtesave dhe kriteret minimale të performancës energjetike 1. Për rinovimin e ndërtesave ekzistuese në sektorin e banimit, Ministria me vendim miraton tipologjinë për performancën energjetike të ndërtesave. 2. Tipologjia për performancën energjetike të ndërtesave, shërben për klasifikimin orientues të ndërtesave ekzistuese dhe interpretimin e kriterëve minimale të performancës energjetike për ndërtesat që i nënshtrohen rinovimit. KAPITULLI IV NDËRTESA ME KONSUM AFËR ZERO ENERGJI Neni 11 Kërkesat për ndërtesa me konsum afër zero energji	5. When the renovation of an existing building also includes the extension of the existing building which increases the floor area by fifty (50) % or more, then the entire existing building together with the extension shall be treated as a new building and shall be subject to the requirements defined in Article 8 of this Regulation. Article 10 Building typology and minimum energy performance criteria 1. For the renovation of existing buildings in the residential sector, the Ministry shall approve by decision the typology for the energy performance of buildings. 2. The typology for the energy performance of buildings shall serve for the indicative classification of existing buildings and the interpretation of the minimum energy performance criteria for buildings subject to renovation. CHAPTER IV NEARLY ZERO-ENERGY BUILDINGS Article 11 Requirements for nearly zero-energy buildings	5. Kada renoviranje postojeće zgrade uključuje proširenje postojeće zgrade koje povećava površinu poda za pedeset (50)% ili više, onda se cela postojeća zgrada, zajedno sa dogradnjom, tretira kao nova zgrada i podleže zahtevima utvrđenim u članu 8. ovog Pravilnika. Član 10 Tipologija zgrada i minimalni kriterijumi energetske efikasnosti 1. Za renoviranje postojećih zgrada u stambenom sektoru, Ministarstvo će, odlukom, odobriti tipologiju energetskih karakteristika zgrada. 2. Tipologija energetskih performansi zgrada služi za indikativnu klasifikaciju postojećih zgrada i tumačenje minimalnih kriterijuma energetskih performansi za zgrade koje se renoviraju. POGLAVLJE IV ZGRADA SA SKORO NULTOM POTROŠNJOM ENERGIJE Član 11 Zahtevi za zgrade sa skoro nultom potrošnjom energije
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1. Ndërtesa konsiderohet se është ndërtesë me konsum afër zero energji nëse plotësohen të gjitha kërkesat e mëposhtme: 1.1. Indikatori numerik i performancës energjetike (PE) të ndërtesës të jetë më e vogël ose e barabartë me zero pikë pesëdhjetë ($\leq 0,50$); 1.2. Siguron një sasi të nevojës për energji të prodhuar nga burimet e ripërtëritshme të energjisë (BRE) në ndërtesë apo në afërsi. 2. Verifikimi i kërkesave të përcaktuara në paragrafin 1 të këtij neni bëhen nga vlerësuesi i energjisë gjatë procesit të Certifikimit të Performancës Energjetike (CPE) të ndërtesës bazuar në MKK të miratuar dhe nëpërmjet përdorimit të softuerit të miratuar. 3. Informatat mbi përputhshmërinë me kërkesat e ndërtesave me konsum afër zero energji futen në Certifikatën e Performancës Energjetike (CPE) dhe në Raportin e CPE-së nga vlerësuesi i energjisë. 4. Kur projektohet ndonjë ndërtesë e re, me konsum afër zero energji (NKAZE), duhet të shqyrtohet mundësia e përdorimit dhe të	1. A building shall be considered a nearly zero-energy building if all of the following requirements are met: 1.1. The numerical energy performance (EP) indicator of the building is less than or equal to zero point fifty ($\leq 0,50$); 1.2. It provides an amount of the energy need produced from renewable energy sources (RES) in the building or nearby. 2. Verification of the requirements defined in paragraph 1 of this Article shall be carried out by the energy assessor during the Energy Performance Certification (EPC) process of the building, based on the approved NCM and through the use of the approved software. 3. Information on compliance with the requirements for nearly zero-energy buildings shall be entered in the Energy Performance Certificate (EPC) and in the EPC Report by the energy assessor. 4. When any new nearly zero-energy building (nZEB) is designed, the possibility of use shall be examined and a cost-benefit	1. Zgrada se smatra zgradom sa skoro nultom potrošnjom energije ako su ispunjeni svi sledeći zahtevi: 1.1. Numerički pokazatelj energetske performansi (PE) zgrade mora biti manji ili jednak nula tačka pedeset ($\leq 0,50$); 1.2. Obezbeđuje potrebnu količinu energije proizvedene iz obnovljivih izvora energije (OIE) u zgradi ili u blizini. 2. Proveru zahteva navedenih u stavu 1. ovog člana vrši procenitelj energije tokom procesa sertifikacije energetske performansi (EPC) zgrade na osnovu odobrenog MCR-a i korišćenjem odobrenog softvera. 3. Informacije o usklađenosti sa zahtevima za zgrade sa skoro nultom potrošnjom energije uključene su u Sertifikat o energetskim performansama (SEP) i u Izveštaj o SEP-u od strane energetskog procenitelja. 4. Prilikom projektovanja nove zgrade sa skoro nultom potrošnjom energije (NKAZE), trebalo bi razmotriti mogućnost korišćenja i izvršiti
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bëhet analiza e kost-benefitit për mundësinë e kyqçes të së paku në një prej sistemeve energjetike alternative me performancë të lartë siç janë: 4.1. Sistemet e decentralizuara të furnizimit me energji që përdorin burime të ripërtërishme të energjisë të prodhuara në ndërtesë ose në afërsi; 4.2. Sistemet që përdorin bashkë-prodhimin (ngrohje dhe energji elektrike) të instaluar në ndërtesë ose në afërsi; 4.3. Sistemet që përdorin pompa termike; 4.4. Sistemet e ngrohjes dhe ftohjes qendrore, ato që përdorin burime të ripërtërishme të energjisë të furnizuar nga ndonjë burim qendror i energjisë për një numër ndërtesash apo lokacionesh. 5. Kur bëhet vlerësimi i përdorimit të sistemeve alternative me efikasitet të lartë, duhet të vlerësohen dhe të merren parasysh: 5.1. Kërkesat teknike, mjedisore dhe ekonomike; 5.2. Kushtet e brendshme klimatike dhe shëndetësore;	analysis shall be carried out for the possibility of connection to at least one of the high-performance alternative energy systems such as: 4.1. Decentralised energy supply systems that use renewable energy sources produced in the building or nearby; 4.2. Systems that use cogeneration (heating and electricity) installed in the building or nearby; 4.3. Systems that use heat pumps; 4.4. Central heating and cooling systems, those that use renewable energy sources supplied from a central energy source for a number of buildings or locations. 5. When assessing the use of high-efficiency alternative systems, the following shall be assessed and taken into account: 5.1. Technical, environmental and economic requirements; 5.2. Indoor climatic and health conditions;	analizu troškova i koristi za mogućnost povezivanja barem jednog od visoko efikasnih alternativnih energetske sistema kao što su: 4.1. Decentralizovani sistemi snabdevanja energijom koji koriste obnovljive izvore energije proizvedene u zgradi ili u blizini; 4.2. Sistemi koji koriste kogeneraciju (toplote i električne energije) instalirani u zgradi ili u blizini; 4.3. Sistemi koji koriste toplotne pumpe; 4.4. Sistemi centralnog grejanja i hlađenja, oni koji koriste obnovljive izvore energije koji se napajaju iz centralnog izvora energije za više zgrada ili lokacija . 5. Prilikom procene upotrebe alternativnih visokoefikasnih sistema, treba proceniti i uzeti u obzir sledeće: 5.1. Tehnički, ekološki i ekonomski zahtevi; 5.2. Unutrašnji klimatski i zdravstveni uslovi;
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5.3. Siguria nga zjarri; dhe 5.4. Rreziqet e larta sizmike. KAPITULLI V VERIFIKIMI I PËRMBUSHJES SË KËRKESAVE MINIMALE Neni 12 Përcaktimi i indikatorit të performancës energjetike (PE) 1. Indikatorit i performancës energjetike (PE) përdoret për verifikimin e përmbushjes së kërkesave minimale të performancës energjetike sipas kësaj Rregulloreje, si dhe për përcaktimin e ndërtesave me konsum afër zero energji, në pajtim me nenin 11 të kësaj Rregulloreje. 2. Indikatorit i performancës energjetike (PE) i ndërtesës shprehet si raport ndërmjet kërkesës së kalkuluar për energji primare të ndërtesës që vlerësohet dhe kërkesës së kalkuluar për energji primare të ndërtesës referente krahasuese, të korrigjuar me faktorin përkatës të korrektimit, sipas formulës në vijim: $PE = \frac{\text{kërkesa për energji primare e ndërtesës së vlerësuar}}{\text{faktor i korrektimit} \times \text{kërkesa për energji primare e ndërtesës referente krahasuese}}$	5.3. Fire safety; and 5.4. High seismic risks. CHAPTER V VERIFICATION OF COMPLIANCE WITH MINIMUM REQUIREMENTS Article 12 Determination of the energy performance (EP) indicator 1. The energy performance (EP) indicator shall be used to verify compliance with the minimum energy performance requirements under this Regulation, as well as to determine nearly zero-energy buildings, in accordance with Article 11 of this Regulation. 2. The energy performance (EP) indicator of the building shall be expressed as the ratio between the calculated primary energy demand of the building being assessed and the calculated primary energy demand of the comparative reference building, corrected by the relevant correction factor, according to the following formula: $EP = \frac{\text{primary energy demand of the assessed building}}{\text{correction factor} \times \text{primary energy demand of the comparative reference building}}$	5.3. Zaštita od požara i 5.4. Visoki seizmički rizici. POGLAVLJE V PROVERA USKLAĐENOSTI SA MINIMALNIM ZAHTEVIMA Član 12 Određivanje indikatora energetske performansi (IP) 1. Indikator energetske performansi (IP) se koristi za proveru usklađenosti sa minimalnim zahtevima za energetske performanse prema ovoj uredbi, kao i za određivanje zgrada sa skoro nultom potrošnjom energije, u skladu sa članom 11 ove uredbe. 2. Indikator energetske performansi (EP) zgrade izražava se kao odnos između izračunate potrebe za primarnom energijom zgrade koja se procenjuje i izračunate potrebe za primarnom energijom uporedne referentne zgrade, korigovane relevantnim faktorom korekcije, prema sledećoj formuli: $EP = \frac{\text{potražnja za primarnom energijom procenjene zgrade}}{\text{faktor korekcije} \times \text{potražnja za primarnom energijom uporedne referentne zgrade}}$
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3. Kërkesa për energji primare e ndërtesës së vlerësuar dhe e ndërtesës referente krahasuese kalkulohet në pajtim me MKK dhe nëpërmjet përdorimit të softuerit të miratuar për certifikimin e performancës energjetike të ndërtesave. 4. Kriteret minimale të performancës energjetike konsiderohen të përmbushura vetëm në rast se indikator i performancës energjetike (PE) është më i vogël ose i barabartë me 1.0.	3. The primary energy demand of the assessed building and of the comparative reference building shall be calculated in accordance with the NCM and through the use of the approved software for the energy performance certification of buildings. 4. The minimum energy performance criteria shall be considered fulfilled only if the energy performance (EP) indicator is less than or equal to 1.0.	3. Potražnja za primarnom energijom procenjene zgrade i uporedne referentne zgrade izračunava se u skladu sa MCR i korišćenjem odobrenog softvera za sertifikaciju energetske performansi zgrada. 4. Minimalni kriterijumi energetske efikasnosti smatraju se ispunjenim samo ako je indikator energetske efikasnosti (EPI) manji ili jednak 1.0.
Neni 13 Faktori i korrektimit 1. Faktori i korrektimit është koeficient metodologjik që përdoret për të përshtatur kërkesën e kalkuluar për energji primare të ndërtesës referente, me qëllim sigurimin e krahasueshmërisë së drejtë të performancës energjetike të ndërtesave të reja dhe ndërtesave ekzistuese që i nënshtrohen rinovimit të madh në përputhje me objektivat kombëtare që synojnë përmirësimin e efijencës së energjisë në ndërtesa përmes uljes së kërkesës për energji primare. 2. Gjatë kalkulimit të indikatorit të performancës energjetike, faktori i korrektimit merr vlerat si në vijim për:	Article 13 Correction factor 1. The correction factor is a methodological coefficient used to adjust the calculated primary energy demand of the reference building, in order to ensure fair comparability of the energy performance of new buildings and existing buildings subject to major renovation in accordance with the national objectives aimed at improving energy efficiency in buildings through the reduction of primary energy demand. 2. During calculation of the energy performance indicator, the correction factor shall take the following values for:	Član 13 Faktor korekcije 1. Faktor korekcije je metodološki koeficijent koji se koristi za prilagođavanje izračunate potrebe za primarnom energijom referentne zgrade, kako bi se obezbedila pravedna uporedivost energetske performansi novih zgrada i postojećih zgrada koje se renoviraju u skladu sa nacionalnim ciljevima usmerenim na poboljšanje energetske efikasnosti u zgradama smanjenjem potražnje za primarnom energijom. 2. Prilikom izračunavanja indikatora energetske performansi, korekcioni faktor uzima sledeće vrednosti za:

2.1. Ndërtesat e reja dhe njësitë e ndërtesave të reja, faktori e ka vlerën një pikë zero (1.0); 2.2. Ndërtesat ekzistuese që i nënshtrohen rinovimit të madh faktori e ka vlerën një pikë pesë (1.5). 3. Vlerat e faktorit të korrektimit mund të rishikohen dhe përditësohen nga Ministria, në përputhje me procedurat ligjore për ndryshimin dhe plotësimin e kësaj Rregulloreje.	2.1. New buildings and new building units, the factor shall have the value one point zero (1.0); 2.2. Existing buildings subject to major renovation, the factor shall have the value one point five (1.5). 3. The values of the correction factor may be reviewed and updated by the Ministry, in accordance with the legal procedures for amending and supplementing this Regulation.	2.1. Nove zgrade i nove građevinske jedinice, faktor ima vrednost jedan zarez nula (1.0); 2.2. Postojeće zgrade koje podležu velikoj obnovi imaju faktor vrednosti jedan zarez pet (1,5). 3. Vrednosti faktora korekcije može biti revidirana i ažurirana od strane Ministarstva, u skladu sa zakonskim postupcima za izmenu i dopunu ove uredbe.
KAPITULLI VI DISPOZITAT PËRFUNDIMTARE Neni 14 Shtojcat	CHAPTER VI FINAL PROVISIONS Article 14 Annexes	POGLAVLJE VI ZAVRŠNE ODREDBE Član 14 Prilozi
1. Pjesë përbërëse e kësaj Rregulloreje janë Shtojcat: 1.1. Shtojca 1 - Parametrat dhe Kërkesat Teknike për Zbatimin e Kërkesave Minimale të Performancës Energjetike në Ndërtesa; 1.2. Shtojca 2 – Karakteristikat e Xhamave dhe Vlerat e Tyre;	1. The Annexes shall form an integral part of this Regulation: 1.1. Annex 1 - Technical Parameters and Requirements for the Implementation of Minimum Energy Performance Requirements in Buildings; 1.2. Annex 2 - Characteristics of Glass and Their Values;	1. Prilozi su sastavni deo ove uredbe: 1.1. Prilog 1 - Parametri i tehnički zahtevi za sprovođenje minimalnih zahteva za energetske performanse u zgradama; 1.2. Prilog 2 - Karakteristike stakla i njihove vrednosti;

