User Manual
EPC Software Albania

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Acknowledgements

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The partners in the project are:

- Fraunhofer Gesellschaft zur Forderung der Angewandten Forschung EV - Fraunhofer Institute for Building Physics IBP, Germany
- KfW Development Bank on behalf of the German Government

Disclaimer

The software **EPCSoftwareAlbania** has been developed as a software for calculating energy performance of buildings. The software development was carefully surveyed. Nevertheless, the software could contain bugs. User should carefully review the results to make sure that they are credible and consistent. If bugs or inconsistencies should occur, please inform the contact information given in the program.

None of the participating organisations, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, expressed or implied, or assume any legal liability or responsibility for the accuracy, completeness or usefulness of any results or of any information disclosed, or represents that its use would not infringe privately owned rights. The program was prepared with the assistance and participation of representatives from many organisations based on consensus and available information.

Contents

1 Introduction

The software EPCSoftwareAlbania was developed for the certification of the buildings according to the Draft-Regulation (Mesp) No. On National Calculation Methodology For Integrated Energy Performance Of Buildings.

The software supports two modes of operation:

- **Calculation for certification**: which implies calculation of energy performance of building under standardized conditions (i.e. data predefined in user profiles cannot be changed for certification purposes). In this mode Energy Performance Certificates (EPCs) are generated.

- **Calculation of energy consumption**: which implies the possibility of changing data predefined in user profiles in order to be in line with the actual use of the building. This mode does not take metered consumption into account.

The calculation is compliant with the requirements of 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.

The calculation itself is based on the German DIN V 18599 with certain adjustments to Albania legislation (climate data, user profiles, construction/material library, conversion factors, etc.). Standard DIN V 18599 meets the requirements in EPBD 2018 Annex 1, where it is defined that "Member States shall describe their national calculation methodology following the national annexes of the overarching standards, namely ISO 52000-1, 52003-1, 52010-1, 52016-1, and 52018-1, developed under mandate M/480 given to the European Committee for Standardization (CEN)". The software uses the calculation library ibp18599kernel from the Fraunhofer Institute for Building Physics, which implements the methodology of DIN V 18599:2018 to calculate energy need, energy use and primary energy or buildings. The methodology is described on the Description of the calculation Methodology, which is an integral part of the software.

1.1 System requirements

System requirements for the installation of the application include:

- Operating system Windows 8.1 or higher
- .Net Framework 4.6 or higher
- At least 200 MB of free disk space

2 User interface

The graphical user interface of the EPCSoftwareAlbania basically consists of four areas:

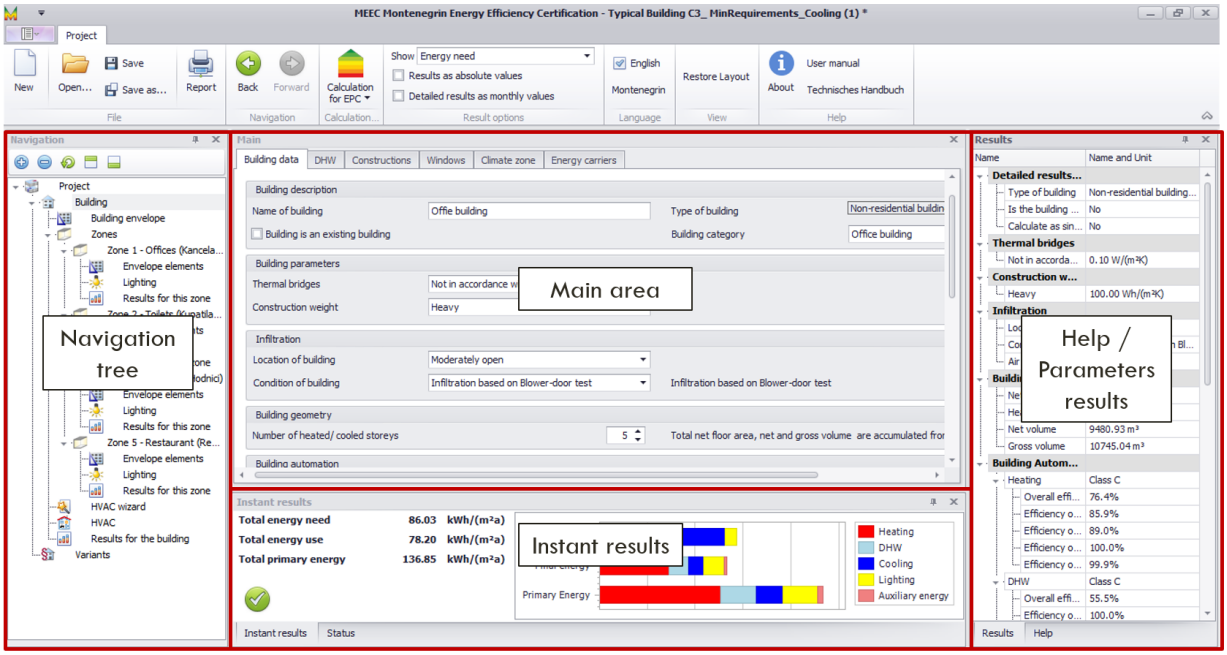


Figure 1: User interface of EPCSOFTWAREALBANIA

Navigation tree:
The navigation tree represents the structure of the project. It also controls what is shown in the main area.

Main area:
The main area contains the edit area to set the parameters for the building, the zones and the technical systems.

Instant results:
The instant results on the bottom of the screen are showing the current results of the building's energy calculation. All changes in the parameters are immediately reflected in the results.

Help/Parameter results:
The help section is showing an explanation of the various parameters of the main area as well as detail results for the parameters from the main area.

2.1 Menu structure of the application

The programme has a menu structure with the following options.

2.1.1 File

New
Start a new project.

Open
Opens a file selection to select a file with already saved project.

Save
Saves the project in a file. The first time the data are saved, a dialog will be shown allowing to specify the file name and the location of the file.

Save as ...
Saves the project in a file with the given name and file location.

2.1.2 Reports

Reports
Opens a user interface that allows to edit and create result reports for the project.

2.1.3 Calculation mode

Calculation for EPC
Energy consumption is calculated under standardized conditions, i.e. it is not possible to change data predefined in user profiles (indoor temperatures, operating times, lighting levels, etc.). This mode is used for creating Energy Performance Certificates (EPCs).

Calculation of consumption
Energy consumption is calculated in accordance with the actual use of the building, i.e. the user is allowed ro change data predefined in user profiles (indoor temperatures, operating times, lighting levels, etc.).

2.1.4 Results options

The content of the energy results screens is controlled here. They all show the same type of energy (energy need, delivered energy (based on net calorific value), delivered energy by energy carrier (based on net calorific value), primary energy).

Results as absolute values
The results can either be shown as absolute values or related to the thermally conditioned (heated/ cooled) net floor area.

Detailed results as monthly values
The results for technical systems (circuits and units) can be presented as monthly values (in addition to total annual values).

2.1.5 Language

English
The programme will open in English language at the next start.

Montenegrin
The programme will open in Montenegrin language at the next start.

2.1.6 Layout

Layout for desktop computers
Layout suitable for desktop use. The graphical user interface is as showed in Figure 1 (four main areas).

Layout for laptop computers
Layout suitable for laptop use. The graphical user interface shows three of four main areas (**Help/Parameters results** area is "hidden" in **Navigation tree** area – separate tabs are added for **Help** and **Parameters** results).

2.1.7 Help

About
Opens a dialog with information on the version, the acknowledgements and the disclaimer of the tool. A check if updates are available can be done as well here.

User manual
Opens the User Manual.

Technical manual
Opens the Technical Manual.

Calculation methodology
Opens the Calculation Methodology that describes the evaluation of the overall energy demand of buildings in the software – Main part (methodology description: zoning of the building, balancing of energy need, calculation of losses for control and emission, distribution and storage, balancing of delivered energy, primary energy evaluation, assessment of CO2 equivalent emissions).

Appendices of Calculation methodology
Opens the Calculation Methodology that describes the evaluation of the overall energy demand of buildings in the software – Annexes (containing all relevant tables and additional information).

Helpful documents
Opens documents that can be of help to the user while working in the software:

- Law on Efficient Use of Energy (Official Gazette of Albania, No. 57/14, 25/19);
- Rulebook on Minimum Energy Efficiency Requirements in Buildings (Official Gazette of Albania, No. 75/15);
- Excel tool facilitate zoning of the building.

2.1.8 Sample buildings

Sample buildings
27 reference buildings determined for Montenegrin building stock inventory (3 building categories (single-family house, multi-family house (apartment building) and office building) for 3 construction periods (before 1960, 1960-2011, after 2011), and 3 climatic zones) are used for definition of notional buildings (hypothetical building of the same size, shape, orientation and shading as the actual building, with the same activities, zoning and system types and exposed to the same weather data, but with pre-defined specified properties for the building fabric, fittings and services). Certification of buildings is carried out in relation to the notional building.

2.1.9 Options

Options
Option for saving address data and data on materials in a shared directory on the company's network (to have a common use of database).

Windows
All areas and windows that are part of the user interface can be shown or hidden depending on the selections made in this option. There is also an option for restoring the layout.

2.1.10 Libraries

Addresses
User may define (and update) data on energy auditors and building owners, which can be used for current and future projects.

Library of materials
User may define (and update) data on materials that are not contained in the standard library of materials in the software, which can be used for current and future projects.

3 Main concepts

The calculation of the energy consumption of a building depends on a lot of parameters. The intention of this software is to make it useable for beginners as well as experienced users. Therefore, a lot of default parameters have been chosen which can be overwritten by experienced users.

3.1 Project types

The programme can calculate residential and non-residential buildings. This selection has to be made at the start-up screen and cannot be changed later in the project. The selection also has an impact on the available entries in the navigation tree.

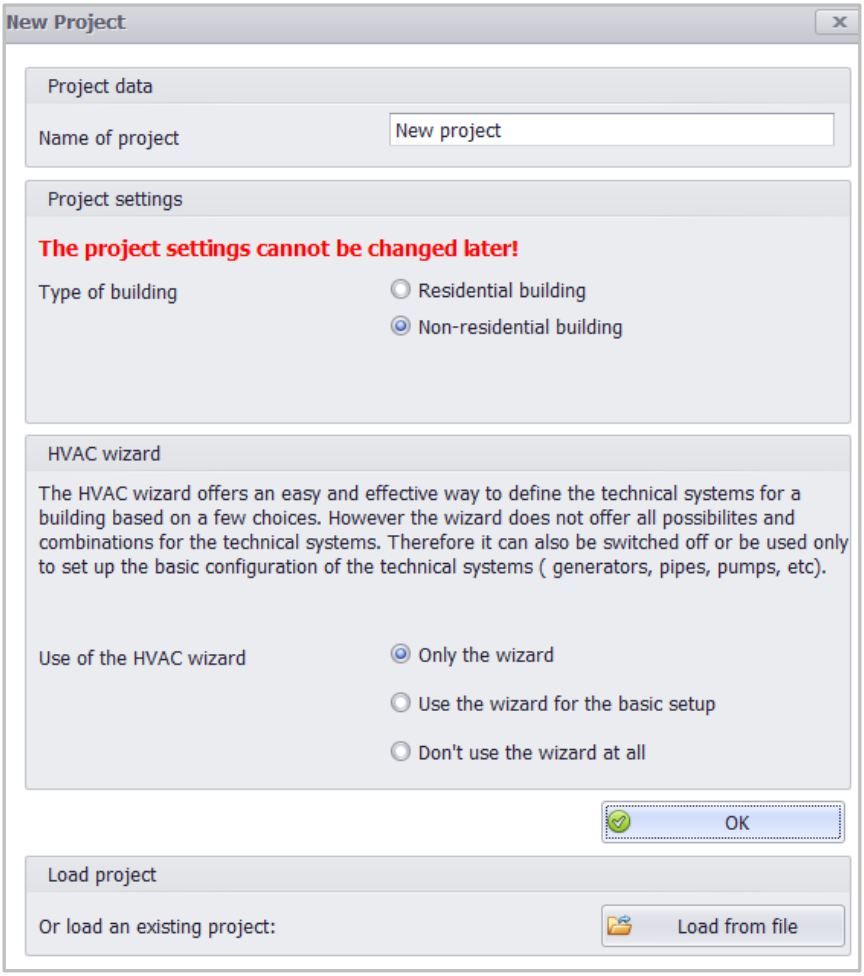


Figure 2: Start-up screen in EPCSOFTWAREALBANIA

There are few main differences in approach when modelling residential building and non-residential buildings in the software:

Residential building:

- The residential buildings are calculated as single-zone buildings.
- Two standard user profiles are available for residential use of buildings:
  - Family house
  - Residential building (apartment building).

- Lighting energy is not considered for residential buildings.
- Demand for domestic hot water for residential building is included in the user profile.
- Mechanical ventilation is considered in HVAC section refering to ventilation systems in residential buildings (Residential ventilaton).
- In addition to the net floor area, the two parameters that define zone geometry are clear room height and height of construction.
- Only standard user profiles are foreseen to be used for residential buildings, so their content cannot be modified.

Non-residential building:

- The non-residential buildings are calculated as multi-zone buildings.
- There are 36 standard user profiles available for zones with a non-residential use:
  - Office area
  - Meeting, conference and seminar room
  - Counter hall
  - Department store
  - Department store (with refrigerated products)
  - Classroom in school
  - Kindergarten
  - Lecture room, auditorium
  - Bedrooms in hospital, nursing home
  - Bedroom
  - Restaurant/canteen/café
  - Commercial kitchen
  - Kitchen - preparation room or storeroom
  - WC and sanitary rooms
  - Common rooms
  - Auxiliary areas
  - Passageway (heated)
  - Passageway (low-heated)
  - Storage
  - Server room
  - Light industry
  - Audience area
  - Foyer
  - Stage
  - Exhibition/congress
  - Exhibition room and museum
  - Library
  - Gymnasium
  - Parking garage
  - Fitness room
  - Laboratory
  - Examination and treatment rooms
  - Special care areas
  - Corridors of the general care area
  - Medical and therapeutic practices
  - Warehouse, logistic hall

- Lighting energy in non-residential buildings is defined at the zone level.
- Demand for domestic hot water for non-residential building is defined at the building level.
- Mechanical ventilation and air conditioning is considered in HVAC section refering to ventilation systems in non-residential building (Ventilaton).
- In addition to the net floor area, the two parameters that define zone geometry are net volume and total volume.

- User profiles for non-residential buildings can be used as standard user profiles, as well as modified in order to reflect the actual use of the building.

In case of buildings used for residential and non-residential purposes (mixed buildings), both type of zone use (residential and non-residential) can be added, with a limitation in terms of the number of zones that can be added: only one residential zone can be added, while number of non-residential zones is limited to 999.

3.2 HVAC wizard

Technical systems in building can be defined in three ways: (i) using HVAC wizard, (ii) using HVAC wizard to start with definition of system parameters in more detail, and (iii) detailed description of all systems (no use of HVAC wizard). These options are offered when starting the programme, but the choice made at the start can be changed when coming up to this screen.

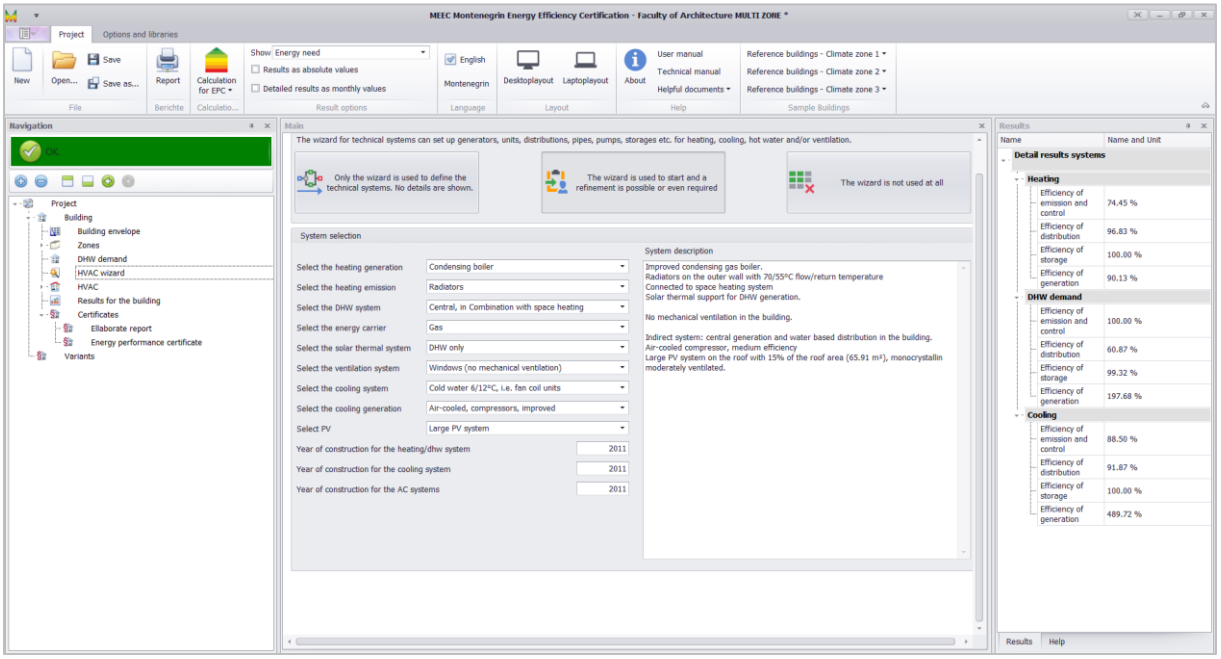


Figure 3: Use of HVAC wizard mode

Using **HVAC wizard** is a simplified approach since the systems are automatically configured according to a small number of selected options referring to some basic information about systems and parts of the systems, such as heat generator, energy carrier, type of emissions, etc. Modelling of technical systems is carried out completely "in the background", by using default values for system parameters. When using HVAC wizard mode, there are no entries in the navigation tree shown.

Users that are interested in the setup of the HVAC systems can look at the details by selecting the second approach for defining technical systems in building – **HVAC wizard is used to start but with refinement possibilities**. Now the details of the technical systems can be seen in the navigation tree and changes can be made.

Technical systems can be defined also using the third approach: **Detailed description of all systems** in the building, which requires the availability of a larger set of data for each technical system, i.e., the entry of a larger number of parameters. This approach excludes the use of HVAC wizard.

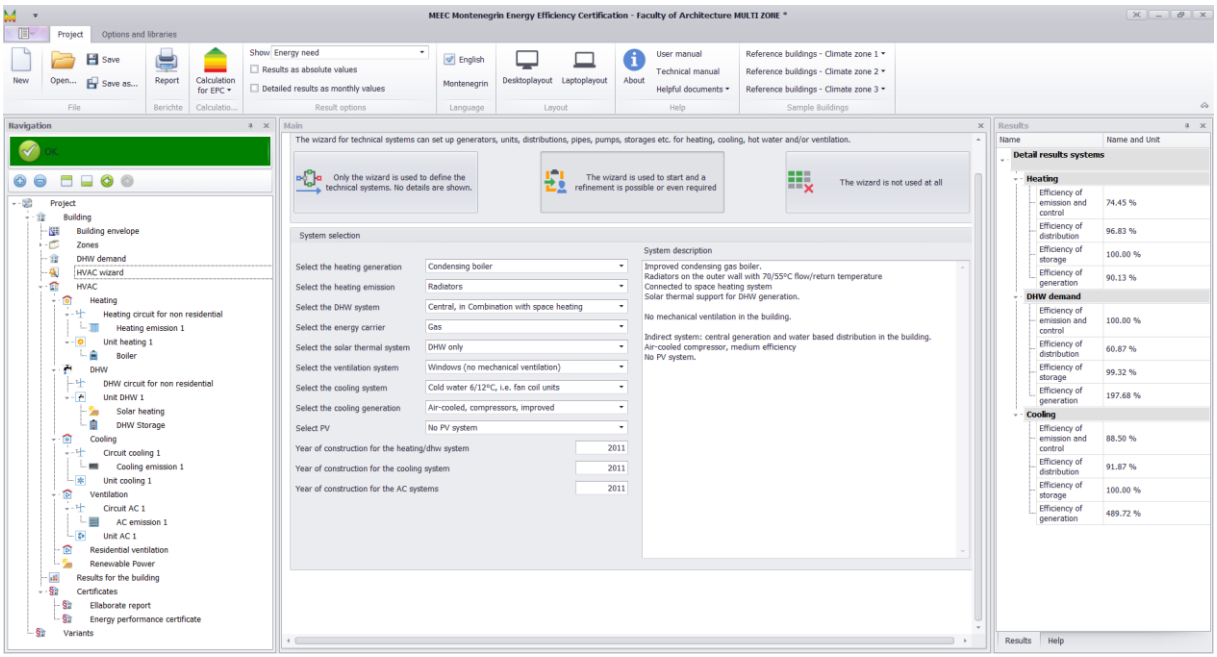


Figure 4: Details of the HVAC systems are visible in the navigation tree

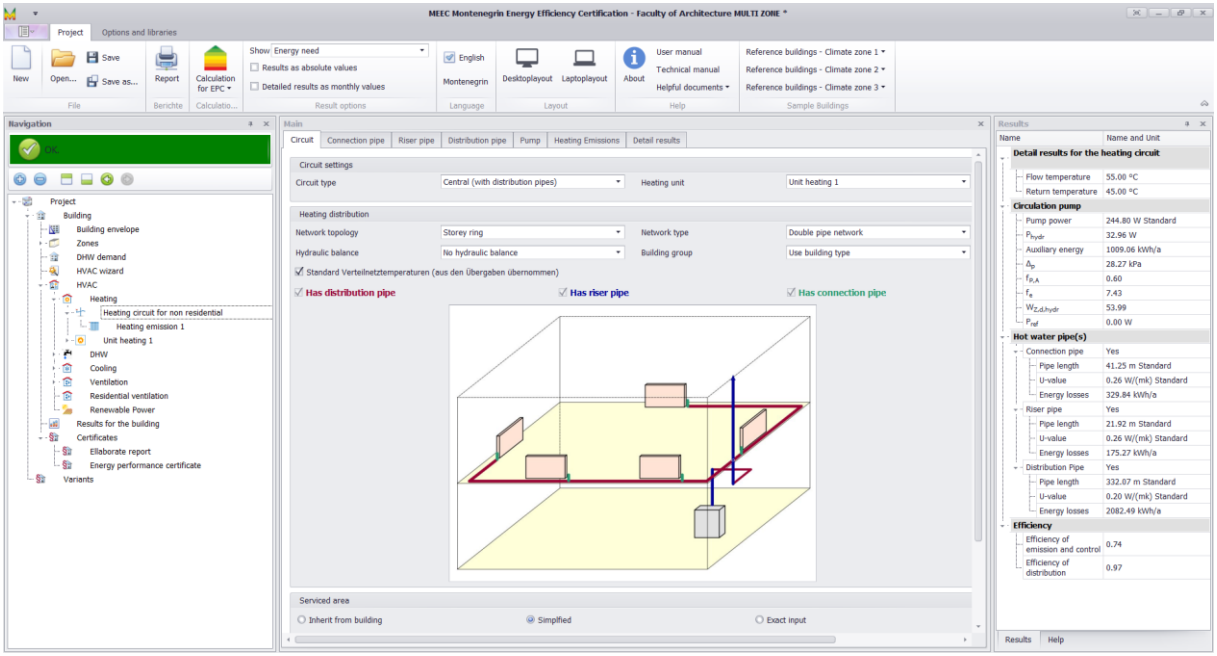


Figure 5: Detailed description of all technical systems

Using HVAC wizard for a basic setup of technical systems in most cases represents a good and efficient way of modeling technical systems. However, there are some limitations regarding the availability of system technologies (not all are available in HVAC wizard mode), as well as the complexity of building (and its systems). For example, in case of modelling a building with more than one technical system for each of the services (heating, cooling, ventilation/air conditioning, DHW preparation), HVAC wizard mode is not appropriate since it allows the selection of only one technical system. In these cases, the detailed description of all systems is recommended.

3.3 Main steps in building modelling

Modelling of the building in EPCSOFTWAREALBANIA can be described through the following steps:

STEP 1: Project type is defined by selecting specific options in the start-up screen (residential or non-residential building). The user can also decide in this step which way to use for defining technical systems in building: whether to use HVAC wizard and and to simplify the process considerably, or to go into all the details of modelling the technical systems (whereby this selection can be changed later).

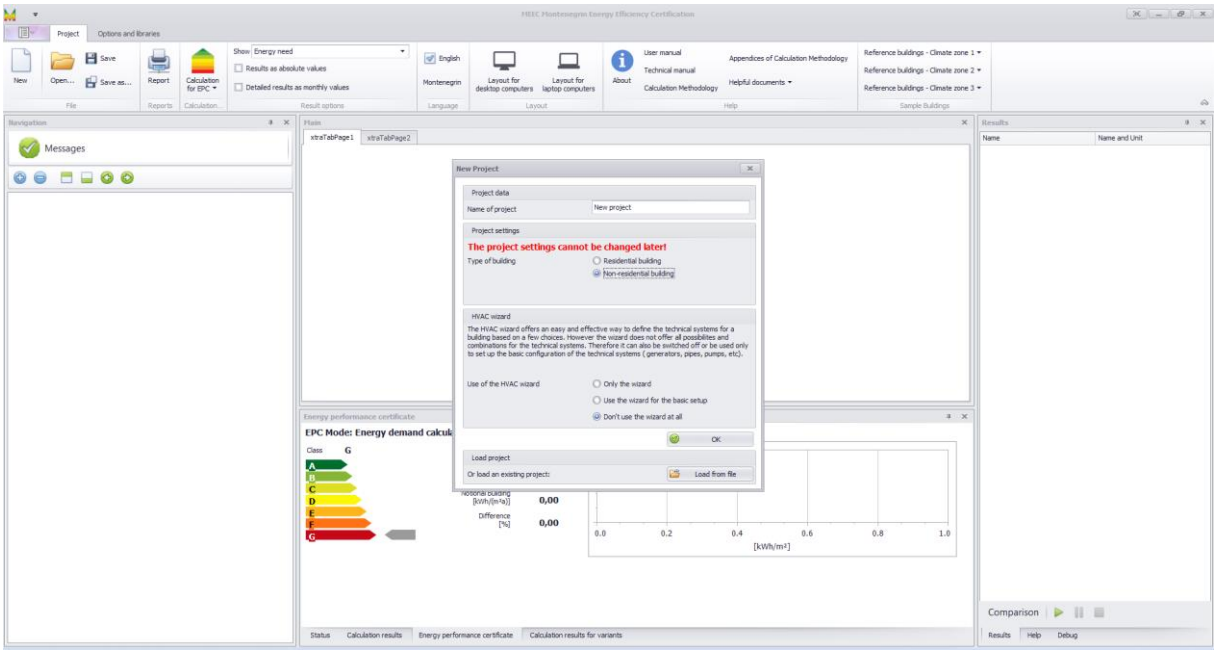


Figure 6: STEP 1 – Definition of project type

STEP 2: Definition of building parameters: geometry, construction weight, thermal bridges, infiltration, building automation, etc. (Figure 7).

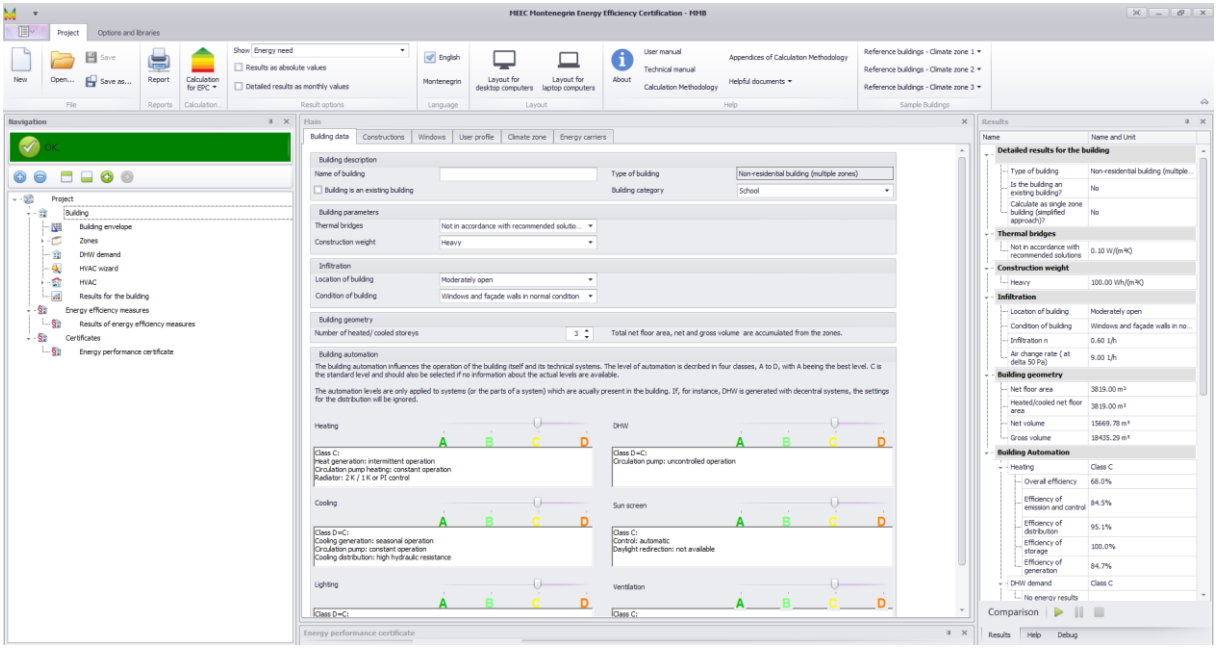


Figure 7: STEP 2 – Definition of building parameters

In this step all constructions and windows used in the project may be defined (not mandatory for this step, but it makes easier defining the building envelope in **STEP 3**). Also, user profiles for non-residential buildings that will be used for calculation of actual consumption of the building may be defined.

STEP 3: Definition of building envelope elements towards the external environment or towards other heated or unheated spaces. The constructions of walls, floors, roofs, windows can be defined either by directly entering the U-value or by combining different layers of the construction, whereby the software itself calculates the U-value.

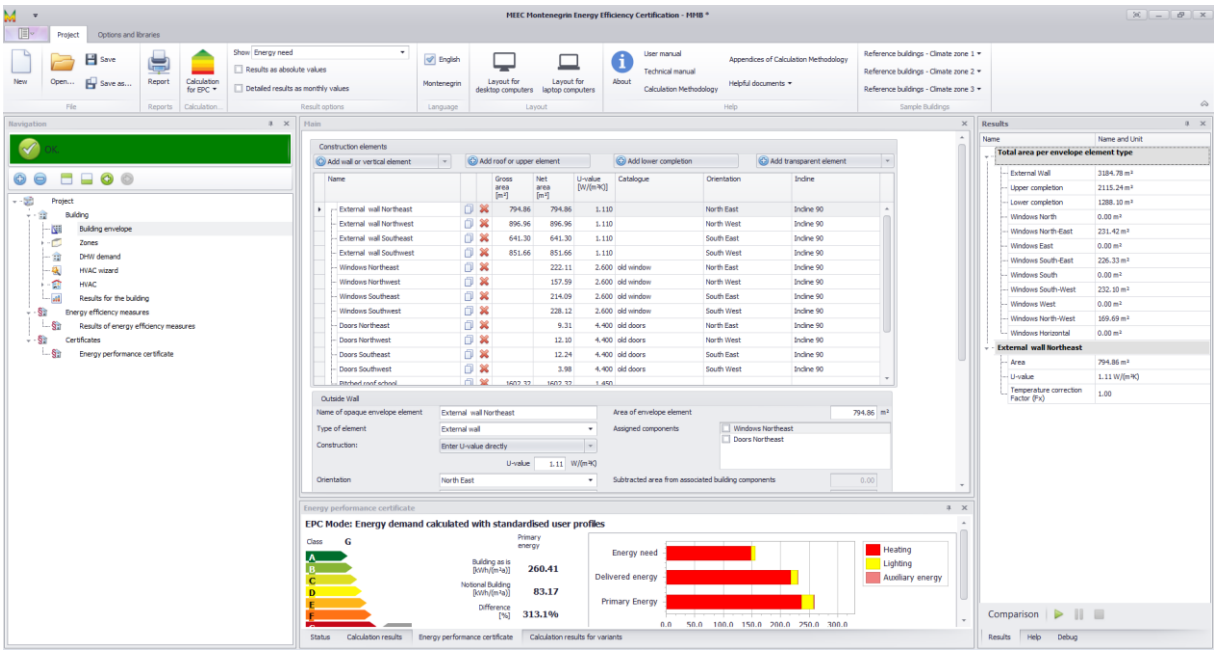


Figure 8: STEP 3 – Definition of building envelope elements

STEP 4: In case of non-residential buildings (multi-zone concept), definition of each zone has to be done, including data for zone geometry, thermal conditioning of the zone, mechanical ventilation, etc. For residential buildings, zone data are defined at the building level (one zone).

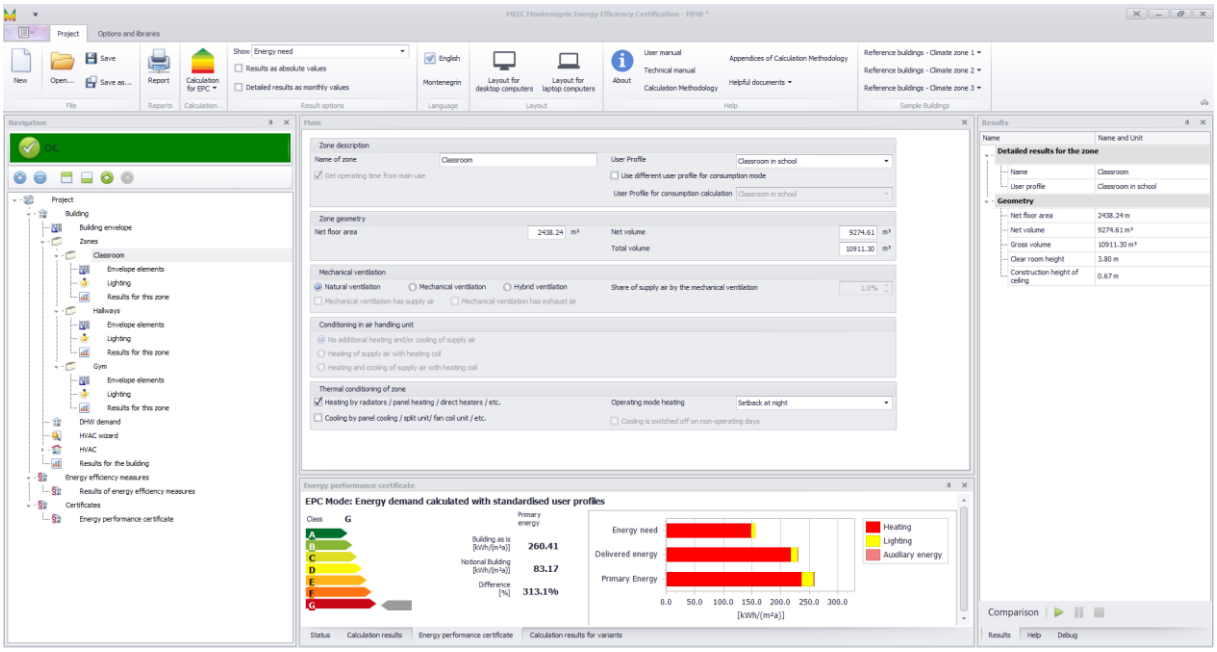


Figure 9: STEP 4 – Definition of zone(s)

STEP 5: For each zone, all building envelope elements defined in **STEP 3** need to be considered whether they contribute to the transmission losses/gains in this zone.

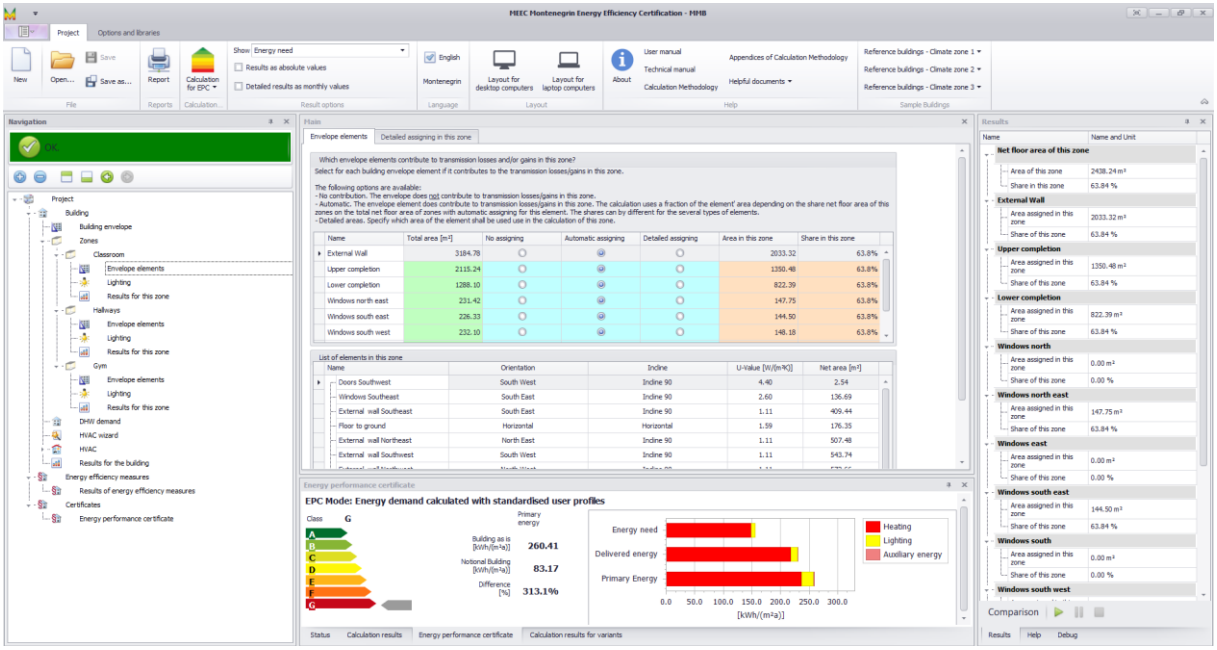


Figure 10: STEP 5 – Definition of envelope elements for the zone

STEP 6: Definition of lighting domains for each zone (for non-residential buildings).

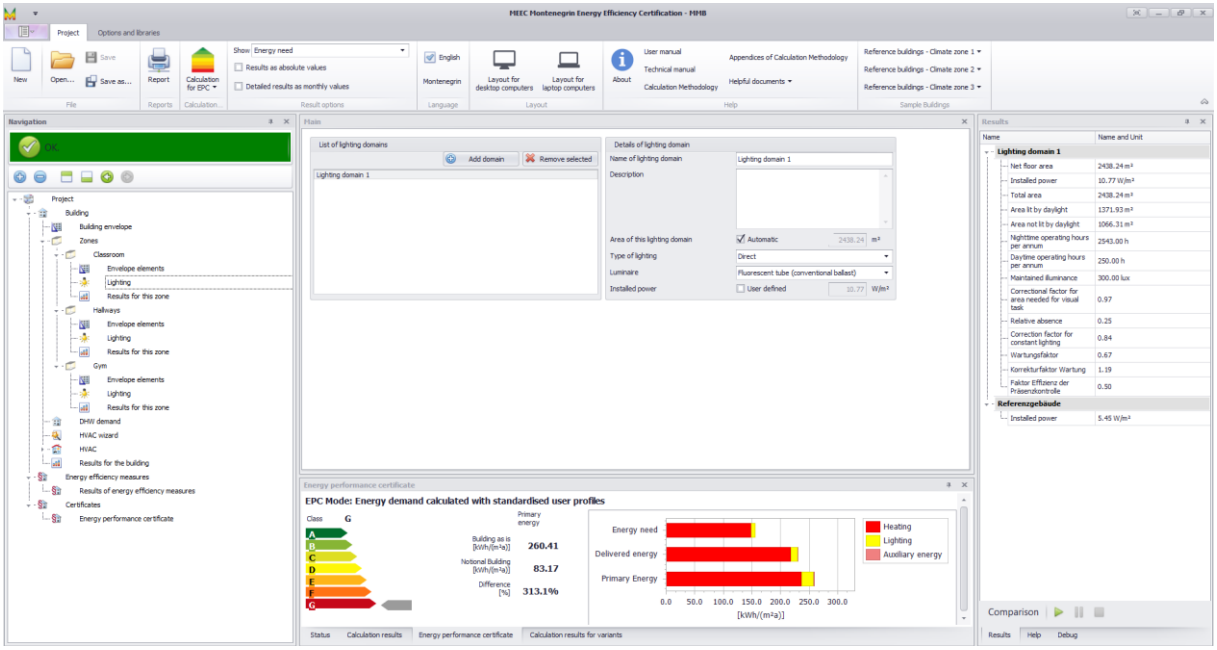


Figure 11: STEP 6 – Definition of lighting domains for the zone

STEP 7: Definition of DHW demands at the building level (for non-residential buildings).

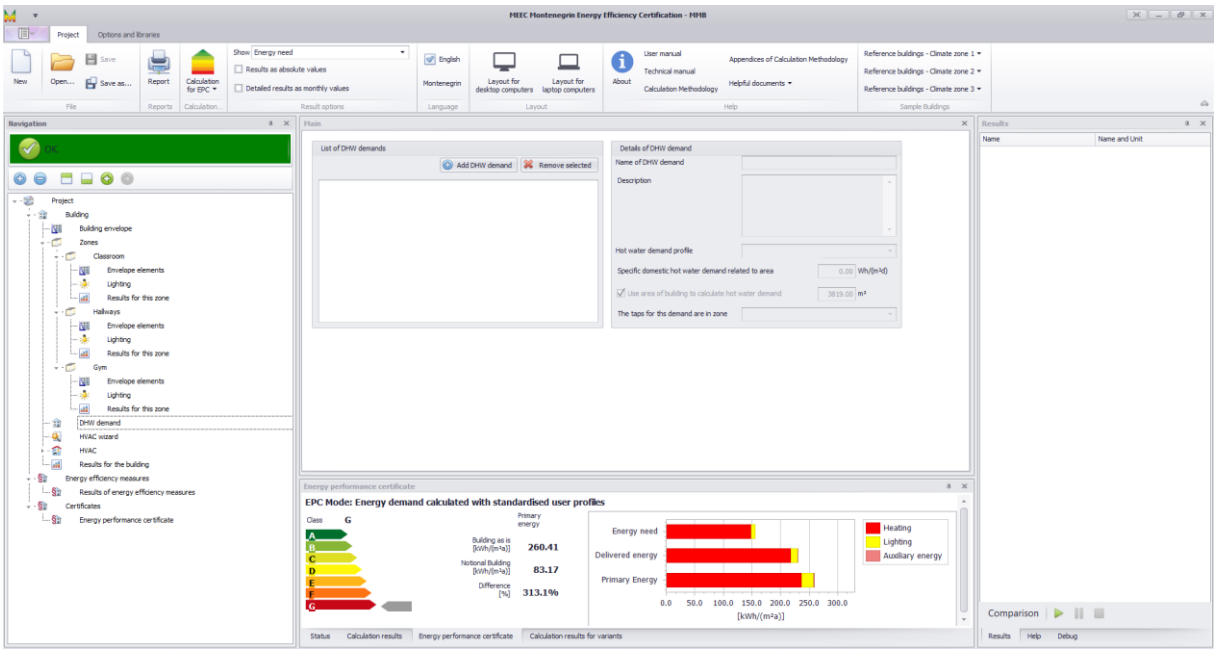


Figure 12: STEP 7 – Definition of DHW demands for the building

STEP 8: Definition of technical systems in building by using HVAC wizard (simplified approach). Modeling of technical systems is carried out completely "in the background", by using default values for system parameters (Figure 13).

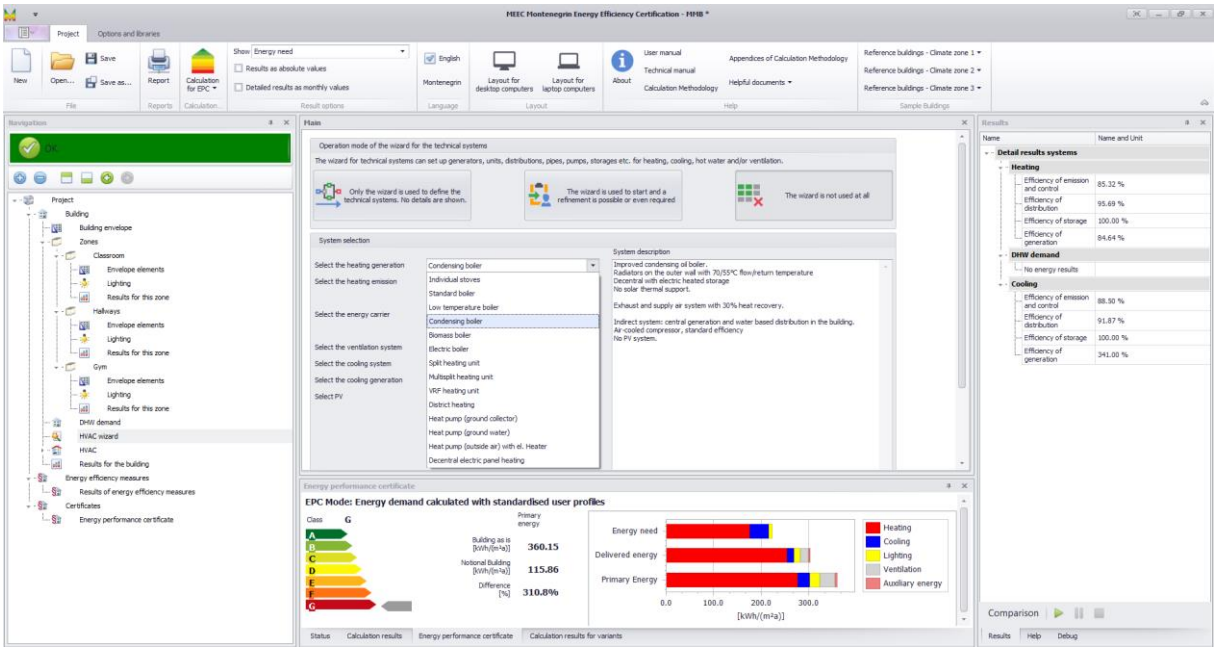


Figure 13: STEP 8 – Definition of HVAC systems with HVAC wizard

Technical systems in buildings can also be defined using a detailed description of all systems in the building, which requires the availability of a larger set of data for each technical system, i.e. the entry of a larger number of parameters is necessary (Figure 14).

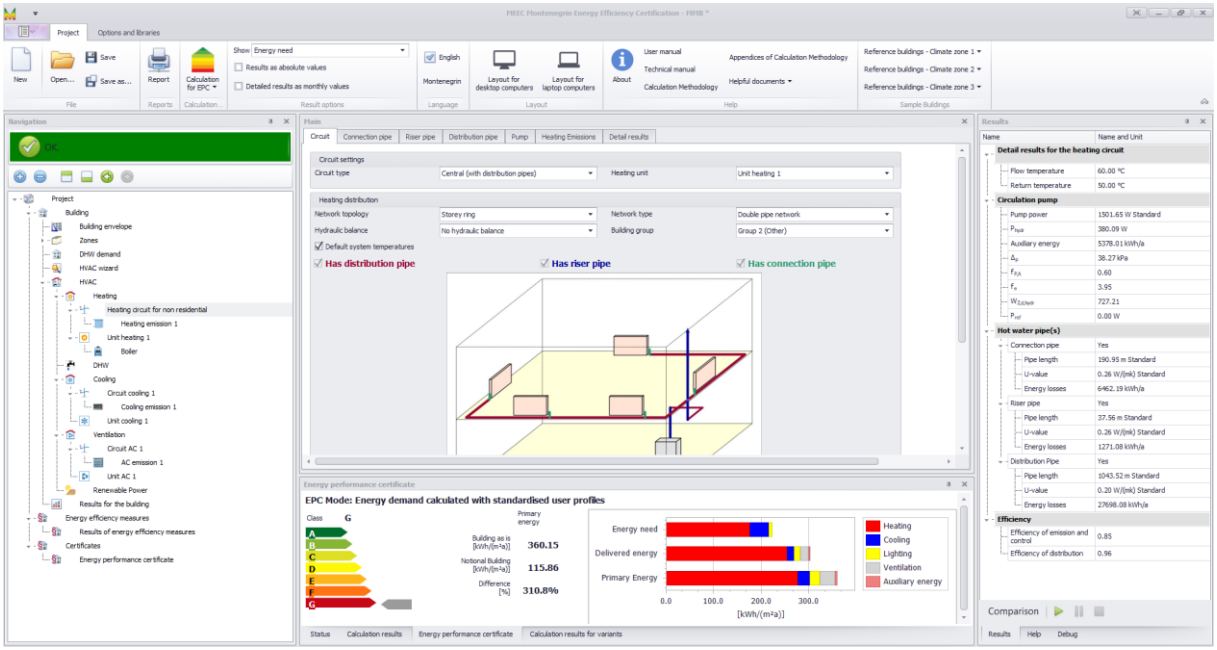


Figure 14: STEP 8 – Definition of technical systems with detailed HVAC properties

STEP 9: The results of the calculation are displayed at the building level, as well as for individual zones (Figure 15). Energy need, delivered energy (total and by energy carriers) and primary energy can be presented as absolute values (in kWh), as well as per unit of reference area (in kWh/m^2). In both cases, the share of individual balance components (heating, cooling, DHW, ventilation, lighting) in the total energy consumption can be read from the graphs. The results of the calculation at the building level include also transmission heat losses for different categories of building envelope elements, CO_2 emissions, etc.

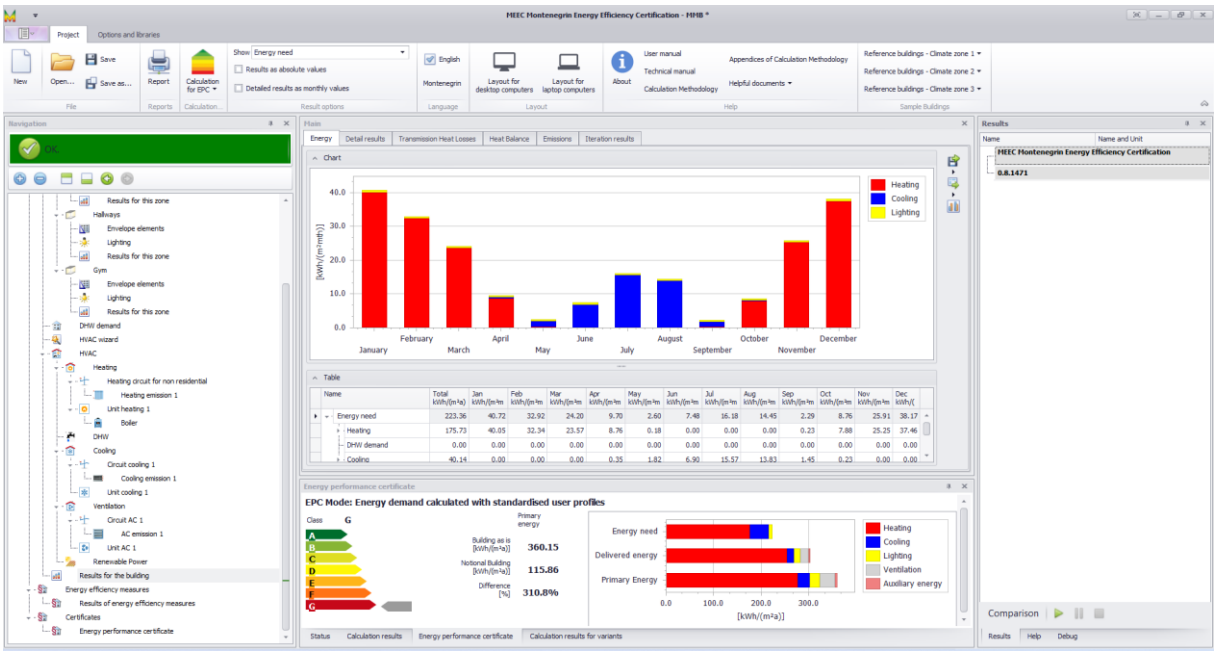


Figure 15: STEP 9 – Display of the results

STEP 10: Once the building input is complete, the generator for measures improving the energy efficiency of the building can be used. Energy efficiency measures from the comprehensive list of measures for the building envelope and the technical systems are combined in packages of measures.

The software calculates the necessary economic parameters and profitability of packages of measures, and is applied in both modes of use (certification of buildings and calculations of consumption mode).

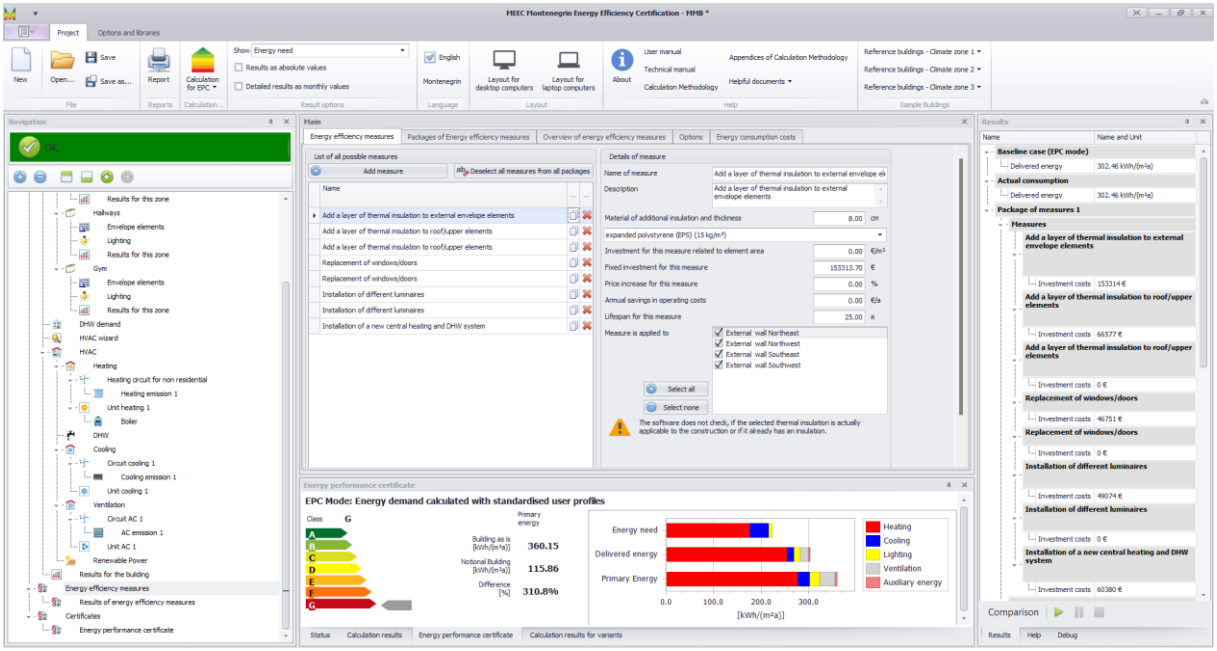


Figure 16 – STEP 10: Definition of packages of measures to improve energy efficiency of the building

STEP 11: Generation of Energy Performance Certificate (EPC) if used in **Calculation for EPC** mode.

Figure 17 – STEP 11: Generation of Energy Performance Certificate (EPC)

4 Input screens for project data

4.1 Project data

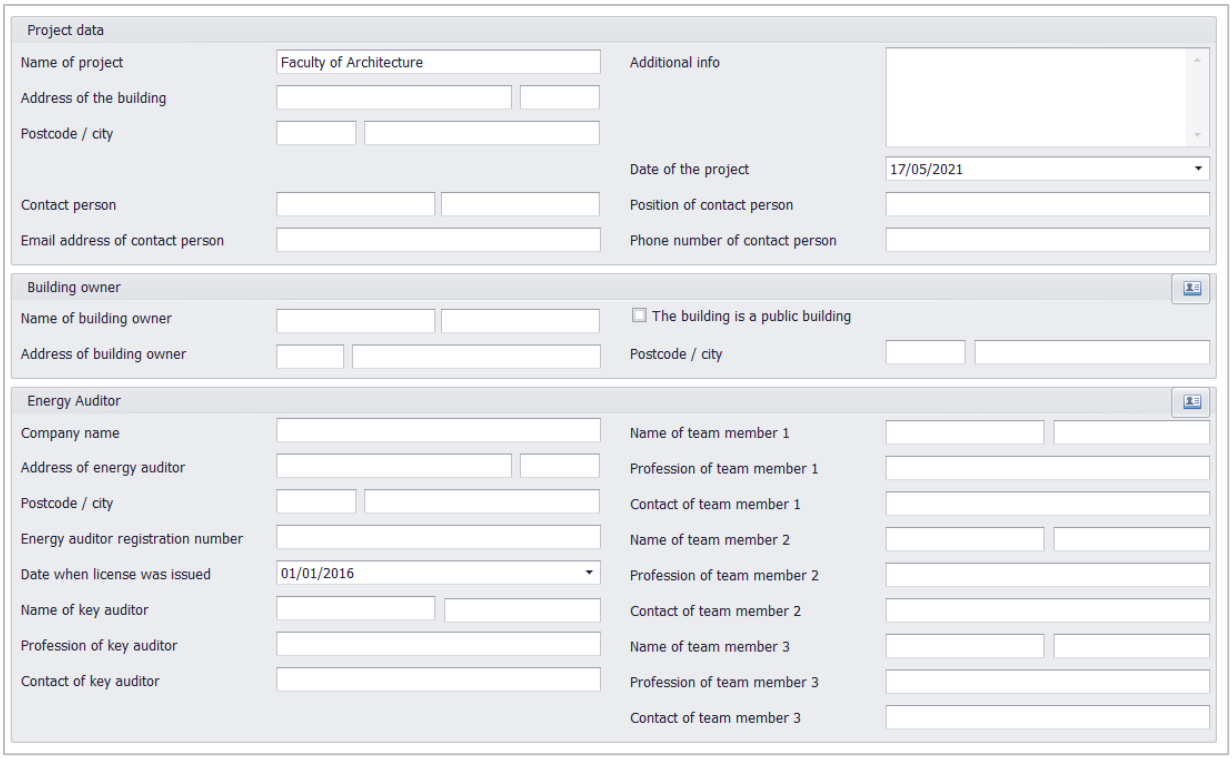


Figure 18: Project data input screen

4.1.1 Project data

Name of project
Enter the name of the project in case it has not been already entered in start-up screen. In case it has been previously inserted in start-up screen, here it will be transferred automatically.

Additional info
In this field some additional information regarding the project can be included (e.g. brief description of the project, executing authorities, financing, etc.).

Postcode / city
Enter the postcode and the city that refers to the building that is the subject of the project.

Address of the building
Enter the address of the building that is the subject of the project.

Contact person
Enter the name and surname of the contact person for this project.

Email address of contact person
Enter the e-mail address of the contact person for this project.

Phone number of contact person
Enter the phone number of the contact person for this project.

Position of contact person

Enter the position of the contact person for this project.

Date of the project
Enter the date of the project by clicking on the specific date in the calendar (drop-down list calendar).

4.1.2 Building owner

Name of building owner
Enter the name and surname of the owner of the building. In case that building owner's data has been previously stored in **Addresses** (**Options and Libraries** tab in the main menu), it can be used for this project by clicking on the icon Address data management.
In case the building is owned by the state or local government, then select this option by clicking in the checkbox **The building is a public building**.

Address of building owner
Enter the address of the owner of the building.

Postcode / city
Enter the postcode and the city of the owner of the building.

4.1.3 Energy auditor

Company name
Enter the name of the authorised person (business entity, entrepreneur or legal person) performing an energy audit. In case that energy auditor's data has been previously stored in **Addresses** (**Options and Libraries** tab in the main menu), it can be used for this project by clicking on the icon Address data management.

Address of energy auditor
Enter the address of the authorised person performing an energy audit.

Postcode / city
Enter the postcode and the city of the authorised person performing an energy audit.

Energy auditor registration number
Enter the registration number of the authorised person performing an energy audit.

Date when license was issued
Enter the date when the authorisation for performing energy audits was issued to an authorised person by clicking on the specific date in the calendar (drop-down list calendar).

Name of key auditor
Enter the name and surname of the key energy auditor.

Profession of key auditor
Enter the profession of the key energy auditor.

Contact of key auditor
Enter the contact details (phone number and/or e-mail address) of the key energy auditor.

Name of team member 1
Enter the name and surname of the first member of the energy audit team.

Profession of team member 1
Enter the profession of the first member of the energy audit team.

Contact of team member 1
Enter the contact details (phone number and/or e-mail address) of the first member of the energy audit team.

Name of team member 2
Enter the name and surname of the second member of the energy audit team.

Profession of team member 2
Enter the profession of the second member of the energy audit team.

Contact of team member 2
Enter the contact details (phone number and/or e-mail address) of the second member of the energy audit team.

Name of team member 3
Enter the name and surname of the third member of the energy audit team.

Profession of team member 3
Enter the profession of the third member of the energy audit team.

Contact of team member 3
Enter the contact details (phone number and/or e-mail address) of the third member of the energy audit team.

4.2 Project images

Figure 19: Project image input screen

Pictures, drawings and images needed for documentation purposes can be inserted by clicking the button **Add picture** and selecting them from their location on PC.

Description:
Enter the title of the added project images and/or their short description.

5 Input screens for building data

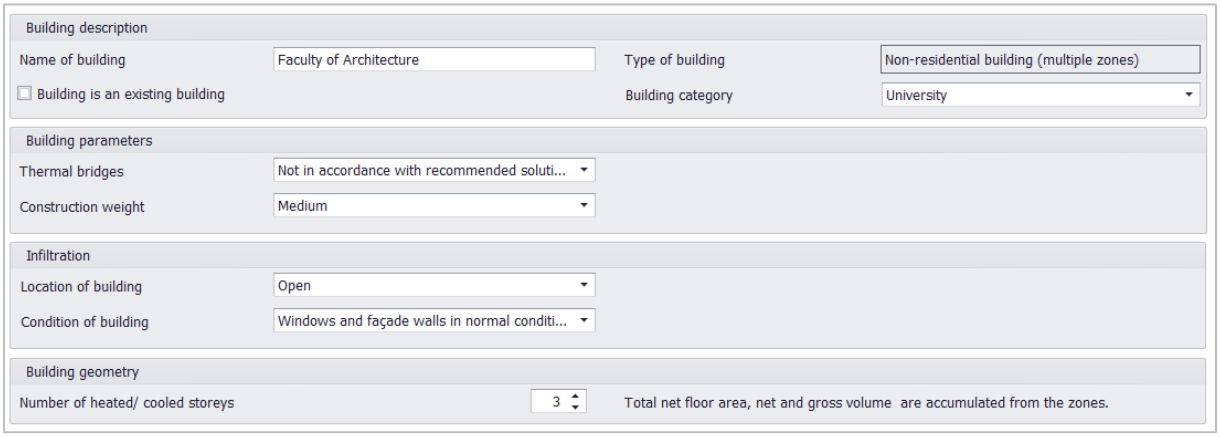


Figure 20: Building data input screen

5.1 Building data

5.1.1 Building description

Name of building
Enter the name of the building that is the subject of the calculation. In case the building is an existing building, then select this option by clicking in the checkbox **Building is an existing building**.

Type of building
Already defined type of building (residential/non-residential) in start-up screen will be transferred in this field automatically.

Building category
Building category can be defined from the drop-down list. There are two categories of buildings for residential use: family house and residential building (apartment building) and 11 categories for non-residential use: office building, kindergarten, school, university, hospital, hotel, recreation building, commercial building, cultural building, warehouse and light industry.

5.1.2 Building parameters

Thermal bridges
Thermal bridges can be defined from the drop-down list by selecting one of two options given in Montenegrin Rulebook on minimum energy efficiency requirements of buildings (in further text: Rulebook): (i) in accordance with the recommended solutions, (ii) not in accordance with recommended solutions. Besides, user-defined value for thermal bridges can be entered if selected option for calculated value from the drop-down list.

Construction weight
Construction weight can be defined from the drop-down list by selecting one of five Rulebook's options (very light/light/medium/heavy/very heavy). Besides, user-defined value for construction weight can be entered if selected this option from the drop-down list.

Effective heat storage capacity
In case that user-defined value for defining construction weight is selected from the drop-down list, then the value for effective heat storage capacity needs to be entered.

User defined value for thermal bridges
In case that user-defined value for defining thermal bridges is selected from the drop-down list, then the calculated value for thermal bridges needs to be entered.

5.1.3 Infiltration

Location of building
Location of building can be defined from the drop-down list by selecting one of three Rulebook's options (open/moderately open/very sheltered). In combination with the options for the **Condition of building** (please see below), values for infiltration according to the Rulebook are obtained.

Infiltration based on Blower-door test
In case that infiltration is to be defined with provided Blower-door test value, as selected from the drop-down list for **Condition of building**, then the value of air change rate at 50 Pa measured using Blower-door test needs to be entered.

Condition of building
Condition of building can be defined from the drop-down list by selecting one of three Rulebook's options (windows and façade in bad condition/windows and façade in normal condition/windows and façade well sealed). In combination with the options for the **Location of building** (please see above), values for infiltration according to the Rulebook are obtained. Besides, infiltration can be defined by providing Blower-door test value if selected this option from the drop-down list.

5.1.4 Building geometry

Total net floor area, net and gross volume are accumulated from the zones.
Total net floor area, net and gross volume of the building are automatically calculated after entering the data on geometry of the zones.

Number of heated/cooled storeys
Enter the number of storeys of the building that are thermally conditioned (heated and/or cooled).

5.1.5 Building automation

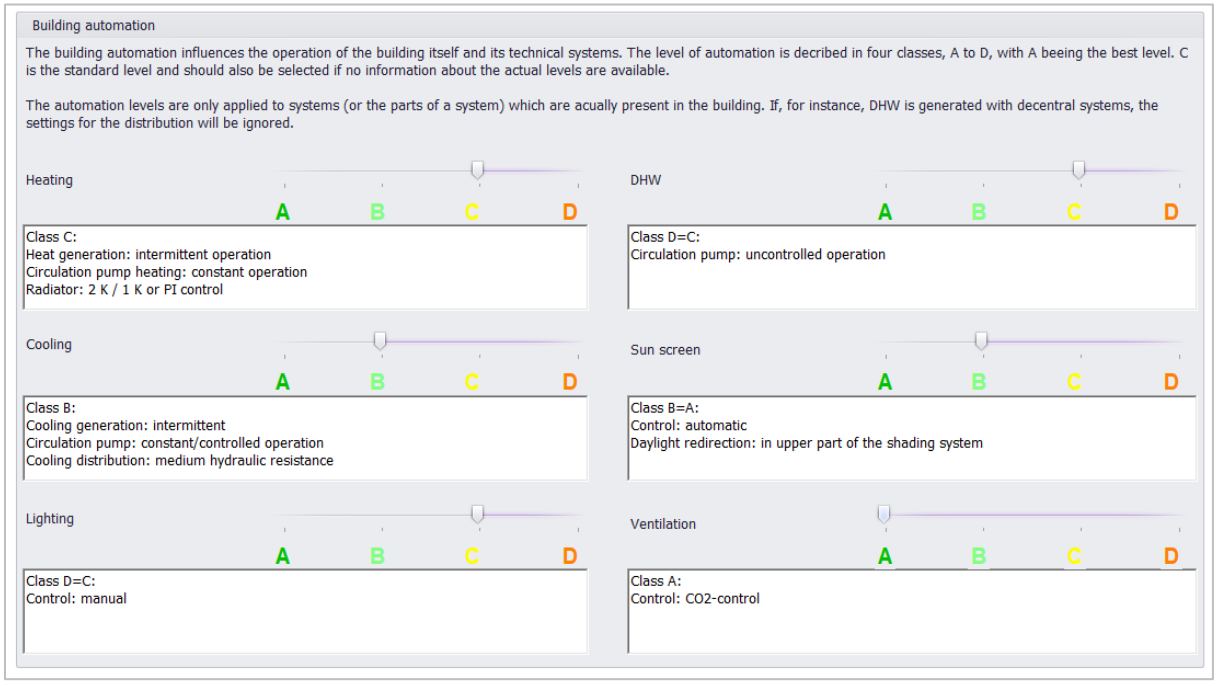


Figure 21: Building automation in Building data input screen

The building automation influences the operation of the building itself and its technical systems. The level of automation is described in four classes, A to D, with A being the best level. C is the standard level and should also be selected if no information about the actual levels is available.