1.3. Shtojca 3 – Lista e Materialeve Ndërtimore; 1.4. Shtojca 4 – Kërkesat Minimale të Performancës së Sistemeve Teknike. Neni 15 Shfuqizimi Me hyrjen në fuqi të kësaj Rregulloreje, shfuqizohet Rregullorja MMPH Nr. 04/18 për Kërkesat Minimale të Përformancës Energjetike të Ndërtesave. Neni 16 Hyrja në fuqi Kjo Rregullore hyn në fuqi shtatë (7) ditë pas publikimit në Gazetën Zyrtare të Republikës së Kosovës. Fitore Pacolli Dalipi Ministre në detyrë e Ministrisë së Mjedisit dhe Planifikimit Hapësinor Prishtinë, _____ 2026	1.3. Annex 3 – List of Building Materials; 1.4. Annex 4 – Minimum Performance Requirements for Technical Systems. Article 15 Repeal Upon entry into force of this Regulation, Regulation MESP No. 04/18 on Minimum Energy Performance Requirements for Buildings shall be repealed. Article 16 Entry into force This Regulation shall enter into force seven (7) days after its publication in the Official Gazette of the Republic of Kosovo. Fitore Pacolli Dalipi Acting Minister of the Ministry of Environment and Spatial Planning Prishtina, _____ 2026	1.3. Prilog 3 – Spisak građevinskog materijala; 1.4. Prilog 4 – Minimalni zahtevi za performanse tehničkih sistema. Član 15 Stavljanje van snage Stupanjem na snagu ove uredbe, stavlja se van snage Uredba MŽSPP Br. 04/18 o minimalnim zahtevima za energetske performanse zgrada. Član 16 Stupanje na snagu Ova Uredba stupa na snagu sedam (7) dana od dana objavljivanja u Službenom listu Republike Kosovo. Fitore Pacoli Dalipi Vršilac dužnosti ministarka ministarstva životne sredine i prostornog planiranja Priština, _____ 2026
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SHTOJCA 1**PARAMETRAT DHE KËRKESAT TEKNIKE PËR ZBATIMIN E KËRKESAVE MINIMALE TË PERFORMANCËS ENERGJETIKE NË NDËRTESA****TABELA 1: Vlerat referente të parametrave të mbështjellësit të ndërtësës**

#		Ndërtesat e rinovuara	Ndërtesat e reja
	Parametrat	Vlerat referente të koeficientit të kalimit të nxehtësisë U [W/m²K]	Vlerat referente të koeficientit të kalimit të nxehtësisë U [W/m²K]
Elementet e strukturës së ndërtësës			
1	Mur i jashtëm	0.35	0.31
2	Mur që kufizohet me tokën,	0.50	0.40
	Dysheme në kontakt me tokën	0.50	0.50
3	Komponentët e xhamëzuara (dritaret, dritaret e kulmit, dyert e xhamëzuara elementet e tejdukshme të fasadës, etj.)	1.60	1.60
4	Dere e jashtme me krah jo transparent	1.60	1.60
5	Kulm i rrafshët dhe i pjerrët	0.30	0.30
6	Pllakë e meskatit që kufizohet me hapësirë që nuk ngrohet	0.50	0.50
7	Pllakë e meskatit	0.90	0.80
8	Mur që kufizohet me hapësirë që nuk ngrohet	1.40	1.20
	Fasadë e xhamëzuar	1.60	1.60
Kërkesat për infiltrim të ajrit në mbështjellësin e ndërtësës			
9	Infilttrimi n_{50}		3.0 l/h
Kërkesat për sistemet e emetimit dhe shpërndarjes për projektimin dhe instalimin e sistemeve inxhinierike në ndërtesat e reja dhe ndërtesat ekzistuese që iu nënshtrohen rinovimit të madh			
10	Kthinë individuale / Emetimi i pajisjeve në zonë / Sistemi i menaxhimit	Modaliteti i operimit me regjim kursimi energjie	Modaliteti i operimit me regjim kursimi energjie

Parametrat e vetive termike diellore	
Faktori i transmetimit diellor i dritares g-vlera	0,60
Fc në sezonin dimrit (faktori i hijezimit)	1,00
Fc në sezonin e verës (faktori i hijezimit)	0,40
Parametrat tjerë të mbështjellësit të ndërtësës	
Urat termike	Në përputhje me praktikat e mira

TABELA 2: Parametrat referentë të sistemeve teknike për ndërtesat e banimit dhe pjesët e banimit të ndërtesave referente krahasuese

#	Parametrat	Vlerat referente
Ngrohja – Sistemet gendrore		
1	Gjeneratori	Nëse vetëm ngrohje: Kaldaja me biomasë

		Nëse ngrohje dhe ftohje: Pompë termike elektrike ajër-ujë, njëshkallëshe bivalente me ngrohës elektrik të integruar Prej datës 01.01.2031 e tutje, vetëm: Pompë termike elektrike ajër-ujë, njëshkallëshe bivalente me ngrohës elektrik të integruar
2	Shpërndarja	Gypat e shpërndarjes jashtë, vertikalet dhe lidhjet e gypave brenda mbështjellësit termik
3	Kontrolli dhe emetimet	Nëse vetëm ngrohje: Radiatorët, me temperaturë dërguese 75°C, dhe kthim 60°C. Nëse ka ngrohje dhe ftohje: Ventilkonvektorët e montuar në parapet, me ujë, temperaturat e furnizimit 50°C, kthimit 30°C, dhe 6/12°C për ftohje
4	Rezervuari i ujit të ngrohtë	Rezervuar i ujit të ngrohte me ngrohje indirekte
5	Uji i ngrohtë sanitar	I kombinuar me ngrohjen
Ngrohja – Sistemet e decentralizuara		
6	Gjeneratori	Nëse ka vetëm ngrohje: Kaldaja (stufa) individuale me pelet Nëse ka ngrohje dhe ftohje: Sistemet multi-split
Uji i ngrohtë sanitar		Ngrohës (Bojler) elektrik me rezervuar
7	Gjeneratori, Shpërndarja	Ngrohës elektrik (bojler) me rrjedhje me kontroll elektronik, lidhjet e gypave brenda mbështjellësit termik
Sistemi i ftohjes		
8	Gjeneratori	Sistemi qendror: Kombinim ngrohje dhe ftohje Sistemi i decentralizuar: Sistemi multi-split

#	Parametrat	Vlerat referente
Sistemi i ventilimit – sistemi për nxjerrjen e ajrit		
9	Shpërndarja	Kapaciteti specifik i ventilatorit $P_{SFP} = 1.0 \text{ kW}/(\text{m}^3/\text{s})$
Sistemi i ventilimit – sistemi për furnizimin dhe nxjerrjen e ajrit		
10	Shpërndarja	Kapaciteti specifik i ventilatorit: - Furnizimi i ajrit $P_{SFP} = 1.5 \text{ kW}/(\text{m}^3/\text{s})$ - Nxjerrja e ajrit $P_{SFP} = 1.0 \text{ kW}/(\text{m}^3/\text{s})$ Shkalla e rikuperimit të nxehtësisë: $\eta = 0.6$

		Kanalet e ajrit: brenda ndërtesës
Automatizimi i ndërtesës		
11	Automatizimi i ndërtesës	Klasa C (sipas klasifikimit të sistemeve të automatizimit të ndërtesave)

TABELA 3: Parametrat referentë të sistemeve teknike për ndërtesat jo-rezidenciale dhe pjesët jo-rezidenciale të ndërtesës referente krahasuese

#	Parametrat	Vlerat referente
Ndriçimi – Relevant vetëm për ndërtesat jo-rezidenciale		
1	Lloji i ndriçimit	Ndriçim direkt / indirekt me llamba LED

#	Parametrat	Vlerat referente
Ngrohja – Sistemet qendrore		
2	Gjeneratori	Nëse vetëm ngrohje: Kaldaja me biomasë Nëse ka ngrohje dhe ftohje: Pompë termike elektrike ajër-ujë, njëshkallëshe bivalente me ngrohës elektrik të integruar Prej datës 01.01.2031 e tutje, vetëm: Pompë termike elektrike ajër-ujë, njëshkallëshe bivalente me ngrohës elektrik të integruar
3	Shpërndarja	Gypat e shpërndarjes jashtë, vertikalet dhe lidhjet e gypave brenda mbështjellësit termik
4	Kontrolli dhe emetimet	Nëse ka vetëm ngrohje: Radiatorët, me temperature dërguese 75°C, dhe kthim 60°C. Nëse ka ngrohje dhe ftohje: Ventilkonvektorët me ujë, të montuar në tokë (ventilkonvektorët e parapetit), temperature në dërgim 50°C, temperature në kthim 30°C. 6/12°C për ftohje
5	Rezervuari i ujit të ngrohtë	Rezervuar i ujit të ngrohte me ngrohje indirekte
6	Uji i ngrohtë sanitar	I kombinuar me ngrohjen
Ngrohja – Sistemi i decentralizuar		
7	Gjeneratori	Sistemet elektrike multi-split
8	Ngrohja e ujit sanitar	Bojler elektrik me rezervuar
Sistemi i ftohjes		
9	Gjeneratori	Sistemi qendror: Kombinim ngrohje dhe ftohje Sistemi i decentralizuar: Sistemet VRF

#	Parametrat	Vlerat referente
Sistemi i ventilimit – sistemi për nxjerrjen e ajrit		
10	Shpërndarja	Kapaciteti specifik i ventilatorit:

		$P_{SFP} = 1.0 \text{ kW}/(\text{m}^3/\text{s})$
Sistemi i ventilimit – sistemi për furnizimin dhe nxjerrjen e ajrit		
11	Shpërndarja	Kapaciteti specifik i ventilatorit: - Furnizimi i ajrit: $P_{SFP} = 1.5 \text{ kW}/(\text{m}^3/\text{s})$ - Nxjerrja e ajrit: $P_{SFP} = 1.0 \text{ kW}/(\text{m}^3/\text{s})$ Shkalla e rikuperimit të nxehtësisë: $\eta = 0.6$ Kanalet e ventilimit: brenda ndërtesës
Sistemi i ventilimit – kondicionimi/lagështimi		
12	Kondicionimi i ajrit	Njësia për trajtimin e ajrit me këmbyes për ngrohje: Temperatura e ajrit të furnizuar 18°C Njësia për trajtimin e ajrit me këmbyes për ngrohje dhe ftohje: Temperatura e ajrit të furnizuar 18°C $6/12^\circ\text{C}$ Pa ftohje evaporative indirekte
Automatizimi i ndërtesës		
13	Automatizimi i ndërtesës	Klasa C (sipas klasifikimit të sistemeve të automatizimit të ndërtesave)

SHTOJCA 2

KARAKTERISTIKAT E XHAMAVE DHE VLERAT E TYRE

Vlerat e paracaktuara për karakteristikat e xhamave dhe pajisjeve për mbrojtjen nga dielli ^a

Lloji i xhamëzimit	Karakteristikat, pa pajisje për mbrojtje nga dielli			Karakteristikat me pajisje të jashtme për mbrojtje nga dielli										Karakteristikat me mbrojtje të brendshme nga dielli						
				Roleta të jashtme veneciane ^b (pozita 10°)		Roleta të jashtme veneciane (pozita 45°)		Markizë vertikale		Roletë (plotësisht e mbyllur)		Roletë ^c (e mbyllur në 3/4)		Roletë e brendshme veneciane ^b (pozita 10°)		Roletë e brendshme veneciane (pozita 45°)		Perde role nga tekstili		Film
				E bardhë	E hirtë e errët	E bardhë	E hirtë e errët	E bardhë ^c	E hirtë mesatare	E bardhë	E hirtë e errët	E bardhë	E hirtë e errët	E bardhë	E hirtë e errët	E bardhë	E hirtë e errët	E bardhë	Alumini	E bardhë ^c
	U_g^d	g	τ_e	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}
Xham i njëfishtë	5,8	0,87	0,85	0,12	0,20	0,18	0,21	0,28	0,23	0,23	0,25	0,39	0,40	0,43	0,64	0,45	0,65	0,42	0,46	0,38
Xham i dyfishtë me mbushje ajri pa veshje mbrojtëse	2,9	0,78	0,73	0,10	0,15	0,15	0,16	0,25	0,19	0,20	0,19	0,35	0,34	0,44	0,63	0,46	0,64	0,42	0,47	0,40
Xham i trefishtë me mbushje ajri, pa veshje mbrojtëse	2,0	0,70	0,63	0,08	0,12	0,13	0,13	0,23	0,16	0,18	0,16	0,31	0,30	0,43	0,59	0,45	0,60	0,41	0,46	0,40
Xham izolues i dyfishtë me mbushje argoni, me një veshje mbrojtëse	1,7	0,72	0,60	0,08	0,11	0,13	0,12	0,23	0,15	0,18	0,16	0,32	0,30	0,44	0,61	0,46	0,62	0,42	0,47	0,40
	1,4	0,67	0,58	0,07	0,10	0,12	0,10	0,21	0,14	0,17	0,14	0,29	0,27	0,43	0,58	0,44	0,58	0,41	0,45	0,39
	1,1	0,64	0,58	0,07	0,08	0,11	0,09	0,20	0,13	0,16	0,13	0,28	0,25	0,42	0,56	0,44	0,56	0,40	0,44	0,39
	1,0	0,53	0,45	0,06	0,08	0,10	0,08	0,17	0,11	0,14	0,11	0,24	0,22	0,38	0,47	0,39	0,48	0,37	0,40	0,36
Xham izolues i trefishtë me mbushje argoni, me dy veshje mbrojtëse	0,8	0,60	0,50	0,06	0,07	0,10	0,07	0,19	0,11	0,15	0,11	0,26	0,23	0,41	0,53	0,42	0,54	0,39	0,43	0,38
	0,7	0,53	0,46	0,05	0,06	0,09	0,06	0,17	0,10	0,13	0,10	0,23	0,20	0,38	0,48	0,39	0,48	0,37	0,40	0,36
Xham i dyfishtë për mbrojtje nga rrezatimi diellorë me mbushje argoni, me një veshje mbrojtëse	1,3	0,48	0,44	0,06	0,09	0,10	0,10	0,17	0,12	0,14	0,12	0,22	0,21	0,35	0,43	0,36	0,43	0,34	0,37	0,34
	1,2	0,37	0,34	0,06	0,09	0,09	0,09	0,14	0,11	0,11	0,11	0,18	0,18	0,29	0,34	0,30	0,34	0,29	0,30	0,28
	1,2	0,25	0,21	0,05	0,08	0,08	0,09	0,12	0,09	0,09	0,10	0,13	0,14	0,21	0,23	0,22	0,23	0,21	0,22	0,21
	1,1	0,36	0,33	0,05	0,08	0,08	0,08	0,14	0,10	0,11	0,11	0,17	0,17	0,29	0,33	0,29	0,33	0,28	0,30	0,28
Xham i trefishtë për mbrojtje nga rrezatimi	1,1	0,27	0,24	0,05	0,08	0,07	0,08	0,12	0,09	0,09	0,10	0,14	0,14	0,23	0,25	0,23	0,25	0,23	0,23	0,22
	0,7	0,34	0,29	0,04	0,06	0,07	0,06	0,12	0,08	0,10	0,08	0,16	0,15	0,28	0,32	0,28	0,32	0,27	0,28	0,27
	0,7	0,24	0,21	0,04	0,06	0,06	0,06	0,10	0,07	0,08	0,07	0,12	0,12	0,21	0,23	0,21	0,23	0,21	0,21	0,20

diellorë me mbushje argoni, me dy veshje mbrojtëse	0,7	0,16	0,13	0,03	0,06	0,05	0,06	0,08	0,06	0,06	0,07	0,09	0,09	0,15	0,15	0,15	0,15	0,14	0,15	0,14
Xham i dyfishtë izolues me mbushje argoni, me një veshje mbrojtëse; I rregullueshëm ^f	1,1	0,41	0,36	$g_{\text{tot}} = 0,20$																
Xham i trefishtë izolues me mbushje argoni, me dy veshje mbrojtëse; I rregullueshëm ^f	0,7	0,36	0,31	$g_{\text{tot}} = 0,17$																
				Karakteristikat e pajisjeve për mbrojtjen nga rrezatimi diellorë																
Kalueshmëria $\tau_{e,B0^\circ}$				0,06	0,01	0,12	0,02	0,27	0,12	0,21	0,09	0,098	0,02	0,13	0,05	0,15	0,06	0,35	0,07	0,15
Reflektueshmëria $\rho_{e,B0^\circ}$				0,74	0,09	0,74	0,09	0,57	0,34	0,65	0,13	0,65	0,13	0,74	0,52	0,74	0,52	0,58	0,45	0,60
a Kalkulimi i g_{tot} sipas EN 13363-1, sikur që është përshkruar për film (shtresë e hollë e aplikuar mbi xham) në EN 410.																				
b Sistemet me lamela preferohet të vlerësohen me vendosjen e këndit të lamelës prej 45°. Vlerat e lamelave të vendosur në këndin prej 10° përcaktohen me peshimin (ponderimin) në këtë mënyrë: $g_{\text{tot},10^\circ} = 2/3 g_{\text{tot},0^\circ} + 1/3 g_{\text{tot},45^\circ}$.																				
c Këto sisteme nuk ofrojnë mbrojtje adekuate nga shkëlqimi. Instalimi i mëvonshëm i mbrojtjes nga shkëlqimi e ul depërtueshmërinë e dritës, por pothuajse nuk ndikon në g_{tot} .																				
d Vlerat projektuese nga DIN V 4108-4 në W/(m²K) (duke përfshirë vlerën korrigjuese prej 0,1 W/(m²K)).																				
e Pajisjet për roleta preferohet të vlerësohen për "3/4 të mbyllura". Vlerat për "3/4 të mbyllura" përcaktohen me peshimin (ponderimin): $g_{\text{tot},3/4 \text{ mbyllura}} = 3/4 g_{\text{tot,plotësisht të mbyllura}} + 1/4 g$.																				
f Vlerat e treguara të g_{tot} nuk marrin parasysh mbrojtje shtesë nga rrezatimi diellorë.																				
g Pajisje të brendshme për mbrojtje nga dielli (film) – shtresa ose folie të vendosur mbi xham nga brenda hapësirës për të kontrolluar depërtimin e dritës dhe energjisë diellore, duke reduktuar ngrohjen dhe rrezatimin UV																				

Lloji i xhamëzimit	Karakteristikat, pa pajisje për mbrojtje nga dielli			Karakteristikat me pajisje të jashtme për mbrojtje nga dielli										Karakteristikat me mbrojtje të brendshme nga dielli						
				Roleta të jashtme veneciane ^b (pozita 10°)		Roleta të jashtme veneciane (pozita 45°)		Markizë vertikale		Roletë (plotësisht e mbyllur)		Roletë ^c (e mbyllur në 3/4)		Roletë e brendshme veneciane ^b (pozita 10°)		Roletë e brendshme veneciane (pozita 45°)		Perde role nga tekstili		Film ^g
				E bardhë	E hirtë e errët	E bardhë	E hirtë e errët	E bardhë	E hirtë mesatare	E bardhë	E hirtë e errët	E bardhë	E hirtë e errët	E bardhë	E hirtë e errët	E bardhë	E hirtë e errët	E bardhë	Alumini	E bardhë ^g
	U_g^d	g	τ_e	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}
Xham i trefishtë për mbrojtje nga rrezatimi diellorë me mbushje argoni, me dy veshje mbrojtëse	0,7	0,34	0,29	0,04	0,06	0,07	0,06	0,12	0,08	0,10	0,08	0,16	0,15	0,28	0,32	0,28	0,32	0,27	0,28	0,27
	0,7	0,24	0,21	0,04	0,06	0,06	0,06	0,10	0,07	0,08	0,07	0,12	0,12	0,21	0,23	0,21	0,23	0,21	0,21	0,20
	0,7	0,16	0,13	0,03	0,06	0,05	0,06	0,08	0,06	0,06	0,07	0,09	0,09	0,15	0,15	0,15	0,15	0,14	0,15	0,14
Xham i dyfishtë izolues me mbushje argoni, me një veshje mbrojtëse; I rregullueshëm ^f	1,1	0,41	0,36	$g_{tot} = 0,20$																
Xham i trefishtë izolues me mbushje argoni, me dy veshje mbrojtëse; I rregullueshëm ^f	0,7	0,36	0,31	$g_{tot} = 0,17$																
				Karakteristikat e pajisjeve për mbrojtjen nga rrezatimi diellorë																
Kalueshmëria $\tau_{e,B0^\circ}$				0,06	0,01	0,12	0,02	0,27	0,12	0,21	0,09	0,098	0,02	0,13	0,05	0,15	0,06	0,35	0,07	0,15
Reflektueshmëria $\rho_{e,B0^\circ}$				0,74	0,09	0,74	0,09	0,57	0,34	0,65	0,13	0,65	0,13	0,74	0,52	0,74	0,52	0,58	0,45	0,60
h	Kalkulimi i g_{tot} sipas EN 13363-1, sikur që është përshkruar për film (shtresë e hollë e aplikuar mbi xham) në EN 410.																			
i	Sistemet me lamela preferohet të vlerësohen me vendosjen e këndit të lamelës prej 45°. Vlerat e lamelave të vendosur në këndin prej 10° përcaktohen me peshimin (ponderimin) në këtë mënyrë: $g_{tot,10^\circ} = 2/3 g_{tot,0^\circ} + 1/3 g_{tot,45^\circ}$.																			
j	Këto sisteme nuk ofrojnë mbrojtje adekuate nga shkëlqimi. Instalimi i mëvonshëm i mbrojtjes nga shkëlqimi e ul depërtueshmërinë e dritës, por pothuajse nuk ndikon në g_{tot} .																			
k	Vlerat projektuese nga DIN V 4108-4 në W/(m ² K) (duke përfshirë vlerën korrigjuese prej 0,1 W/(m ² K)).																			
l	Pajisjet për roleta preferohet të vlerësohen për "3/4 të mbyllura". Vlerat për "3/4 të mbyllura" përcaktohen me peshimin (ponderimin): $g_{tot,3/4 \text{ mbyllura}} = 3/4 g_{tot,plotësisht \text{ e mbyllura}} + 1/4 g$.																			
m	Vlerat e treguara të g_{tot} nuk marrin parasysh mbrojtje shtesë nga rrezatimi diellorë.																			
n	Pajisje të brendshme për mbrojtje nga dielli (film) – shtresa ose folie të vendosur mbi xham nga brenda hapësirës për të kontrolluar depërtimin e dritës dhe energjisë diellore, duke reduktuar ngrohjen dhe rrezatimin UV																			

SHTOJCA 3

LISTA E MATERIALEVE NDËRTIMORE

Vlerat projektuese të përcjellshmërisë termike, λ [$W/(m \cdot K)$], dhe vlerat e përafërta të faktorit të rezistencës ndaj difuzionit të avullit të ujit μ (-)

Nr. rend.	Emri	Dendësia ρ kg/m ³	Koeficienti i përcjellshmërisë termike λ W/(m·K)	Kapaciteti specifik i nxehtësisë c_p J/(kg·K)	Faktori i rezistencës ndaj difuzionit të avullit të ujit, vlera e poshtme μ (-)	Faktori i rezistencës ndaj difuzionit të avullit të ujit, vlera e sipërme μ (-)
1.	Muret					
1.01	Tullë e plotë nga argjila	1800	0,810	900	5	10
1.02	Tullë e plotë nga argjila	1600	0,680	900	5	10
1.03	Tullë e klinkerit	1900	0,850	800	50	100
1.04	Tullë e klinkerit	1700	0,800	800	50	100
1.05	Tullë e plotë nga argjila për fasadë	1800	0,830	900	5	10
1.06	Tullë e plotë nga argjila për fasadë	1600	0,700	900	5	10
1.07	Tullë e plotë nga argjila për fasadë	1200	0,550	900	5	10
1.08	Blok poroz nga argjila	1100	0,480	900	5	10
1.09	Blok poroz nga argjila	1000	0,450	900	5	10
1.10	Blok poroz nga argjila	900	0,420	900	5	10
1.11	Blok poroz nga argjila	800	0,390	900	5	10
1.12	Tullë e plotë silikate gëlqerore	1800	0,990	900	15	25
1.13	Tullë e plotë silikate gëlqerore	1600	0,790	900	15	25
1.14	Tullë e plotë silikate gëlqerore	1200	0,560	900	15	25
1.15	Gur natyror	2000	1,400	1000	50	
1.16	Blok poroz nga betoni	1000	0,700	1000	5	15
1.17	Blok poroz nga betoni	1200	0,800	1000	5	15
1.18	Blok poroz nga betoni	1400	0,900	1000	20	30
1.19	Blok poroz nga betoni	1600	1,100	1000	20	30
1.20	Blok poroz nga betoni	1800	1,200	1000	20	30
1.21	Blok poroz nga betoni	2000	1,400	1000	20	30
1.22	Blok poroz nga betoni i lehtë	500	0,300	1000	5	10
1.23	Blok poroz nga betoni i lehtë	700	0,370	1000	5	10
1.24	Blok poroz nga betoni i lehtë	900	0,460	1000	5	10
1.25	Blok poroz nga betoni i lehtë	1000	0,520	1000	5	10
1.26	Blok poroz nga betoni i lehtë	1200	0,600	1000	5	10
1.27	Blok poroz nga betoni i lehtë	1400	0,720	1000	5	10
2	Betone dhe betonet e armuar					
	Bloqe të plota nga betoni të lehtë	1000 - 1600	0,470 - 0,800	1000	4 - 9	

Nr. rend.	Emri	Dendësia ρ kg/m ³	Koeficienti i përcjellshmërisë termike λ W/(m·K)	Kapaciteti specifik i nxehhtësisë c_p J/(kg·K)	Faktori i rezistencës ndaj difuzionit të avullit të ujit, vlera e poshtme μ (-)	Faktori i rezistencës ndaj difuzionit të avullit të ujit, vlera e sipërme μ (-)
	Tulla nga hiri	1300 - 1500	0,470 – 0,580	930	4 - 5	
	Blloqet e ygavruara nga zgjyra	1200 - 1600	0,520 – 0,640	650-990	4	
	Blloqet me gazbeton të autoklavuara (AAC)	440 - 650	0,130 – 0,180	840-1000	5	
2.01	Beton i armuar	2500	2,600	1000	80	130
2.02	Beton i rëndë	3200	2,60	1000	80	130
2.03	Beton	2400	2,500	1000	80	130
2.04	Beton	2200	1,650	1000	70	120
2.05	Beton	2000	1,350	1000	60	100
2.06	Beton me agregat të lehtë	2000	1,350	1000	60	100
2.07	Beton me agregat të lehtë	1800	1,300	1000	60	100
2.08	Beton me agregat të lehtë	1600	1,000	1000	60	100
2.09	Beton me agregat të lehtë	1500	0,890	1000	60	100
2.10	Beton me agregat të lehtë	1400	0,790	1000	60	100
2.11	Beton me agregat të lehtë	1300	0,700	1000	60	100
2.12	Beton me agregat të lehtë	1200	0,620	1000	60	100
2.13	Beton me agregat të lehtë	1100	0,550	1000	60	100
2.14	Beton me agregat të lehtë	1000	0,490	1000	60	100
2.15	Beton me agregat të lehtë	900	0,440	1000	60	100
2.16	Beton me agregat të lehtë	800	0,390	1000	60	100
2.17	Beton poroz - Porobeton	1000	0,310	1000	6	10
2.18	Beton poroz - Porobeton	900	0,290	1000	6	10
2.19	Beton poroz - Porobeton	800	0,250	1000	6	10
2.20	Beton poroz - Porobeton	750	0,240	1000	6	10
2.21	Beton poroz - Porobeton	700	0,220	1000	6	10
2.22	Beton poroz - Porobeton	650	0,210	1000	6	10
2.23	Beton poroz - Porobeton	600	0,190	1000	6	10
2.24	Beton poroz - Porobeton	550	0,180	1000	6	10
2.25	Beton poroz - Porobeton	500	0,160	1000	6	10
2.26	Beton poroz - Porobeton	450	0,150	1000	6	10
2.27	Beton poroz - Porobeton	400	0,130	1000	6	10
2.28	Beton poroz - Porobeton	350	0,110	1000	6	10
2.29	Beton poroz - Porobeton	300	0,100	1000	6	10
2.30	Beton me agregat të njëllojshëm	2000	1,400	1000	60	100
2.31	Beton me agregat të njëllojshëm	1800	1,100	1000	60	100
2.32	Beton me agregat të njëllojshëm	1600	0,810	1000	60	100
3	Suvatë dhe estrihet (shtresat rrafshuese)					
	Beton me agregat argjile të zgjeruar të lehtë	800 - 1400	0,290 – 0,580	840-1200	3 - 7	
	Beton me tulla të grimcuara si agregat	1200 - 1600	0,470 – 0,760	1000	3 - 6	
3.01	Llaç me çimento	2000	1,600	1000	15	35
3.02	Llaç me gëlqere	1600	0,800	1000	6	10
3.03	Llaç me gëlqere-çimento	1800	1,000	1000	15	35
3.04	Llaç me gëlqere-gjips	1400	0,700	1000	6	10

Nr. rend.	Emri	Dendësia ρ kg/m ³	Koeficienti i përcjellshmërisë termike λ W/(m·K)	Kapaciteti specifik i nxehhtësisë c_p J/(kg·K)	Faktori i rezistencës ndaj difuzionit të avullit të ujit, vlera e poshtme μ (-)	Faktori i rezistencës ndaj difuzionit të avullit të ujit, vlera e sipërme μ (-)
3.05	Llaç me ghips	1500	0,540	1000	6	10
3.06	Llaç me ghips	1400	0,510	1000	6	10
3.07	Llaç me ghips	1300	0,470	1000	6	10
3.08	Llaç me ghips	1200	0,430	1000	6	10
3.09	Llaç i lehtë	1300	0,560	1000	15	20
3.10	Llaç i lehtë	1000	0,380	1000	15	20
3.11	Llaç i lehtë	700	0,250	1000	15	20
3.12	Llaç për izolim termik	400	0,110	1000	5	20
3.13	Llaç për izolim termik	250	0,080	1000	5	20
3.14	Llaç për sanim	1400	0,650	1000	6	15
3.15	Llaç polimeri	1100	0,700	1000	50	200
3.16	Llaç silikati	1800	0,900	1000	50	70
3.17	Llaç me bazë akrilati	1700	0,900	1000	100	150
3.18	Llaç me çimento	2000	1,600	1000	15	35
3.19	Estrihu (shtresa rrafshuese) nga çimento	2000	1,600	1100	50	
3.20	Estrihu anhidrit	2100	1,200	1000	15	35
3.21	Estrihu magnezit	2300	0,700	1000	15	35
4	Veshjet e mureve, dyshemeve dhe tavaneve					
	Suva gipsi mbi kallam	1000	0,470	1100	3	
	Pllakë nga gjipskartoni	900	0,250	900	8	
	Pllakë nga gipsi me shtresë të fijeve celuloze	1300	0,380	1000	10	15
	Pllakë qeramike	2300	1,300	840	200	
	Pllaka muri qeramike të glazuara (me shkëlqim)	1700	0,870	900	200	
	Pllaka qeramike të glazuruara (me shkëlqim) për fasadë	1800	0,920	900	300	
	Mozaik qeramike (16% mbushës për fuga)	1900	0,990	900	140	
	Mozaik qeramike (21% mbushës për fuga)	1900	0,990	900	100	
	Mozaik qeramike (26% mbushës për fuga)	1900	0,990	900	90	
	Mozaik i xhamit	2000	1,200	750	150	
	Pllakë guri	2500	2,800	1000	40	200
	Druri	550	0,150	1600	50	70
	Druri i fortë	700	0,180	1600	50	70
	Shtresë prej çimentoje me fibra	1200	0,230	1000	50	30
	Pllakë më presim të vazhduar (shperpplakë)	300 - 1000	0,090 – 0,240	1500-1700	150 - 250	50 - 110
	Pllakë kompenzate druri rezistente ndaj ujit (për mbulesa të brendshme)	550	0,140	1600	60	
	Pllakë kompenzate druri rezistente ndaj ujit	600	0,140	1600	100	
	Pllaka druri nga fibra të orientuara (OSB)	650	0,130	1700	50	30