The automation levels are only applied to systems (or the parts of a system) which are actually present in the building. If, for instance, DHW is generated with decentral systems, the settings for the distribution will be ignored.

For each of the systems presented (heating, cooling, DHW, lighting, ventilation, sun protection), one of four classes needs to be selected by moving the scale pointer to the appropriate position.

Heating system

Class A: intermittent operation of heat generator, circulation pump control (constant/variable pressure difference), radiators provided with PI control with optimisation and temperature drop based on occupancy detection

Class B: intermittent operation of heat generator, circulation pump control (constant/variable pressure difference), radiators provided with PI control with optimisation

Class C: intermittent operation of heat generator, constant operation of circulation pump, radiators provided with 2K/1K or PI control

Class D: constant operation of heat generator, constant operation of circulation pump, radiator operation is not controlled

DHW system

Class A: controlled operation of circulation pump

Class B: controlled operation of circulation pump

Class C: uncontrolled operation of circulation pump

Class D: uncontrolled operation of circulation pump

Cooling system

Class A: operation of cooling generator is fully automated, controlled operation of circulation pump, cooling energy distribution is optimized

Class B: intermittent operation of cooling generator, constant or controlled operation of circulation pump, cooling energy distribution with medium hydraulic resistance

Class C: seasonal operation of cooling generator, constant operation of circulation pump, cooling energy distribution with high hydraulic resistance

Class D: seasonal operation of cooling generator, constant operation of circulation pump, cooling energy distribution with high hydraulic resistance

Ventilation system

Class A: CO_2 control

Class B: occupancy control

Class C: time-dependent control

Class D: manual control

Lighting

Class A: daylight dependent control (optimized) and occupancy sensors

Class B: daylight dependent control and occupancy sensors

Class C: manual control

Class D: manual control

Sunscreen (solar protection devices)

Class A: automatic control, daylight redirection in upper part of the shading system

Class B: automatic control, daylight redirection in upper part of the shading system

Class C: automatic control, daylight redirection is not available

Class D: manual control, daylight redirection is not available

5.2 Constructions

Constructions – opaque envelope elements (external/internal wall, roof/upper completion, floor/lower completion) can be defined either by directly entering the U-value or by combining different layers of construction, whereby the software itself calculates the U-value.

New construction is entered by clicking **Add construction** button. The details of the added constructions are defined afterwards in the section below the list of constructions used in the project.

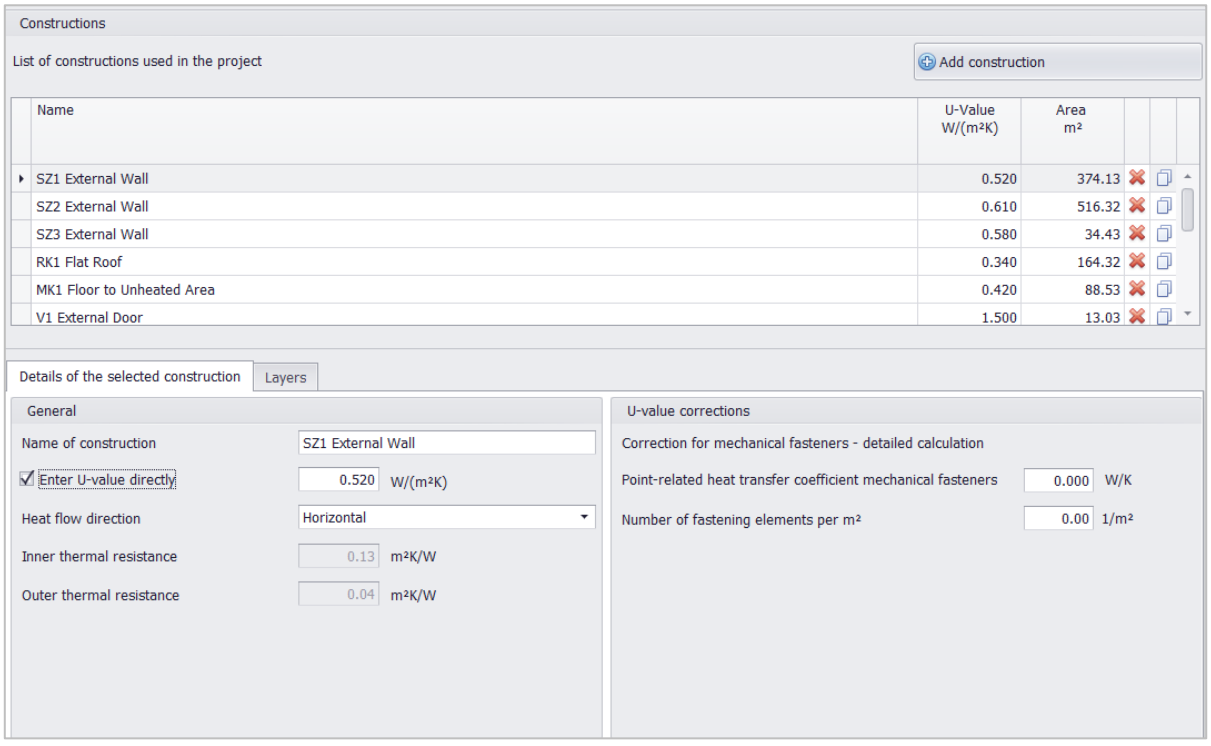


Figure 22: Input screen for defining constructions (direct U-value entry)

The name of construction is to be entered in the field **Name of construction**.

Heat flow direction for each construction has to be selected from the drop-down list. Mainly three types of heat flow direction are provided as options: upward, downward and horizontal, with certain distinctions regarding the surrounding environment where the heat is transferred (outdoor air, ground, basement).

Values for **Internal surface resistance** (Rsi) and **External surface resistance** (Rse) are assigned automatically upon selecting the option for **Heat flow direction**.

U-value can be defined directly by clicking in the checkbox **Enter U-value directly** and entering already known U-value. By using this option, the **Layers** tab is "locked".

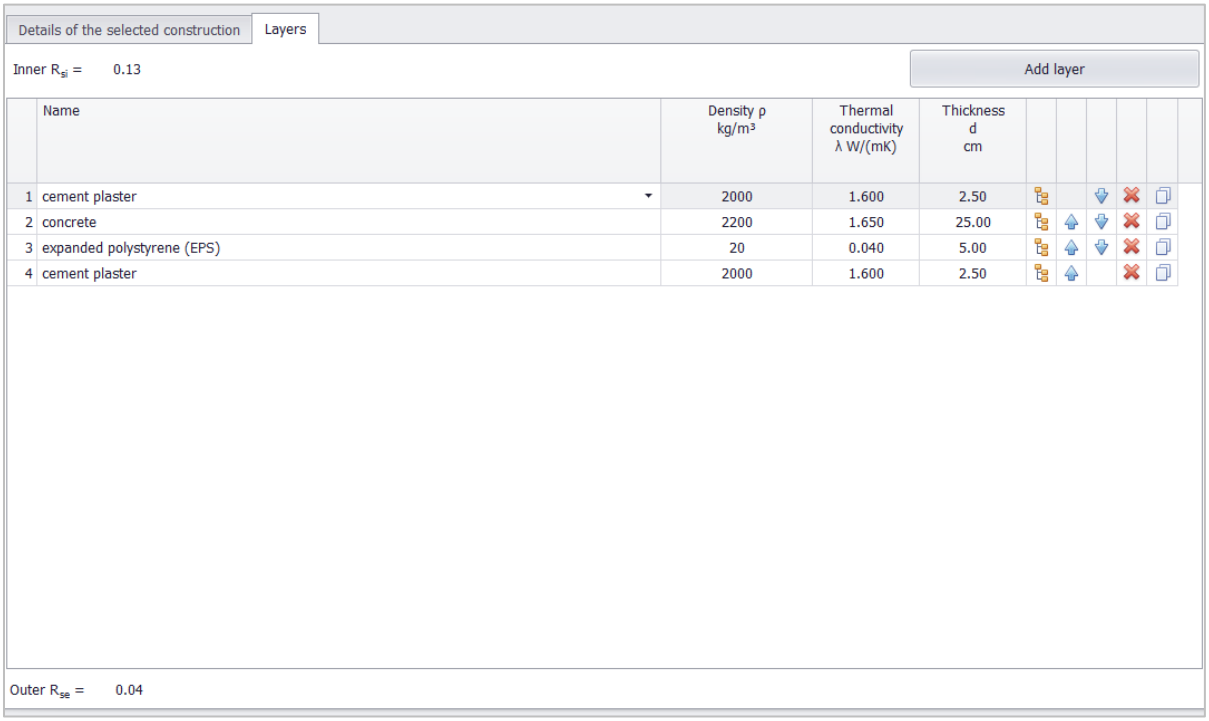


Figure 23: Input screen for defining constructions (layers definition)

If U-value is to be calculated by the software itself, the **Layers** tab is active and the layers of construction need to be entered by clicking **Add layer** button, starting with the innermost layer and finishing with the outermost layer. The layers are selected from the library of materials that shows up when clicking on an empty field in the column related to the material name. For easier finding of materials, there is a filtering option available, classifying materials in eight categories: walls, concrete, plasters, coverings, waterproofing materials, thermal insulating materials, loose material and air. Material selected from the library automatically brings up data on density [kg/m^3] and thermal conductivity [W/(mK)], while data on thickness of the layer need to be entered in centimetres [cm].

In addition to introducing homogeneous materials as layers, it is also possible to introduce a **Layer with compartment**. In this case, the thickness of the compartment layer needs to be entered in [cm], as well as the width of each of selected component part (studs/rafters and compartment).

Moving layers up and down is possible, as well as deleting them.

Added constructions may be deleted from the list of constructions. They can be also duplicated in order to make easier editing of similar constructions.

Constructions may also be defined in later stage in **Building envelope** screen by directly entering the U-value.

5.3 Windows

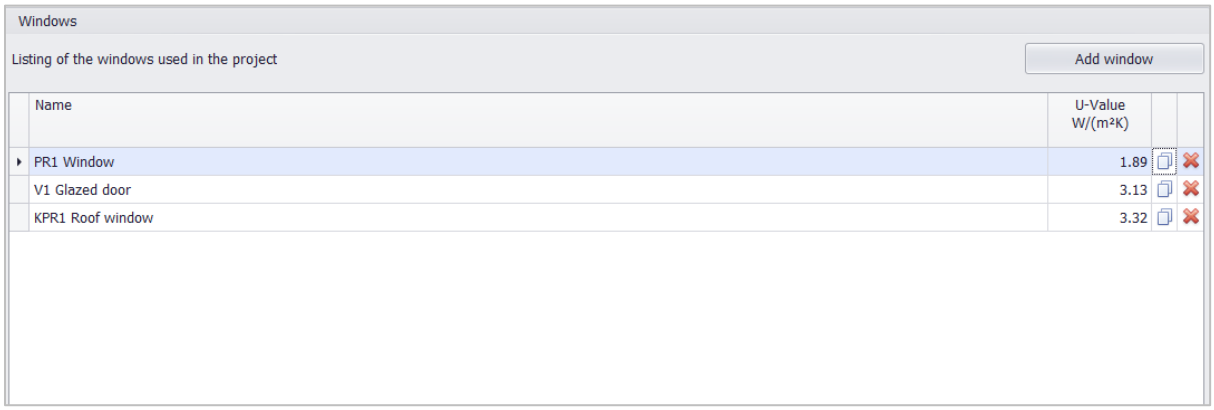


Figure 24: Input screen for defining windows (list of windows)

Windows can be defined either by selecting available options for glazing, frame and spacer or by direct entering of U-value and corresponding g- and τ-values.

New window is entered by clicking **Add window** button, whereupon the screen for defining this transparent element opens.

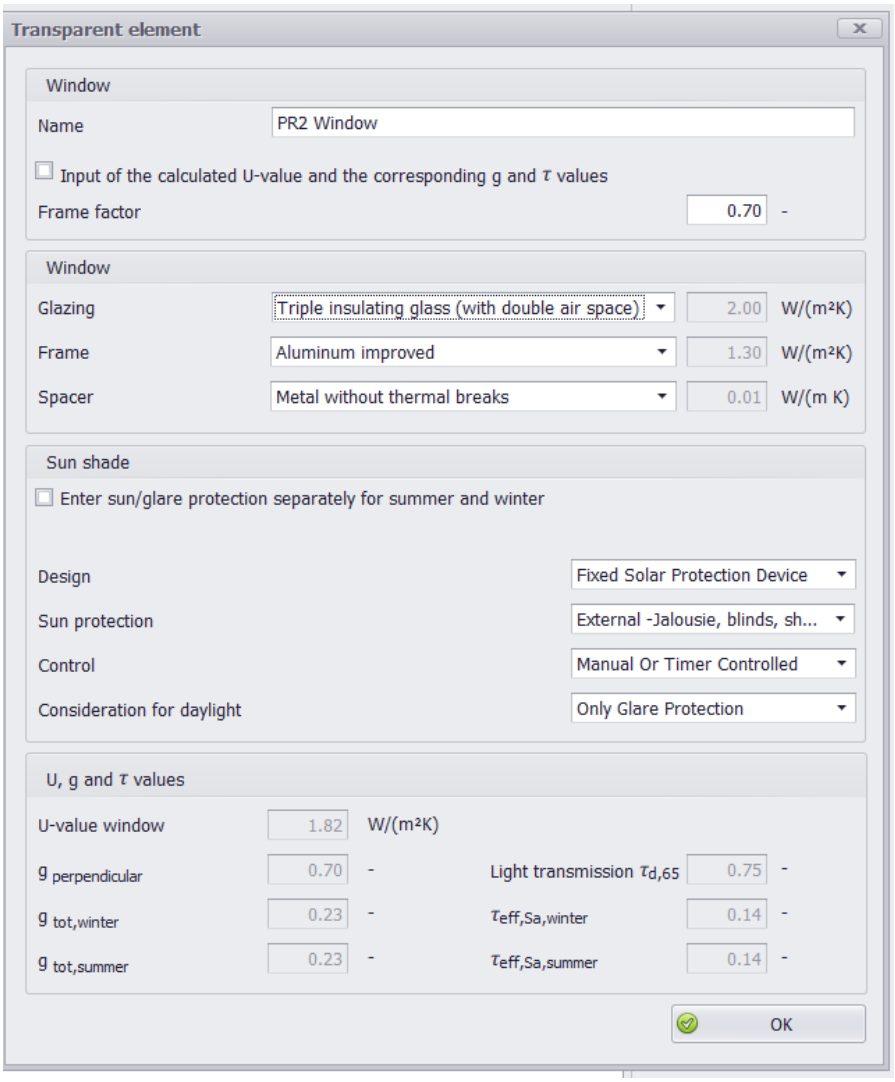


Figure 25: Input screen for defining window properties

The name of the window is to be entered in the field **Name**.

The value for the ratio between the transparent glazed area of a window and the area of the whole window unit, including the frame needs to be entered in the **Frame factor** field.

In case U-values and corresponding g-values and τ-values are already known/calculated, then this option should be selected by clicking in the checkbox **Input of the calculated U-value and the corresponding g- and τ-values**. By using this option, the section **Window** is automatically "locked", while section **U-, g- and τ-values** appears editable. **g-value** is total solar energy transmittance, representing the fraction of the incident solar radiation that is totally transmitted by the glass. **τ-value** is the light transmittance representing the fraction of the incident light that is transmitted by the transparent material. Both g- and τ-values need to be entered as summer and winter period values. Also, solar factor for radiation incidence at normal angle ($\mathbf{g}_{\perp}$) needs to be entered, as well as the light transmittance of the glazing for the standard illuminant D65 ($\boldsymbol{\tau}_{D,65}$). More information on determining these values may be found in standard EN 410 (Glass in building – Determination of luminous and solar characteristics of glazing).

In case that U-values and corresponding g-values and τ-values are not known/calculated, the software calculates them itself upon selection of available options for glazing, frame and spacer in **Window** section. Various options for glazing, frame and spacer are given in corresponding drop-down lists. Besides the specified options with already defined U-values for frame and spacer, there is a possibility for user to define its own value.

Data on solar protection for transparent element being considered need to be entered in **Solar protection** section. Design of solar protection refers to the concept of the system in case it exists, i.e. whether it is fixed or variable. In case of existence of solar protection devices, a number of options for different external and internal devices are given in drop-down menu. One of two options for mode of the solar protection device control needs to be selected, i.e. manual/timer controlled or automatic. Consideration of a daylight is also to be selected from the drop-down list (none/automatic/only glare protection/light redirection). Definition of a solar/glare protection system can be done separately for summer and winter periods.

Windows may also be defined in later stage in **Building envelope** screen.

5.4 User profile

For energy balancing of non-residential buildings, it is necessary to divide the building into several zones. The zone comprises the (net floor) area of a group of rooms within the building, which are characterized by equal type of usage, same type of conditioning (heating, cooling, ventilation, humidification, lighting and domestic hot water supply), and uniform additional zoning criteria. More information on zoning procedure can be found in the Calculation methodology in Chapter 5.

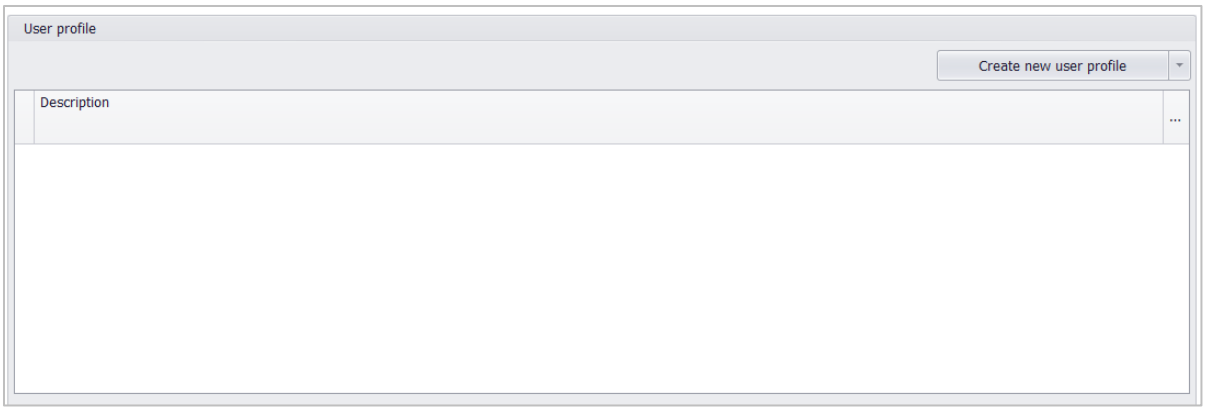


Figure 26: Input screen for defining user defined user profiles

Each zone is assigned one **user profile**. User profiles represent a set of data that characterize certain spaces depending on their use. These data include usage times, indoor space conditions, minimum outdoor air volume flow, internal heat sources, lighting levels, etc. For zones with a non-residential use, there are 36 standard user profiles available. For residential buildings, two standard user profiles are available: family house and residential building (apartment building). User profile is assigned to a zone in **Zone** screen.

The software can operate in two modes: **Calculation for EPC** and **Calculation of consumption** (options in the main menu: **Calculation mode**). **Calculation for EPC** mode is used for creating Energy Performance Certificates (EPC), and the energy consumption is calculated under standardized conditions, i.e. standard user profiles are used. **Calculation of consumption** mode is used for calculation of energy consumption in accordance with the actual use of the building, and in this regard data predefined in user profiles for non-residential buildings can be modified and saved as own user profiles (additional to the standard ones). This is done by clicking **Create new user profile** button and selecting one of standard user profiles from the drop-down menu. The content of the selected user profile appears just below the window with list of user profiles, and it can be further edited by the user to reflect the actual use of the building. Thus defined additional user profile is created by the user in this screen and it is used for calculation of energy consumption in **Calculation of consumption** mode (please see **Zone** screen). This user profile can be used as well for calculation of energy consumption after applied packages of energy efficiency measures (please see **Energy efficiency measures** screen, tab **Options**).

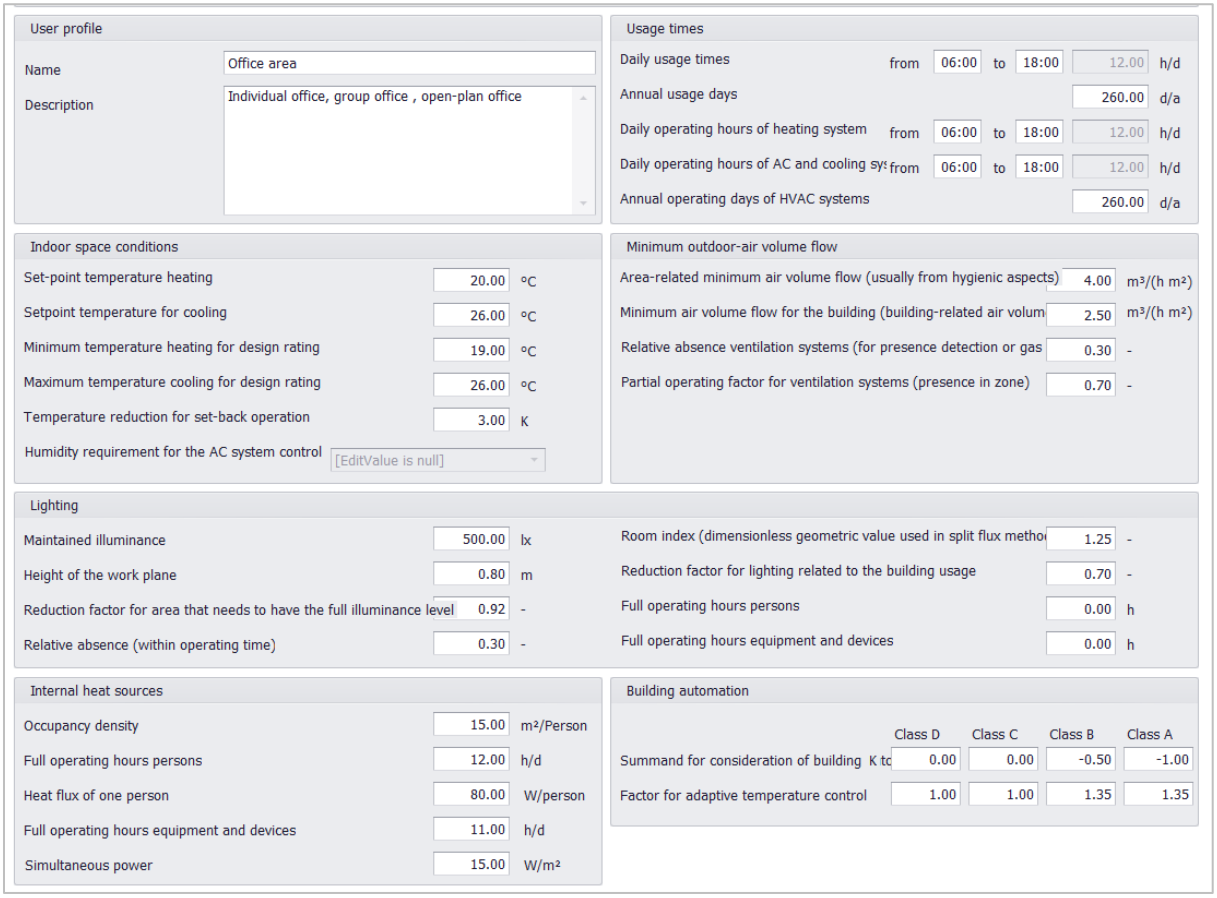


Figure 27: Input screen for editing data predefined in user profiles

NOTE: The purpose of this section is to include user profiles for non-residential buildings that are different from the standard user profiles and will be used in **Calculation of consumption** mode. User profiles for residential use of buildings (family house and residential building) are not foreseen to be modified by the user. Only standard user profiles are to be used for residential buildings and their content can be seen (but not edited) in **Zone** screen.

User profile

Name
Name of the user profile.

Description
More precise information about the type of spaces that are covered by this user profile.

Usage times

Daily usage times
The times at which use commences and ends, usually the beginning and end of the period during which persons are present in the facility and/or during which the facility is in operation.

Annual usage days
Number of days in a year on which the building is used. A distinction is made according to the number of usage days per week: five, six and seven days (corresponding to 250, 300, 365 d/a respectively).

Daily operating hours of heating system
The length of time for which the system is operated each day. This describes the period during which the set-point value required for the respective type of usage is maintained. It is assumed that night-time and/or weekend set-back operation is used outside of the operating times. The standard operating time values stated are defined on the assumption that a two-hour boost period precedes the respective usage time.

Daily operating hours of AC and cooling systems
The length of time during which the HVAC and cooling system is operated in one day. If the respective system is not operated around the clock, it is assumed that it will be started up two hours before the beginning of usage.

Annual operating days of HVAC systems
Number of days in a year on which the HVAC, cooling and heating systems are operated according to the daily utilization profile.

Indoor space conditions

Set-point temperature heating
Set-point value for the monthly mean temperature in the space being evaluated. The values stated do not take into account spatial and temporal partial or setback heating modes.

Set-point temperature for cooling
Set-point value for the monthly mean temperature in the space being assessed. The internal set-point temperature for cooling operation is the mean temperature to be maintained in average during the normal usage time when the cooling unit is in operation. On the basis of conventional settings for cooling systems, it shall be assumed that higher room temperatures are permitted when high outdoor temperatures occur. For this reason, the mean value is used.

Minimum temperature heating for design rating
Minimum temperature for heating, design rating. A value of 20° C may be assumed for all types of usage, when no other value is given.

Maximum temperature cooling for design rating
Maximum temperature for cooling operation, design rating: A value of 26° C may be assumed for all types of usage, when no other value is given.

Temperature reduction for set-back operation

Temperature reduction for set-back operation (set-back heating mode). A reduction of 4 K may be assumed for all types of usage, when no other value is given.

Humidity requirement for the AC system control
Specification whether the HVAC system is operated with a humidity control tolerance or with strictly defined humidity control, i.e. without any tolerance.

Minimum outdoor-air volume flow

Area-related minimum air volume flow (usually from hygienic aspects)
Air volume flow rate per unit area given in [$m^3/(h\ m^2)$], which is usually to be maintained for hygienic reasons.

Minimum air volume flow for the building (building-related air volume flow)
The minimum external air-supply volume flow for buildings, given in [$m^3/(h\ m^2)$], is the building related part of the minimum ventilation airflow. This value is required if automatic control strategies are used for the ventilation system.

Relative absence ventilation systems (for presence detection or gas sensors)
The relative absence HVAC takes into account information about the air quality of a room via e.g. people counters or gas sensors.

Partial operating factor for ventilation systems (presence in zone)
The partial operation factor describes the proportion of the usage time in which no person are present in the area.

Lighting

Maintained illuminance
The maintained illuminance required at the work plane is given in lux.

Height of the work plane
Vertical distance from the floor to the plane, where the required maintained illuminance is to be achieved (task area). Usually, a value of 0,8 m can be applied (which derives as mean value of 0,75 m for mainly sitting tasks and of 0,85 for mainly standing tasks).

Reduction factor for area that needs to have the full illuminance level
Factor defining by how much the maintained illuminance is allowed to be reduced. The reduction factor is calculated based on the assumed ratio of the area required for the visual task to the area of the immediate surroundings for the respective usage and on the ratio of the maintained illuminance specified for the visual task to the maintained illuminance specified for the immediate surroundings.

Relative absence (within operating time)
Parameter describing the proportion of usage time in which no persons are present in the area being assessed (F_A = 0: permanent presence, F_A = 1: no presence). The relative absence accounts for part-time operation during a usage day (e.g. absences due to meetings, breaks etc.).

Room index (dimensionless geometric value used in split flux method)
Dimensionless geometric parameter used to determine the utilance (utilization factor) of a room.

Reduction factor for lighting related to the building usage
Factor defining the degree to which the usage time stated for the respective utilization profile may be reduced when calculating the energy demand for lighting. The partial-operation factor allows for the effect of part-time operation during the balance calculation period (e.g. holidays, illness, leave etc.).

Internal heat sources

Occupancy density
Occupancy density for this use.

Full operating hours persons
Number of full operationg hours for persons.

Heat flux of one person
The values stated for the heat dissipated by persons depend on assumed activity level and specific occupancy (persons per unit area) values. They are based on full utilization hours and a normal sensible heat dissipation of a person.

Full operating hours equipment and devices
Number of full operating hours for equipment and devices.

Simultaneous power
The values of the specific heat dissipation per unit area are given. The area-specific heat gain due to equipment, machinery and appliances is stated as a daily value. This is derived from the number of full utilization hours and the specific power of the heat sources. Lighting is not included in this value, since a separate energy balance is calculated for lighting systems. This values is used, when standard equipment is used.

Building automation

Summand for consideration of building automation
Summand for consideration of building automation (in correction of reference internal temperature for the balance calculations).

Factor for adaptive temperature control
Factor for adaptive temperature control (derived from the frequency of defined partial load cases).

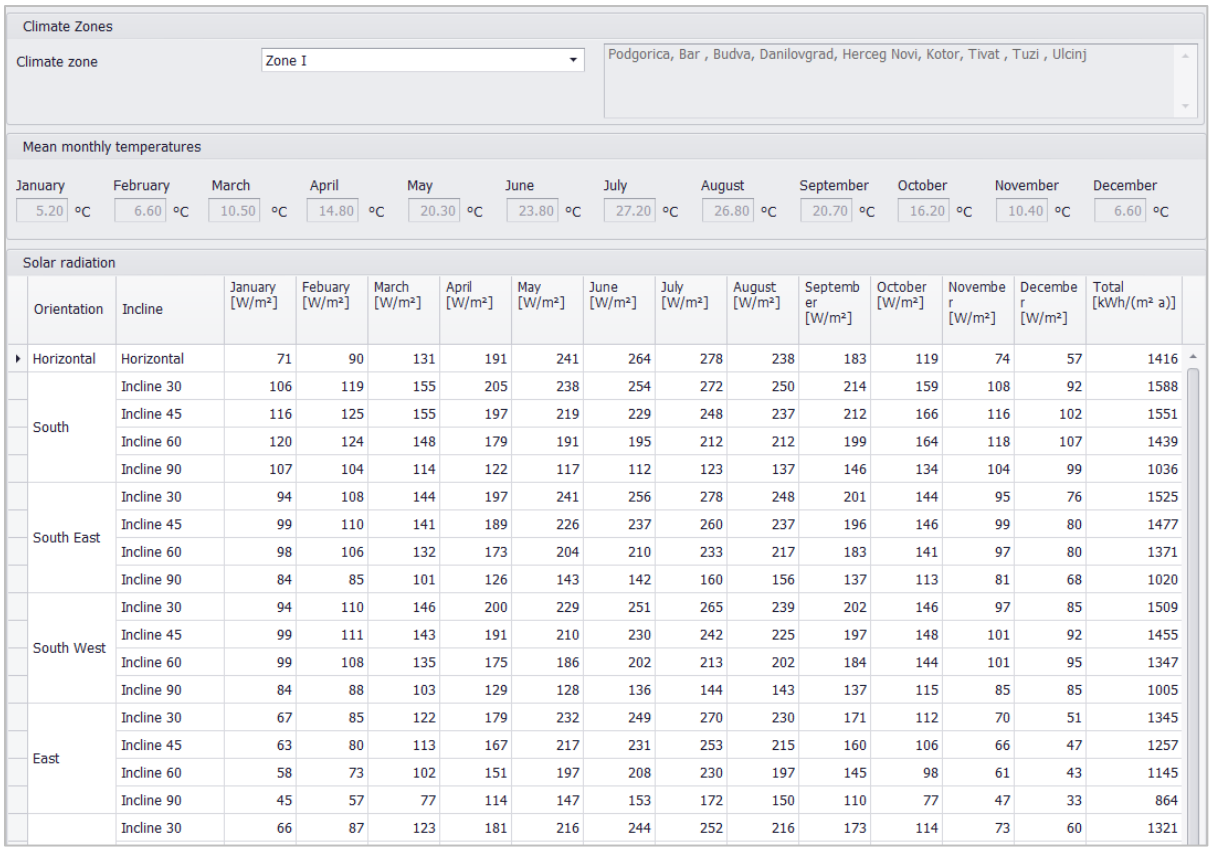
More information on building automation can be found in Calculation methodology in Annex J.

5.5 Climate zone

Climate data for the calculation are specified in accordance to the Rulebook. Three climate zones are defined for Albania. By selecting certain climate zone from the drop-down menu, the list of municipalities that belong to that zone will be displayed. Zone I is represented with climate data of Podgorica, Zone II with Cetinje and Zone III with Pljevlja climate data.

Mean monthly temperatures
Outdoor air temperatures for the individual months are given for each reference location/climate zone.

Solar radiation
Mean solar irradiance for the individual months and for a year are given for each reference location/climate zone for eight orientations (N, S, E, W, NE, SE, NW, SW) and five inclinations (0°, 30°, 45°, 60°, 90°).



Climate Zones

Climate zone: Zone I

Podgorica, Bar , Budva, Danilovgrad, Herceg Novi, Kotor, Tivat , Tuzi , Ulcinj

Mean monthly temperatures

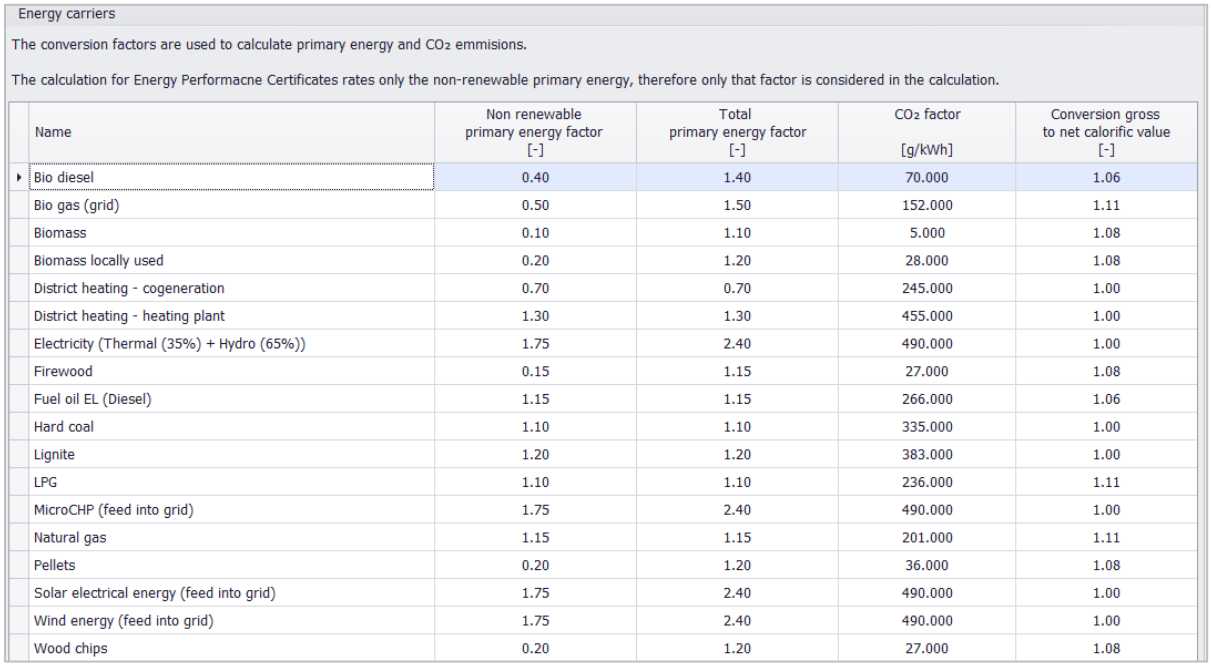
January	February	March	April	May	June	July	August	September	October	November	December
5.20 °C	6.60 °C	10.50 °C	14.80 °C	20.30 °C	23.80 °C	27.20 °C	26.80 °C	20.70 °C	16.20 °C	10.40 °C	6.60 °C

Solar radiation

Orientation	Incline	January [W/m²]	Febuary [W/m²]	March [W/m²]	April [W/m²]	May [W/m²]	June [W/m²]	July [W/m²]	August [W/m²]	September [W/m²]	October [W/m²]	November [W/m²]	December [W/m²]	Total [kWh/(m² a)]
Horizontal	Horizontal	71	90	131	191	241	264	278	238	183	119	74	57	1416
South	Incline 30	106	119	155	205	238	254	272	250	214	159	108	92	1588
	Incline 45	116	125	155	197	219	229	248	237	212	166	116	102	1551
	Incline 60	120	124	148	179	191	195	212	212	199	164	118	107	1439
	Incline 90	107	104	114	122	117	112	123	137	146	134	104	99	1036
South East	Incline 30	94	108	144	197	241	256	278	248	201	144	95	76	1525
	Incline 45	99	110	141	189	226	237	260	237	196	146	99	80	1477
	Incline 60	98	106	132	173	204	210	233	217	183	141	97	80	1371
	Incline 90	84	85	101	126	143	142	160	156	137	113	81	68	1020
South West	Incline 30	94	110	146	200	229	251	265	239	202	146	97	85	1509
	Incline 45	99	111	143	191	210	230	242	225	197	148	101	92	1455
	Incline 60	99	108	135	175	186	202	213	202	184	144	101	95	1347
	Incline 90	84	88	103	129	128	136	144	143	137	115	85	85	1005
East	Incline 30	67	85	122	179	232	249	270	230	171	112	70	51	1345
	Incline 45	63	80	113	167	217	231	253	215	160	106	66	47	1257
	Incline 60	58	73	102	151	197	208	230	197	145	98	61	43	1145
	Incline 90	45	57	77	114	147	153	172	150	110	77	47	33	864
	Incline 30	66	87	123	181	216	244	252	216	173	114	73	60	1321

Figure 28: Input screen for climate zone selection

5.6 Energy carriers



Energy carriers

The conversion factors are used to calculate primary energy and CO_2 emmisions.

The calculation for Energy Performacne Certificates rates only the non-renewable primary energy, therefore only that factor is considered in the calculation.

Name	Non renewable primary energy factor [-]	Total primary energy factor [-]	CO_2 factor [g/kWh]	Conversion gross to net calorific value [-]
Bio diesel	0.40	1.40	70.000	1.06
Bio gas (grid)	0.50	1.50	152.000	1.11
Biomass	0.10	1.10	5.000	1.08
Biomass locally used	0.20	1.20	28.000	1.08
District heating - cogeneration	0.70	0.70	245.000	1.00
District heating - heating plant	1.30	1.30	455.000	1.00
Electricity (Thermal (35%) + Hydro (65%))	1.75	2.40	490.000	1.00
Firewood	0.15	1.15	27.000	1.08
Fuel oil EL (Diesel)	1.15	1.15	266.000	1.06
Hard coal	1.10	1.10	335.000	1.00
Lignite	1.20	1.20	383.000	1.00
LPG	1.10	1.10	236.000	1.11
MicroCHP (feed into grid)	1.75	2.40	490.000	1.00
Natural gas	1.15	1.15	201.000	1.11
Pellets	0.20	1.20	36.000	1.08
Solar electrical energy (feed into grid)	1.75	2.40	490.000	1.00
Wind energy (feed into grid)	1.75	2.40	490.000	1.00
Wood chips	0.20	1.20	27.000	1.08

Figure 29: Energy carriers data

The conversion factors are used to calculate primary energy and CO_2 emissions.

The **primary energy factor** is expressed as a numeric value and indicates the ratio between the amount of primary energy needed to supply one unit of delivered energy, taking into account the energy required for extraction, conversion, transport and distribution.

Primary energy factors are the ratio of a given type of primary energy (renewable, non-renewable, total) to the actual energy amount. On the one hand, if only non-renewable primary energy is taken into account in the calculation, **non-renewable primary energy factors** are used. On the other hand, if renewable and non-renewable primary energy is considered, then, **total primary energy factors** are used. Thus, the total primary energy factor is calculated as the sum of the non-renewable primary energy factor and renewable primary energy factor.

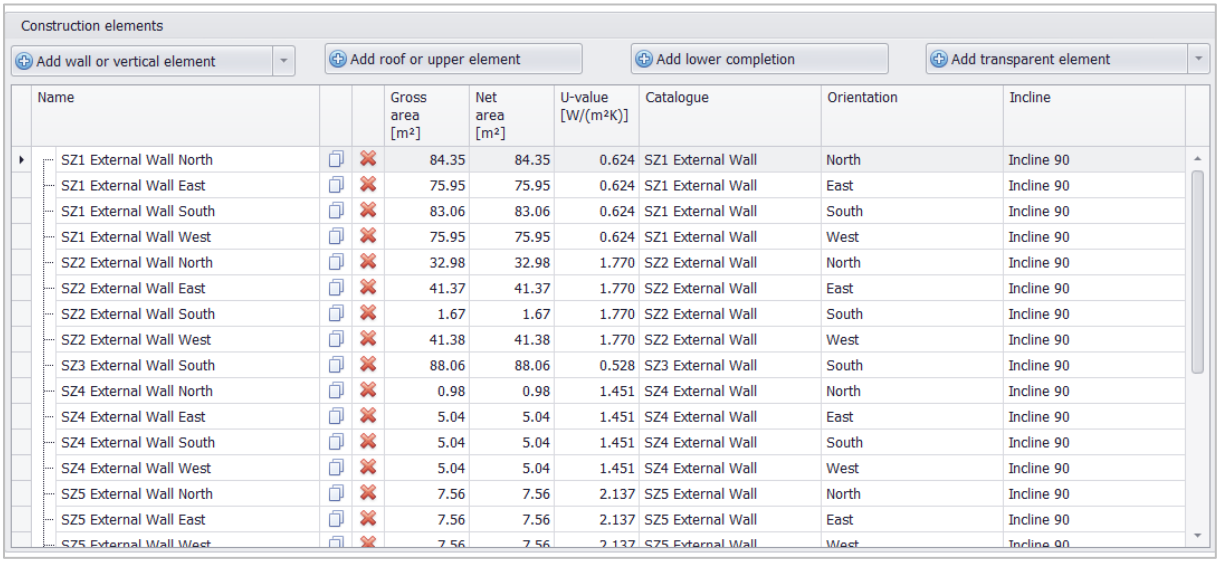
The calculation for Energy Performance Certificates (EPCs) rates only the non-renewable primary energy, therefore only that factor is considered in the calculation.

CO_2 emission factor indicates the relationship between greenhouse gases emissions and consumption of delivered energy.

Factors for converting the energy content of energy carriers are specified as **conversion gross to net calorific value.**

Primary energy factors and CO_2 factors are defined on national level in the Rulebook.

6 Input screens for building envelope



Name	Gross area [m²]	Net area [m²]	U-value [W/(m²K)]	Catalogue	Orientation	Incline
SZ1 External Wall North	84.35	84.35	0.624	SZ1 External Wall	North	Incline 90
SZ1 External Wall East	75.95	75.95	0.624	SZ1 External Wall	East	Incline 90
SZ1 External Wall South	83.06	83.06	0.624	SZ1 External Wall	South	Incline 90
SZ1 External Wall West	75.95	75.95	0.624	SZ1 External Wall	West	Incline 90
SZ2 External Wall North	32.98	32.98	1.770	SZ2 External Wall	North	Incline 90
SZ2 External Wall East	41.37	41.37	1.770	SZ2 External Wall	East	Incline 90
SZ2 External Wall South	1.67	1.67	1.770	SZ2 External Wall	South	Incline 90
SZ2 External Wall West	41.38	41.38	1.770	SZ2 External Wall	West	Incline 90
SZ3 External Wall South	88.06	88.06	0.528	SZ3 External Wall	South	Incline 90
SZ4 External Wall North	0.98	0.98	1.451	SZ4 External Wall	North	Incline 90
SZ4 External Wall East	5.04	5.04	1.451	SZ4 External Wall	East	Incline 90
SZ4 External Wall South	5.04	5.04	1.451	SZ4 External Wall	South	Incline 90
SZ4 External Wall West	5.04	5.04	1.451	SZ4 External Wall	West	Incline 90
SZ5 External Wall North	7.56	7.56	2.137	SZ5 External Wall	North	Incline 90
SZ5 External Wall East	7.56	7.56	2.137	SZ5 External Wall	East	Incline 90
SZ5 External Wall West	7.56	7.56	2.137	SZ5 External Wall	West	Incline 90

Figure 30: Input screen for defining building envelope elements

Building envelope elements to be defined in this screen are divided in four categories: walls/vertical elements, roofs/upper completion elements, floors/lower completion elements and transparent elements. Each envelope element is entered by selecting one of these categories, whereupon the details of the added element are defined in the section below the listed construction elements.

6.1 Walls and vertical elements

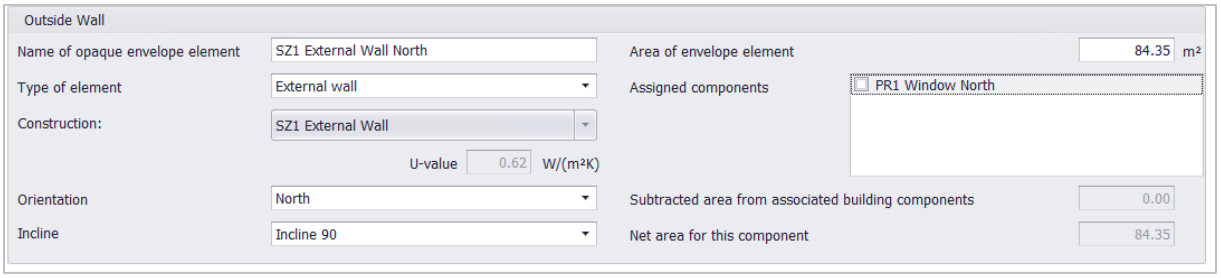


Figure 31: Input screen for defining walls and vertical elements

External walls, internal walls to unheated areas and doors (opaque) are entered by clicking **Add wall or vertical element** button and selecting one of specified options for this category.

The name of building envelope element is to be entered in the field **Name of opaque envelope element**.

A subcategory of added envelope element, if existing, may be selected from the drop-down list referring to **Type of element**.

U-value for the added construction element can be defined either by selecting the option **Enter U-value directly** and entering an already known U-value, or by selecting from the drop-down menu an already defined construction in **Building/Constructions** screen. The latter is the case when the U-value is not known but must be calculated based on the given layer structure of the building element.

For each element **Orientation** and **Inclination** need to be selected from the corresponding drop-down menu.

The area for each element needs to be defined by entering the value in **Area of envelope element**. The area is entered in [m^2] and refers to the gross area of the element.

In case there are transparent envelope elements (windows, glazed doors) that belong to this opaque envelope element, they can be defined in two ways. One way is to select **Add window as part of the façade** from **Add transparent element**, whereupon these windows will be automatically assigned to this opaque element. The windows area will be automatically subtracted from the gross area of the opaque element, thus calculating the net area of the opaque element. Another way is to define windows as separate envelope elements, whereupon all windows having the same orientation as opaque element under consideration, will appear in **Assigned components** box. All windows that belong to this opaque element should be selected by clicking in the related checkboxes. As in the first way, the windows area will be automatically subtracted from the gross area of the opaque element, thus calculating the net area of the opaque element.

6.2 Roofs and upper completion elements

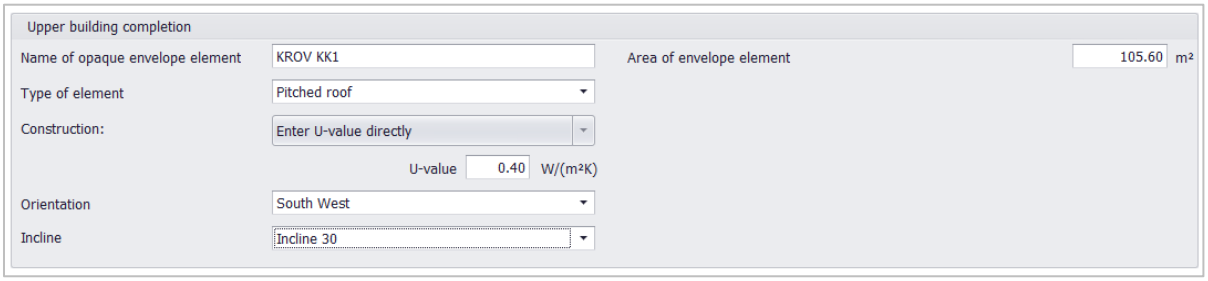


Figure 32: Input screen for defining roofs and upper completion elements

Roofs and upper completion elements are entered by clicking **Add roof or upper element** button.

The name of building envelope element is to be entered in the field **Name of opaque envelope element**.

A subcategory of added envelope element needs to be selected from the drop-down list referring to **Type of element**.

U-value for the added construction element can be defined either by selecting the option **Enter U-value directly** and entering an already known U-value, or by selecting from the drop-down menu an already defined construction in **Building**/**Constructions** screen. The latter is the case when the U-value is not known but must be calculated based on the given layer structure of the building element.

For pitched roofs **Orientation** and **Inclination** need to be selected from the corresponding drop-down menu.

The area for each element needs to be defined by entering the value in **Area of envelope element**. The area is entered in [m^2] and refers to the gross area of the element.

In case there are transparent envelope elements (roof windows) that belong to this upper completion element (i.e. flat roof), they can be defined similarly as for windows and associated façade. Specifically, for upper completion element under consideration, all previously defined transparent elements (roof windows) will appear in **Assigned components** box. Roof windows that belong to this upper completion element should be selected by clicking in the related checkboxes. The windows area will be automatically subtracted from the gross area of the upper completion element, thus calculating the net area of the upper completion element.

6.3 Floors and lower completion elements

Floors and lower completion elements are entered by clicking **Add lower completion** button.

The name of building envelope element is to be entered in the field **Name of opaque envelope element**.

A subcategory of added envelope element needs to be selected from the drop-down list referring to **Type of element**.

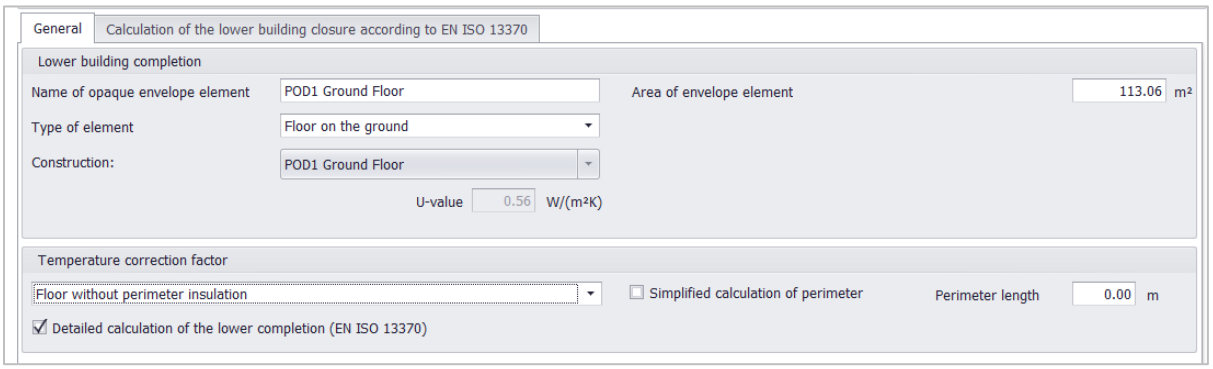


Figure 33: Input screen for defining floors and lower completion elements

U-value for the added construction element can be defined either by selecting the option **Enter U-value directly** and entering an already known U-value, or by selecting from the drop-down menu an already defined construction in **Building/Constructions** screen. The latter is the case when the U-value is not known but must be calculated based on the given layer structure of the building element.

The area for each element needs to be defined by entering the value in **Area of envelope element**. The area is entered in [m^2] and refers to the net area of the element.

Heat transfer via the ground is characterized by heat flow related to the area of the floor (depending on the construction of the floor), heat flow related to the perimeter of the floor (depending on thermal bridging at the edge of the floor) and the annual periodic heat flow (also related to the perimeter of the floor, resulting from the thermal inertia of the ground). In this regard, calculation of thermal transmittance for floors and basements includes many different factors, such as parameters of the floor slab, walls and floor in the basement, thermal resistance of constructions, thermal properties of the ground (soil), geometric parameters, etc.

Temperature correction factor is calculated depending on the selected type of floor/lower completion from the drop-down menu **Type of element**. For each of selected types (floor on the ground, floor to the basement, floor over outside air, wall to the ground), a corresponding subtype needs to be selected from the drop-down menu in **Temperature correction factor** section. **Perimeter length** for selected floor/lower completion element needs to be calculated and entered in [m], or the simplified approach can be used for its calculation. If latter is the case, then this option should be selected clicking in the checkbox **Simplified calculation of parameter**, after which no additional input data is required.

For certain floor/lower completion types/subtypes, a detailed method for calculating thermal transmittance in accordance with EN ISO 13370 can be used. By clicking in the checkbox **Detailed calculation of the lower completion (EN ISO 13370)**, a new tab is displayed next to the **General** tab containing a number of required input data on geometric parameters and thermal insulation properties. Value for **Thickness of the enclosure walls at ground level** need to be entered in [m]. In case of slab-on-ground floors with edge insulation, the corresponding option should be selected from the **Orientation** drop-down menu: horizontal, vertical and both (horizontal and vertical). Depending

on this selection, the values for **width and thickness of the horizontal and/or vertical edge insulation** need to be entered in [m], as well as the **thermal resistance of the insulation** in [W/(mK)]. In case of stilted (suspended) floors, the following input values are needed: **height of the upper surface** of the floor above outside ground level in [m], **thermal transmittance of walls** of underfloor space above ground level in [W/(m^2K)], **area of ventilation openings per perimeter length** of underfloor space in [m^2/m], and **thermal resistance of** any **insulation** on the base of the underfloor space in [m^2K/W]. More information on this approach can be found in the standard EN ISO 13770 (Thermal performance of buildings — Heat transfer via the ground — Calculation methods).

6.4 Windows, glazed doors and roof windows/lights

Windows, glazed doors and roof windows/lights/bands are entered by clicking **Add transparent element** button and selecting one of specified options for this category.

The name of transparent building envelope element is to be entered in the field **Name of element**.

The details for added window or glazed door are defined by selecting one of the options from the drop-down list referring to **Type of element**. The list contains previously defined windows in **Building/Windows screen**, if any, or the option for selecting and defining a new window from the library. If the latter is the case, the windows can be defined either by selecting available options for glazing, frame and spacer or by direct entering of U-value and corresponding g- and τ-values (please see explanations in the section **Building/Windows**).

The area for each window or glazed door needs to be defined by entering the value in **Total area**. The area is entered in [m^2] and refers to the raw building carcass opening of the window, i.e. the opening in the wall in which the window or its frame is attached.

For each window or glazed door **Orientation** and **Inclination** need to be selected from the corresponding drop-down menu.

In case of selecting a category **Add window as part of the façade** from **Add transparent element** drop-down menu, this window will be automatically assigned to the opaque element below which it added (please see explanations above related to definition of **Walls and vertical elements**).

Light bands and light domes are entered by selecting a category **Add rooflight (band/dome)** from **Add transparent element** drop-down menu, followed by further selection in drop-down menu related to **Structure** field. For each category selected (light band or light dome), there is a drop-down list with different options for glazing (with corresponding U-values and g-values).

The area for each light band/dome needs to be defined by entering the value in **Skylight area**. The area is entered in [m^2] and refers to the raw building carcass opening of the transparent element, i.e. the opening in the opaque element in which the transparent element or its frame is attached.

The area in which the skylights are located need to be defined by entering the values for its width and length in [m^2]. Besides, the following geometric parameters for skylights need to be defined: **length and width of roof opening** without skylight base/frame in [m], **length and width of top opening of the skylight** including skylight base/frame in [m], and **height of the skylight** in [m], **and angle of inclination of the skylight** in [°].

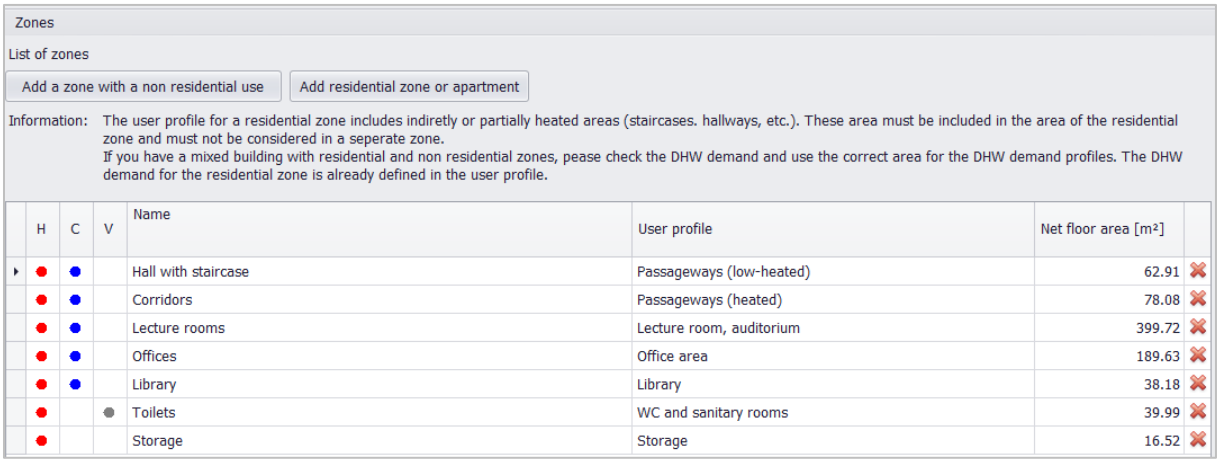
For determination of daylight supply factor for roof lights/bands when sun shading is not activated, the reduction factors for pollution of the glazing, non-vertical light incidence and shoots (frames and subdivisions) has to be entered in related fields in section **Reduction factors**. More information on daylight factors can be found in Calculation methodology in Chapter 8.3.2.

7 Input screens for zones

7.1 Overview of zones

As already explained in **User profile** section (**Building** screen), for energy balancing of non-residential buildings, it is necessary to divide the building into several zones. The zone comprises the (net floor) area of a group of rooms within the building, which are characterized by equal type of usage, same type of conditioning (heating, cooling, ventilation, humidification, lighting and domestic hot water supply), and uniform additional zoning criteria. More information on zoning procedure can be found in the Calculation methodology in Chapter 5.

A zone may have all types of conditioning (heating, cooling, ventilation, humidification, lighting) or just a single one (e.g. lighting). Zones having at least one type of conditioning are so called "conditioned zones". In case a zone is heated and/or cooled, it is called a "thermally conditioned zone". Areas of a building that are not conditioned are grouped together as "unconditioned" 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".



H	C	V	Name	User profile	Net floor area [m²]
●	●		Hall with staircase	Passageways (low-heated)	62.91
●	●		Corridors	Passageways (heated)	78.08
●	●		Lecture rooms	Lecture room, auditorium	399.72
●	●		Offices	Office area	189.63
●	●		Library	Library	38.18
●		●	Toilets	WC and sanitary rooms	39.99
●			Storage	Storage	16.52

Figure 34: Overview of defined zones in a building

All defined thermally conditioned zones in a building are entered by clicking **Add a zone with a non-residential use** or **Add a residential zone or apartment**. Although residential buildings are considered as buildings with one zone, this concept of adding both residentail and non-residential zones is assumed for mixed buildings (buildings used for residential and non-residential purposes). Only one residential zone can be added, while number of non-residential zones is limited to 999.

In this window, the building zones are only added, while all data regarding each of them (usage profile, geometric parameters, type of conditioning) are defined separately in a window related to each zone (one lower level in navigation tree structure). Upon entering details for each zone, the overview of zones in this window will show the name of the zone, the net floor area of the zone, the user profile of the zone, as well as whether the zone is heated/cooled/ventilated, which will be indicated with red/blue/gray circles refering to these types of conditioning, respectively.

Lighting energy is not considered for residential buildings. Demand for domestic hot water for residential building is included in the user profile.

Lighting energy in non-residential buildings is defined on zone level. Demand for domestic hot water for non-residential building is defined on building level (please see **DHW demand** window).

Information:
The user profile for a residential zone includes indirectly or partially heated areas (staircases, hallways, etc.). These areas must be included in the area of the residential zone and must not be considered in a separate zone.
If you have a mixed building with residential and non-residential zones, please check the DHW demand and use the correct area for the DHW demand profiles. The DHW demand for the residential zone is already defined in the user profile.

7.2 Zone data for non-residential zones

Figure 35: Input screen for defining zone data for non-residential buildings

7.2.1 Zone description

Name of zone
Enter the name of the zone.

User Profile
User profiles represent a set of data that characterize certain spaces depending on their use. These data include usage times, indoor space conditions, minimum outdoor air volume flow, internal heat sources, lighting levels, etc.

User profile for zone is selected from the drop-down menu. For zones with a non-residential use, there are 36 user profiles available. These user profiles are considered standard and only these profiles can be used in **Calculation for EPC** mode (i.e. mode used for creating energy performance certificates).

For **Calculation of consumption** mode, standard user profiles can be modified in order to reflect the actual use of the building. These modified user profiles are defined in **Building** screen in **User profile** tab. In case that for this zone the standard user profile is not used for calculation of consumption mode, then this option needs to be selected by clicking in the checkbox **Use different user profile for consumption mode**. Afterwards, from the dropdown menu the user profile that was adapted to reflect the actual use of the building (previously done in **Building** screen) needs to be selected for this zone. This user profile is used for calculation of energy consumption in **Calculation of consumption** mode,

and can be used as well as for calculation of energy consumption after applied packages of energy efficiency measures (please see **Energy efficiency measures** screen, tab **Options**).

For zones like passageways, sanitary rooms, kitchens, etc. that are common to various types of building and follow the usage times of the building (its main use), there is an option to be selected by clicking in the checkbox **Get operating time from main use**. Enabling this option, the usage times of building in this profile will be the same as in user profile that determines the main use of the building (e.g. offices in office building, classroom in schools).

7.2.2 Zone geometry

Net floor area
The net floor area (A_{NF}) is used as the reference area and it refers to the useful floor area within the conditioned volume of the building.

Net volume
The net volume (V) is the 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. The clear room height is the difference in height between the upper surface of the floor and the lower surface of the storey floor above or suspended ceiling. As an estimate, e.g. if no internal measurements are taken, the net volume is calculated using the equation $V=0,8 \cdot V_e$, with V_e being the total volume (gross volume, external volume).

Total volume
The total volume (V_e) is the volume of a building or of a building zone as calculated on the basis of external dimensions. This volume includes, at least, all the spaces in a building or zone which are directly or, since they are interconnected, indirectly conditioned as required for their function. More details for determining the total volume (gross volume, external volume) can be found in the Calculation methodology in Chapter 11.

7.2.3 Mechanical ventilation

The required air exchange from outdoor air can be provided in three ways (and therefore selection of one of these options is necessary):

Natural ventilation
The required outdoor air is provided by opening the windows.

Mechanical ventilation
The supply and/or exhaust air are supplied by a mechanical ventilation system. In this regard, there are three types of ventilation systems to be selected by clicking in the relevant checkbox: systems with only supply air (**Mechanical ventilation has supply air**), systems with only exhaust air (**Mechanical ventilation has exhaust air**), and systems with supply and exhaust air (both options **Mechanical ventilation has supply air** and **Mechanical ventilation has exhaust air**).

Hybrid ventilation
A part of the required outdoor air change defined in the user profile is provided by a mechanical ventilation system. The rest is achieved by window airing.

Share of supply air by the mechanical ventilation
In case of hybrid ventilation, the share of supply air provided by the mechanical ventilation system is entered as a precentage.

7.2.4 Conditioning in air-handling unit

The supply air can be conditioned in an air handling unit.

In case there is no heating and/or cooling in an air handling unit, this option should be entered by clicking in the checkbox **No additional heating and/or cooling of supply air**.

In case the supply air is heated up to a given set-point temperature in an air handling unit, this option should be entered by clicking in the checkbox **Heating of supply air with heating coil**.

In case the supply air is heated up and cooled down to a given set-point temperature in an air handling unit, this option should be entered by clicking in the checkbox **Heating and cooling of supply air with heating coil**.

NOTE: A zone can be conditioned only by air (air heating/cooling). In that case only the conditioning of the air in the air handling unit should be selected, but no additional thermal conditioning of the zone.

7.2.5 Thermal conditioning of zone

Heating by radiators/panel heating/direct heaters/etc.
The zone is thermally conditioned – heated. This can be done by radiators, panel heating, direct heaters or similar systems, i.e. systems where the emission of heat is done directly in the room or zone. This does not include air-handling units, where the emission usually takes place in the air-handling unit.

Operating mode heating
Operating mode of the heating system is selected from the drop-down menu. Three options are available: **Full operation** for the heating system working continuously (24-hour usage), **Setback at night** for lowering the heating supply temperature for a pre-specified period at night-time, and **Switch-off at night** for shutting down the heating system for a pre-specified period at night-time (this period includes associated lowering and boost mode times).

Cooling by panel cooling/split unit/fan coil unit/etc.
The zone is thermally conditioned – cooled. This can be done by panel cooling, split unit, fan coil unit or similar systems, i.e. systems where the transfer of energy is done directly in the room or zone. This does not include air-handling units, where the emission usually takes place in the air-handling unit.

Cooling is switched-off on non-operating days
In case that cooling system is not functioning during non-operating days (at weekends and during holiday periods), this option should be entered by clicking in the related checkbox.

NOTE: Neither having a thermal conditioning of the zone nor a conditioning in the air-handling unit means that this is an unheated zone.

7.2.6 User profile

There are 36 user profiles available for zones with a non-residential use. The content of standard user profile assigned to a certain zone (in **Zone** screen) can be seen in this window (but it cannot be edited).

User profile

Name
Name of the user profile.

Description
More precise information about the type of spaces that are covered by this user profile.

Usage times

Daily usage times
The times at which use commences and ends, usually the beginning and end of the period during which persons are present in the facility and/or during which the facility is in operation.

Annual usage days
Number of days in a year on which the building is used. A distinction is made according to the number of usage days per week: five, six and seven days (corresponding to 250, 300, 365 d/a respectively).