Nr. rend.	Emri	Dendësia ρ kg/m ³	Koeficienti i përcjellshmërisë termike λ W/(m·K)	Kapaciteti specifik i nxehhtësisë c_p J/(kg·K)	Faktori i rezistencës ndaj difuzionit të avullit të ujit, vlera e poshtme μ (-)	Faktori i rezistencës ndaj difuzionit të avullit të ujit, vlera e sipërme μ (-)
	Pllakë kompakte/druri i ngjeshur	300 - 900	0,100 – 0,180	1500-1800	50	10 - 20
	Qylym	200	0,060	1600	5	5
	Pllakë çeliku	7800	50,000	500	∞	
	Pllakë alumini	2800	160,000	900	∞	
	Pllakë bakri e limuar	8900	380,000	385	∞	
	Plastikë	1700	0,250	1300	10	
	Dysheme epokside	1200	0,200	1300	10	
	Dysheme vinili	1390	0,170	1350	50	
	Parket	700	0,210	1600	15	
	Pllaka klinkeri	1900	1,050	900	100	
	Pllaka të argjilës	1800	0,790	850	20	
	Linoleum	1200	0,170	1450	500	
	Gomë	1000	0,160	1600	10000	
	Elemente të parafabrikuara betoni	2400 - 2500	2,040 – 2,330	900	70 -90	
	Elemente të lehta betoni	1200	0,470	1050	10	
	Xham i dritares	2500	0,810	750	10000	
	Xham e perforuar, armuar	2600	0,440	750	10000	
	Bllaqe qelqi të zbrazëta	1100	0,440	750	4000	
	Tapeta muri prej letre	600	0,150	1500	5	
	Tapeta muri prej letre – që lahen	700	0,150	1500	10	
	Tapeta muri prej plastikës	700	0,200	1350	3000	
Materialet hidroizoluese, barrierat e avullit						
	Shirit bitumi me shtojcë nga leshi i xhamit	1100	0,230	1000	50000	
	Shirit bitumi me shtojcë nga pëlhura e xhamit	1100	0,230	1000	50000	
	Shirit bitumi me shtojcë nga coha e poliestirenit	1100	0,230	1000	50000	
	Shirit bitumi me shtojcë të kartonit për kulme	1100	0,230	1000	50000	
	Shirit hidroizolues polimer në bazë të PVC-P	1200	0,140	1000	100000	
	Shirit hidroizolues polimer në bazë të PIB	1600	0,260	900	300000	
	Shirit hidroizolues polimer në bazë të CR	1300	0,230	1000	100000	
	Shirit hidroizolues polimer në bazë të VAE	1300	0,140	1000	20000	
	Shirit hidroizolues polimer në bazë të ECB	1600	0,260	960	90000	
	Shirit hidroizolues polimer në bazë të FTO/TPO	1600	0,260	960	90000	
	Shirit hidroizolues polimer në bazë të PEHD	1600	0,500	960	50000	
	Folia PE, e palosur	1000	0,190	1250	50000	
	Folia Al, e palosur	2800	160,000	880	∞	

Nr. rend.	Emri	Dendësia ρ kg/m ³	Koeficienti i përcjellshmërisë termike λ W/(m·K)	Kapaciteti specifik i nxehhtësisë c_p J/(kg·K)	Faktori i rezistencës ndaj difuzionit të avullit të ujit, vlera e poshtme μ (-)	Faktori i rezistencës ndaj difuzionit të avullit të ujit, vlera e sipërme μ (-)
	Materialet e shkrifta për mbushje					
	Perlit i ekspanduar	≤ 100	0,060	1000	3	
	Grimcat e tapës së ekspanduar	≤ 200	0,055	1300	3	
	Grimcat e tullës nga argjila	≤ 800	0,410	900	3	
	Rërë, zhavor, gur i thyer	≤ 700	0,810	1000	3	
	Rërë e thatë	1800	0,580	830	1,4	
	Gurë të vegjël (popla) të thatë	1700	0,810	800	1,5	
	Argjilë e ekspanduar	400	0,220	950	1,3	
	Tallash (pluhur i sharres)	250	0,090	1650	1,2	
	Dhe (me lagështi)	1700	2,100	1300	-	
	Materialet termoizoluese					
	Lesh mineral (MW)	10 deri 200	0,035 deri 0,050	1030	1 – 1,2	
	Polistiren i ekspanduar (EPS)	15 deri 30	0,035 deri 0,040	1300	20	100
	Polistiren i ekstruduar (XPS)	25 - 45	0,029 – 0,036	1450	80	200
	Shkumë e forte poliuretani (PUR)	30 - 60	0,022 – 0,028	1400	30	200
	Shkumë fenolike (PF)	35 - 80	0,020 – 0,025	1400	40	150
	Shkumë qelqi (CG)	100 - 200	0,036 – 0,055	800	-	-
	Lesh druri	250 - 400	0,065 – 0,090	2100	5	10
	Pllakë e ekspanduar perliti (EPB)	100 - 150	0,040 – 0,060	1000	5	15
	Beton me tallash (pluhur sharre)	550 - 800	0,140 – 0,240	1200	5 - 10	
	Pllaka prej rrëshirës akrilike	1180	0,190	1480	8000	
	Pllaka (pane) PVC	1400	0,210	1200	16000	
	Plaka fenolike	40 - 60	0,041	1450	35 - 40	
	Lesh i deles	20	0,040	1750	1	
	Fibra kokosi	100	0,045	1750	1	
	Fibra celuloze	85	0,040	1750	1	
	Pambuk	20	0,040	1750	1	
	Pllaka termike perliti	150	0,060	800	5	
	Mbushës me perlit	90	0,055	800	3	

SHTOJCA 4

KËRKESAT MINIMALE TË PERFORMANCËS SË SISTEMEVE TEKNIKE

Gjeneratori i nxehtësisë	Burimi i nxehtësisë	Njësia e kërkuar	Kërkesa minimale E PROPOZUAR
Stufat individuale (ngrohje direkte)	Gaz	Efiçienca e gjenerimit (%)	≥ 75.00 %
	Biogaz	Efiçienca e gjenerimit (%)	≥ 75.00 %
	Naftë (dizel)	Efiçienca e gjenerimit (%)	≥ 80.00 %
	Bionaftë (biodizel)	Efiçienca e gjenerimit (%)	≥ 80.00 %
	Biomasë e përdorur lokalisht (tradicionale)	Efiçienca e gjenerimit (%)	≥ 60.00 %
	Pelet	Efiçienca e gjenerimit (%)	≥ 85.00 %
	Ashkla druri	Efiçienca e gjenerimit (%)	≥ 80.00 %
	Dru zjarri dhe linjit	Efiçienca e gjenerimit (%)	≥ 65.00 %
	Energjia elektrike	Efiçienca e gjenerimit (%)	≥ 100.00 %
Kaldajë standarde (ngrohje me radiatorë) (75/60°C)	Gaz	Efiçienca e gjenerimit (%)	≥ 85%
	Biogaz	Efiçienca e gjenerimit (%)	≥ 85%
	Naftë (dizel)	Efiçienca e gjenerimit (%)	≥ 85%
	Bionaftë (biodizel)	Efiçienca e gjenerimit (%)	≥ 85%
	Energjia elektrike	Efiçienca e gjenerimit (%)	≥ 99.00 %
Kaldajë me temperaturë të ulët (55/45°C)	Gaz	Efiçienca e gjenerimit (%)	≥ 90.00 %
	Biogaz	Efiçienca e gjenerimit (%)	≥ 90.00 %
	Naftë (dizel)	Efiçienca e gjenerimit (%)	≥ 88.00 %
	Bionaftë (biodizel)	Efiçienca e gjenerimit (%)	≥ 88.00 %
	Energjia elektrike	Efiçienca e gjenerimit (%)	≥ 99.00 %
Kaldajë kondensuese (me radiatorë) (55/45°C)	Gaz	Efiçienca e gjenerimit (%)	≥ 94.00 %
	Biogaz	Efiçienca e gjenerimit (%)	≥ 94.00 %
	Naftë (dizel)	Efiçienca e gjenerimit (%)	≥ 92.00 %
	Bionaftë (biodizel)	Efiçienca e gjenerimit (%)	≥ 92.00 %
	Energjia elektrike	Efiçienca e gjenerimit (%)	≥ 100.00 %
Kaldajë me biomasë (me ngrohje me radiatorë) (75/60°C)	Biomasë e përdorur lokalisht	Efiçienca e gjenerimit (%)	
	Dru zjarri	Efiçienca e gjenerimit (%)	≥ 70.00 %
	Pelet	Efiçienca e gjenerimit (%)	≥ 85.00 %

	Ashkla druri	Efiçienca e gjenerimit (%)	≥ 80.00 %
Njësi ngrohjeje split (njësi split për ngrohje me ajër të jashtëm me pompa termike ajër-ajër)	Energjia elektrike	Ngrrohje	
		SCOP	≥ 3.2
Njësi multi-split për ngrohje (njësi multi-split për ngrohje me pompa termike ajër-ajër me ajër të jashtëm)	Energjia elektrike	Ngrrohje	
		SCOP	≥ 3.4
Njësi VRF për ngrohje (njësi VRF për ngrohje me ajër të jashtëm, pompa termike ajër-ajër)	Energjia elektrike	Ngrrohje	
		SCOP	≥ 3.6
Pompë termike (kolektori tokësor), tokë-ujë	Energjia elektrike	Ngrrohje	
		SCOP	≥ 4.0
Pompë termike (ujë nëntokësor), ujë-ujë	Energjia elektrike	Ngrrohje	
		SCOP	≥ 4.5
Pompë termike ajër-ujë monovalente	Energjia elektrike	Ngrrohje	
		SCOP	≥ 3.5
Pompë termike (ajër i jashtëm) me ngrohës elektrik	Energjia elektrike	Ngrrohje	
		SCOP	≥ 3.0
Ngrrohje elektrike e decentralizuar me panel	Energjia elektrike	Efiçienca e gjenerimit (%)	≥ 100.00%
Ngrrohje qendrore (ngrohje qendrore me 110/90°C, radiatorë 75/60°C)	Ngrrohje me radiatorë (75/60°C)	Efiçienca e gjenerimit (%)	≥ 82.00%
	Ngrrohje në dysheme (40/30°C)	Efiçienca e gjenerimit (%)	≥ 86.00%

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Treguesit e performancës** Performanca energjetike e sistemeve të ngrohjes shprehet si: eficienca e gjenerimit (njen, %) për: -sistemet me djegie (gaz, naftë, biomasë) -ngrohjen qendrore (district heating) -ngrohjen elektrike direkte Koeficient sezonal i performancës (SCOP) për: -pompat e nxehtësisë Vlerat e deklaruara të performancës duhet të verifikohen përmes: - Raportet e certifikuara të testimit (kur është e zbatueshme)	Kërkesa metodologjike shtesë** Vlerat SCOP duhet të referohen në: -kushte të temperaturës mesatare të sistemit (55°C) përveç rasteve kur specifikohet ndryshe. Për sistemet me ngrohës elektrik ndihmës: -performanca duhet të përfshijë funksionimin e tij në vlerën e deklaruar SCOP. Për sistemet e ngrohjes qendrore (district heating): - efikasiteti duhet të përfshijë: -prodhimin -shpërndarjen -humbjet në rrjet
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Për pompat termike, Koeficienti Sezonal i Performancës (SCOP) merret për aplikim me temperaturë mesatare (55°C).

Për sistemet e ngrohjes qendrore, vlerat e efikasitetit bazohen në të dhënat e ofruara nga operatori i sistemit ose në vlerat e paracaktuara të përcaktuara në metodologjinë kombëtare të kalkulimit.

ANNEX 1

TECHNICAL PARAMETERS AND REQUIREMENTS FOR THE IMPLEMENTATION OF MINIMUM ENERGY PERFORMANCE REQUIREMENTS IN BUILDINGS

TABELA 1: Reference values of building envelope parameters

#	Parameters	Renovated buildings Reference values of the heat transmission coefficient U [W/m²K]	New buildings Reference values of the heat transmission coefficient U [W/m²K]
Structural elements of buildings			
1	Outside wall	0.35	0.31
2	Wall adjacent to ground, Floor adjacent to ground	0.50	0.40
3	Glazed components (windows, roof-lights, glazed doors, transparent façade elements, etc.)	1.60	1.60
4	Exterior door with opaque wing	1.60	1.60
5	Flat and pitched roof	0.30	0.30
6	Ceiling between floors bordering unheated space	0.50	0.50
7	Ceiling between floors	0.90	0.80
8	Wall bordering unheated space	1.40	1.20
	Glazed façade	1.60	1.60
Airtightness requirements of the building envelope			
9	Infiltration n ₅₀		3.0 l/h
Requirements for emission and distribution systems for the design and installation of engineering systems in new buildings and existing buildings subject to major renovation			
10	Individual room / Zone device emission / Management system	Energy-saving operation mode	Energy-saving operation mode

Solar thermal properties	
g-value of the window	0,60
Fc in the winter season (shading factor)	1,00
Fc in the summer season (shading factor)	0,40
Other parameters of the building envelope	
Thermal bridges	In accordance with good practices

TABELA 2: Reference parameters of technical systems for residential buildings and residential parts of comparative reference buildings

#	Parameters	Reference values
Heating – Central systems		
1	Generator	If only heating: Boiler on biomass If heating and cooling: Electric Heat Pump air-water, single stage bivalent with integrated electric heater From 01.01.2031 onwards, only: Electric Heat Pump air-water, single stage bivalent with integrated electric heater
2	Distribution	Distribution pipes outside, risers and pipe connections inside the thermal hull
3	Control and emission	If only heating: Radiators, with supply temperature 75°C, and return

		60°C. If there is heating and cooling: Parapet-mounted fan-coils, with water, supply temperature 50°C, return 30°C, and 6/12°C for cooling
4	Hot water storage	Indirect heated hot water storage
5	Domestic hot water	Combined with heating
Heating – Decentralised systems		
6	Generator	If there is only heating: Individual pellet boiler (stove) If there is heating and cooling: Multi-split systems
Domestic hot water		Electric heater (boiler) with storage
7	Generator, Distribution	Electronically controlled instantaneous electric heater (boiler), pipe connections inside the thermal envelope
Cooling system		
8	Generator	Central system: Combined heating and cooling Decentralized system: Multi-split system

#	Parameters	Reference values
Ventilation system – exhaust air system		
9	Distribution	Specific fan power: $P_{SFP} = 1.0 \text{ kW}/(\text{m}^3/\text{s})$
Ventilation system – supply and exhaust air system		
10	Distribution	Specific fan power: - Supply air: $P_{SFP} = 1.5 \text{ kW}/(\text{m}^3/\text{s})$ - Exhaust air $P_{SFP} = 1.0 \text{ kW}/(\text{m}^3/\text{s})$ Heat recovery rate: $\eta = 0.6$ Ventilation ducts: inside the building
Building automation		
11	Building automation	Class C (according to the classification of building automation systems)

TABELA 3: Reference parameters of technical systems for non-residential buildings and non-residential parts of the comparative reference building

#	Parameters	Reference values
Lighting – Relevant only for non-residential buildings		
1	Type of lighting	Direct / indirect lighting with LED lamps

#	Parameters	Reference values
Heating – Central systems		
2	Generator	If only heating: Boiler on biomass If there is heating and cooling: Electric Heat Pump air-water, single stage bivalent with integrated electric heater From 01.01.2031 onwards, only: Electric Heat Pump air-water, single stage bivalent

		with integrated electric heater
3	Distribution	Distribution pipes outside, risers and pipe connections inside the thermal hull
4	Control and emission	If there is only heating: Radiators, with supply temperature 75°C, and return 60°C. If there is heating and cooling: Floor-mounted water fan-coils (parapet fan-coils), supply temperature 50°C, return temperature 30°C. 6/12°C for cooling
5	Hot water storage	Indirect heated hot water storage
6	Domestic hot water	Combined with heating
Heating – Decentralized system		
7	Generator	Electric Multi-split systems
8	Domestic hot water heating	Electric boiler with storage
Cooling system		
9	Generator	Central system: Combined heating and cooling Decentralized system: VRF systems

#	Parameters	Reference values
Ventilation system – exhaust air system		
10	Distribution	Specific fan power: $P_{SFP} = 1.0 \text{ kW}/(\text{m}^3/\text{s})$
Ventilation system – supply and exhaust air system		
11	Distribution	Specific fan power: - Supply air: $P_{SFP} = 1.5 \text{ kW}/(\text{m}^3/\text{s})$ - Exhaust air: $P_{SFP} = 1.0 \text{ kW}/(\text{m}^3/\text{s})$ Heat recovery rate: $\eta = 0.6$ Air ducts: inside the building
Ventilation system – conditioning/humidification		
12	Air conditioning	Air handling unit with heating coil: Supply air temperature 18 °C Air handling unit with heating and cooling coil: Supply air temperature 18 °C 6/12 °C No indirect evaporative cooling
Building automation		
13	Building automation	Class C (according to the classification of building automation systems)

ANNEX 2

CHARACTERISTICS OF GLAZING AND THEIR VALUES

Default values for characteristics of glazing and solar protection devices

Type of glazing	Characteristics, without solar protection device			Characteristics with external solar protection										Characteristics with internal solar protection						
				External Venetian blind ^b (10° position)		External Venetian blind (45° position)		Vertical marquee		Roller shutter (fully closed)		Roller shutter ^e (3/4 closed)		Internal Venetian blind ^b (10° position)		Internal Venetian blind (45° position)		Textile roller blind		Film
				White	Dark grey	White	Dark grey	White ^c	Medium grey	White	Dark grey	White	Dark grey	White	Dark grey	White	Dark grey	White	Aluminium	White ^c
	U_g^d	g	τ_e	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}
Single glazing	5,8	0,87	0,85	0,12	0,20	0,18	0,21	0,28	0,23	0,23	0,25	0,39	0,40	0,43	0,64	0,45	0,65	0,42	0,46	0,38
Double glazing with air filling, without coating	2,9	0,78	0,73	0,10	0,15	0,15	0,16	0,25	0,19	0,20	0,19	0,35	0,34	0,44	0,63	0,46	0,64	0,42	0,47	0,40
Triple glazing with air filling, without coating	2,0	0,70	0,63	0,08	0,12	0,13	0,13	0,23	0,16	0,18	0,16	0,31	0,30	0,43	0,59	0,45	0,60	0,41	0,46	0,40
Thermal insulation glazing double with argon filling, with one coating	1,7	0,72	0,60	0,08	0,11	0,13	0,12	0,23	0,15	0,18	0,16	0,32	0,30	0,44	0,61	0,46	0,62	0,42	0,47	0,40
	1,4	0,67	0,58	0,07	0,10	0,12	0,10	0,21	0,14	0,17	0,14	0,29	0,27	0,43	0,58	0,44	0,58	0,41	0,45	0,39
	1,1	0,64	0,58	0,07	0,08	0,11	0,09	0,20	0,13	0,16	0,13	0,28	0,25	0,42	0,56	0,44	0,56	0,40	0,44	0,39
	1,0	0,53	0,45	0,06	0,08	0,10	0,08	0,17	0,11	0,14	0,11	0,24	0,22	0,38	0,47	0,39	0,48	0,37	0,40	0,36
Thermal insulation glazing triple with argon filling, with two coatings	0,8	0,60	0,50	0,06	0,07	0,10	0,07	0,19	0,11	0,15	0,11	0,26	0,23	0,41	0,53	0,42	0,54	0,39	0,43	0,38

	0,7	0,53	0,46	0,05	0,06	0,09	0,06	0,17	0,10	0,13	0,10	0,23	0,20	0,38	0,48	0,39	0,48	0,37	0,40	0,36
Double solar protection glazing with argon filling, with one coating	1,3	0,48	0,44	0,06	0,09	0,10	0,10	0,17	0,12	0,14	0,12	0,22	0,21	0,35	0,43	0,36	0,43	0,34	0,37	0,34
	1,2	0,37	0,34	0,06	0,09	0,09	0,09	0,14	0,11	0,11	0,11	0,18	0,18	0,29	0,34	0,30	0,34	0,29	0,30	0,28
	1,2	0,25	0,21	0,05	0,08	0,08	0,09	0,12	0,09	0,09	0,10	0,13	0,14	0,21	0,23	0,22	0,23	0,21	0,22	0,21
	1,1	0,36	0,33	0,05	0,08	0,08	0,08	0,14	0,10	0,11	0,11	0,17	0,17	0,29	0,33	0,29	0,33	0,28	0,30	0,28
	1,1	0,27	0,24	0,05	0,08	0,07	0,08	0,12	0,09	0,09	0,10	0,14	0,14	0,23	0,25	0,23	0,25	0,23	0,23	0,22
Triple solar protection glazing with argon filling, with two coatings	0,7	0,34	0,29	0,04	0,06	0,07	0,06	0,12	0,08	0,10	0,08	0,16	0,15	0,28	0,32	0,28	0,32	0,27	0,28	0,27
	0,7	0,24	0,21	0,04	0,06	0,06	0,06	0,10	0,07	0,08	0,07	0,12	0,12	0,21	0,23	0,21	0,23	0,21	0,21	0,20
	0,7	0,16	0,13	0,03	0,06	0,05	0,06	0,08	0,06	0,06	0,07	0,09	0,09	0,15	0,15	0,15	0,15	0,14	0,15	0,14
Double insulating glazing with argon filling, with one coating; Switchable f	1,1	0,41	0,36	$g_{\text{tot}} = 0,20$																
Triple insulating glazing with argon filling, with two coatings; Switchable f	0,7	0,36	0,31	$g_{\text{tot}} = 0,17$																
				Characteristics of solar protection devices																
Transmittance $\tau_{e,B0^\circ}$				0,06	0,01	0,12	0,02	0,27	0,12	0,21	0,09	0,098	0,02	0,13	0,05	0,15	0,06	0,35	0,07	0,15
Reflectance $\rho_{e,B0^\circ}$				0,74	0,09	0,74	0,09	0,57	0,34	0,65	0,13	0,65	0,13	0,74	0,52	0,74	0,52	0,58	0,45	0,60
a Calculation of g_{tot} according to EN 13363-1, as described for film (a thin layer applied to glass) in EN 410.																				
b Systems with slats are preferably assessed with the slat angle set at 45°. The values of slats set at an angle of 10° are determined by weighting as follows: $g_{\text{tot},10^\circ} = 2/3 g_{\text{tot},0^\circ} + 1/3 g_{\text{tot},45^\circ}$.																				
c These systems do not provide adequate glare protection. Subsequent installation of glare protection reduces light transmittance, but has almost no effect on g_{tot} .																				
d Design values from DIN V 4108-4 in W/(m2K) (including the correction value of 0,1 W/(m2K)).																				
e Roller shutter devices are preferably assessed as "3/4 closed". The values for "3/4 closed" are determined by weighting: $g_{\text{tot},3/4 \text{ closed}} = 3/4 g_{\text{tot,fully closed}} + 1/4 g$.																				
f The indicated gtot values do not take into account additional solar protection.																				
g Internal solar protection device (film) – layers or foils placed on the glass from the inside of the space to control the penetration of light and solar energy, reducing heating and UV radiation																				

Type of glazing	Characteristics, without solar protection device			Characteristics with external solar protection										Characteristics with internal solar protection						
				External Venetian blind ^b (10° position)		External Venetian blind (45° position)		Vertical marquee		Roller shutter (fully closed)		Roller shutter ^e (3/4 closed)		Internal Venetian blind ^b (10° position)		Internal Venetian blind (45° position)		Textile roller blind		Film ^g
				White	Dark grey	White	Dark grey	White ^c	Medium grey	White	Dark grey	White	Dark grey	White	Dark grey	White	Dark grey	White	Aluminium	White ^e
				g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}
Triple solar protection glazing with argon filling, with two coatings	0,7	0,34	0,29	0,04	0,06	0,07	0,06	0,12	0,08	0,10	0,08	0,16	0,15	0,28	0,32	0,28	0,32	0,27	0,28	0,27
	0,7	0,24	0,21	0,04	0,06	0,06	0,06	0,10	0,07	0,08	0,07	0,12	0,12	0,21	0,23	0,21	0,23	0,21	0,21	0,20
	0,7	0,16	0,13	0,03	0,06	0,05	0,06	0,08	0,06	0,06	0,07	0,09	0,09	0,15	0,15	0,15	0,15	0,14	0,15	0,14
Double insulating glazing with argon filling, with one coating; Switchable f	1,1	0,41	0,36	$g_{tot} = 0,20$																
Triple insulating glazing with argon filling, with two coatings; Switchable f	0,7	0,36	0,31	$g_{tot} = 0,17$																
				Characteristics of solar protection devices																
Transmittance $\tau_{e,B0^\circ}$				0,06	0,01	0,12	0,02	0,27	0,12	0,21	0,09	0,098	0,02	0,13	0,05	0,15	0,06	0,35	0,07	0,15
Reflectance $\rho_{e,B0^\circ}$				0,74	0,09	0,74	0,09	0,57	0,34	0,65	0,13	0,65	0,13	0,74	0,52	0,74	0,52	0,58	0,45	0,60
h				Calculation of g_{tot} according to EN 13363-1, as described for film (a thin layer applied to glass) in EN 410.																
i				Systems with slats are preferably assessed with the slat angle set at 45°. The values of slats set at an angle of 10° are determined by weighting as follows: $g_{tot,10^\circ} = 2/3 g_{tot,0^\circ} + 1/3 g_{tot,45^\circ}$.																
j				These systems do not provide adequate glare protection. Subsequent installation of glare protection reduces light transmittance, but has almost no effect on g_{tot} .																
k				Design values from DIN V 4108-4 in W/(m2K) (including the correction value of 0,1 W/(m2K)).																
l				Roller shutter devices are preferably assessed as "3/4 closed". The values for "3/4 closed" are determined by weighting: $g_{tot,3/4 \text{ closed}} = 3/4 g_{tot, \text{fully closed}} + 1/4 g$.																
m				The indicated g_{tot} values do not take into account additional solar protection.																
n				Internal solar protection device (film) – layers or foils placed on the glass from the inside of the space to control the penetration of light and solar energy, reducing heating and UV radiation																

ANNEX 3

LIST OF BUILDING MATERIALS

Design values of thermal conductivity, λ [W/(m·K)], and approximate values of the water vapour diffusion resistance factor μ (-)

Ser. No.	Name	Density ρ kg/m ³	Coefficient of thermal conductivity λ W/(m·K)	Specific heat capacity c_p J/(kg·K)	Water vapour resistance factor lower μ (-)	Water vapour resistance factor upper μ (-)
1.	Walls					
1.01	Solid clay brick	1800	0,810	900	5	10
1.02	Solid clay brick	1600	0,680	900	5	10
1.03	Clinker bricks	1900	0,850	800	50	100
1.04	Clinker bricks	1700	0,800	800	50	100
1.05	Solid clay façade brick	1800	0,830	900	5	10
1.06	Solid clay façade brick	1600	0,700	900	5	10
1.07	Solid clay façade brick	1200	0,550	900	5	10
1.08	Porous clay block	1100	0,480	900	5	10
1.09	Porous clay block	1000	0,450	900	5	10
1.10	Porous clay block	900	0,420	900	5	10
1.11	Porous clay block	800	0,390	900	5	10
1.12	Solid calcium silicate brick	1800	0,990	900	15	25
1.13	Solid calcium silicate brick	1600	0,790	900	15	25
1.14	Solid calcium silicate brick	1200	0,560	900	15	25
1.15	Natural stone	2000	1,400	1000	50	
1.16	Porous concrete block	1000	0,700	1000	5	15
1.17	Porous concrete block	1200	0,800	1000	5	15
1.18	Porous concrete block	1400	0,900	1000	20	30
1.19	Porous concrete block	1600	1,100	1000	20	30
1.20	Porous concrete block	1800	1,200	1000	20	30
1.21	Porous concrete block	2000	1,400	1000	20	30
1.22	Porous lightweight concrete block	500	0,300	1000	5	10
1.23	Porous lightweight concrete block	700	0,370	1000	5	10
1.24	Porous lightweight concrete block	900	0,460	1000	5	10
1.25	Porous lightweight concrete block	1000	0,520	1000	5	10
1.26	Porous lightweight concrete block	1200	0,600	1000	5	10
1.27	Porous lightweight concrete block	1400	0,720	1000	5	10
2	Concrete and reinforced concrete					
	Solid lightweight concrete blocks	1000 - 1600	0,470 - 0,800	1000	4 - 9	
	Fly ash bricks	1300 - 1500	0,470 - 0,580	930	4 - 5	
	Hollow slag blocks	1200 - 1600	0,520 - 0,640	650-990	4	
	Autoclaved aerated concrete blocks (AAC)	440 - 650	0,130 - 0,180	840-1000	5	
2.01	Reinforced concrete	2500	2,600	1000	80	130
2.02	Heavy concrete	3200	2,60	1000	80	130
2.03	Concrete	2400	2,500	1000	80	130

Ser. No.	Name	Density ρ kg/m ³	Coefficient of thermal conductivity λ W/(m·K)	Specific heat capacity c_p J/(kg·K)	Water vapour resistance factor lower μ (-)	Water vapour resistance factor upper μ (-)
2.04	Concrete	2200	1,650	1000	70	120
2.05	Concrete	2000	1,350	1000	60	100
2.06	Lightweight aggregate concrete	2000	1,350	1000	60	100
2.07	Lightweight aggregate concrete	1800	1,300	1000	60	100
2.08	Lightweight aggregate concrete	1600	1,000	1000	60	100
2.09	Lightweight aggregate concrete	1500	0,890	1000	60	100
2.10	Lightweight aggregate concrete	1400	0,790	1000	60	100
2.11	Lightweight aggregate concrete	1300	0,700	1000	60	100
2.12	Lightweight aggregate concrete	1200	0,620	1000	60	100
2.13	Lightweight aggregate concrete	1100	0,550	1000	60	100
2.14	Lightweight aggregate concrete	1000	0,490	1000	60	100
2.15	Lightweight aggregate concrete	900	0,440	1000	60	100
2.16	Lightweight aggregate concrete	800	0,390	1000	60	100
2.17	Porous concrete - Porobeton	1000	0,310	1000	6	10
2.18	Porous concrete - Porobeton	900	0,290	1000	6	10
2.19	Porous concrete - Porobeton	800	0,250	1000	6	10
2.20	Porous concrete - Porobeton	750	0,240	1000	6	10
2.21	Porous concrete - Porobeton	700	0,220	1000	6	10
2.22	Porous concrete - Porobeton	650	0,210	1000	6	10
2.23	Porous concrete - Porobeton	600	0,190	1000	6	10
2.24	Porous concrete - Porobeton	550	0,180	1000	6	10
2.25	Porous concrete - Porobeton	500	0,160	1000	6	10
2.26	Porous concrete - Porobeton	450	0,150	1000	6	10
2.27	Porous concrete - Porobeton	400	0,130	1000	6	10
2.28	Porous concrete - Porobeton	350	0,110	1000	6	10
2.29	Porous concrete - Porobeton	300	0,100	1000	6	10
2.30	Concrete with one type of aggregate	2000	1,400	1000	60	100

Ser. No.	Name	Density ρ kg/m ³	Coefficient of thermal conductivity λ W/(m·K)	Specific heat capacity c_p J/(kg·K)	Water vapour resistance factor lower μ (-)	Water vapour resistance factor upper μ (-)
2.31	Concrete with one type of aggregate	1800	1,100	1000	60	100
2.32	Concrete with one type of aggregate	1600	0,810	1000	60	100
3	Plasters and screeds (levelling layers)					
	Lightweight expanded clay aggregate concrete	800 - 1400	0,290 – 0,580	840-1200	3 - 7	
	Concrete with crushed brick as aggregate	1200 - 1600	0,470 – 0,760	1000	3 - 6	
3.01	Cement plaster	2000	1,600	1000	15	35
3.02	Lime plaster	1600	0,800	1000	6	10
3.03	Lime-cement plaster	1800	1,000	1000	15	35
3.04	Lime-gypsum plaster	1400	0,700	1000	6	10
3.05	Gypsum plaster	1500	0,540	1000	6	10
3.06	Gypsum plaster	1400	0,510	1000	6	10
3.07	Gypsum plaster	1300	0,470	1000	6	10
3.08	Gypsum plaster	1200	0,430	1000	6	10
3.09	Lightweight plaster	1300	0,560	1000	15	20
3.10	Lightweight plaster	1000	0,380	1000	15	20
3.11	Lightweight plaster	700	0,250	1000	15	20
3.12	Thermal insulation plaster	400	0,110	1000	5	20
3.13	Thermal insulation plaster	250	0,080	1000	5	20
3.14	Renovation plaster	1400	0,650	1000	6	15
3.15	Polymer plaster	1100	0,700	1000	50	200
3.16	Silicate plaster	1800	0,900	1000	50	70
3.17	Acrylate-based plaster	1700	0,900	1000	100	150
3.18	Cement plaster	2000	1,600	1000	15	35
3.19	Cement screed (levelling layer)	2000	1,600	1100	50	
3.20	Anhydrite screed	2100	1,200	1000	15	35
3.21	Magnesite screed	2300	0,700	1000	15	35
4	Wall, floor and ceiling coverings					
	Gypsum plaster on reed	1000	0,470	1100	3	
	Plasterboard	900	0,250	900	8	
	Gypsum board with cellulose fibre layer	1300	0,380	1000	10	15
	Ceramic tile	2300	1,300	840	200	
	Glazed ceramic wall tiles	1700	0,870	900	200	
	Glazed ceramic façade tiles	1800	0,920	900	300	
	Ceramic mosaic (16% joint filler)	1900	0,990	900	140	
	Ceramic mosaic (21% joint filler)	1900	0,990	900	100	
	Ceramic mosaic (26% joint filler)	1900	0,990	900	90	
	Glass mosaic	2000	1,200	750	150	
	Stone slab	2500	2,800	1000	40	200
	Wood	550	0,150	1600	50	70
	Hardwood	700	0,180	1600	50	70
	Fibre cement sheet	1200	0,230	1000	50	30
	Plywood	300 - 1000	0,090 – 0,240	1500-1700	150 - 250	50 - 110