Daily operating hours of heating system
The length of time for which the system is operated each day. This describes the period during which the set-point value required for the respective type of usage is maintained. It is assumed that night-time and/or weekend set-back operation is used outside of the operating times. The standard operating time values stated are defined on the assumption that a two-hour boost period precedes the respective usage time.

Daily operating hours of AC and cooling systems
The length of time during which the HVAC and cooling system is operated in one day. If the respective system is not operated around the clock, it is assumed that it will be started up two hours before the beginning of usage.

Annual operating days of HVAC systems
Number of days in a year on which the HVAC, cooling and heating systems are operated according to the daily utilization profile.

Indoor space conditions

Set-point temperature heating
Set-point value for the monthly mean temperature in the space being evaluated. The values stated do not take into account spatial and temporal partial or setback heating modes.

Set-point temperature for cooling
Set-point value for the monthly mean temperature in the space being assessed. The internal set-point temperature for cooling operation is the mean temperature to be maintained in average during the normal usage time when the cooling unit is in operation. On the basis of conventional settings for cooling systems, it shall be assumed that higher room temperatures are permitted when high outdoor temperatures occur. For this reason, the mean value is used.

Minimum temperature heating for design rating
Minimum temperature for heating, design rating. A value of 20° C may be assumed for all types of usage, when no other value is given.

Maximum temperature cooling for design rating
Maximum temperature for cooling operation, design rating: A value of 26° C may be assumed for all types of usage, when no other value is given.

Temperature reduction for set-back operation
Temperature reduction for set-back operation (set-back heating mode). A reduction of 4 K may be assumed for all types of usage, when no other value is given.

Humidity requirement for the AC system control
Specification whether the HVAC system is operated with a humidity control tolerance or with strictly defined humidity control, i.e. without any tolerance.

Minimum outdoor-air volume flow

Area-related minimum air volume flow (usually from hygienic aspects)
Air volume flow rate per unit area given in [$m^3/(h\ m^2)$], which is usually to be maintained for hygienic reasons.

Minimum air volume flow for the building (building-related air volume flow)
The minimum external air-supply volume flow for buildings, given in [$m^3/(h\ m^2)$], is the building related part of the minimum ventilation airflow. This value is required if automatic control strategies are used for the ventilation system.

Relative absence ventilation systems (for presence detection or gas sensors)
The relative absence HVAC takes into account information about the air quality of a room via e.g. people counters or gas sensors.

Partial operating factor for ventilation systems (presence in zone)
The partial operation factor describes the proportion of the usage time in which no person are present in the area.

Lighting

Maintained illuminance
The maintained illuminance required at the work plane is given in lux.

Height of the work plane
Vertical distance from the floor to the plane, where the required maintained illuminance is to be achieved (task area). Usually, a value of 0,8 m can be applied (which derives as mean value of 0,75 m for mainly sitting tasks and of 0,85 for mainly standing tasks).

Reduction factor for area that needs to have the full illuminance level
Factor defining by how much the maintained illuminance is allowed to be reduced. The reduction factor is calculated based on the assumed ratio of the area required for the visual task to the area of the immediate surroundings for the respective usage and on the ratio of the maintained illuminance specified for the visual task to the maintained illuminance specified for the immediate surroundings.

Relative absence (within operating time)
Parameter describing the proportion of usage time in which no persons are present in the area being assessed (F_A = 0: permanent presence, F_A = 1: no presence). The relative absence accounts for part-time operation during a usage day (e.g. absences due to meetings, breaks etc.).

Room index (dimensionless geometric value used in split flux method)
Dimensionless geometric parameter used to determine the utilance (utilization factor) of a room.

Reduction factor for lighting related to the building usage
Factor defining the degree to which the usage time stated for the respective utilization profile may be reduced when calculating the energy demand for lighting. The partial-operation factor allows for the effect of part-time operation during the balance calculation period (e.g. holidays, illness, leave etc.).

Internal heat sources

Occupancy density
Occupancy density for this use.

Full operating hours persons
Number of full operationg hours for persons.

Heat flux of one person

The values stated for the heat dissipated by persons depend on assumed activity level and specific occupancy (persons per unit area) values. They are based on full utilization hours and a normal sensible heat dissipation of a person.

Full operating hours equipment and devices
Number of full operating hours for equipment and devices.

Simultaneous power
The values of the specific heat dissipation per unit area are given. The area-specific heat gain due to equipment, machinery and appliances is stated as a daily value. This is derived from the number of full utilization hours and the specific power of the heat sources. Lighting is not included in this value, since a separate energy balance is calculated for lighting systems. This values is used, when standard equipment is used.

Building automation

Summand for consideration of building automation
Summand for consideration of building automation (in correction of reference internal temperature for the balance calculations).

Factor for adaptive temperature control
Factor for adaptive temperature control (derived from the frequency of defined partial load cases).

More information on building automation can be found in Calculation methodology in Annex J.

7.3 Zone data for residential zones

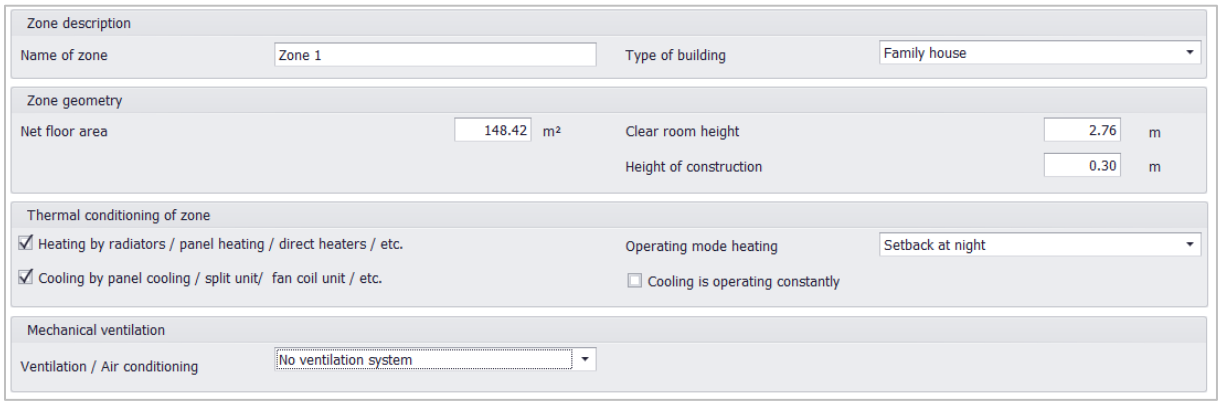


Figure 36: Input screen for defining zone data for residential buildings

7.3.1 Zone description

Name of zone
Enter the name of the zone.

Type of building
Type of building is selected from the drop-down menu. There are two options available for residential buildings: family house and residential building (apartment building). Each selected type of building has its corresponding user profile which represents a set of data that characterize certain spaces depending on their use. These data include usage times, indoor space conditions, minimum outdoor air volume flow, internal heat sources, lighting levels, etc.

7.3.2 Zone geometry

Net floor area
The net floor area (A_{NF}) is used as the reference area and it refers to the useful floor area within the conditioned volume of the building.

Clear room height
The clear storey height is the difference in height between the upper surface of the floor and the lower surface of the storey floor or a suspended ceiling. If the clear storey height varies in the zone, building or serviced area, a characteristic height shall be used. This is the height applying to the majority of the spaces (with an accuracy of 0,3 m).

Height of construction
Height of ceiling, including a suspended ceiling.

7.3.3 Thermal conditioning of zone

Heating by radiators/panel heating/direct heaters/etc.
The zone is thermally conditioned – heated. This can be done by radiators, panel heating, direct heaters or similar systems, i.e. systems where the emission of heat is done directly in the room or zone. This does not include air-handling units, where the emission usually takes place in the air-handling unit.

Operating mode heating
Operating mode of the heating system is selected from the drop-down menu. Three options are available: **Full operation** for the heating system working continuously (24-hour usage), **Setback at night** for lowering the heating supply temperature for a pre-specified period at night-time, and **Switch-off at night** for shutting down the heating system for a pre-specified period at night-time (this period includes associated lowering and boost mode times).

Cooling by panel cooling/split unit/fan coil unit/etc.
The zone is thermally conditioned – cooled. This can be done by panel cooling, split unit, fan coil unit or similar systems, i.e. systems where the transfer of energy is done directly in the room or zone. This does not include air-handling units, where the emission usually takes place in the air-handling unit.

Cooling is operating constantly
In case that cooling system is functioning also during non-operating times (out of usage times and on weekends), this option should be entered by clicking in the related checkbox.

NOTE: Neither having a thermal conditioning of the zone nor a conditioning in the air-handling unit means that this is an unheated zone.

7.3.4 Mechanical ventilation

Ventilation / Air conditioning
The required air exchange from outdoor air in residential zones/buildings is defined by selecting one of the options from the related drop-down menu: **No ventilation system** when required outdoor air is provided by opening the windows, **Providing only supply air** when there is a system with only supply air ventilation, **Extraction only** when there is a system with only exhaust air ventilation, **Ventilation with supply and exhaust air** for system with both supply and exhaust air ventilation, and **Air heating system** for system with additional heating coil.

7.3.5 User profile

There are two user profiles for residential use of buildings: family house and residential building (i.e. apartment building). Only standard user profiles are foreseen to be used for residential buildings, so their content cannot be modified.

User profile

Name
Name of the user profile.

Description
More precise information about the type of spaces that are covered by this user profile.

Usage times

Daily usage times
The times at which use commences and ends, usually the beginning and end of the period during which persons are present in the facility and/or during which the facility is in operation.

Annual usage days
Number of days in a year on which the building is used. A distinction is made according to the number of usage days per week: five, six and seven days (corresponding to 250, 300, 365 d/a respectively).

Daily operating hours of heating system
The length of time for which the system is operated each day. This describes the period during which the set-point value required for the respective type of usage is maintained. It is assumed that night-time and/or weekend set-back operation is used outside of the operating times. The standard operating time values stated are defined on the assumption that a two-hour boost period precedes the respective usage time.

Daily operating hours of AC and cooling systems
The length of time during which the HVAC and cooling system is operated in one day. If the respective system is not operated around the clock, it is assumed that it will be started up two hours before the beginning of usage.

Annual operating days of HVAC systems
Number of days in a year on which the HVAC, cooling and heating systems are operated according to the daily utilization profile.

Indoor space conditions

Set-point temperature heating
Set-point value for the monthly mean temperature in the space being evaluated. The values stated do not take into account spatial and temporal partial or setback heating modes.

Set-point temperature for cooling
Set-point value for the monthly mean temperature in the space being assessed. The internal set-point temperature for cooling operation is the mean temperature to be maintained in average during the normal usage time when the cooling unit is in operation. On the basis of conventional settings for cooling systems, it shall be assumed that higher room temperatures are permitted when high outdoor temperatures occur. For this reason, the mean value is used.

Minimum temperature heating for design rating
Minimum temperature for heating, design rating. A value of 20° C may be assumed for all types of usage, when no other value is given.

Maximum temperature cooling for design rating
Maximum temperature for cooling operation, design rating: A value of 26° C may be assumed for all types of usage, when no other value is given.

Temperature reduction for set-back operation

Temperature reduction for set-back operation (set-back heating mode). A reduction of 4 K may be assumed for all types of usage, when no other value is given.

Humidity requirement for the AC system control
Specification whether the HVAC system is operated with a humidity control tolerance or with strictly defined humidity control, i.e. without any tolerance.

Minimum outdoor-air volume flow

Area-related minimum air volume flow (usually from hygienic aspects)
Air volume flow rate per unit area given in [$m^3/(h\ m^2)$], which is usually to be maintained for hygienic reasons.

Minimum air volume flow for the building (building-related air volume flow)
The minimum external air-supply volume flow for buildings, given in [$m^3/(h\ m^2)$], is the building related part of the minimum ventilation airflow. This value is required if automatic control strategies are used for the ventilation system.

Relative absence ventilation systems (for presence detection or gas sensors)
The relative absence HVAC takes into account information about the air quality of a room via e.g. people counters or gas sensors.

Partial operating factor for ventilation systems (presence in zone)
The partial operation factor describes the proportion of the usage time in which no person are present in the area.

Lighting

Maintained illuminance
The maintained illuminance required at the work plane is given in lux.

Height of the work plane
Vertical distance from the floor to the plane, where the required maintained illuminance is to be achieved (task area). Usually, a value of 0,8 m can be applied (which derives as mean value of 0,75 m for mainly sitting tasks and of 0,85 for mainly standing tasks).

Reduction factor for area that needs to have the full illuminance level
Factor defining by how much the maintained illuminance is allowed to be reduced. The reduction factor is calculated based on the assumed ratio of the area required for the visual task to the area of the immediate surroundings for the respective usage and on the ratio of the maintained illuminance specified for the visual task to the maintained illuminance specified for the immediate surroundings.

Relative absence (within operating time)
Parameter describing the proportion of usage time in which no persons are present in the area being assessed (F_A = 0: permanent presence, F_A = 1: no presence). The relative absence accounts for part-time operation during a usage day (e.g. absences due to meetings, breaks etc.).

Room index (dimensionless geometric value used in split flux method)
Dimensionless geometric parameter used to determine the utilance (utilization factor) of a room.

Reduction factor for lighting related to the building usage
Factor defining the degree to which the usage time stated for the respective utilization profile may be reduced when calculating the energy demand for lighting. The partial-operation factor allows for the effect of part-time operation during the balance calculation period (e.g. holidays, illness, leave etc.).

Internal heat sources

Occupancy density
Occupancy density for this use.

Full operating hours persons
Number of full operationg hours for persons.

Heat flux of one person
The values stated for the heat dissipated by persons depend on assumed activity level and specific occupancy (persons per unit area) values. They are based on full utilization hours and a normal sensible heat dissipation of a person.

Full operating hours equipment and devices
Number of full operating hours for equipment and devices.

Simultaneous power
The values of the specific heat dissipation per unit area are given. The area-specific heat gain due to equipment, machinery and appliances is stated as a daily value. This is derived from the number of full utilization hours and the specific power of the heat sources. Lighting is not included in this value, since a separate energy balance is calculated for lighting systems. This values is used, when standard equipment is used.

Building automation

Summand for consideration of building automation
Summand for consideration of building automation (in correction of reference internal temperature for the balance calculations).

Factor for adaptive temperature control
Factor for adaptive temperature control (derived from the frequency of defined partial load cases).

More information on building automation can be found in Calculation methodology in Annex J.

7.4 Building envelope elements for the zones

All building envelope elements defined in **Building envelope** screen are showed in this overview of the elements grouped into the following categories: **External wall**, **Upper completion**, **Lower completion**, **Windows North**, **Windows East**, **Window South**, **Windows West**. For each of these categories the total area is given in [m^2].

Each building envelope element/category needs to be considered whether it contributes to the transmission losses/gains in this zone. In case the element/category contributes to transmission losses/gains in this zone, it should be specified in which way the area of element/category for this zone is to be assessed.

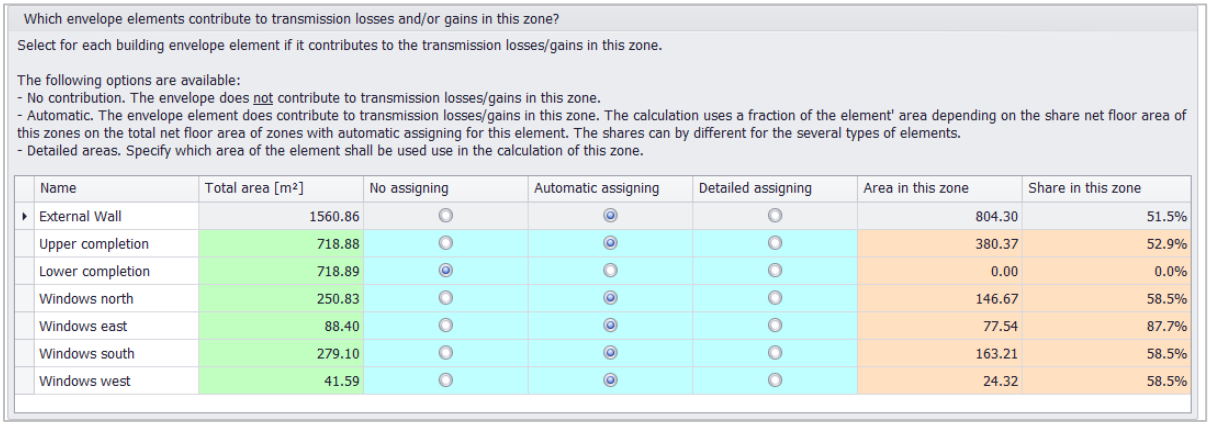
Therefore, for each envelope element/category one of the following options needs to be selected:

No contribution
The envelope element/category does not contribute to transmission losses/gains in this zone.

Automatic assigning
The envelope element/category does contribute to transmission losses/gains in this zone. The determination of area of element/category for this zone is made using the simplified approach that implies approximate allocation based on the fraction of the area of the element/category depending on the percentage of net floor area of this zone to the sum of net floor areas of all zones with automatic assigning for this element/category. For example, the total area of the roof (uper completion) is

allocated to all zones covered by the roof (with automatic assigning selected), depending on the percentage of each zone on the total net floor area.
In the case of selecting the automatic assigning option for certain category, all envelope elements in selected category will be listed in the section below (**List of elements in this zone**) with corresponding orientations, inclinations, U-values and net areas.

Detailed assigning
The envelope element/category does contribute to transmission losses/gains in this zone. The area of element for this zone needs to be specified (previously calculated). When selecting this option for certain category, all envelope elements in selected category will be listed in the section **Detailed assigning in this zone** (separate tab).


Which envelope elements contribute to transmission losses and/or gains in this zone?

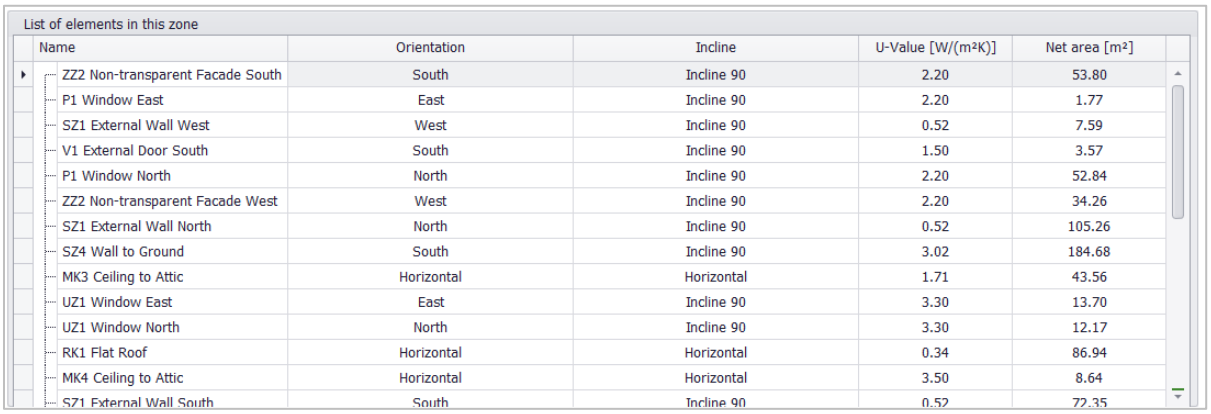
Select for each building envelope element if it contributes to the transmission losses/gains in this zone.

The following options are available:
- No contribution. The envelope does not contribute to transmission losses/gains in this zone.
- Automatic. The envelope element does contribute to transmission losses/gains in this zone. The calculation uses a fraction of the element' area depending on the share net floor area of this zones on the total net floor area of zones with automatic assigning for this element. The shares can by different for the several types of elements.
- Detailed areas. Specify which area of the element shall be used use in the calculation of this zone.

Name	Total area [m²]	No assigning	Automatic assigning	Detailed assigning	Area in this zone	Share in this zone
External Wall	1560.86	○	◉	○	804.30	51.5%
Upper completion	718.88	○	◉	○	380.37	52.9%
Lower completion	718.89	◉	○	○	0.00	0.0%
Windows north	250.83	○	◉	○	146.67	58.5%
Windows east	88.40	○	◉	○	77.54	87.7%
Windows south	279.10	○	◉	○	163.21	58.5%
Windows west	41.59	○	◉	○	24.32	58.5%

Figure 37: Input screen for assigning building elements to the zone

In the case of selecting the automatic assigning option for certain category, all envelope elements in selected category will be listed in the section **List of elements in this zone** with corresponding orientations, inclinations, U-values and net areas:


List of elements in this zone

Name	Orientation	Incline	U-Value [W/(m²K)]	Net area [m²]
ZZ2 Non-transparent Facade South	South	Incline 90	2.20	53.80
P1 Window East	East	Incline 90	2.20	1.77
SZ1 External Wall West	West	Incline 90	0.52	7.59
V1 External Door South	South	Incline 90	1.50	3.57
P1 Window North	North	Incline 90	2.20	52.84
ZZ2 Non-transparent Facade West	West	Incline 90	2.20	34.26
SZ1 External Wall North	North	Incline 90	0.52	105.26
SZ4 Wall to Ground	South	Incline 90	3.02	184.68
MK3 Ceiling to Attic	Horizontal	Horizontal	1.71	43.56
UZ1 Window East	East	Incline 90	3.30	13.70
UZ1 Window North	North	Incline 90	3.30	12.17
RK1 Flat Roof	Horizontal	Horizontal	0.34	86.94
MK4 Ceiling to Attic	Horizontal	Horizontal	3.50	8.64
SZ1 External Wall South	South	Incline 90	0.52	72.35

Figure 38: List of elements automatically assigned to the zone

All envelope elements in categories selected for detailed assigning will be listed in the separate tab **Detailed assigning in this zone**. For each element, the area of element in this zone needs to be specified in [m^2], as well as the data necessary to take into account external shading.

The following types of external shading are taken into consideration: shading from the horizon (shading by other buildings and topography features (e.g. hills, trees, etc.), overhangs (projections above the element being assessed, e.g. canopies, balconies, etc.) and fins (projections at the side of the element being assessed).

For each type of external shading the adequate option (angle range) should be selected from drop-down menu that appears when clicking on the related field: horizon angle, overhang angle and fin angle.

More information on external shadings and angles can be found in the Calculation methodology in Annex F (Chapter F.7).

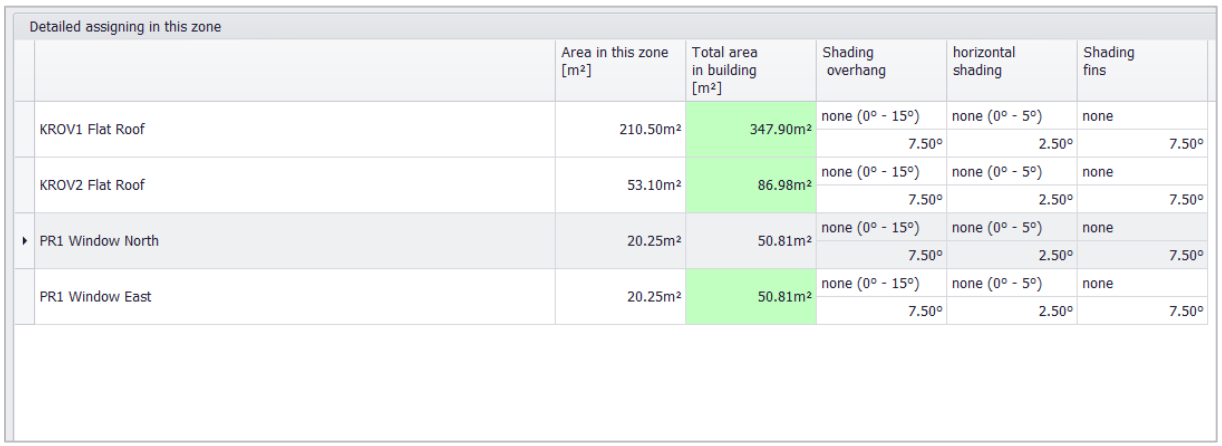


Figure 39: Input screen for detailed assigning of envelope elements in the zone

All envelope elements that contribute to the transmission losses/gains in this zone, selected either by automatic assigning option or by detailed assigning, are listed at the bottom of this screen with corresponding net areas, orientations, inclinations, U-values and reference U-values.

7.5 Lighting

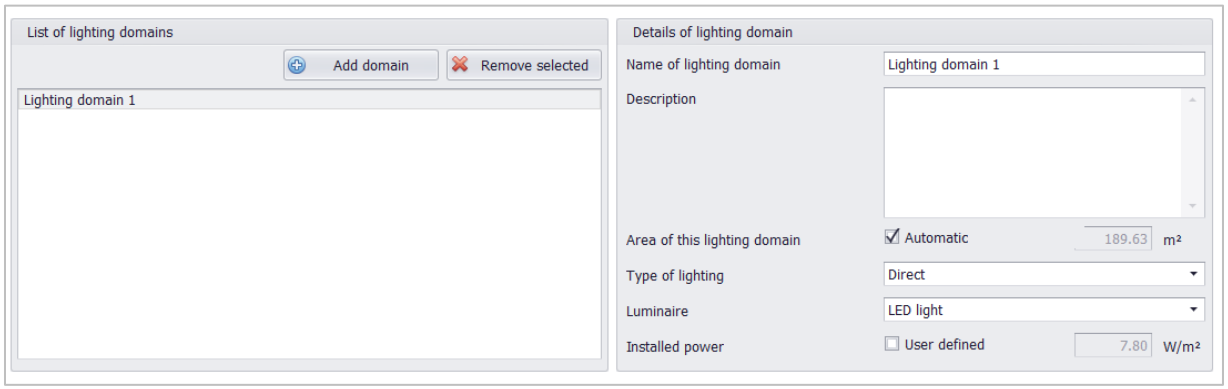


Figure 40: Input screen for defining lighting domains in a zone

For determination of the lighting energy, it may be necessary to subdivide a building zone into evaluation areas (lighting domains). This subdivision may be necessary due to differences in the boundary conditions (e.g. technical design of the artificial lighting system, lighting control systems, characteristics of the façades). The lighting energy is summed up over all relevant areas within one zone and over all zones of one building respectively.

Lighting domain is entered by clicking **Add lighting domain** button. The details of the added lighting domain are defined in the section **Details of lighting domain**.

Each added lighting domain may be deleted by clicking **Remove selected** button.

In **Details of lighting domain** section, the following data needs to be defined:

Name of lighting domain
Enter the name of lighting domain.

Description

In this field some brief description of the lighting domain may be included (e.g. illumination solution and lighting design related to space concept, technical specifications, etc.).

Area of this lighting domain
In case that zone is represented with one lighting domain, and **Automatic** option is checked, then it is assumed that area of this lighting domain is the area of this zone. In case there are several lighting domains in one zone, **Automatic** option should be unchecked, and the area of the respective lighting domain should be entered in [m^2].

Type of lighting
Three types of illumination are distinguished and offered in drop-down menu: direct (a type of lighting that focuses the light beam on a particular object or area), indirect (illumination is mainly a reflection of the original light source hidden behind a structural element) and direct/indirect (mixed from direct sources and indirect reflection).

Luminaire
Type of luminaires for the lighting system in this lighting domain shall be selected from the drop-down list.

Installed power
For selected type of illumination and type of luminaries, the software provides a default value for electrical power requirement of the lighting system. In addition, there is an option to enter already known/calculated value in [W/m^2] by clicking in the checkbox **User defined**.

7.6 Results for the zone

The calculation results are displayed at the building zone level.

The contents of the chart and table depend on the selections made in **Results options** in the main software menu, i.e. selection of the type of energy to be shown: energy need, delivered energy (total and by energy carrier) or primary energy. These energies can be shown as absolute values (in kWh) by clicking in the checkbox **Results as absolute values**. Otherwise, they will be expressed per unit of reference area (in kWh/m^2).

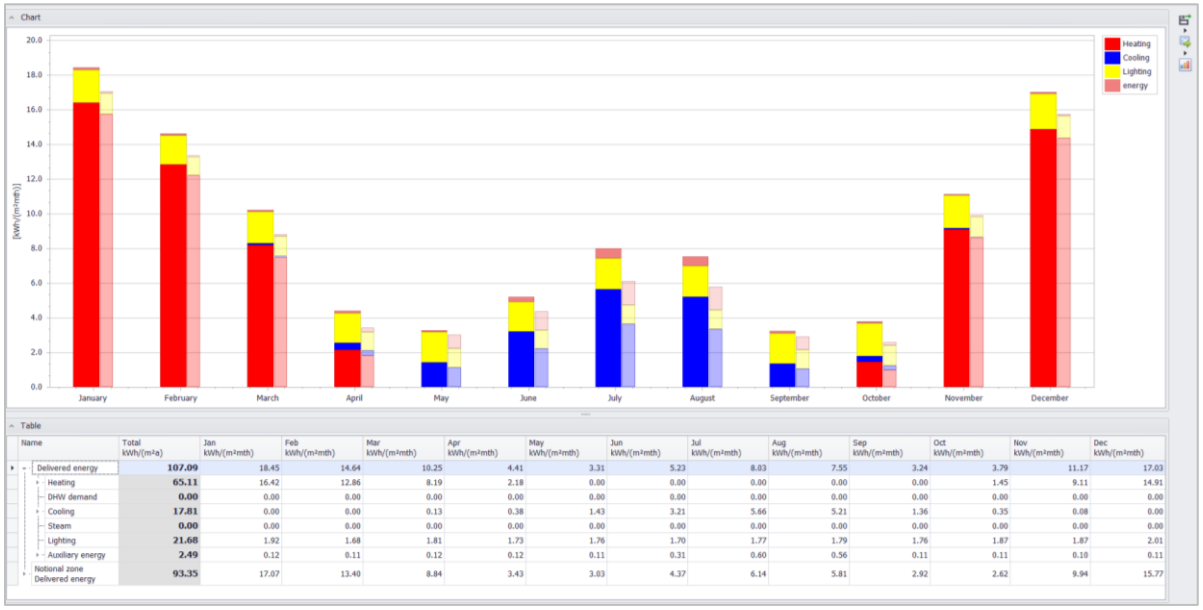


Figure 41: Display of results for the zone

7.6.1 Chart

The shares of individual balance calculation items (heating, cooling, DHW, ventilation, lighting, auxiliary energy) in the total energy consumption are shown for each month, and they can be read from the chart by moving the cursor over the relevant item.

The shares for the same balance items are presented for the notional building (hypothetical building of the same size, shape, orientation and shading as the actual building, with the same activities, zoning and system types and exposed to the same weather data, but with pre-defined specified properties for the building fabric, fittings and services). The notional building can also be displayed on the chart next to the actual building, but in less intensive colors. By clicking on the icon **Show notional building** (in the upper right corner), the notional building appears/dissapears from the chart.

Charts can be exported by clicking on the icon **Export chart** (in the upper right corner) in one of the available formats (PDF, XTML, MHT, XLS, XLSX, RTF, Image (BMP, GIF, JPEG, PNG, TIFF), SVG), and saved to a file on a disc.

7.6.2 Table

The table shows the energy consumption for each individual balance calculation item (heating, cooling, DHW, ventilation, lighting, auxiliary energy) as monthly values, as well as in total (annual value). Some balance items are divided into sub-categories, like heating (heating system, heating function of an HVAC system, heating via residential ventilation), cooling (cooling system, cooling function of an HVAC system, residential cooling), and auxiliary energy (for each of the balance items and sub-items, including automation).

The table also shows the energy consumption for the same balance items (and sub-items) for the notional building. By clicking on the icon **Show notional building** (in the upper right corner), the notional building appears/dissapears from the table.

Tables can be exported by clicking on the icon **Export table** (in the upper right corner) in one of the available formats (PDF, XLS, XLSX, CSV, XML, RTF).

7.6.3 Detail results

Data on energy consumption for each individual balance calculation item is presented in more details at the zone level.

The overview of the data depends on the selection made in drop-down menu regarding the type of energy (energy need or delivered energy) and the balance calculation item (heating, cooling, ventilation/air conditioning, DHW, lighting).

Energy need for heating
Energy need for heating is calculated separately for operating days and for days with reduced operation. For each of them, the following parameters are specified on a montly basis: reference internal temperature, all types of heat sinks and heat sources (transmission, ventilation, solar, internal), heat transmission coefficients (tranmission and ventilation), monthly heating time, number of days of usage, utilization factor and time constant. Besides, the maximum required heating power in a building zone is calculated (without mechanical ventilation and taking into consideration mechanical ventilation system).

Energy need for cooling
Energy need for cooling is calculated separately for operating days and for days with reduced operation. For each of them, the following parameters are specified on a montly basis: reference internal temperature, all types of heat sinks and heat sources (transmission, ventilation, solar, internal), heat

transmission coefficients (tranmission and ventilation), monthly heating time, number of days of usage, utilization factor and time constant. Besides, the maximum required cooling power in a building zone is calculated (without mechanical ventilation and taking into consideration mechanical ventilation system).

Energy need for ventilation/air conditioning
Energy need for air transport is calculated for operating days both for exhaust and supply air (as annual values and on a monthly basis). Monthly values for air volume flows for exhaust and supply air are specified, as well as monthly temperatures of supply air.

Lighting energy
Energy for lighting is given in total (annual value) and on a monthly basis for a zone, as well as for each lighting domain. Besides, important parameters for calculation of lighting energy are also specified: total area, daytime and nightime operation hours per year, maintained illuminance, height of task area, height of lighting level, different corrector factors. Installed power for artificial lighting is also presented, as well as daylighting figures.

Delivered energy for heating
Delivered energy for heating is calculated separately for conventional heating systems (radiators, panel heating, direct heaters, etc.), heat delivered by the heating function of an HVAC system, heat supplied to an absorption chiller, heat provided via residential ventilation system. Delivered energy is the sum of the energy need, system losses due to control and emission, distribution and storage (sub-total: generator heat output) and heat generation losses. Therefore, an overview of all mentioned energy items that constitute delivered energy is given, including also produced or regenerative energy used for the heat supply (environmental heat for the heating system).

Separately from the calculation of delivered energy for heating, the delivered energy for auxiliary energy (energy additionally required by the heating system in order to provide energy supply, e.g. energy for pumps, fans, control, electronics etc.) is also calculated and presented for each type of heating energy supply above-mentioned. Auxiliary energy quantities of all subsystems (control and emission, distribution, storage, generation) are determined and presented individually.

Delivered energy for cooling
Delivered energy for cooling is calculated separately for conventional cooling systems (panel cooling, fan coil units, split units, etc.), cooling energy delivered by the cooling function of an HVAC system, and for residential cooling systems. Delivered energy is the sum of the energy need, system losses due to control and emission, distribution and storage (sub-total: generator cooling energy output) and losses due to generation of cooling energy. Therefore, an overview of all mentioned energy items that constitute delivered energy is given, including also regenerative energy used for the cooling energy supply.

Separately from the calculation of delivered energy for cooling, the delivered energy for auxiliary energy (energy additionally required by the cooling system in order to provide energy supply, e.g. energy for pumps, fans, control, electronics etc.) is also calculated and presented for each type of cooling energy supply above-mentioned. Auxiliary energy quantities of all subsystems (control and emission, distribution, storage, generation) are determined and presented individually.

Delivered energy for DHW
Delivered energy for DHW preparation is calculated and presented as a sum of the energy need, system losses due to control and emission, distribution and storage (sub-total: generator energy output) and generation losses. Therefore, an overview of all mentioned energy items that constitute delivered energy is given, including also produced or regenerative energy used for the DHW preparation.

Separately from the calculation of delivered energy for DHW preparation, the delivered energy for auxiliary energy (energy additionally required by DHW system in order to provide energy supply, e.g. energy for pumps, fans, control, electronics etc.) is also calculated. Auxiliary energy quantities of all subsystems (control and emission, distribution, storage, generation) are determined and presented individually.

8 Input screen for DHW demand

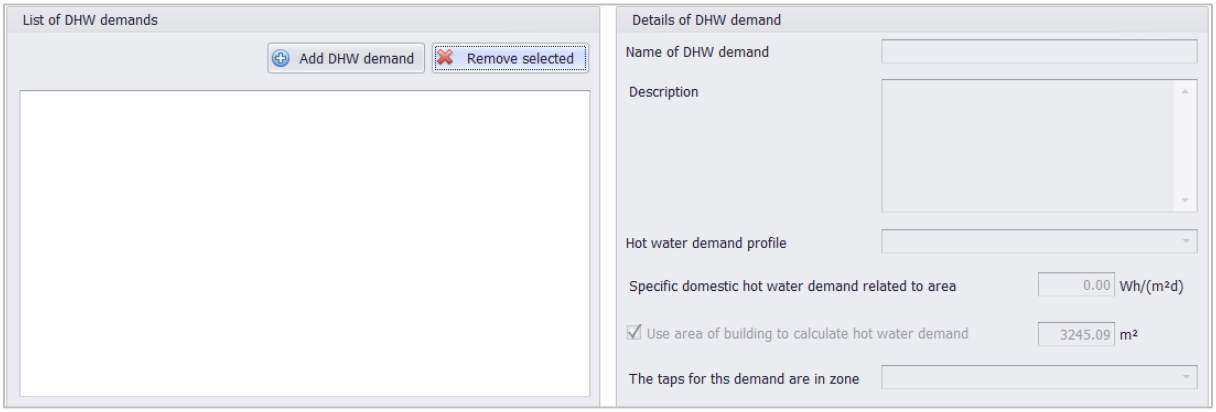


Figure 42: Input screen for defining DHW demands for the building

List of DHW demands

Demand for domestic hot water (DHW) in non-residential buildings is defined on a building level.

DHW demand is entered by clicking **Add DHW demand** button. The details of the added DHW demand are defined in the section **Details of DHW demand**.

Each added DHW demand may be deleted by clicking **Remove selected** button.

Details of DHW demand

Name of DHW demand
Enter the name of added DHW demand.

Description
In this field some brief description of DHW use in a building may be included (e.g. use of the building/related area, type of installation, technical solutions, etc.).

Hot water demand profile
Demand for domestic hot water (DHW) is selected from the drop-down menu containing twelve profiles (different building categories). In addition, there is a possibility for user to define its own DHW demand value by selecting option **User defined** from the drop-down list.

Specific domestic hot water demand related to area
If selected one of the already defined profiles given in drop-down menu, this value cannot be edited.
If **User defined** option is selected from the drop-down menu, then specific value for DHW demand related to the area needs to be entered in Wh/(m^2d).

By default, the area of the building is used for calculation of DHW demand. If this is not the case, then the option **Use area of building to calculate hot water demand** needs to be unchecked, and the area of the building to be used for calculation needs to be entered in [m^2].

The taps for this demand are in zone
The zone where the user outlets (taps) for this DHW demand are located should be selected from the drop-down menu.

9 Input screen for HVAC wizard

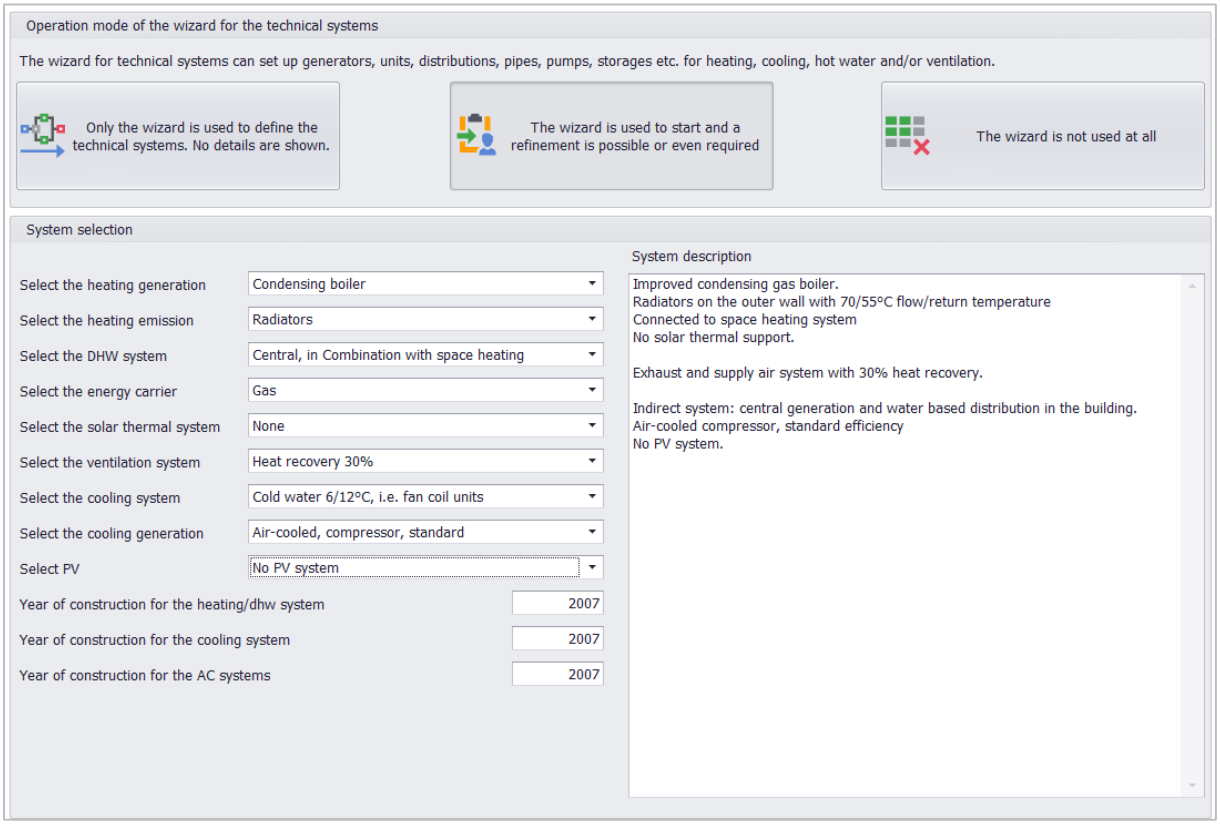


Figure 43: Input screen for defining technical systems – HVAC wizard

Technical systems in building can be defined in three ways: (i) using HVAC wizard, (ii) using HVAC wizard to start with definition of system parameters in more detail, and (iii) detailed description of all systems (no use of HVAC wizard). These options are offered when starting the programme, but the choice made at the start can be changed when coming up to this screen.

Using HVAC wizard is a simplified approach since the systems are automatically configured according to a small number of selected options referring to some basic information about systems and parts of the systems, such as heat generator, energy carrier, type of emissions, etc. Modelling of technical systems is carried out completely "in the background", by using default values for system parameters. When using HVAC wizard mode, there are no entries in the navigation tree shown.

NOTE: In case of modelling a building with more than one technical system for each of the services (heating, cooling, ventilation/air conditioning, DHW preparation), HVAC wizard mode is not appropriate since it allows the selection of only one technical system. In these cases, the detailed description of all systems is recommended.

All items that are shown in this window for defining technical systems depend on the selections made when entering **Zone data** (conditioning of zone: thermal conditioning/mechanical ventilation/ conditioning in air handling unit). Furthermore, items related to year of construction of technical systems will appear in case that in the **Building data** screen, it is confirmed that the building is an existing building. In case the building is not an existing building, the items related to the year of construction of the systems will not be shown, and the programme assumes that all technical systems are new.

Select the heating generation
The option for heating energy generation needs to be selected from the drop-down menu. Different options are available for decentral systems (individual generation and direct emission) and central systems (central generation and distribution network).

Select the heating emission
Type of heating emission needs to be selected from the drop-down menu. Specification of options in this drop-down menu is affected by the selection made for the heating generation option.

Select the DHW system
Type of system for preparation of domestic hot water needs to be selected from the drop-down menu. Different options are available for decentral systems and central systems (in combination with space heating or separated from space heating).

Select the energy carrier
Type of energy carrier used for heating needs to be selected from the drop-down menu. Specification of options in this drop-down menu is affected by the selection made for the heating generation option.

Select the solar thermal system
Option for solar thermal system needs to be selected from the drop-down menu: no solar thermal system in the building, the system exists and it is used only for DHW, and the system exists and is used both for DHW and heating.

Select the ventilation system
The option for ventilation system needs to be selected from the drop-down menu. Different options are available in terms of type of ventilation (supply/exhaust), as well as presence of the heat recovery and its energy efficiency.

Select the cooling system
Type of cooling system needs to be selected from the drop-down menu. Different options are available for direct systems (split systems) and indirect systems (central generation and water-based distribution).

Select the cooling generation
The option for cooling energy generation needs to be selected from the drop-down menu. Specification of options in this drop-down menu is affected by the selection made for the cooling system option.

Select PV
Option for photovoltaic system needs to be selected from the drop-down menu. In case that photovoltaic system exists in the building, the adequate option regarding its size should be selected: small (systems with 5 % of the roof area), medium (systems with 10 % of the roof area) and large (systems with 15 % of the roof area).

Year of construction for the heating/DHW system
Enter the year of construction for the heating/DHW system in the building. In case of separate systems, the year of construction for the heating system should be entered. The year of construction for DHW system can be entered later stage when using more detailed mode.

Year of construction for the cooling system
Enter the year of construction for the cooling system in the building.

Year of construction for the AC/ventilation systems
Enter the year of construction for the ventilation/air conditioning system in the building.

System description
Software automatically generates short description of the selected technical systems. This text is editable and can be completed with more details on each system.

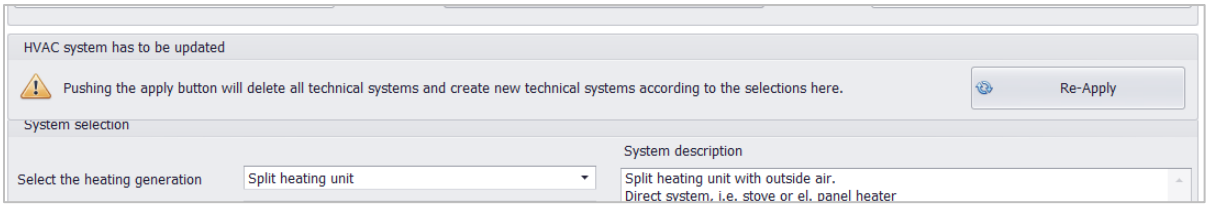


Figure 44: Warning dialog box for updating HVAC systems

In case that certain technical systems are defined in more detail and they are not in accordance with the previously selected options in the HVAC wizard mode, a warning dialog box appears requesting further action regarding HVAC system update. By pressing the **Re-apply** button all technical systems will be deleted and new technical systems will be created according to the current selections in HVAC wizard. In case that defined technical systems are to be kept, then this warning message should be ignored and the button **The wizard is not used at all** should be pressed.

10 Input screens for the heating systems

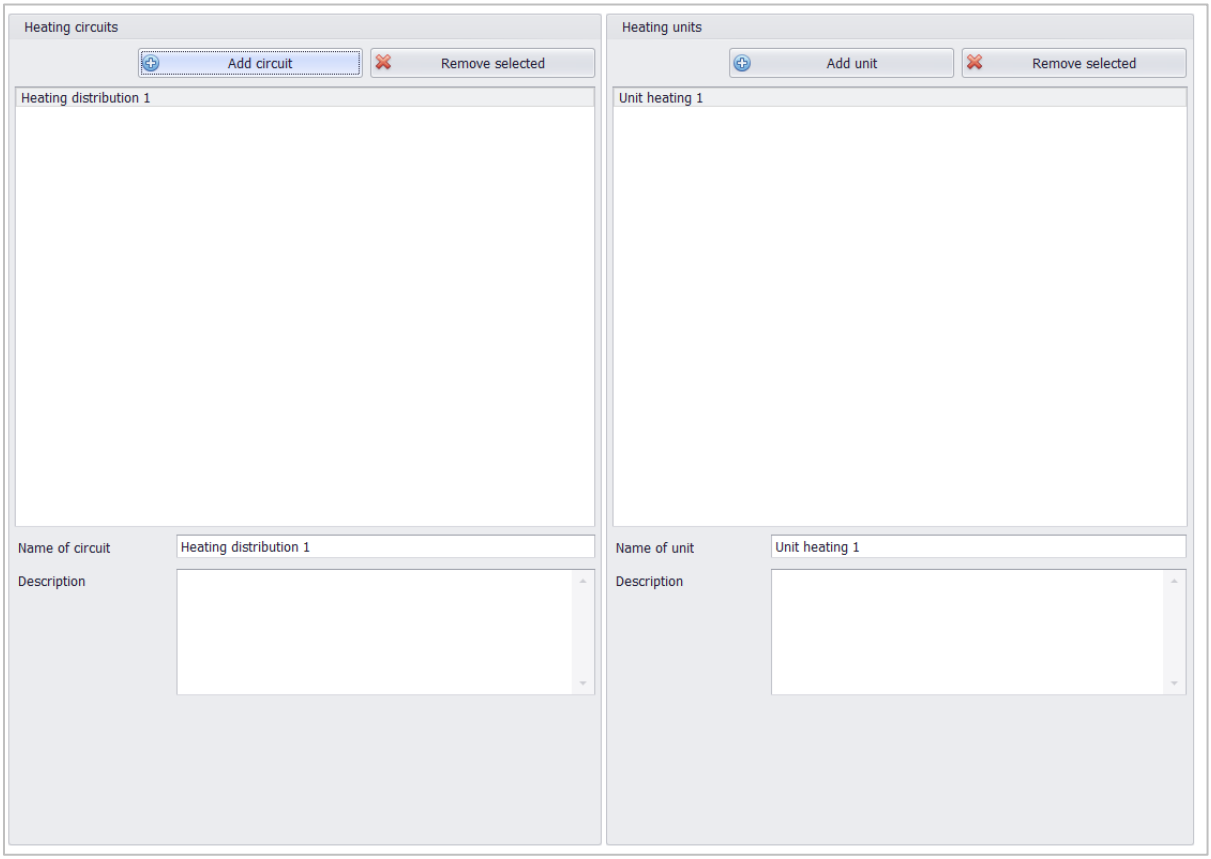


Figure 45: Input screen for defining heating system

The heating system configuration starts with defining the **Heating circuit** and the related **Heating unit**.

The heating circuit actually represents the connection of the heating energy generation with the zones in the building through the distribution network and related heating emissions. The heating circuit is defined regardless of whether it is a central or decentral system.

The heating unit refers to the generation of heating energy, whether it is a central heat generation (boilers, heat pumps), or decentral (direct emission systems, e.g. individual stoves/heaters, split systems).

NOTE: One heating unit can provide the heat for several heating circuits. One heating circuit can not be connected with several heating units.

The heating circuit is entered by clicking **Add circuit** button.

The name of the added heating circuit is entered in **Name of circuit**.

Some short description of the added heating circuit can be entered in the **Description** field.

More information and parameters of the added heating circuit are defined afterwards in the separate screen (one lower level in navigation tree structure).

The heating unit is entered by clicking **Add unit** button.

The name of the added heating unit is entered in **Name of unit**.

Some short description of the added heating unit can be entered in the **Description** field.

More information and parameters of the added heating unit are defined afterwards in the separate screen (one lower level in navigation tree structure).

Each added heating circuit and heating unit may be deleted by clicking **Remove selected** button.

10.1 Heating circuit

10.1.1 Circuit

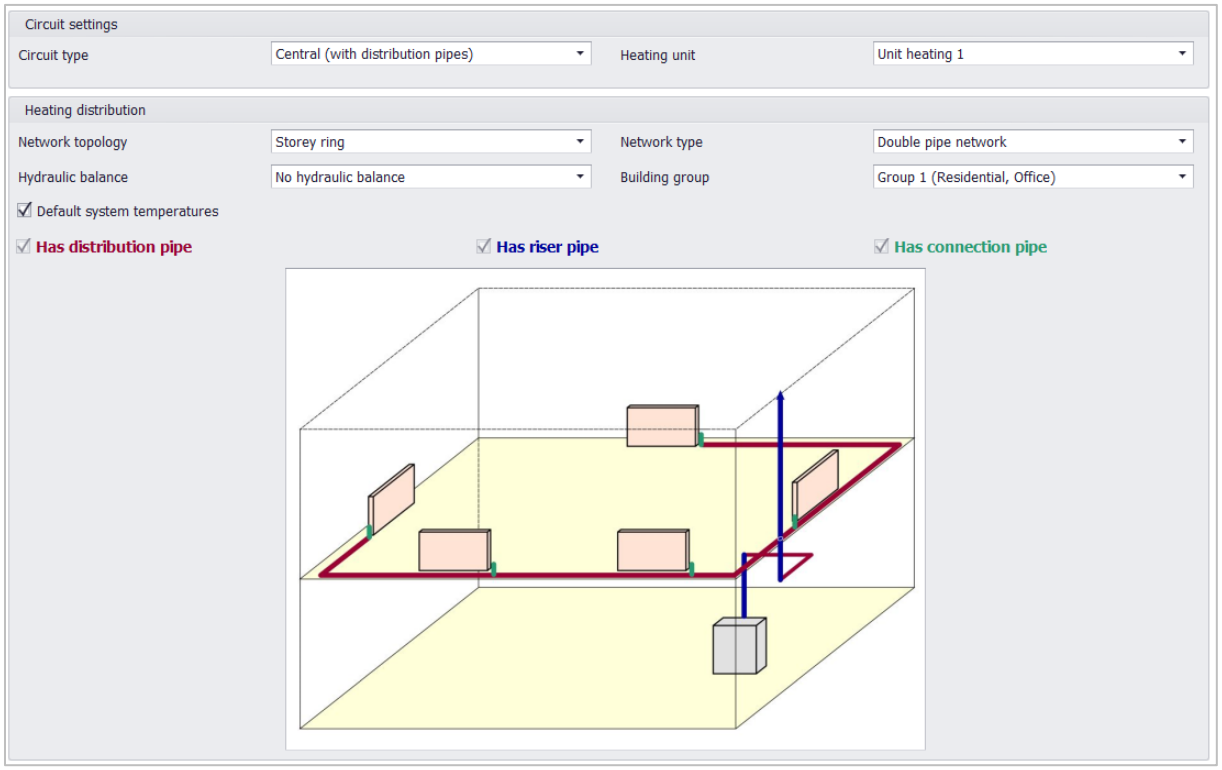


Figure 46: Input screen for defining heating circuit

Circuit settings

Circuit type
Circuit type is selected from the drop-down menu. There are two types of heating circuit: decentral (direct emission of heat, i.e. stove, electrical heater, split systems), and central (central generation and distribution via hot water pipe network).

Heating unit
Heat generation unit that provides the heat for this circuit is selected from the drop-down menu (and previously defined in **Heating** screen).

Heating distribution

Parameters in this window are relevant for central circuit type. In case of decentral circuit type, the content of this window disappears.

Network topology
One of five standard network types is selected from the drop-down menu, thus allowing standard pipe lengths to be assumed for calculation of distribution losses. To help identify the type of network, images of all types have been inserted, so when selecting the option from the drop-down menu, the image changes accordingly. Besides these standard network types, the user is able to enter its own values for pipe lengths by selecting the option **Custom** from the menu.

Network type
Network type in terms of the connection of the heat generation unit with the emission units (single-pipe network or double-pipe network) is selected from the drop-down menu.

Hydraulic balance
From the drop-down menu it is selected if the network is hydraulically balanced or not, and what balancing technique is used. This information is important for calculation of control and emission losses in this heating circuit.

Building group
Besides the type of network, the building group is also used for determination of the standard pipe lengths. Building groups are classified in five categories related to the type of use:

1) Group 1: residential, office, medical practices, hotels, seminar, bedrooms, dormitories, kindergarten, nursing homes;
2) Group 2: schools, event halls, airport halls, laboratory buildings, computer centre, library, museum, theatre, auditorium;
3) Group 3: sales building, kitchens, restaurants, canteen, butcher shop, bakery, hairdressers
4) Group 4: swimming hall, gymnasium, changing rooms (including changing rooms of production facilities);
5) Group 5: production facilities, workshops.

Temperature (flow/return)
If default values for flow and return temperatures are assumed for this heating circuit then this option should be selected by clicking in the checkbox **Default system temperatures**. If this is not the case, this box should be unchecked and the flow and return temperatures should be entered in °C.

Average pipe network comprises three different pipeline sections: horizontal distribution of heat from the generator to the main supply pipes (**Distribution pipe**), main supply pipes (**Riser pipe**), and branching pipes to the radiators within the building (**Connection pipe**). When selecting options for standard network types, the checkboxes related to these pipeline sections (**Has distribution pipe**, **Has riser pipe**, **Has connection pipe**) are automatically checked or unchecked. In the case of user defined network topology (option **Custom** from the menu), these checkboxes should be checked or unchecked manually. According to the selections made, the tabs related to these pipeline sections appear or disappear in this screen.

Serviced area

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. The characteristic energy values or energy balance shares are determined for a serviced area (and later divided among the zones of the building).

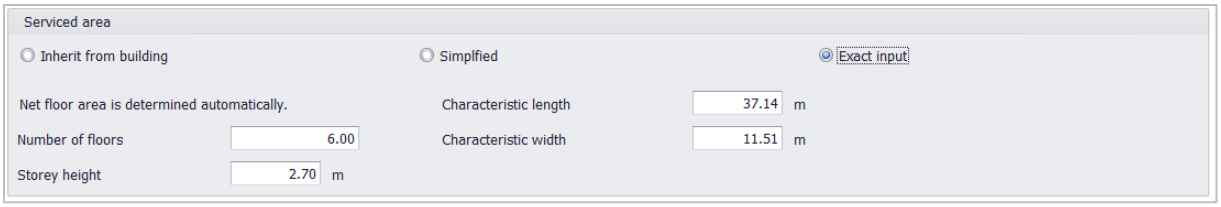


Figure 47: Input screen for defining serviced area for heating circuit

Serviced area for this heating circuit can be calculated in three ways:

- **Inherit from the building**: reference geometry dimensions are taken from the building (the case when a building is served by one heating system/distribution network).
- **Simplified**: this approach is a simplification of the third method (**Exact input**), and it does not require any input data, since it include standard values for geometric factors depending on usage type (more data on this can be found in the Calculation methodology in Chapter 11).
- **Exact input**: serviced area is calculated based on the calculated values for **characteristic length** and **characteristic width**. Besides characteristic length and width (that need to be previously calculated), the **number of floors** and **storey height** need to be entered as well for the calculation of serviced area. Determination of characteristic width and length can be found in the Calculation methodology in Chapter 11).

10.1.2 Heating circuit: Heating pipes (connection pipe, riser pipe, distribution pipe)

Connection pipe refers to branching pipes to the radiators within the building (connection between the circulating pipe sections and the radiators). **Riser pipe** refers to main supply pipes (vertical and, in some cases, horizonal). **Distribution pipe** refers to pipe section between heat generator and main supply pipes (risers).

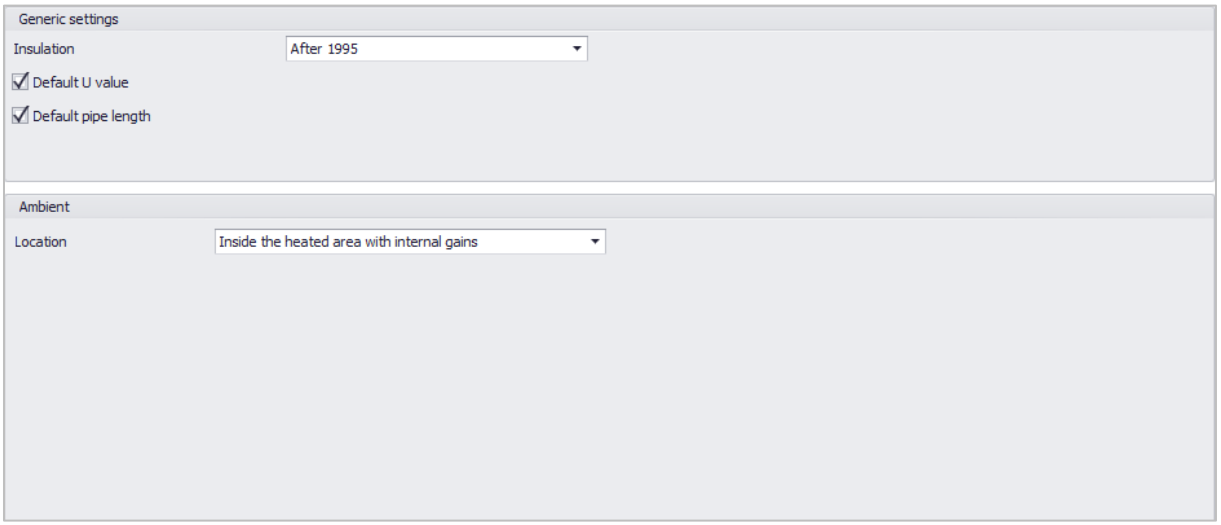


Figure 48: Input screen for defining heating pipes (connection pipe, riser pipe, distribution pipe)

For each of these pipeline sections, the following data need to be defined:

Generic settings

Insulation
Insulation of the pipe is defined by selecting one of the options from the drop-down menu. These options refer to the age class of building (before 1980, between 1980 and 1995, and after 1995), which imply use of the standard values for heat transfer coefficients (U-values).

In case the value for heat transfer coefficient (U-value) is known, then the checkbox **Default U-value** should be unchecked and the U-value need to be entered in [W/(mK)].

Pipe length
Pipe length is determined based on the selected network type, building group, pipeline section (horizontal distribution, risers and connection lines), and geometric parameters of building (net floor area, storey height, number of storeys, etc.).

In case the value for pipe length is known, then the checkbox **Default pipe length** should be unchecked and the pipe length value need to be entered in [m].

Ambient

Location
For the calculation of the distribution losses, the location of the pipe needs to be selected from the drop-down menu: **Outside the heated area** or **Inside the heated area** (two options: (i) **with internal gains**, i.e. pipe is located in the heated area within the building envelope, or (ii) **without internal gains**, i.e. pipe is located in the heated area outside the building envelope, such as the area of the adjacent building that is heated). In case the pipeline is located within certain zone(s), this option can be selected from the drop-down menu (option: **Within a zone**), whereby a new menu with a checkbox next to each zone in the building opens automatically. In addition, it is possible to enter the ambient temperature, if known, either as an annual value, or as seasonal (winter and summer) values (options: **Custom annual temperature** and **Custom seasonal temperatures**).

10.1.3 Heating circuit: Pumps

Figure 49: Input screen for defining pump parameters

The following parameters need to be defined for calculation of the auxiliary energy expenditure required to operate circulation pumps in the heating system.

Relief valve
A relief valve is used to control or limit the pressure in a system, and it has effect on the average hydraulic demand. In case it exists in the system, this option should be selected by clicking in the related checkbox.

Intermittent operation
The pump operates in the intermittent mode if it is operated outside the usage time at limited power or is switched off. In these cases, the calculation of the electrical energy expenditure of the circulation pumps has to take into account the correction factor for set-back or switch-off of the pump. Therefore, in case of intermittent mode of pump operation, this option should be selected by clicking in the related checkbox.

Default pump power
In case electrical power consumption of the pump from manufacturer's data is available, this value should be entered in [W]. In case this value is not available, the default pump power should be used and this option should be selected by clicking in the related checkbox.

10.1.4 Heating circuit: Heating emissions

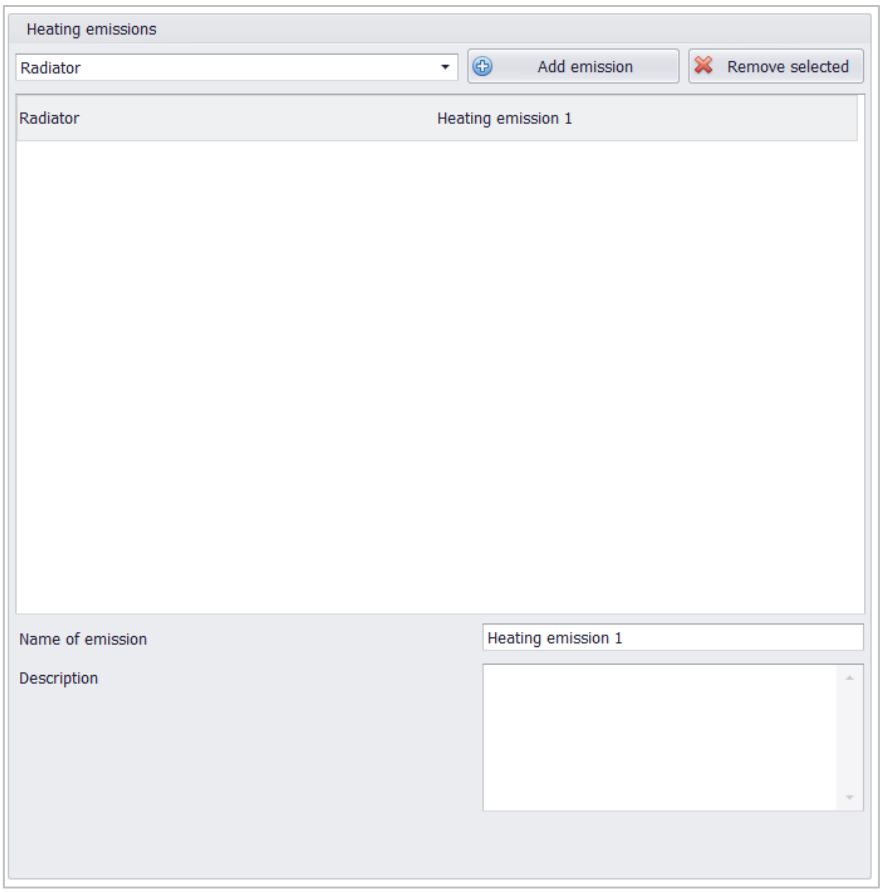


Figure 50: Input screen for adding heating emissions

All heating emissions that belong to this heating circuit should be added in this screen.

The type of heating emission is first selected from the drop-down menu and then is entered by clicking **Add emission** button.

The following types of heating emissions are defined and specified in the drop-down menu:

- **Radiators**, which refers to the commonly used emitters in central heating systems, with hot water generated in a central boiler and circulated by pumps through radiators within the building;
- **Panel heating (floor, ceiling)**, which refers to the heating systems with heating surfaces integrated into the building components (panel heating);
- **Direct (i.e. stove)**, which refers to the decentralised fuel fired systems;
- **Thermally activated building systems** (or TABS), which refers to the heating systems with pipes embedded in the structural concrete slabs or walls of multi-storey buildings;
- **Air heating**, which refers to the air heating systems, i.e. recirculation air heating systems (induction unit, fan convectors) in residential and non-residential buildings, and air heating systems with additional heating of the supply air in non-residential buildings;
- **Electric heating**, which refers to the decentralised systems that uses electricity as the main energy source for space heating (direct electric heaters and storage heaters);

- **Hall heating**, which refers to the heating systems in large indoor spaces (clear room height ≥ 4 m).

The name of the added heating emission is entered in **Name of emission**.

Some short description of the added heating emission can be entered in the **Description** field.

More information and parameters of the added heating emission are defined afterwards in the separate window (one lower level in navigation tree structure).

Each added heating emission may be deleted by clicking **Remove selected** button.

10.1.5 Heating circuit: Detail results

The calculation results for this heating circuit are displayed in details.

Energy results for this heating circuit overview the energy need, system losses due to control and emission, and system losses due to distribution. These results refer to the conventional heating systems (radiators, panel heating, direct heaters, etc.). The total values on an annual basis are given, as well as a small graph representing their distibution over the course of the year.