Ser. No.	Name	Density ρ kg/m ³	Coefficient of thermal conductivity λ W/(m·K)	Specific heat capacity c_p J/(kg·K)	Water vapour resistance factor lower μ (-)	Water vapour resistance factor upper μ (-)
	Water-resistant plywood board (for interior coverings)	550	0,140	1600	60	
	Water-resistant plywood board	600	0,140	1600	100	
	Oriented strand board (OSB)	650	0,130	1700	50	30
	Chipboard	300 - 900	0,100 – 0,180	1500-1800	50	10 - 20
	Carpet	200	0,060	1600	5	5
	Steel sheet	7800	50,000	500	∞	
	Aluminium sheet	2800	160,000	900	∞	
	Polished copper sheet	8900	380,000	385	∞	
	Plastic	1700	0,250	1300	10	
	Epoxy flooring	1200	0,200	1300	10	
	Vinyl flooring	1390	0,170	1350	50	
	Parquet	700	0,210	1600	15	
	Clinker tiles	1900	1,050	900	100	
	Brick tiles	1800	0,790	850	20	
	Linoleum	1200	0,170	1450	500	
	Rubber	1000	0,160	1600	10000	
	Precast concrete elements	2400 - 2500	2,040 – 2,330	900	70 -90	
	Lightweight concrete elements	1200	0,470	1050	10	
	Window glass	2500	0,810	750	10000	
	Perforated, reinforced glass	2600	0,440	750	10000	
	Hollow glass blocks	1100	0,440	750	4000	
	Paper-based wallpaper	600	0,150	1500	5	
	Paper-based wallpaper – washable	700	0,150	1500	10	
	Plastic wallpaper	700	0,200	1350	3000	
Waterproofing materials, vapor barriers						
	Bitumen strip with glass wool insert	1100	0,230	1000	50000	
	Bitumen strip with glass cloth insert	1100	0,230	1000	50000	
	Bitumen strip with polystyrene fabric insert	1100	0,230	1000	50000	
	Bitumen strip with roofing cardboard insert	1100	0,230	1000	50000	
	PVC-P-based polymer waterproofing strip	1200	0,140	1000	100000	
	PIB-based polymer waterproofing strip	1600	0,260	900	300000	
	CR-based polymer waterproofing strip	1300	0,230	1000	100000	
	VAE-based polymer waterproofing strip	1300	0,140	1000	20000	
	ECB-based polymer waterproofing strip	1600	0,260	960	90000	
	FTO/TPO-based polymer waterproofing strip	1600	0,260	960	90000	
	PEHD-based polymer	1600	0,500	960	50000	

Ser. No.	Name	Density ρ kg/m ³	Coefficient of thermal conductivity λ W/(m·K)	Specific heat capacity c_p J/(kg·K)	Water vapour resistance factor lower μ (-)	Water vapour resistance factor upper μ (-)
	waterproofing strip					
	PE foil, folded	1000	0,190	1250	50000	
	Al foil, folded	2800	160,000	880	∞	
	Loose fill materials					
	Expanded perlite	≤ 100	0,060	1000	3	
	Expanded cork granules	≤ 200	0,055	1300	3	
	Clay brick granules	≤ 800	0,410	900	3	
	Sand, gravel, crushed stone	≤ 700	0,810	1000	3	
	Dry sand	1800	0,580	830	1,4	
	Dry pebbles	1700	0,810	800	1,5	
	Expanded clay	400	0,220	950	1,3	
	Sawdust	250	0,090	1650	1,2	
	Soil (moist)	1700	2,100	1300	-	
	Thermal insulation materials					
	Mineral wool (MW)	10 to 200	0.035 to 0.050	1030	1 – 1,2	
	Expanded polystyrene (EPS)	15 to 30	0.035 to 0.040	1300	20	100
	Extruded polystyrene (XPS)	25 - 45	0,029 – 0,036	1450	80	200
	Rigid polyurethane foam (PUR)	30 - 60	0.022 – 0.028	1400	30	200
	Phenolic foam (PF)	35 - 80	0.020 – 0.025	1400	40	150
	Cellular glass foam (CG)	100 - 200	0.036 – 0.055	800	-	-
	Wood wool	250 - 400	0.065 – 0.090	2100	5	10
	Expanded perlite board (EPB)	100 - 150	0.040 – 0.060	1000	5	15
	Concrete with sawdust	550 - 800	0,140 – 0,240	1200	5 - 10	
	Acrylic resin boards	1180	0,190	1480	8000	
	PVC boards (panels)	1400	0,210	1200	16000	
	Phenolic boards	40 - 60	0,041	1450	35 - 40	
	Sheep wool	20	0,040	1750	1	
	Coconut fibre	100	0,045	1750	1	
	Cellulose fibre	85	0,040	1750	1	
	Cotton	20	0,040	1750	1	
	Perlite thermal boards	150	0,060	800	5	
	Perlite filler	90	0,055	800	3	

ANNEX 4

MINIMUM PERFORMANCE REQUIREMENTS FOR TECHNICAL SYSTEMS

Heat generator	Heat source	The requested unit	The minimum requirement PROPOSED
Individual stoves(direct heating)	Gas	Efficiency of generation (%)	≥ 75.00 %
	Biogas	Efficiency of generation (%)	≥ 75.00 %
	Oil (diesel)	Efficiency of generation (%)	≥ 80.00 %
	Bio oil (bio diesel)	Efficiency of generation (%)	≥ 80.00 %
	Biomass locally used (traditional)	Efficiency of generation (%)	≥ 60.00 %
	Pellet	Efficiency of generation (%)	≥ 85.00 %
	Woodchips	Efficiency of generation (%)	≥ 80.00 %
	Firewood and Lignite	Efficiency of generation (%)	≥ 65.00 %
	Electricity	Efficiency of generation (%)	≥ 100.00 %
Standard boiler (heating with radiators) (75/60°C)	Gas	Efficiency of generation (%)	≥ 85%
	Biogas	Efficiency of generation (%)	≥ 85%
	Oil (diesel)	Efficiency of generation (%)	≥ 85%
	Bio oil (bio diesel)	Efficiency of generation (%)	≥ 85%
	Electricity	Efficiency of generation (%)	≥ 99.00 %
Low temperature boiler (55/45°C)	Gas	Efficiency of generation (%)	≥ 90.00 %
	Biogas	Efficiency of generation (%)	≥ 90.00 %
	Oil (diesel)	Efficiency of generation (%)	≥ 88.00 %
	Bio oil (bio diesel)	Efficiency of generation (%)	≥ 88.00 %
	Electricity	Efficiency of generation (%)	≥ 99.00 %
Condensing boiler (with radiators) (55/45°C)	Gas	Efficiency of generation (%)	≥ 94.00 %
	Biogas	Efficiency of generation (%)	≥ 94.00 %
	Oil (diesel)	Efficiency of generation (%)	≥ 92.00 %
	Bio oil (bio diesel)	Efficiency of generation (%)	≥ 92.00 %
	Electricity	Efficiency of generation (%)	≥ 100.00 %

Biomass boiler (with radiator heating) (75/60°C)	Biomass locally used	Efficiency of generation (%)	
	Firewood	Efficiency of generation (%)	≥ 70.00 %
	Pellet	Efficiency of generation (%)	≥ 85.00 %
	Wood chips	Efficiency of generation (%)	≥ 80.00 %
Split heating units(split heating unit with outside air with air-to-air heat pumps)	Electricity	Heating	
		SCOP	≥ 3.2
Multi split heating units(multi split heating unit with outside air to air heat pumps)	Electricity	Heating	
		SCOP	≥ 3.4
VRF heating units (VRF heating units with outside air, air to air heat pumps)	Electricity	Heating	
		SCOP	≥ 3.6
Heat pump (ground collector),ground to water	Electricity	Heating	
		SCOP	≥ 4.0
Heat pump (ground water)water to water	Electricity	Heating	
		SCOP	≥ 4.5
Heat pump air- to-water monovalent	Electricity	Heating	
		SCOP	≥ 3.5
Heat pump (outside air) with electric heater	Electricity	Heating	
		SCOP	≥ 3.0
Decentral electric panel heating	Electricity	Efficiency of generation (%)	≥ 100.00%
District heating(district heating with	Radiators heating (75/60°C)	Efficiency of generation (%)	≥ 82.00%

110/90°C, radiators 75/60°C)	Floor heating (40/30°C)	Efficiency of generation (%)	≥ 86.00%
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Performance indicators**** The energy performance of heating systems is expressed as: generation efficiency (η_{gen}, %) for: - combustion systems (gas, oil, biomass) - central heating (district heating) - direct electric heating Seasonal coefficient of performance (SCOP) for: -heat pumps The declared performance values shall be verified through: -the manufacturer's technical documentation -the product fiche - the EPREL database or equivalent sources - Certified test reports (where applicable)	Additional methodological requirements** SCOP values shall refer to: - medium system temperature conditions (55°C), except where specified otherwise. For systems with auxiliary electric heater: - the performance shall include its operation in the declared SCOP value. For central heating systems (district heating) efficiency shall include: -generation -distribution -network losses
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For heat pumps, the Seasonal Coefficient of Performance (SCOP) shall be taken for medium temperature application (55°C).

For district heating systems, efficiency values shall be based on data provided by the system operator or default values defined in the national calculation methodology.

PRILOG 1

PARAMETRI I TEHNIČKI ZAHTEVI ZA SPROVOĐENJE MINIMALNIH ZAHTEVA ZA ENERGETSKE PERFORMANSE U ZGRADAMA

TABELA 1: Referentne vrednosti parametara omotača zgrade

#	Parametri	Renovirane zgrade Referentne vrednosti koeficijenta prenosa toplote U [W/m²K]	Nove zgrade Referentne vrednosti koeficijenta prenosa toplote U [W/m²K]
Elementi konstrukcije zgrade			
1	Spoljni zid	0.35	0.31
2	Zid koji se graniči sa zemljom, Podovi u kontaktu sa zemljom	0.50	0.40
3	Zastakljene komponente (prozori, krovni prozori, zastakljena vrata, providni fasadni elementi itd.)	1.60	1.60
4	Spoljna vrata sa neprozirnim krilom	1.60	1.60
5	Ravan i kosi krov	0.30	0.30
6	Međuspratna ploča omeđena neogrejanim prostorom	0.50	0.50
7	Međuspratna ploča	0.90	0.80
8	Zid koji se graniči sa neogrevanim prostorom Zastakljena fasada	1.40	1.20
		1.60	1.60
Zahtevi za infiltraciju vazduha u omotaču zgrade			
9	Infiltracija n ₅₀		3.0 l/h
Zahtevi za sisteme emisije i distribucije za projektovanje i ugradnju inženjerskih sistema u novim zgradama i postojećim zgradama koje podležu renoviranju			
10	Pojedinačna prostorija / Emisija uređaja u zonu/ Sistem upravljanja	Modalitet rada u režimu uštede energije	Modalitet rada u režimu uštede energije

Parametri solarnih termalnih svojstava	
Faktor solarne propustljivosti prozora g-vrednost	0,60
Fc u zimskoj sezoni (faktor senčenja)	1,00
Fc u letnjoj sezoni (faktor senčenja)	0,40
Ostali parametri omotača zgrade	
Termalni mostovi	U skladu sa dobrim praksama

TABELA 2: Referentni parametri tehničkih sistema za stambene zgrade i stambene delove uporednih referentnih zgrada

#	Parametri	Referentne vrednosti
Grejanje – Centralni sistemi		
1	Generator	Ako je samo grejanje: Kotlovi na biomasu Ako se greje i hladi: Električna toplotna pumpa vazduh-voda, jednostepena bivalentna sa integrisanim električnim grejačem Od 01.01.2031. pa nadalje, samo: Električna toplotna pumpa vazduh-voda, jednostepena bivalentna sa integrisanim električnim grejačem
2	Distribucija:	Spoljašnje distributivne cevi, usponi i cevni priključci unutar termičkog omotača
3	Kontrola i emisije	Ako je samo grejanje:

		Radijatori, sa temperaturom isporuke od 75°C i temperaturom povratka od 60°C. Ako postoji grejanje i hlađenje: Ventilatorski konvektori montirani na parapet, sa vodom, temperatura dovoda 50°C, povratka 30°C i hlađenja 6/12°C
4	Bojler za toplu vodu	Indirektno zagrejani bojler za toplu vodu
5	Sanitarna topla voda	U kombinaciji sa grejanjem
Grejanje – Decentralizovani sistemi		
6	Generator	Ako postoji samo grejanje: Individualni kotlovi (peći) na pelet Ako postoji grejanje i hlađenje: Multi-split sistemi
Sanitarna topla voda		Električni grejač (bojler) sa rezervoarom
7	Generator, Distribucija	Električni protočni bojler sa elektronskom kontrolom, cevni priključci unutar termičkog omotača
Sistem hlađenja		
8	Generator	Centralni sistem: Kombinovano grejanje i hlađenje Decentralizovani sistem: Multi-split sistem

#	Parametri	Referentne vrednosti
Sistem ventilacije – sistem za izvlačenje vazduha		
9	Distribucija	Specifični kapacitet ventilatora $P_{SFP} = 1,0 \text{ kW}/(\text{m}^3/\text{s})$
Ventilacioni sistem – sistem za dovod i izvlačenje vazduha		
10	Distribucija:	Specifični kapacitet ventilatora: -Dovod vazduha $P_{SFP} = 1,5 \text{ kW}/(\text{m}^3/\text{s})$ -Uisavanje vazduha $P_{SFP} = 1,0 \text{ kW}/(\text{m}^3/\text{s})$ Stopa povraćaja toplote: $\eta = 0,6$ Vazdušni kanali: unutar zgrade
Automatizacija zgrada		
11	Automatizacija zgrada	Klasa C (prema klasifikaciji sistema automatizacije zgrada)

TABELA 3: Referentni parametri tehničkih sistema za nestambene zgrade i nestambene delove uporedne referentne zgrade

#	Parametri	Referentne vrednosti
Rasveta – Relevantna samo za nestambene zgrade		
1	Vrsta rasvete	Direktna / indirektna rasveta sa LED lampama

T	Parametri	Referentne vrednosti
Grejanje – Centralni sistemi		
2	Generator	Ako je samo grejanje: Kotlovi na biomasu Ako postoji grejanje i hlađenje: Električna toplotna pumpa vazduh-voda, jednostepena bivalentna sa integrisanim električnim grejačem Od 01.01.2031. pa nadalje, samo:

		Električna toplotna pumpa vazduh-voda, jednostepena bivalentna sa integrisanim električnim grejačem
3	Distribucija	Spoljašnje distributivne cevi, usponi i cevni priključci unutar termičkog omotača
4	Kontrola i emisije	Ako postoji samo grejanje: Radijatori, sa temperaturom isporuke od 75°C i temperaturom povratka od 60°C. Ako postoji grejanje i hlađenje: Ventilatorski konvektori sa vodenim hlađenjem, montirani na zemlju (parapetni ventilatorski konvektori), temperatura isporuke 50°C, temperatura povratka 30°C. 6/12°C za hlađenje
5	Bojler za toplu vodu	Rezervoar tople vode sa indirektnim zagrevanjem
6	Sanitarna topla voda	U kombinaciji sa grejanjem
Grejanje – Decentralizovani sistem		
7	Generator	Multi-split električni sistemi
8	Grejanje sanitarne vode	Električni bojler sa rezervoarom
Sistem hlađenja		
9	Generator	Centralni sistem: Kombinovano grejanje i hlađenje Decentralizovani sistem: VRF sistemi