Delivered energy for auxiliary energy (energy additionally required by the heating system in order to provide energy supply, e.g. energy for pumps, fans, control, electronics etc.) is also calculated. Auxiliary energy quantities of control and emission, and distribution are determined and presented individually.

10.2 Heating emission

Heating emission types are added in **Heating circuit** screen, thus becoming visible in navigation tree. Heating emission screen differs for each type of emission. Nevertheless, for each type of heating emission, all building zones in which these heating emissions are represented need to be selected and the contribution of the respective heating emissions in this zone needs to be specified.

10.2.1 Heating emission: Radiators

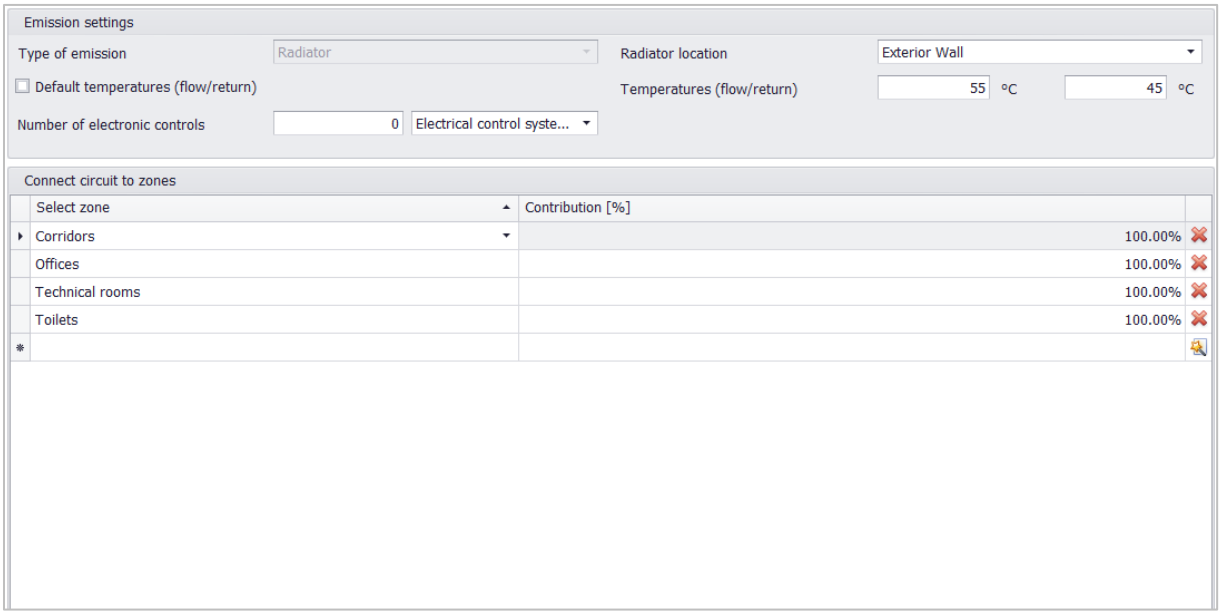


Figure 51: Input screen for defining heating emission – radiators

Emission settings

Type of emission
Already defined type of emission in **Heating circuit** screen (one level up in the navigation tree structure) will be transferred in this field automatically.

Radiator location
Location of the radiators is selected from the drop-down menu.

Temperatures (flow/return)
If default values for flow and return temperatures are assumed then this option should be selected by clicking in the checkbox **Default temperatures (flow/return)**. If this is not the case, this box should be unchecked and the flow and return temperatures should be entered in °C.

Electronic controls
Auxiliary energy for the control system is determined based on the number of controls/drives (to be entered) and the type of electronic control (to be selected from the drop-down menu).

Connect circuit to zones

In this window all zones in which these heating emissions are represented need to be selected from the drop-down list that appears when clicking each empty field in the column **Select zone**. After that, it is necessary to specify the share (in percentages) of the respective heating emissions in this zone.

Heating demand for each zone that is designated as heated (in **Zone data** screen) need to be fulfilled, which means that if different heating emissions from the same heating circuit, or heating emissions from different heating circuits provide heating for a certain zone, then total share of all heating emissions for this zone has to be 100 %. If this is not the case, the programme sends the warning message that the heating demand is not fulfilled or it is overfulfilled for this zone, and further action in this regard is required.

For easier entry of data for contribution of respective heating emissions to the zones, there is a wizard icon (just below the listed zones and connected heating emissions), that allows the programme to automatically adjust heating demand requirement for this heating circuit.

10.2.2 Heating emission: Panel heating (floor, ceiling)

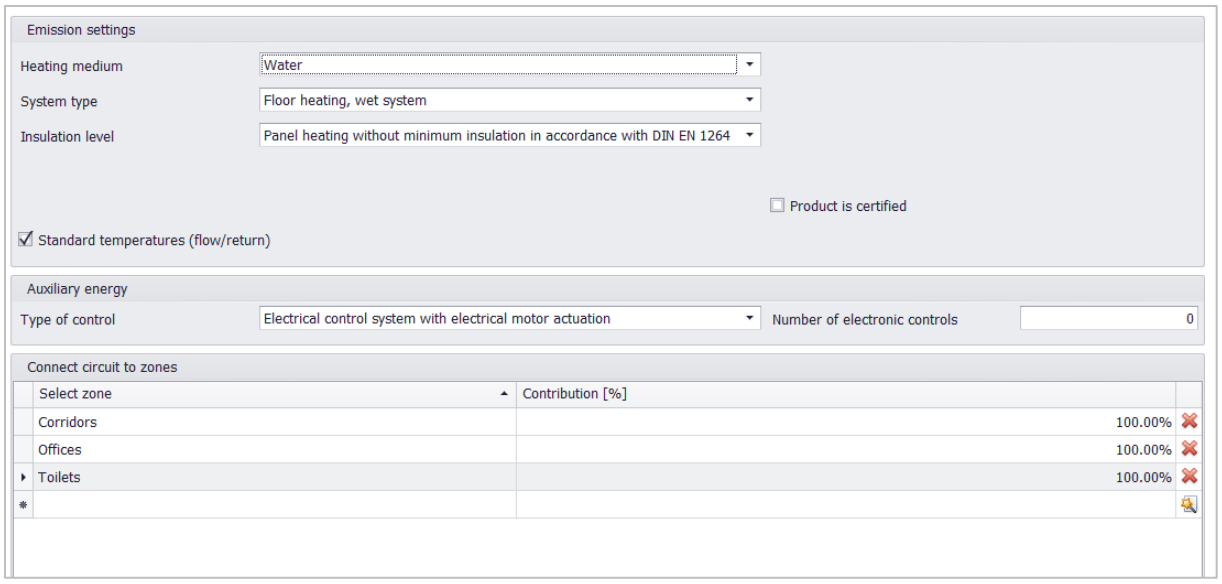


Figure 52: Input screen for defining heating emission – panel heating

Emission settings

In **Heating circuit** screen (one level up in the navigation tree structure) defined type of emission is **Panel heating (floor, ceiling)**, which refers to the heating systems with heating surfaces integrated into the building components (panel heating).

Heating medium
Heating medium is selected from the drop-down menu: water or electric.

System type
Type of the system is selected from the drop-down menu: floor heating (wet/dry/dry-low coverage), wall heating, ceiling heating, heating systems in combination with mechanical ventilation.

Insulation level
An option for insulation level is selected from the drop-down menu. Options have references to standards DIN EN 1264 and DIN 4108. Minimum insulation according to the standard DIN EN 1264 assumes thermal resistance values of $R \geq 1,25$ [m^2 K/W] (U-value of 0,7 [W/m^2 K]). Minimum insulation according to the standard DIN 4108 assumes thermal resistance values of $R \geq 0,90$ [m^2 K/W] (U-value of 1,0 [W/m^2 K]).

Temperatures (flow/return)
If default values for flow and return temperatures are assumed then this option should be selected by clicking in the checkbox **Default temperatures (flow/return)**. If this is not the case, this box should be unchecked and the flow and return temperatures should be entered in °C.

In case that heating emissions are certified products, then this option should be selected by clicking in the checkbox **Product is certified**. This information is important for calculation of the temperature variations required to determine the losses due to control and emission.

Auxiliary energy

Number of electronic controls
Number of electronic controls needs to be entered for calculation of the auxiliary energy for the control system.

Type of control
Type of electronic control needs to be selected from the drop-down menu for calculation of the auxiliary energy for the control system.

Connect circuit to zones

In this window all zones in which these heating emissions are represented need to be selected from the drop-down list that appears when clicking each empty field in the column **Select zone**. After that, it is necessary to specify the share (in percentages) of the respective heating emissions in this zone.

Heating demand for each zone that is designated as heated (in **Zone data** screen) need to be fulfilled, which means that if different heating emissions from the same heating circuit, or heating emissions from different heating circuits provide heating for a certain zone, then total share of all heating emissions for this zone has to be 100 %. If this is not the case, the programme sends the warning message that the heating demand is not fulfilled or it is overfulfilled for this zone, and further action in this regard is required.

For easier entry of data for contribution of respective heating emissions to the zones, there is a wizard icon (just below the listed zones and connected heating emissions), that allows the programme to automatically adjust heating demand requirement for this heating circuit.

10.2.3 Heating emission: Direct heating (e.g. stove)

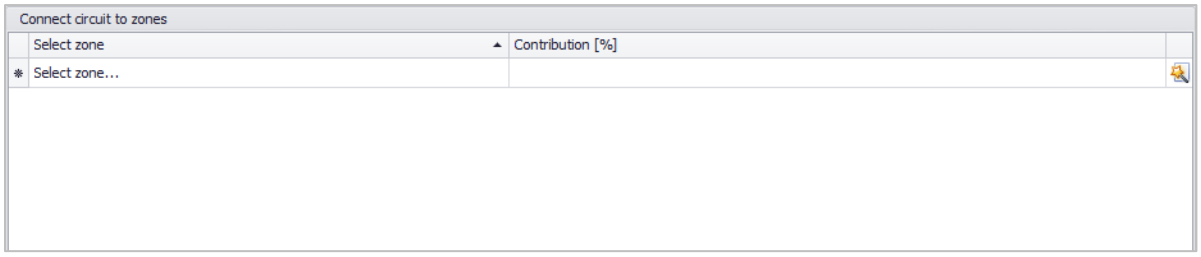


Figure 53: Input screen for defining heating emission – direct heating

In **Heating circuit** screen (one level up in the navigation tree structure) defined type of emission is **Direct (i.e. stove)**, which refers to the decentralised fuel fired systems.

Connect circuit to zones

In this window all zones in which these heating emissions are represented need to be selected from the drop-down list that appears when clicking each empty field in the column **Select zone**. After that, it is necessary to specify the share (in percentages) of the respective heating emissions in this zone.

Heating demand for each zone that is designated as heated (in **Zone data** screen) need to be fulfilled, which means that if different heating emissions from the same heating circuit, or heating emissions from different heating circuits provide heating for a certain zone, then total share of all heating emissions for this zone has to be 100 %. If this is not the case, the programme sends the warning message that the heating demand is not fulfilled or it is overfulfilled for this zone, and further action in this regard is required.

For easier entry of data for contribution of respective heating emissions to the zones, there is a wizard icon (just below the listed zones and connected heating emissions), that allows the programme to automatically adjust heating demand requirement for this heating circuit.

10.2.4 Heating emission: Thermally activated building systems (TABS)

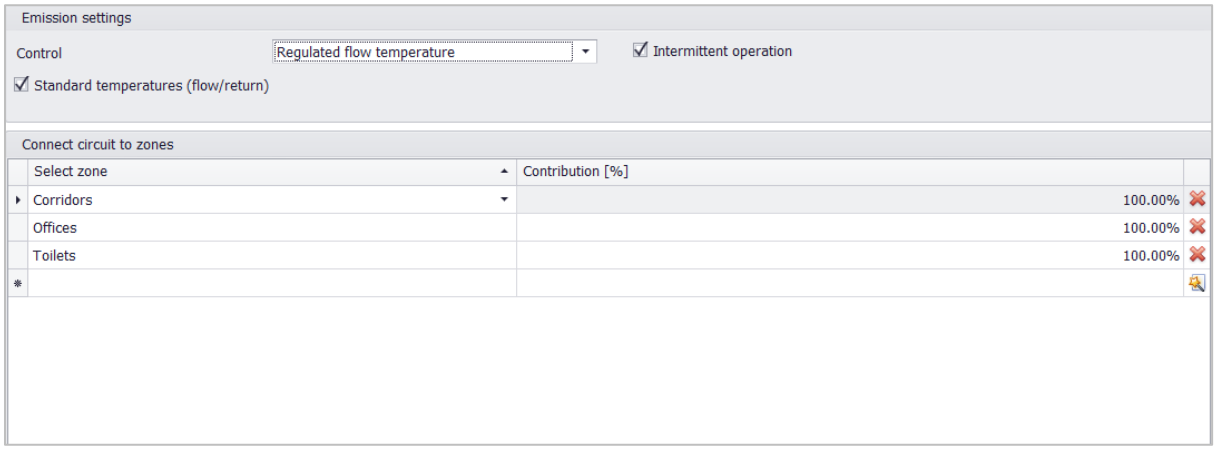


Figure 54: Input screen for defining heating emission – TABS

Emission settings

In **Heating circuit** screen (one level up in the navigation tree structure) defined type of emission is **Thermally activated building systems** (or TABS), which refers to the heating systems with pipes embedded in the structural concrete slabs or walls of multi-storey buildings.

Control
Type of control needs to be selected from the drop-down menu (constant supply temperature or central supply temperature control).

Temperatures (flow/return)
If default values for flow and return temperatures are assumed then this option should be selected by clicking in the checkbox **Default temperatures (flow/return)**. If this is not the case, this box should be unchecked and the flow and return temperatures should be entered in °C.

If system is operating in the intermittent mode, this option should be selected by clicking in the checkbox **Intermittent operation**.

Connect circuit to zones

In this window all zones in which these heating emissions are represented need to be selected from the drop-down list that appears when clicking each empty field in the column **Select zone**. After that, it is necessary to specify the share (in percentages) of the respective heating emissions in this zone.

Heating demand for each zone that is designated as heated (in **Zone data** screen) need to be fulfilled, which means that if different heating emissions from the same heating circuit, or heating emissions from different heating circuits provide heating for a certain zone, then total share of all heating emissions for this zone has to be 100 %. If this is not the case, the programme sends the warning message that the heating demand is not fulfilled or it is overfulfilled for this zone, and further action in this regard is required.

For easier entry of data for contribution of respective heating emissions to the zones, there is a wizard icon (just below the listed zones and connected heating emissions), that allows the programme to automatically adjust heating demand requirement for this heating circuit.

10.2.5 Heating emission: Air heating

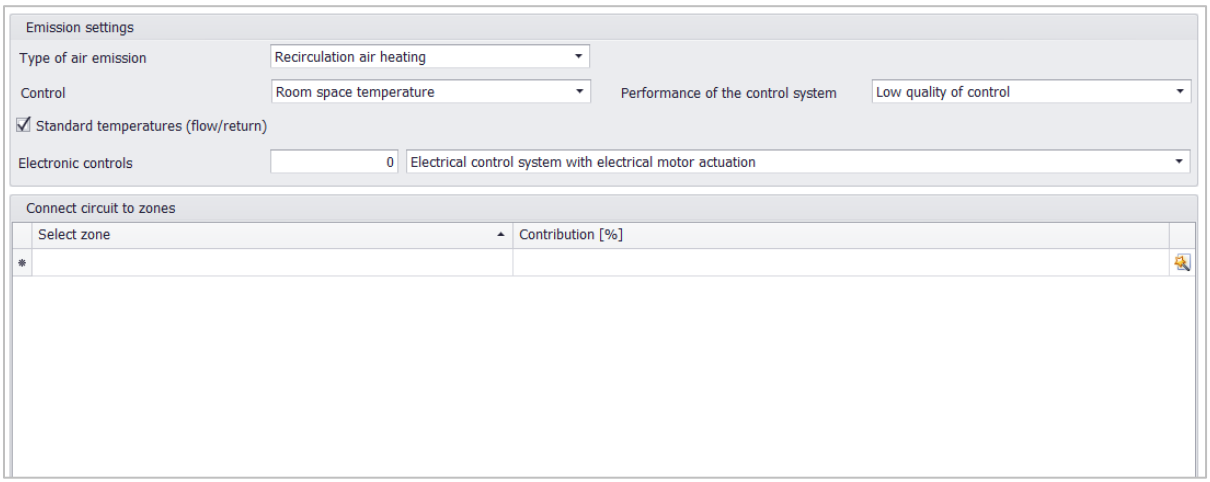


Figure 55: Input screen for defining heating emission – air heating

Emission settings

In **Heating circuit** screen (one level up in the navigation tree structure) defined type of emission is **Air heating**, which refers to the air heating systems, i.e. recirculation air heating systems (induction unit, fan convectors) in residential and non-residential buildings, and air heating systems with additional heating of the supply air in non-residential buildings.

Type of air emission
From the drop-down menu it should be selected whether it is recirculation air heating system or air heating system with additional heating of the supply air.

Control
Type of control parameter needs to be selected from the drop-down menu (room temperature, room temperature (cascade control of supply air temperature) or exhaust air temperature).

Performance of the control system
Performance of the control system (low or high quality control) should be selected from the drop-down menu.

Temperatures (flow/return)
If default values for flow and return temperatures are assumed then this option should be selected by clicking in the checkbox **Default temperatures (flow/return)**. If this is not the case, this box should be unchecked and the flow and return temperatures should be entered in °C.

Electronic controls
Auxiliary energy for the control system is determined based on the number of controls/drives (to be entered) and the type of electronic control (to be selected from the drop-down menu).

Connect circuit to zones

In this window all zones in which these heating emissions are represented need to be selected from the drop-down list that appears when clicking each empty field in the column **Select zone**. After that, it is necessary to specify the share (in percentages) of the respective heating emissions in this zone.

Heating demand for each zone that is designated as heated (in **Zone data** screen) need to be fulfilled, which means that if different heating emissions from the same heating circuit, or heating emissions from different heating circuits provide heating for a certain zone, then total share of all heating emissions for this zone has to be 100 %. If this is not the case, the programme sends the warning message that the heating demand is not fulfilled or it is overfulfilled for this zone, and further action in this regard is required.

For easier entry of data for contribution of respective heating emissions to the zones, there is a wizard icon (just below the listed zones and connected heating emissions), that allows the programme to automatically adjust heating demand requirement for this heating circuit.

10.2.6 Heating emission: Electric heating

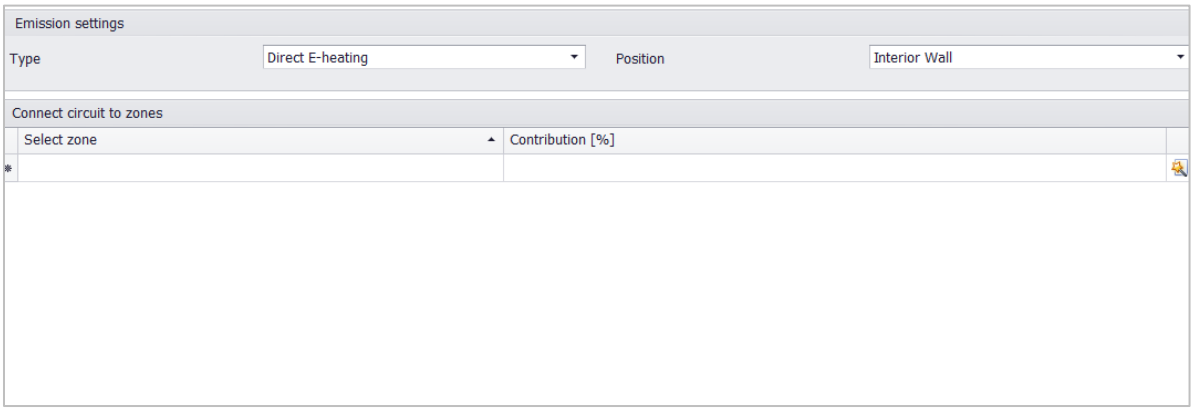


Figure 56: Input screen for defining heating emission – electric heating

Emission settings

In **Heating circuit** screen (one level up in the navigation tree structure) defined type of emission is **Electric heating**, which refers to the decentralised systems that uses electricity as the main energy source for space heating.

Type
Type of electric heating should be selected from the drop-down menu: direct electric heaters or storage heaters.

Position
Position of electric heaters should be selected from the drop-down menu: interior or exterior wall.

Connect circuit to zones

In this window all zones in which these heating emissions are represented need to be selected from the drop-down list that appears when clicking each empty field in the column **Select zone**. After that, it is necessary to specify the share (in percentages) of the respective heating emissions in this zone.

Heating demand for each zone that is designated as heated (in **Zone data** screen) need to be fulfilled, which means that if different heating emissions from the same heating circuit, or heating emissions from different heating circuits provide heating for a certain zone, then total share of all heating emissions for this zone has to be 100 %. If this is not the case, the programme sends the warning message that the heating demand is not fulfilled or it is overfulfilled for this zone, and further action in this regard is required.

For easier entry of data for contribution of respective heating emissions to the zones, there is a wizard icon (just below the listed zones and connected heating emissions), that allows the programme to automatically adjust heating demand requirement for this heating circuit.

10.2.7 Heating emission: Hall heating

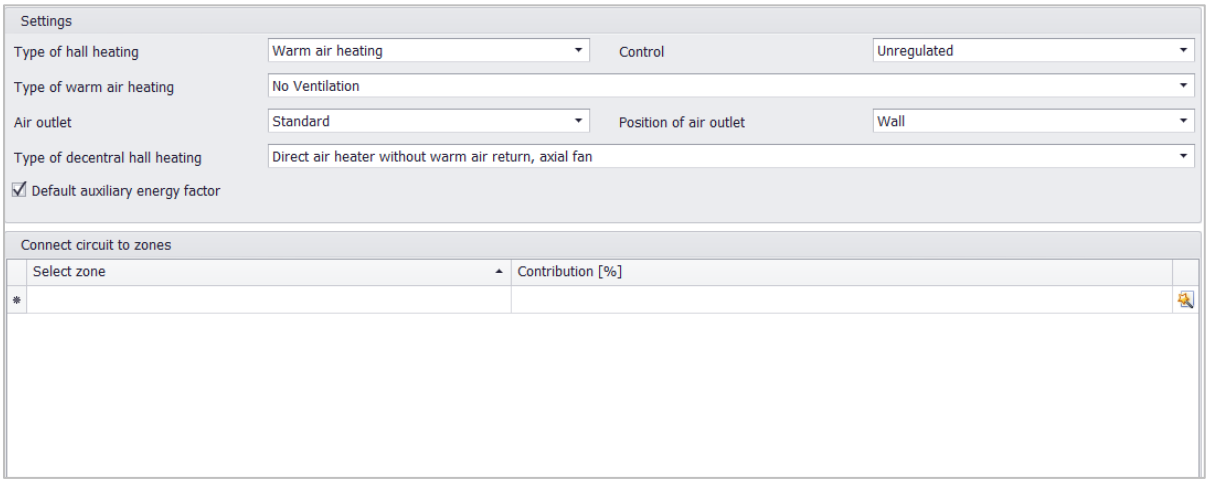


Figure 57: Input screen for defining heating emission – hall heating

Settings

In **Heating circuit** screen (one level up in the navigation tree structure) defined type of emission is **Hall heating**, which refers to the heating systems in large indoor spaces (clear room height ≥ 4 m). Hall heating systems can be central (floor heating, radiant heating – radiant hot air) and decentral (warm air heating, radiant heating – dark/luminous radiant heaters). Decentral heating emissions have to be defined for decentral ciruit type, as well as connected to decentral heating generation (option

Decentral hall heating in **Heating generation** screen). Central heating emissions have to be defined for central ciruit type, as well as connected to central heating generation (e.g. boiler, heat pump).

Type of hall heating
Type of hall heating should be selected from the drop-down menu: warm air heating, radiant heating or floor heating.

Type of warm air heating
Type of warm air heating should be selected from the drop-down menu: warm air without additional vertical recirculation and warm air with additional vertical recirculation (controlled by a P-controller or PI-controller).

Type of radiation heating
Type of radiation heating should be selected from the drop-down menu: radiant hot air (standard version), as central heating emissions, and dark/luminous radiant heaters (standard and improved version) and radiant hot air (improved version), as decentral heating emissions.

Type of ceiling radiation
In case of radiation heating, the type of ceiling radiant panels should be selected from the drop-down menu: standard or improved design (with keeping distances to the wall).

Air outlet
In case of warm air without additional vertical recirculation, the air outlet needs to be defined from the drop-down menu with respect to the system temperature (standard or low-temperature).

Position of air outlet
In case of warm air without additional vertical recirculation, the position of air outlet needs to be defined from the drop-down menu (wall or ceiling).

Insulation
In case of floor heating, the option for insulation level needs to be defined from the drop-down menu. Options have references to standards DIN EN 1264 and DIN 4108. Minimum insulation according to the standard DIN EN 1264 assumes thermal resistance values of $R \geq 1{,}25$ [m^2 K/W] (U-value of 0,7 [W/m^2 K]). Minimum insulation according to the standard DIN 4108 assumes thermal resistance values of $R \geq 0{,}90$ [m^2 K/W] (U-value of 1,0 [W/m^2 K]).

Covering
In case of floor heating, the option for covering thickness needs to be defined from the drop-down menu.

Control
Type of control needs to be selected from the drop-down menu.

Type of central hall heating
Type of central hall heating (different subtypes for already defined/selected type of hall heating) needs to be selected from the drop-down menu for calculation of the auxiliary energy for the control system.

Type of decentral hall heating
Type of decentral hall heating (different subtypes for already defined/selected type of hall heating) needs to be selected from the drop-down menu for calculation of the auxiliary energy for the control system.

Auxiliary energy factor needs to be defined in [kW/kW], unless the default value is to be used. In this case the option **Default auxiliary energy factor** should be checked.

Connect circuit to zones

In this window all zones in which these heating emissions are represented need to be selected from the drop-down list that appears when clicking each empty field in the column **Select zone**. After that, it is necessary to specify the share (in percentages) of the respective heating emissions in this zone.

Heating demand for each zone that is designated as heated (in **Zone data** screen) need to be fulfilled, which means that if different heating emissions from the same heating circuit, or heating emissions from different heating circuits provide heating for a certain zone, then total share of all heating emissions for this zone has to be 100 %. If this is not the case, the programme sends the warning message that the heating demand is not fulfilled or it is overfulfilled for this zone, and further action in this regard is required.

For easier entry of data for contribution of respective heating emissions to the zones, there is a wizard icon (just below the listed zones and connected heating emissions), that allows the programme to automatically adjust heating demand requirement for this heating circuit.

10.3 Heating unit

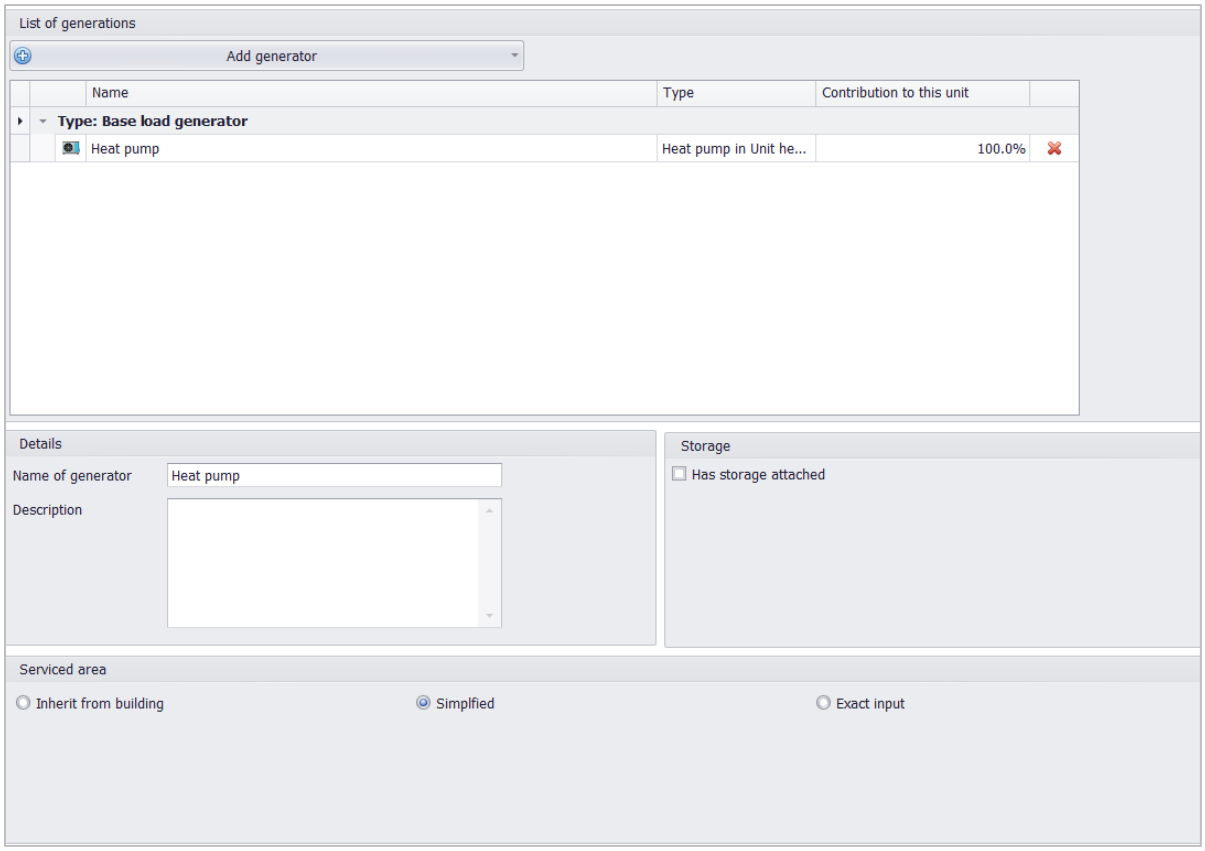


Figure 58: Input screen for adding heating generation unit

Heating generation unit that provides heat for this heating circuit has been added previously in **Heating** screen (as **Heating unit**), but the unit's configuration (generator with or without storage, additional generator if any), the type of generator and related serviced area need to be defined here.

The following options are available for defining heating generator:

- Boiler (central systems);
- District heating (central systems);

- Oven/stove (decentralised fuel fired systems);
- Electric heater (decentralised systems using electricity as a fuel);
- Heat pump (central systems);
- Solar thermal (central systems);
- Hall heating (decentralised systems).

Solar thermal system can be added only as an additional generator and in combination with DHW heating (to be defined in screen related to DHW unit).

Contribution of each added heating generator to this heating unit is presented in percentages in the generators overview.

Details

Name of generator
Enter the name of the added heating generator.

Description
Some short description of the added heating generator can be entered in this field (e.g. type of fuel used, capacity, name of manufacturer, etc.).

More information and parameters of the added heating generator are defined afterwards in the separate screen (one lower level in navigation tree structure).

Storage

In case the heating unit has a storage tank connected, then this option should be selected by clicking in the checkbox **Has storage attached**. When selecting this option, the screen related to a storage tank appears in navigation tree structure (just below the connected heating generator).

Serviced area

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. The characteristic energy values or energy balance shares are determined for a serviced area (and later divided among the zones of the building).

Serviced area covered by this heating unit can be calculated in three ways:

- **Inherit from the building**: reference geometry dimensions are taken from the building (the case when a building is served by one heating unit).

- **Simplified**: this approach is a simplification of the third method (**Exact input**), and it does not require any input data, since it include standard values for geometric factors depending on usage type (more data on this can be found in the Calculation methodology in Chapter 11).

- **Exact input**: serviced area is calculated based on the calculated values for **characteristic length** and **characteristic width**. Besides characteristic length and width (that need to be previously calculated), the **number of floors** and **storey height** need to be entered as well for the calculation of serviced area. Determination of characteristic width and length can be found in the Calculation methodology in Chapter 11.

Detail results

The calculation results for this heating unit are displayed in details.

The results represent an overview of all energy components calculated separately for each type of heating energy supply provided by this heating unit (where applicable): conventional heating systems (radiators, panel heating, direct heaters, etc.), heat delivered by the heating function of an HVAC system, heat supplied to an absorption chiller, heat provided via residential ventilation system, etc. Delivered energy is the sum of the energy need, system losses due to control and emission, distribution and storage (sub-total: generator heat output) and heat generation losses. Therefore, an overview of all mentioned energy items that constitute delivered energy is given, including also produced or regenerative energy used for the heat supply (environmental heat for the heating system).

Separately from the calculation of delivered energy for heating, the delivered energy for auxiliary energy (energy additionally required by the heating system in order to provide energy supply, e.g. energy for pumps, fans, control, electronics etc.) is also calculated and presented for each type of heating energy supply above-mentioned. Auxiliary energy quantities of all subsystems (control and emission, distribution, storage, generation) are determined and presented individually.