#	Parametri	Referentne vrednosti
Sistem ventilacije – sistem za izvlačenje vazduha		
10	Distribucija	Specifični kapacitet ventilatora: $P_{SFP} = 1.0 \text{ kW}/(\text{m}^3/\text{s})$
Ventilacioni sistem – sistem za dovod i izvlačenje vazduha		
11	Distribucija	Specifični kapacitet ventilatora: -Dovod vazduha: $P_{SFP} = 1.5 \text{ kW}/(\text{m}^3/\text{s})$ -Usisavanje vazduha: $P_{SFP} = 1.0 \text{ kW}/(\text{m}^3/\text{s})$ Stopa povraćaja toplote: $\eta = 0.6$ Ventilacioni kanali: unutar zgrade
Sistem ventilacije – klimatizacija/vlaženje vazduha		
12	Klimatizacija	Jedinica za tretman vazduha sa izmenjivačem za grejanje: Temperatura dovodnog vazduha 18 °C Jedinica za tretman vazduha sa izmenjivačem za grejanje i hlađenje: Temperatura dovodnog vazduha 18 °C 6/12 °C Bez indirektnog isparivčkog hlađenja
Automatizacija zgrada		
13	Automatizacija zgrade	Klasa C (prema klasifikaciji sistema automatizacije zgrada)

PRILOG 2

KARAKTERISTIKE STAKLA I NJIHOVE VREDNOSTI

Podrazumevane vrednosti za karakteristike stakla i opreme za zaštitu od sunca

Tip zastakljivanja	Karakteristike, bez uredaja za zaštitu od sunca			Karakteristike sa spoljnim uredajima za zaštitu od sunca										Karakteristike sa unutrašnjom zaštitom od sunca						
				Spoljašnje venecijaner roletne (položaj 10°)		Spoljašnje venecijaner roletne (položaj 45°)		Vertikalna tenda		Roletne (potpuno zatvorene)		Roletne (3/4 zatvorene)		Unutrašnje venecijaner roletne (položaj 10°)		Unutrašnje venecijaner roletne (položaj 45°)		Tekstilne rolo zavese		Folija
				Bela	Tamno siva	Bela	Tamno siva	Bela	Srednje siva	Bela	Tamno siva	Bela	Tamno siva	Bela	Tamno siva	Bela	Tamno siva	Bela	Aluminijum	Bela
	U_g^d	g	τ_e	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}
Jednoslojno staklo	5,8	0,87	0,85	0,12	0,20	0,18	0,21	0,28	0,23	0,23	0,25	0,39	0,40	0,43	0,64	0,45	0,65	0,42	0,46	0,38
Dvostruko staklo sa vazдушnim punjenjem bez zaštitnog premaza	2,9	0,78	0,73	0,10	0,15	0,15	0,16	0,25	0,19	0,20	0,19	0,35	0,34	0,44	0,63	0,46	0,64	0,42	0,47	0,40
Trostruko staklo sa vazдушnim punjenjem , bez zaštitnog premaza	2,0	0,70	0,63	0,08	0,12	0,13	0,13	0,23	0,16	0,18	0,16	0,31	0,30	0,43	0,59	0,45	0,60	0,41	0,46	0,40
Dvostruko izolaciono staklo sa argonskim punjenjem sa jednim zaštitnim premaza	1,7	0,72	0,60	0,08	0,11	0,13	0,12	0,23	0,15	0,18	0,16	0,32	0,30	0,44	0,61	0,46	0,62	0,42	0,47	0,40
	1,4	0,67	0,58	0,07	0,10	0,12	0,10	0,21	0,14	0,17	0,14	0,29	0,27	0,43	0,58	0,44	0,58	0,41	0,45	0,39
	1,1	0,64	0,58	0,07	0,08	0,11	0,09	0,20	0,13	0,16	0,13	0,28	0,25	0,42	0,56	0,44	0,56	0,40	0,44	0,39
	1,0	0,53	0,45	0,06	0,08	0,10	0,08	0,17	0,11	0,14	0,11	0,24	0,22	0,38	0,47	0,39	0,48	0,37	0,40	0,36
Trostruko izolaciono staklo sa argonskim punjenjem , sa dva zaštitna premaza	0,8	0,60	0,50	0,06	0,07	0,10	0,07	0,19	0,11	0,15	0,11	0,26	0,23	0,41	0,53	0,42	0,54	0,39	0,43	0,38

	0,7	0,53	0,46	0,05	0,06	0,09	0,06	0,17	0,10	0,13	0,10	0,23	0,20	0,38	0,48	0,39	0,48	0,37	0,40	0,36
Dvostruko solarno zaštitno staklo sa argonskim punjenjem i jednim zaštinim premazom	1,3	0,48	0,44	0,06	0,09	0,10	0,10	0,17	0,12	0,14	0,12	0,22	0,21	0,35	0,43	0,36	0,43	0,34	0,37	0,34
	1,2	0,37	0,34	0,06	0,09	0,09	0,09	0,14	0,11	0,11	0,11	0,18	0,18	0,29	0,34	0,30	0,34	0,29	0,30	0,28
	1,2	0,25	0,21	0,05	0,08	0,08	0,09	0,12	0,09	0,09	0,10	0,13	0,14	0,21	0,23	0,22	0,23	0,21	0,22	0,21
	1,1	0,36	0,33	0,05	0,08	0,08	0,08	0,14	0,10	0,11	0,11	0,17	0,17	0,29	0,33	0,29	0,33	0,28	0,30	0,28
	1,1	0,27	0,24	0,05	0,08	0,07	0,08	0,12	0,09	0,09	0,10	0,14	0,14	0,23	0,25	0,23	0,25	0,23	0,23	0,22
Trostruko solarno zaštitno staklo sa argonskim punjenjem i dva zaština premaza	0,7	0,34	0,29	0,04	0,06	0,07	0,06	0,12	0,08	0,10	0,08	0,16	0,15	0,28	0,32	0,28	0,32	0,27	0,28	0,27
	0,7	0,24	0,21	0,04	0,06	0,06	0,06	0,10	0,07	0,08	0,07	0,12	0,12	0,21	0,23	0,21	0,23	0,21	0,21	0,20
	0,7	0,16	0,13	0,03	0,06	0,05	0,06	0,08	0,06	0,06	0,07	0,09	0,09	0,15	0,15	0,15	0,15	0,14	0,15	0,14
Dvostruko izolaciono staklo sa argonskim punjenjem sa jednim zaštitnim premazom; Podesivo	1,1	0,41	0,36	$g_{tot} = 0,20$																
Trostruko izolaciono staklo sa argonskim punjenjem sa dva zaštitna premaza; Podesivi f	0,7	0,36	0,31	$g_{tot} = 0,17$																
				Karakteristike uređaja za zaštitu od sunca																
Propustljivost $\tau_{e,B0^{\circ}}$				0,06	0,01	0,12	0,02	0,27	0,12	0,21	0,09	0,098	0,02	0,13	0,05	0,15	0,06	0,35	0,07	0,15
Reflektivnost $\rho_{e,B0^{\circ}}$				0,74	0,09	0,74	0,09	0,57	0,34	0,65	0,13	0,65	0,13	0,74	0,52	0,74	0,52	0,58	0,45	0,60
a Izračunavanje g_{tot} prema EN 13363-1, kao što je opisano za foliju (tanki sloj nanet na staklo) u EN 410.																				
b Sistemi sa lamelama se preporučuju da se procenjuju podešavanjem ugla lamele od 45°. Vrednosti lamela postavljenih pod uglom od 10° određuju se merenjem (ponderisanjem) na ovaj način: $g_{tot,10^{\circ}} = 2/3 g_{ukupno} g_{tot,0^{\circ}} + 1/3 g_{tot,45^{\circ}}$.																				
c Ovi sistemi ne pružaju adekvatnu zaštitu od odsjaja. Naknadna ugradnja zaštite od odsjaja smanjuje prodor svetlosti, ali gotovo da nema uticaja na g_{tot} .																				
d Projektne vrednosti iz DIN V 4108-4 u W/(m2K) (uključujući korekcionu vrednost od 0,1 W/(m2K)).																				
e Uređaji za roletne su preporučuje da se vrednuju kao "3/4" zatvoreni“. Vrednosti za „3/4 zatvoreno“ se određuju merenjem težine (ponderisanjem): $g_{tot,3/4\text{ zatvoreno}} = 3/4 g_{tot,potpuno\text{ zatvoreno}} + 1/4 g$.																				
f Navedene vrednosti g_{tot} ne uzimate u obzir dodatnu zaštitu od sunčevog zračenja.																				
g Unutrašnji uređaji za zaštitu od sunca (folija) – sloj ili folija postavljena na staklo sa unutrašnje strane prostora radi kontrole prodora svetlosti i sunčeve energije, smanjujući toplotu i UV zračenje																				

Vrsta zastakljenja	Karakteristike, bez uređaja za zaštitu od sunca			Karakteristike sa spoljnim uređajima za zaštitu od sunca										Karakteristike sa unutrašnjom zaštitom od sunca						
				Spoljašnje venecijaner roletne (položaj 10°)		Spoljašnje venecijaner roletne (položaj 45°)		Vertikalna tenda		Roletne (potpuno zatvorene)		Roletne (3/4 zatvorene)		Unutrašnje venecijaner roletne (položaj 10°)		Unutrašnje venecijaner roletne (položaj 45°)		Tekstilne rolo zavese		Folija za staklo
				Bela	Tamno siva	Bela	Tamno siva	Bela	Srednje siva	Bela	Tamno siva	Bela	Tamno siva	Bela	Tamno siva	Bela	Tamno siva	Bela	Aluminijum	Bela
	U_g^d	g	τ_e	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	g_{tot}	
Trostruko solarno zaštitno staklo sa argonskim punjenjem i dva zaština premaza	0,7	0,34	0,29	0,04	0,06	0,07	0,06	0,12	0,08	0,10	0,08	0,16	0,15	0,28	0,32	0,28	0,32	0,27	0,28	0,27
	0,7	0,24	0,21	0,04	0,06	0,06	0,06	0,10	0,07	0,08	0,07	0,12	0,12	0,21	0,23	0,21	0,23	0,21	0,21	0,20
	0,7	0,16	0,13	0,03	0,06	0,05	0,06	0,08	0,06	0,06	0,07	0,09	0,09	0,15	0,15	0,15	0,15	0,14	0,15	0,14
Dvostruko izolaciono staklo sa argonskim punjenjem sa jednim zaštitnim premazom; Podesivi f	1,1	0,41	0,36	$g_{tot} = 0,20$																
Trostruko izolaciono staklo sa argonskim punjenjem sa dva zaštitna premaza; Podesivi f	0,7	0,36	0,31	$g_{tot} = 0,17$																
				Karakteristike uređaja za zaštitu od sunčevog zračenja																
Propustljivost $\tau_{e,B0^\circ}$				0,06	0,01	0,12	0,02	0,27	0,12	0,21	0,09	0,098	0,02	0,13	0,05	0,15	0,06	0,35	0,07	0,15
Reflektivnost $\rho_{e,B0^\circ}$				0,74	0,09	0,74	0,09	0,57	0,34	0,65	0,13	0,65	0,13	0,74	0,52	0,74	0,52	0,58	0,45	0,60
h Izračunavanje g_{tot} prema EN 13363-1, kao što je opisano za foliju (tanki sloj nanet na staklo) u EN 410.																				
i Sistemi sa lamelama se preporučuju da se procenjuju podešavanjem ugla lamele od 45°. Vrednosti lamela postavljenih pod uglom od 10° određuju se merenjem (ponderisanjem) na ovaj način: $g_{tot,10^\circ} = 2/3 g$ ukupno $g_{tot,0^\circ} + 1/3 g_{tot,45^\circ}$.																				
j Ovi sistemi ne pružaju adekvatnu zaštitu od odsjaja. Naknadna ugradnja zaštite od odsjaja smanjuje prodor svetlosti, ali gotovo da nema uticaja na g_{tot} .																				
k Projektno vrednosti iz DIN V 4108-4 u W/(m2K) (uključujući korekcionu vrednost od 0,1 W/(m2K)).																				
l Uređaji za roletne su preporučuje da se vrednuju kao "3/4" zatvoreni“. Vrednosti za „3/4 zatvoreno“ se određuju merenjem težine (ponderisanjem): $g_{tot,3/4\text{ zatvoreno}} = 3/4 g_{tot,potpuno\text{ zatvoreno}} + 1/4 g$.																				
m Navedene vrednosti g_{tot} ne uzimate u obzir dodatnu zaštitu od sunčevog zračenja.																				

ⁿ Unutrašnji uređaji za zaštitu od sunca (folija) – sloj ili folija postavljena na staklo sa unutrašnje strane prostora radi kontrole prodora svetlosti i sunčeve energije, smanjujući toplotu i UV zračenje

PRILOG 3

SPISAK GRAĐEVINSKOG MATERIJALA

Projektne vrednosti toplotne provodljivosti, λ [W/(m·K)], i približne vrednosti faktora otpora difuziji vodene pare μ (-)

Red.broj.	Ime	Gustina ρ kg/m ³	Koeficijent termalne provodljivosti λ W/(m·K)	Specifični toplotni kapacitet c_p J/(kg·K)	Faktor otpornosti na vodena isparenja donji μ (-)	Faktor otpornosti na vodena isparenja gornji μ (-)
1.	Zidovi					
1.01	Puna glinena cigla	1800	0,810	900	5	10
1.02	Puna glinena cigla	1600	0,680	900	5	10
1.03	Klinker cigla	1900	0,850	800	50	100
1.04	Klinker cigla	1700	0,800	800	50	100
1.05	Puna glinena cigla za fasadu	1800	0,830	900	5	10
1.06	Puna glinena cigla za fasadu	1600	0,700	900	5	10
1.07	Puna glinena cigla za fasadu	1200	0,550	900	5	10
1.08	Porozni glineni blok	1100	0,480	900	5	10
1.09	Porozni glineni blok	1000	0,450	900	5	10
1.10	Porozni glineni blok	900	0,420	900	5	10
1.11	Porozni glineni blok	800	0,390	900	5	10
1.12	Puna krečno-silikatna cigla	1800	0,990	900	15	25
1.13	Puna krečno-silikatna cigla	1600	0,790	900	15	25
1.14	Puna krečno-silikatna cigla	1200	0,560	900	15	25
1.15	Prirodni kamen	2000	1,400	1000	50	
1.16	Porozni betonski blok	1000	0,700	1000	5	15
1.17	Porozni betonski blok	1200	0,800	1000	5	15
1.18	Porozni betonski blok	1400	0,900	1000	20	30
1.19	Porozni betonski blok	1600	1,100	1000	20	30
1.20	Porozni betonski blok	1800	1,200	1000	20	30
1.21	Porozni betonski blok	2000	1,400	1000	20	30
1.22	Porozni lagani betonski blok	500	0,300	1000	5	10
1.23	Porozni lagani betonski blok	700	0,370	1000	5	10
1.24	Porozni lagani betonski blok	900	0,460	1000	5	10
1.25	Porozni lagani betonski blok	1000	0,520	1000	5	10
1.26	Porozni lagani betonski blok	1200	0,600	1000	5	10
1.27	Porozni lagani betonski blok	1400	0,720	1000	5	10
2	Beton i armirani beton					
	Puni blokovi od lakog betona	1000-1600	0,470-0,800	1000	4-9	
	Cigle od pepela	1300-1500	0,470– 0,580	930	4-5	
	Šuplji blokovi od šljake	1200-1600	0,520– 0,640	650-990	4	
	Autoklavirani gasbetonski blokovi (AAC)	440-650	0,130– 0,180	840-1000	5	
2.01	Armirani beton	2500	2,600	1000	80	130
2.02	Teški beton	3200	2,60	1000	80	130
2.03	Beton	2400	2,500	1000	80	130
2.04	Beton	2200	1,650	1000	70	120
2.05	Beton	2000	1,350	1000	60	100
2.06	Laki agregatni beton	2000	1,350	1000	60	100
2.07	Laki agregatni beton	1800	1,300	1000	60	100
2.08	Laki agregatni beton	1600	1,000	1000	60	100

Red.broj.	Ime	Gustina ρ kg/m ³	Koeficijent termalne provodljivosti λ W/(m·K)	Specifični toplnotni kapacitet c_p J/(kg·K)	Faktor otpornosti na vodena isparenja donji μ (-)	Faktor otpornosti na vodena isparenja gornji μ (-)
2.09	Laki agregatni beton	1500	0,890	1000	60	100
2.10	Laki agregatni beton	1400	0,790	1000	60	100
2.11	Laki agregatni beton	1300	0,700	1000	60	100
2.12	Laki agregatni beton	1200	0,620	1000	60	100
2.13	Laki agregatni beton	1100	0,550	1000	60	100
2.14	Laki agregatni beton	1000	0,490	1000	60	100
2.15	Laki agregatni beton	900	0,440	1000	60	100
2.16	Laki agregatni beton	800	0,390	1000	60	100
2.17	Porozni beton - Porobeton	1000	0,310	1000	6	10
2.18	Porozni beton - Porobeton	900	0,290	1000	6	10
2.19	Porozni beton - Porobeton	800	0,250	1000	6	10
2.20	Porozni beton - Porobeton	750	0,240	1000	6	10
2.21	Porozni beton - Porobeton	700	0,220	1000	6	10
2.22	Porozni beton - Porobeton	650	0,210	1000	6	10
2.23	Porozni beton - Porobeton	600	0,190	1000	6	10
2.24	Porozni beton - Porobeton	550	0,180	1000	6	10
2.25	Porozni beton - Porobeton	500	0,160	1000	6	10
2.26	Porozni beton - Porobeton	450	0,150	1000	6	10
2.27	Porozni beton - Porobeton	400	0,130	1000	6	10
2.28	Porozni beton - Porobeton	350	0,110	1000	6	10
2.29	Porozni beton - Porobeton	300	0,100	1000	6	10
2.30	Beton sa ujednačenim agregatom	2000	1,400	1000	60	100
2.31	Beton sa ujednačenim agregatom	1800	1,100	1000	60	100
2.32	Beton sa ujednačenim agregatom	1600	0,810	1000	60	100
3	Gips i košuljice (slojevi za izravnavanje)					
	Beton sa lakim agregatom od ekspandirane gline	800- 1400	0,290– 0,580	840-1200	3-7	
	Beton sa drobljenom ciglom kao agregatom	1200- 1600	0,470– 0,760	1000	3-6	
3.01	Cementni malter	2000	1,600	1000	15	35
3.02	Krečni malter	1600	0,800	1000	6	10
3.03	Krečno-cementni malter	1800	1,000	1000	15	35
3.04	Krečno-gipsani malter	1400	0,700	1000	6	10
3.05	Gipsani malter	1500	0,540	1000	6	10
3.06	Gipsani malter	1400	0,510	1000	6	10
3.07	Gipsani malter	1300	0,470	1000	6	10
3.08	Gipsani malter	1200	0,430	1000	6	10
3.09	Laki malter	1300	0,560	1000	15	20
3.10	Laki malter	1000	0,380	1000	15	20
3.11	Laki malter	700	0,250	1000	15	20
3.12	Termoizolacioni malter	400	0,110	1000	5	20
3.13	Termoizolacioni malter	250	0,080	1000	5	20
3.14	Malter za sanaciju	1400	0,650	1000	6	15
3.15	Polimerni malter	1100	0,700	1000	50	200
3.16	Silikatni malter	1800	0,900	1000	50	70
3.17	Malter na bazi akrilata	1700	0,900	1000	100	150
3.18	Cementni malter	2000	1,600	1000	15	35
3.19	Cementna košuljica (sloj za izravnavanje)	2000	1,600	1100	50	

Red.broj.	Ime	Gustina ρ kg/m ³	Koeficijent termalne provodljivosti λ W/(m·K)	Specifični toplotni kapacitet cp J/(kg·K)	Faktor otpornosti na vodena isparenja donji μ (-)	Faktor otpornosti na vodena isparenja gornji μ (-)
3.20	Anhidritna košuljica	2100	1,200	1000	15	35
3.21	Magnezijumska košuljica	2300	0,700	1000	15	35
4	Obloge za zidove, podove i plafone					
	Gipsani malter na trsci	1000	0,470	1100	3	
	Gipskartonska ploča	900	0,250	900	8	
	Gipsane ploče sa slojem celuloznih vlakana	1300	0,380	1000	10	15
	Keramičke pločice	2300	1,300	840	200	
	Glazirane keramičke zidne pločice (sjajne)	1700	0,870	900	200	
	Glazirane keramičke pločice (sjajne) za fasadu	1800	0,920	900	300	
	Keramički mozaik (16% punila za fuge)	1900	0,990	900	140	
	Keramički mozaik (21% punila za fuge)	1900	0,990	900	100	
	Keramički mozaik (26% punila za fuge)	1900	0,990	900	90	
	Stakleni mozaik	2000	1,200	750	150	
	Kamena ploča	2500	2,800	1000	40	200
	Drvo	550	0,150	1600	50	70
	Tvrdo drvo	700	0,180	1600	50	70
	Cementni sloj sa vlaknima	1200	0,230	1000	50	30
	Ploča sa kontinuiranim presovanjem (šperploča)	300- 1000	0,090– 0,240	1500-1700	150-250	50-110
	Vodootporna kompenzovana drvena ploča (za unutrašnje obloge)	550	0,140	1600	60	
	Vodootporna kompenzovana drvena ploča	600	0,140	1600	100	
	(OSB) ploča orijentisana ploča od drvenih vlakana	650	0,130	1700	50	30
	Kompaktna ploča/presovano drvo	300-900	0,100– 0,180	1500-1800	50	10-20
	Tepih	200	0,060	1600	5	5
	Čelična ploča	7800	50,000	500	∞	
	Aluminijumska ploča	2800	160,000	900	∞	
	Polirana bakarna ploča	8900	380,000	385	∞	
	Plastika	1700	0,250	1300	10	
	Epoksidni podovi	1200	0,200	1300	10	
	Vinil podovi	1390	0,170	1350	50	
	Parquet	700	0,210	1600	15	
	Klinker pločice	1900	1,050	900	100	
	Glinene pločice	1800	0,790	850	20	
	Linoleum	1200	0,170	1450	500	
	Guma	1000	0,160	1600	10000	
	Prefabrikovani betonski elementi	2400- 2500	2,040– 2,330	900	70 -90	
	Laki betonski elementi	1200	0,470	1050	10	
	Prozorsko staklo	2500	0,810	750	10000	
	Perforirano, armirano staklo	2600	0,440	750	10000	
	Šuplji stakleni blokovi	1100	0,440	750	4000	

Red.broj.	Ime	Gustina ρ kg/m ³	Koeficijent termalne provodljivosti W/(m·K) λ	Specifični toplotni kapacitet cp J/(kg·K)	Faktor otpornosti na vodena isparenja donji μ (-)	Faktor otpornosti na vodena isparenja gornji μ (-)
	Papirne tapete	600	0,150	1500	5	
	Papirne tapete – perive	700	0,150	1500	10	
	Plastične tapete	700	0,200	1350	3000	
	Hidroizolacioni materijali, parne brane					
	Bitumenske trake sa uloškom od staklene vune	1100	0,230	1000	50000	
	Bitumenske trake sa uloškom od staklene vune	1100	0,230	1000	50000	
	Bitumenska traka sa uloškom od polistirenske tkanine	1100	0,230	1000	50000	
	Bitumenska traka sa kartonskim uloškom za krovove	1100	0,230	1000	50000	
	Polimerna hidroizolaciona traka na bazi PVC-P	1200	0,140	1000	100000	
	Polimerna hidroizolaciona traka na bazi PIB	1600	0,260	900	300000	
	Polimerna hidroizolaciona traka na bazi CR	1300	0,230	1000	100000	
	Polimerna hidroizolaciona traka na bazi VAE	1300	0,140	1000	20000	
	Polimerna hidroizolaciona traka na bazi ECB	1600	0,260	960	90000	
	Polimerna hidroizolaciona traka na bazi FTO/ TPO	1600	0,260	960	90000	
	Polimerna hidroizolaciona traka na bazi PEHD	1600	0,500	960	50000	
	PE folija, presavijena	1000	0,190	1250	50000	
	Al folija, presavijena	2800	160,000	880	∞	
	Prhki materijali za punjenje					
	Ekspandirani perlit	≤ 100	0,060	1000	3	
	Čestice ekspandirane plute	≤ 200	0,055	1300	3	
	Čestice glinene cigle	≤ 800	0,410	900	3	
	Pesak, šljunak, drobljeni kamen	≤ 700	0,810	1000	3	
	Suvi pesak	1800	0,580	830	1,4	
	Malo suvo kamenje (popla)	1700	0,810	800	1,5	
	Ekspandirana glina	400	0,220	950	1,3	
	Piljevina (piljevina)	250	0,090	1650	1,2	
	I (sa vlagom)	1700	2,100	1300	-	
	Materijali za toplotnu izolaciju					
	Mineralna vuna (MW)	10 do 200	0,035 do 0,050	1030	1– 1,2	
	Ekspandirani polistiren (EPS)	15 do 30	0,035 do 0,040	1300	20	100
	Ekstrudirani polistiren (XPS)	25-45	0,029– 0,036	1450	80	200
	Kruta poliuretanska pena (PUR)	30-60	0022– 00,28	1400	30	200
	Fenolna pena (PF)	35-80	0020– 0025	1400	40	150
	Staklena pena (CG)	100-200	0036– 0055	800	-	-

Red.broj.	Ime	Gustina ρ kg/m ³	Koeficijent termalne provodljivosti λ W/(m·K)	Specifični toplotni kapacitet cp J/(kg·K)	Faktor otpornosti na vodena isparenja donji μ (-)	Faktor otpornosti na vodena isparenja gornji μ (-)
	Drvena vuna	250-400	0065– 0090	2100	5	10
	Ploča od ekspandiranog perlita (EPB)	100-150	0040– 0060	1000	5	15
	Beton sa piljevinom	550-800	0,140– 0,240	1200	5-10	
	Pločice od akrilne smole	1180	0,190	1480	8000	
	PVC paneli	1400	0,210	1200	16000	
	PVC paneli Fenolna ploča	40-60	0,041	1450	35-40	
	Ovčija vuna	20	0,040	1750	1	
	Kokosova vlakna	100	0,045	1750	1	
	Celulozna vlakna	85	0,040	1750	1	
	Pamuk	20	0,040	1750	1	
	Perlitne termičke ploče	150	0,060	800	5	
	Perlitni punilo	90	0,055	800	3	

PRILOG 4

MINIMALNI ZAHTEVI ZA PERFORMANSE TEHNIČKIH SISTEMA

Generator toplote	Izvor toplote	Tražena jedinica	Minimalni uslov PREDLOŽENI
Pojedinačni šporeti (daljinsko grejanje)	Gas	Efikasnost proizvodnje (%)	≥ 75.00 %
	Biogas	Efikasnost proizvodnje (%)	≥ 75.00 %
	Nafta (dizel)	Efikasnost proizvodnje (%)	≥ 80.00 %
	Bioulja (bio dizel)	Efikasnost proizvodnje (%)	≥ 80.00 %
	Biomasa korišćena lokalno (tradicionalna)	Efikasnost proizvodnje (%)	≥ 60.00 %
	Pelet	Efikasnost proizvodnje (%)	≥ 85.00 %
	Sečka	Efikasnost proizvodnje (%)	≥ 80.00 %
	Ogrevno drvo i lignit	Efikasnost proizvodnje (%)	≥ 65.00 %
	Struja	Efikasnost proizvodnje (%)	≥ 100.00 %
Standardni kotao (grejanje sa radijatorima) (75/60°C)	Gas	Efikasnost proizvodnje (%)	≥ 85%
	Biogas	Efikasnost proizvodnje (%)	≥ 85%
	Nafta (dizel)	Efikasnost proizvodnje (%)	≥ 85%
	Bioulja (bio dizel)	Efikasnost proizvodnje (%)	≥ 85%
	Struja	Efikasnost proizvodnje (%)	≥ 99.00 %
Niskotemperaturni kotao (55/45°C)	Gas	Efikasnost proizvodnje (%)	≥ 90.00 %
	Biogas	Efikasnost proizvodnje (%)	≥ 90.00 %
	Nafta (dizel)	Efikasnost proizvodnje (%)	≥ 88.00 %
	Bioulja (bio dizel)	Efikasnost proizvodnje (%)	≥ 88.00 %
	Struja	Efikasnost proizvodnje (%)	≥ 99.00 %
Kondenzacioni kotao (sa radijatorima) (55/45°C)	Gas	Efikasnost proizvodnje (%)	≥ 94.00 %
	Biogas	Efikasnost proizvodnje (%)	≥ 94.00 %
	Nafta (dizel)	Efikasnost proizvodnje (%)	≥ 92.00 %
	Bioulja (bio dizel)	Efikasnost proizvodnje (%)	≥ 92.00 %
	Struja	Efikasnost proizvodnje (%)	≥ 100.00 %
Kotao na biomasu (sa radijatorskim grejanjem) (75/60°C)	Biomasa se koristi lokalno	Efikasnost proizvodnje (%)	
	Ogrevno drvo	Efikasnost proizvodnje (%)	≥ 70.00 %
	Pelet	Efikasnost proizvodnje (%)	≥ 85.00 %
	Sečka	Efikasnost proizvodnje (%)	≥ 80.00 %

Split grejne jedinice (split grejna jedinica sa spoljašnjim vazduhom i toplotnim pumpama vazduh-vazduh)	Struja	Grejanje	
		SCOP	≥ 3.2
Multi split grejne jedinice (multi split grejna jedinica sa spoljašnjim toplotnim pumpama vazduh-vazduh)	Struja	Grejanje	
		SCOP	≥ 3.4
VRF grejne jedinice (VRF grejne jedinice sa spoljašnjim vazduhom, toplotne pumpe vazduh-vazduh)	Struja	Grejanje	
		SCOP	≥ 3.6
Toplotna pumpa (zemljani kolektor), zemlja-voda	Struja	Grejanje	
		SCOP	≥ 4.0
Toplotna pumpa (podzemna voda), voda-voda	Struja	Grejanje	
		SCOP	≥ 4.5
Toplotna pumpa vazduh-voda monovalentna	Struja	Grejanje	
		SCOP	≥ 3.5
Toplotna pumpa (spoljni vazduh) sa električnim grejačem	Struja	Grejanje	
		SCOP	≥ 3.0
Decentralno grejanje na struju	Struja	Efikasnost proizvodnje (%)	$\geq 100.00\%$
Daljinsko grejanje (daljinsko grejanje sa 110/90°C, radijatori 75/60°C)	Radijatorsko grejanje (75/60°C)	Efikasnost proizvodnje (%)	$\geq 82.00\%$
	Podno grejanje (40/30°C)	Efikasnost proizvodnje (%)	$\geq 86.00\%$

Indikatori učinka** Energetske performanse sistema grejanja izražavaju se kao: efikasnost proizvodnje (η_{gen} , %) za:	Dodatni metodološki zahtevi** Vrednosti SCOP-a treba da se odnose na: - uslove prosečne temperature sistema (55°C),
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- sisteme sagorevanja (gas, nafta, biomasa) - centralno grejanje (district heating) - direktno grejanje na električnu energiju Sezonski koeficijent učinka (SCOP) za: - toplotne pumpe Deklarisane vrednosti učinka moraju se proveriti putem: - tehničke dokumentacije proizvođača - liste proizvoda (product fiche) - EPREL baze podataka ili ekvivalentnih izvora - Sertifikovani izveštaji o ispitivanju (gde je primenljivo)	osim ako nije drugačije naznačeno. Za sisteme sa električnim pomoćnim grejačem: - performanse treba da uključuju njegov rad na deklarisanjoj vrednosti SCOP-a. Za sisteme centralnog grejanja (district heating) efikasnost treba da uključuje: - proizvodnju - distribuciju - gubitke u mreži
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Za toplotne pumpe, sezonski koeficijent performansi (SCOP) će se uzeti za primenu srednje temperature (55°C).

Za sisteme daljinskog grejanja, vrednosti efikasnosti će se zasnivati na podacima koje daje operater sistema ili podrazumevanim vrednostima definisanim u nacionalnoj metodologiji proračuna.