10.3.1 Heating Generator: Boiler

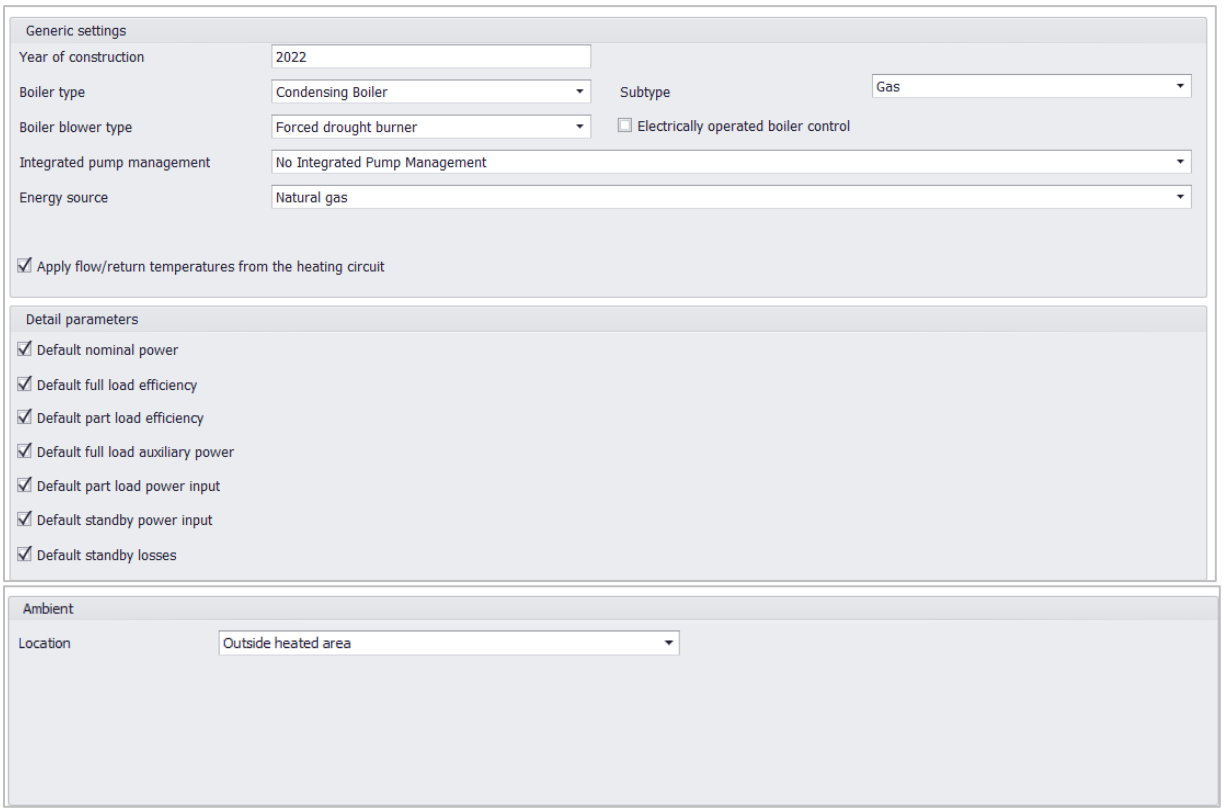


Figure 59: Input screen for defining heating generator - boiler

Generic settings

Year of construction
Enter the year of construction for the boiler.

Boiler type
The option for the type of boiler needs to be selected from the drop-down menu. There are four options available: standard boiler, low-temperature boiler, condensing boiler and biomass boiler.

Boiler subtype

The option for the additional boiler specification by type needs to be selected from the drop-down menu. Specification of options in this drop-down menu is affected by the selection made for the boiler type.

Boiler blower type
The option for the type of the boiler blower needs to be selected from the drop-down menu. Specification of options in this drop-down menu is affected by the selection made for the boiler type.

Energy source
The option for the energy source needs to be selected from the drop-down menu. Specification of options in this drop-down menu is affected by the selection made for the boiler type.

Integrated pump management
The option for the pump management needs to be selected from the drop-down menu (no integrated pump management or integrated pump management with control based on external/internal temperature).

Detail parameters

Default nominal power
The nominal power of the boiler can be defined either by selecting default value (from the standard) or by entering the known value for this parameter in [kW].

Default full load efficiency
The full load efficiency of a boiler (efficiency at nominal load) can be defined either by selecting default value (from the standard) or by entering the known value for this parameter in [%].

Default part load efficiency
The part load efficiency of a boiler (efficiency at partial load) can be defined either by selecting default value (from the standard) or by entering the known value for this parameter in [%].

Default full load auxiliary power
The auxiliary power at nominal load can be defined either by selecting default value (from the standard) or by entering the known value for this parameter in [kW].

Default part load power input
The power input at partial load can be defined either by selecting default value (from the standard) or by entering the known value for this parameter in [kW].

Default standby power input
The power input of the boiler in standby mode can be defined either by selecting default value (from the standard) or by entering the known value for this parameter in [kW].

Default standby losses
Standby losses refer to the 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. It can be defined either by selecting default value (from the standard) or by entering the known value for this parameter in [kW].

Ambient

Location
For the calculation of the generation losses, the location of the heat generator needs to be selected from the drop-down menu: **Outside the heated area** or **Inside the heated area** (two options: (i) **with internal gains**, i.e. generator is located in the heated area within the building envelope, or (ii) **without internal gains**, i.e. generator is located in the heated area outside the building envelope, such as the area of the adjacent building that is heated). In case the generator is located within certain zone(s), this option can be selected from the drop-down menu (option: **Within a zone**), whereby a

new menu with a checkbox next to each zone in the building opens automatically. In addition, it is possible to enter the ambient temperature, if known, either as an annual value, or as seasonal (winter and summer) values (options: **Custom annual temperature** and **Custom seasonal temperatures**).

10.3.2 Heating generator: Solar thermal system

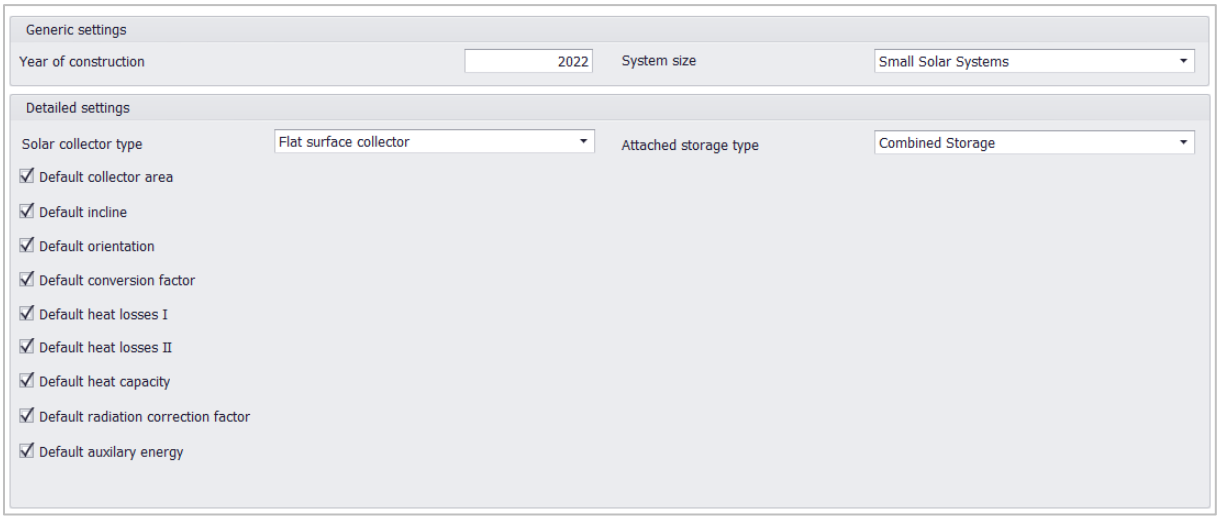


Figure 60: Input screen for defining heating generator – solar thermal system

Generic settings

Year of construction
Enter the year of construction for the solar thermal system.

System size
The system size is selected from the drop-down menu. Two options are available: small solar systems and large solar systems. **Small solar systems** relate to net floor area smaller than 500 m². **Large solar systems** relate to net floor area above 500 m^2 up to 3000 m². In case of small solar systems, a number of parameters need to be defined in **Detail settings** window (below). In case of large solar systems the solar yield has to be entered for each month, for DHW and heating separately.

Detailed settings

Solar collector type
The type of collector (flat plate collector, tube collector) is selected from the drop-down menu.

Attached storage type
The type of storage is selected from the drop-down menu. Two options are available: combined storage (tank-in-tank-principle) and dual storage system (solar buffer storage + DHW storage).

In addition, the following parameters need to be entered in case that default values (from the standard) are not selected: **collector area** in [m^2], **orientation** and **inclination** of the collector field in [%], **conversion factor** η_0 in [-], **heat loss coefficients** k_1 and k_2 in [$W/(m^2K)$], **heat capacity** in [kJ/m^2K], **irradiation angle correction factor at 50°** in [-], and **auxiliary energy** (for solar pump) in [W]. More information on these parameters can be found in the Calculation methodology (Chapter 8).

External simulation

For large solar systems the solar yield has to be entered for each month, for DHW and heating separately.

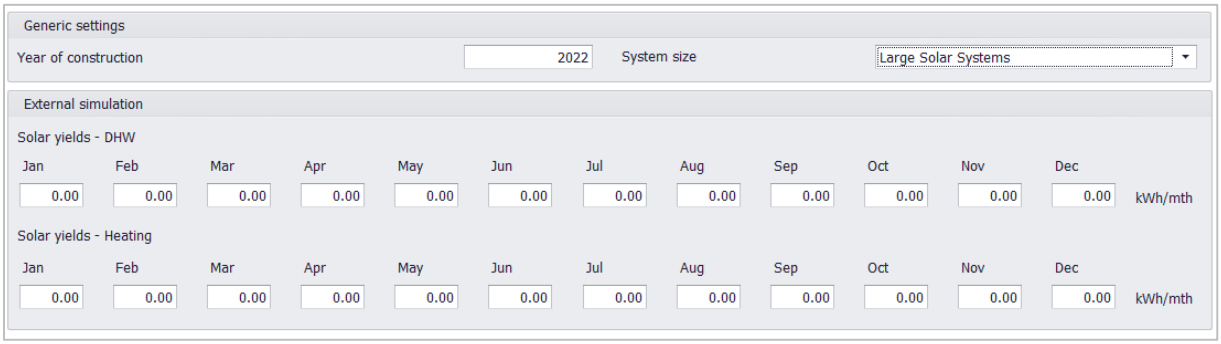


Figure 61: Input screen for defining solar thermal system by external simulation

Solar yields - DHW
Data for energy yield of the solar system for domestic hot water heating need to be entered for each month in [kWh].

Solar yields - Heating
Data for energy yield of the solar system for back-up space heating need to be entered for each month in [kWh].

10.3.3 Heating generator: Heat pump

Settings

Year of construction
Enter the year of construction for the heat pump.

Energy carrier
Energy carrier used to run the heat pump is selected from the drop-down menu: electricity for electrically driven heat pump, or gas (natural gas, LPG, bio-gas) for gas-engine heat pump.

Heat pump type
Type of heat pump with regard to the medium at source and sink side is selected from the drop-down menu: air-water, air-air, brine-water and water-water.

Type of geothermal heat pump
In case of selecting the brine-water heat pump type, its subtype should be selected from the drop-down menu: downhole or ground collector.

Operating mode
Operating mode of the heat pump is selected from the drop-down menu: **monovalent** or **bivalent** (with internal electrical heater or external secondary generator). In monovalent operation, the heat pump covers 100% of the demand (for space and/or DHW heating). In case of bivalent operation an additional heat generator is used, which covers the demand in co-action with the heat pump.

Bivalent mode
In case of bivalent operation of the heat pump, it should be selected from the drop-down menu one of three options for bivalent mode: alternate, parallel and partly parallel operation. In **alternate operation**, the heat pump supplies all the heating energy down to a specified outdoor temperature (bivalence temperature), after which the heat pump switches off and the second heat generator takes over the full heating energy requirement. In **parallel operation**, the heat pump alone supplies the

necessary heat down to a specified outdoor temperature (bivalence temperature), after which the second generator switches on and they both operate in parallel (the second generator supplies only the part that the heat pump cannot supply because of its heat output limitation). In **partly parallel operation**, compared to the parallel mode, when the lower operating limit of the heat pump is reached, the heat pump switches off and the second generator alone supplies the heat required (below the operating limit, the second heat generator works alternatively).

Type of heat distribution system
Type of distribution/emission system connected to the heat pump is selected from the drop-down menu: floor heating or radiators (with or without storage).

If the flow and return temperatures defined for the heating circuit are assumed for the distribution system then this option should be selected by clicking in the checkbox **Apply flow/return temperatures from heating circuit**. If this is not the case, this box should be unchecked and the flow and return temperatures should be entered in °C.

Controllability
With regard the controllability of heat pumps, one of three options need to be selected from the drop-down menu: single-stage (non-controllable), multi-stage (control in stages) and continuously controlled heat pumps.

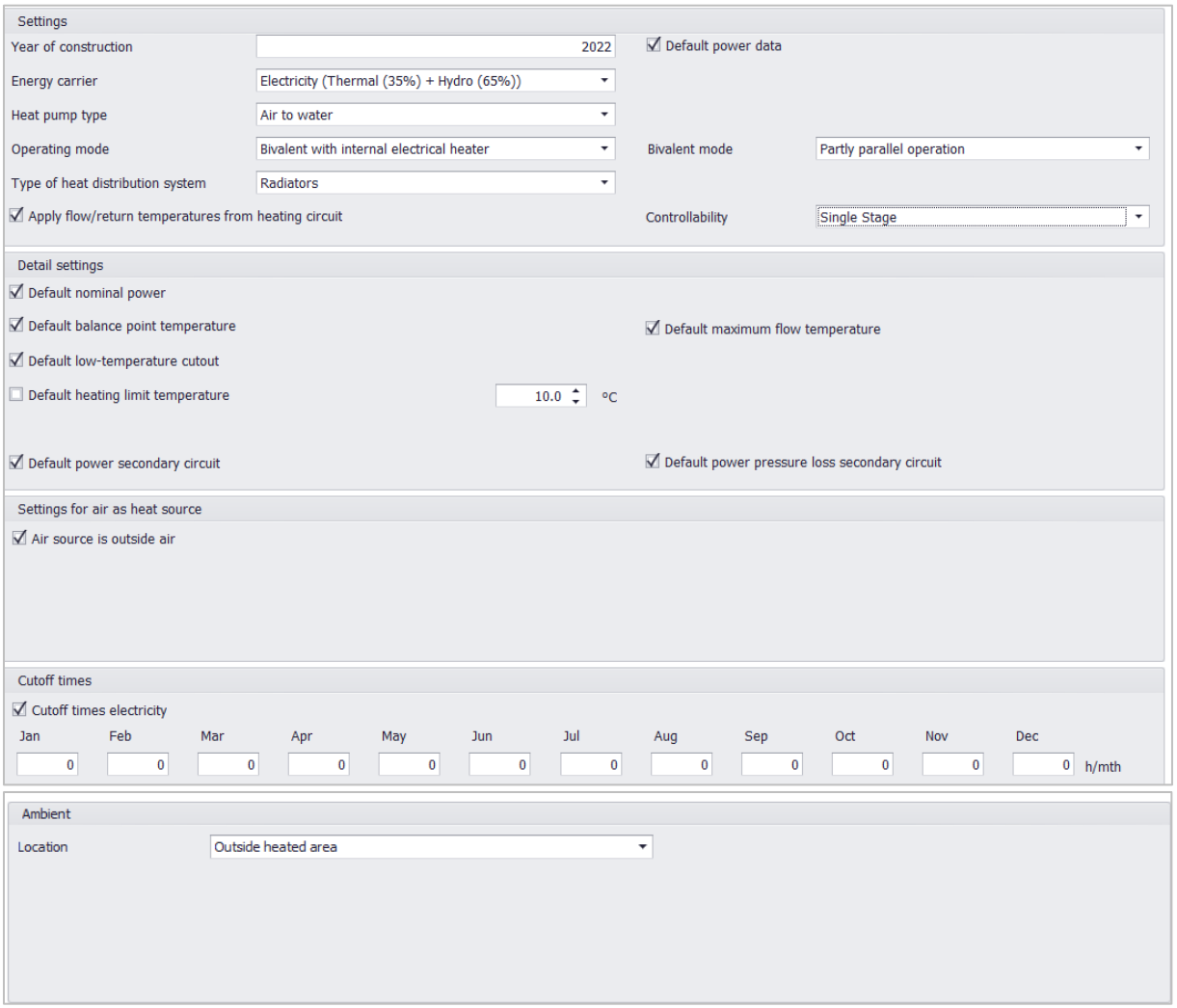


Figure 62: Input screen for defining heating generator – heat pump

Detail settings

The parameters to be defined in this window depend on the selected type of heat pump and its operating mode. All parameters can be defined either by selecting default value (from the standard) or by entering the known value for these parameters.

Nominal power of the heat pump is the electrical power consumption at nominal voltage under specified operating conditions and maximum load. The **heating limit temperature** refers to the upper operating limit of the heat pump, and it depends on the usage profile of the building. For its determination, the requirements for the generator heat output for the whole year need to be known.

In case of bivalent operation of the heat pump, the **bivalence point temperature** needs to be defined, i.e. temperature at which the second generator switches on and takes over the full heating energy requirement (alternate operation), or part of the heating energy requirement (parallel operation). In partly parallel operation, it is necessary to define the **low-temperature cut-out**, i.e. the temperature of the lower operating limit of the heat pump (switch-off point).

Depending on the selected heat pump type, the following parameters need to be defined for the calculation of the auxiliary energy (energy expenditure required for the source and sink pump (primary and secondary sides), for overcoming the internal pressure drop in the heat pump evaporator and condenser, as well as the auxiliary energy for control, for defrosting and any back-up heating equipment): **power primary circuit** and **power secondary circuit** in [kW], as well as **pressure loss primary circuit** and **pressure loss secondary circuit** in [kPa].

More information on the heat pump parameters can be found in the Calculation methodology (Chapter 8 and Annex A).

Settings for air as heat source

In case that external air is a heat source (air-air and air-water heat pumps), this option should be selected by clicking in the checkbox **Air source is outside air**. In case that external air is not a heat source, but some other ambient air, the **Air source temperature** need to be defined by selecting one of the options from the related drop-down menu: **in heated area** or **outside heated area**, **within a zone** (with additional menu appearing for the specification of the zone, and the option for selecting heat recovery with its rate, if exists), or certain ambient defined with **custom seasonal temperatures** (winter and summer value).

Settings for domestic hot water

In case that heat pump is used also for domestic hot water heating and the different operating mode applies for domestic hot water heating, then this option should be selected by clicking in the checkbox **Different setting of the operating mode for hot water preparation**. The adequate option for the DHW heating operating mode is selected from the drop-down menu: **monovalent** or **bivalent** (with internal electrical heater or external secondary generator).

As for space heating, the **upper temperature limit (domestic hot water) for heat pump operation** needs to be entered in [°C]. Unless there is a known upper limit temperature, the value of 65°C can be used.

Cut-off times

For calculation of the running time of the heat pump, in case there are interuptions in the supply of the electricity by the power utility, it should be specified by clicking in the checkbox **Cut-off times electricity**. Upon that, the number of hours (cut-off times) for each month need to be entered in [h/mth].

Ambient

Location
For the calculation of the generation losses, the location of the heat generator needs to be selected from the drop-down menu: **Outside the heated area** or **Inside the heated area** (two options: (i) **with internal gains**, i.e. generator is located in the heated area within the building envelope, or (ii) **without internal gains**, i.e. generator is located in the heated area outside the building envelope, such as the area of the adjacent building that is heated). In case the generator is located within certain zone(s), this option can be selected from the drop-down menu (option: **Within a zone**), whereby a new menu with a checkbox next to each zone in the building opens automatically. In addition, it is possible to enter the ambient temperature, if known, either as an annual value, or as seasonal (winter and summer) values (options: **Custom annual temperature** and **Custom seasonal temperatures**).

10.3.4 Heating generator: District heating

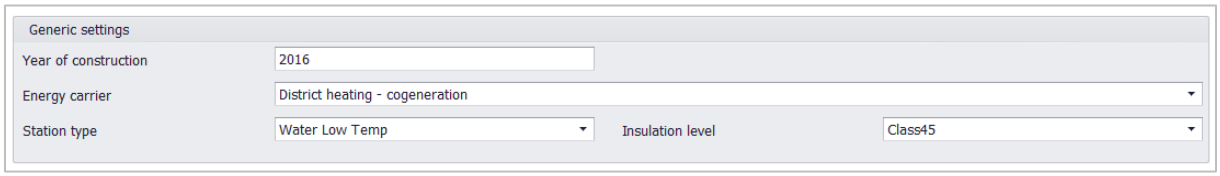


Figure 63: Input screen for defining heating generator – district heating

Generic settings

Year of construction
Enter the year of construction for the distric heating system.

Energy carrier
Energy carrier for the district heating needs to be selected from the drop-down menu (two values are given in accordance with the Rulebook: for cogeneration and for heating plant).

Station type
Type of district heating station needs to be selected from the drop down menu: (i) hot water, low temperature; (ii) hot water, high temperature; (iii) low pressure steam; (iv) high pressure steam.

Insulation level
Insulation class of the components of the district heating station is defined according to EN 12828, and it needs to be selected from the drop-down menu. Each class is marked with two numbers – the first one refers to the secondary side, the second one to the primary side.

More information on district heating parameters can be found in the Calculation methodology (Chapter 8).

10.3.5 Heating generator: Hall heating

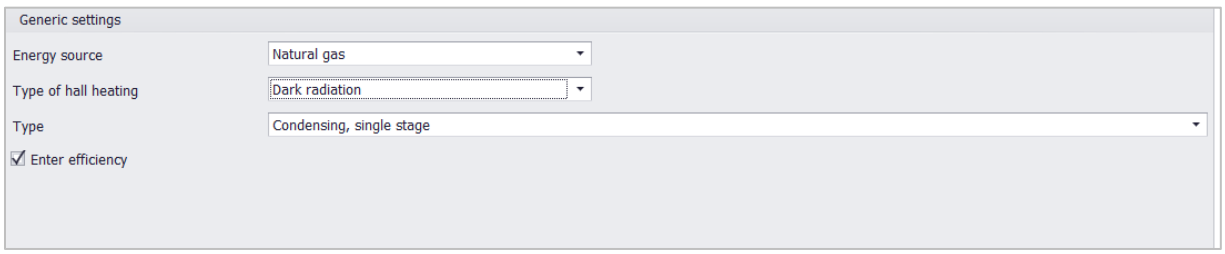


Figure 64: Input screen for defining heating generator – hall heating

Generic settings

Energy source
Energy source used by decentralised hall heating systems is selected from the drop-down menu (natural gas, LPG, bio-gas).

Type of hall heating
Type of hall heating is selected from the drop-down menu: luminous radiant heaters, dark radiant heaters or warm air heaters.

Subtype of hall heating
The option for the additional hall heating specification by type needs to be selected from the drop-down menu. Specification of options in this drop-down menu refers to exhaust gas system (condensing/non-condensing) and power control (single-stage/multi-stage generator).

In case of known value for generator efficiency related to calorific value, this option should be selected by unchecking the box **Enter efficiency**, and entering the known value. In case the efficiency is not known, the checkbox should be left checked and the default value (from the standard) is assumed.

10.3.6 Heating generator: Individual stoves

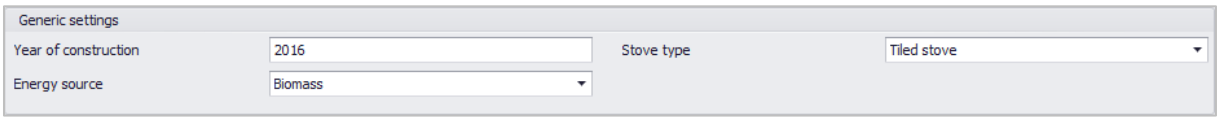


Figure 65: Input screen for defining heating generator – individual stoves

Generic settings

Year of construction
Enter the year of construction for the decentralised fuel-fired system.

Stove type
Type of decentralised fuel-fired system is selected from the drop-down menu: gas heaters (on chimney or outer wall), oil-fired stoves, tiled stoves and coal-fired iron stoves.

Energy source
Energy source used by decentralised fuel-fired system is selected from the drop-down menu. This selection is directly related to the selected type of decentralised fuel-fired system.

10.3.7 Heating generator: Electric heaters

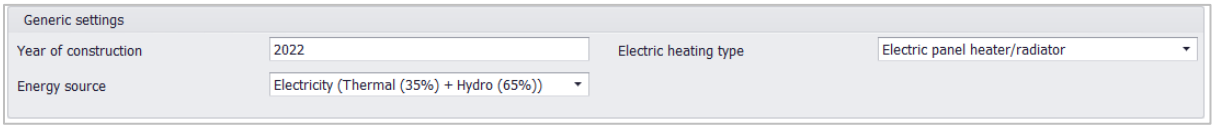


Figure 66: Input screen for defining heating generator – electric heaters

Generic settings

Year of construction
Enter the year of construction for the electric heating system.

Electric heating type
Type of electric heating system is selected from the drop-down menu: electric panel heaters and radiators, thermal accumulation with separate generation and thermal accumulation with integrated generation.

Energy source
Energy source used by electric heating system is selected from the drop-down menu.

10.4 Heating storage

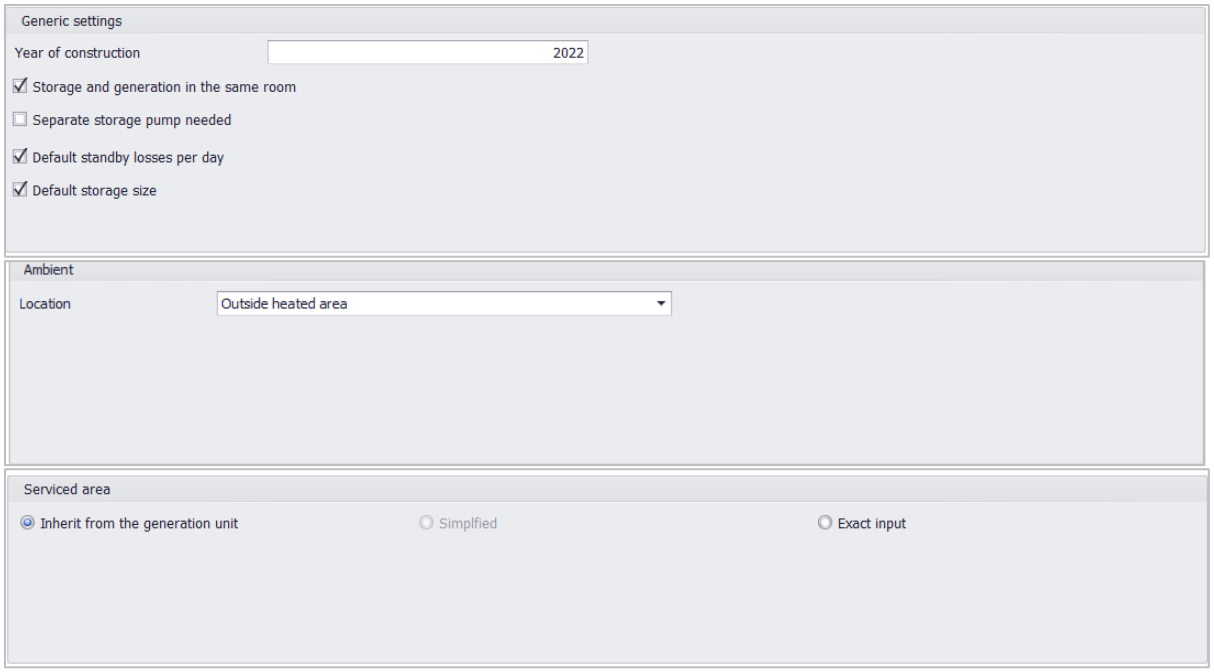


Figure 67: Input screen for defining heating storage

Generic settings

System losses and auxiliary energy due to installed storage tanks are calculated based on the following parameters and information:

Year of construction of the storage tank needs to be specified.

The heat loss from the pipe between heat generator and storage tank depends on their location/ configuration. In case they are located in the same room, the checkbox for option **Storage and generation are in the same room** needs to be selected.

In case that separate circulation pump is needed for the storage system, the checkbox for option **Separate storage pump needed** needs to be selected.

If the stand-by heat losses per day are known, this value should be entered when unchecking the option **Default standby losses per day**. In case this value is not known, then this option should be left checked and the default value (from the standard) is assumed.

If the nominal capacity of the storage tank is known, this value should be entered when unchecking the option **Default storage size**. In case this value is not known, then this option should be left checked and the default value (from the standard) is assumed.

Ambient

Location
For the calculation of the storage losses, the location of the storage tank needs to be selected from the drop-down menu: **Outside the heated area** or **Inside the heated area** (two options: (i) **with internal gains**, i.e. storage tank is located in the heated area within the building envelope, or (ii) **without internal gains**, i.e. storage tank is located in the heated area outside the building envelope, such as the area of the adjacent building that is heated). In case the storage tank is located within certain zone(s), this option can be selected from the drop-down menu (option: **Within a zone**), whereby a new menu with a checkbox next to each zone in the building opens automatically. In addition, it is possible to enter the ambient temperature, if known, either as an annual value, or as seasonal (winter and summer) values (options: **Custom annual temperature** and **Custom seasonal temperatures**).

Serviced area

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. The characteristic energy values or energy balance shares are determined for a serviced area (and later divided among the zones of the building).

Serviced area covered by this storage system can be calculated in two ways:

- **Inherit from the generation unit**: reference geometry dimensions are taken as for the heating generation unit.

- **Exact input**: serviced area is calculated based on the calculated values for **characteristic length** and **characteristic width**. Besides characteristic length and width (that need to be previously calculated), the **number of floors** and **storey height** need to be entered as well for the calculation of serviced area. Determination of characteristic width and length can be found in the Calculation methodology in Chapter 11.

11 Input screens for the domestic hot water systems

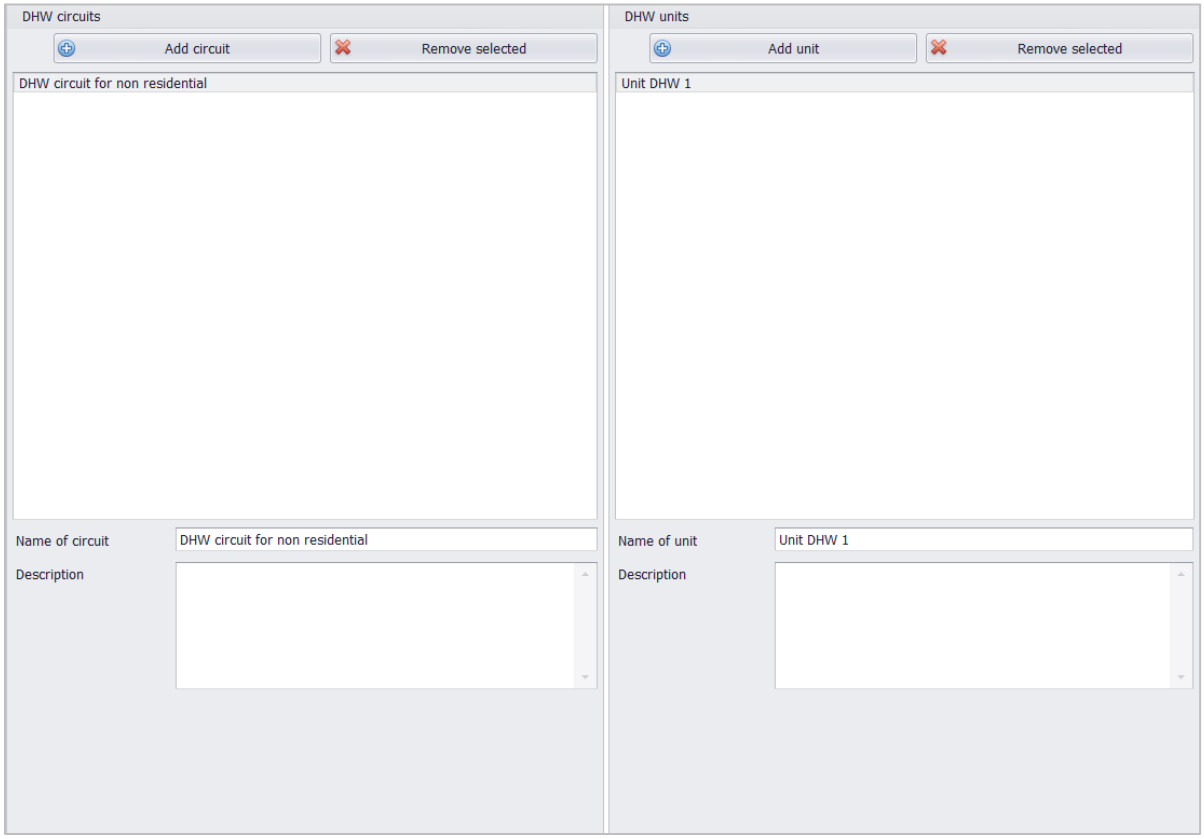


Figure 68: Input screen for defining DHW system

DHW system configuration starts with defining the **DHW circuit** and the related **DHW unit**.

DHW circuit actually represents the connection of the DHW heating energy generation with the zones in the building through the distribution network to the user outlets. DHW circuit is defined regardless of whether it is a central or decentral system.

DHW unit refers to the generation of heating energy for DHW, whether it is a central heat generation (boilers, heat pumps), or decentral (electric/gas water heaters, storage/flow heaters).

NOTE: One DHW unit can provide the heat for several DHW circuits. One DHW circuit can not be connected with several DHW units.

DHW circuit is entered by clicking **Add circuit** button.

The name of the added DHW circuit is entered in **Name of circuit**.

Some short description of the added DHW circuit can be entered in the **Description** field.

More information and parameters of the added DHW circuit are defined afterwards in the separate screen (one lower level in navigation tree structure).

DHW unit is entered by clicking **Add unit** button.

The name of the added DHW unit is entered in **Name of unit**.

Some short description of the added DHW unit can be entered in the **Description** field.

More information and parameters of the added DHW unit are defined afterwards in the separate screen (one lower level in navigation tree structure).

Each added DHW circuit and DHW unit may be deleted by clicking **Remove selected** button.

11.1 DHW circuit

11.1.1 Circuit

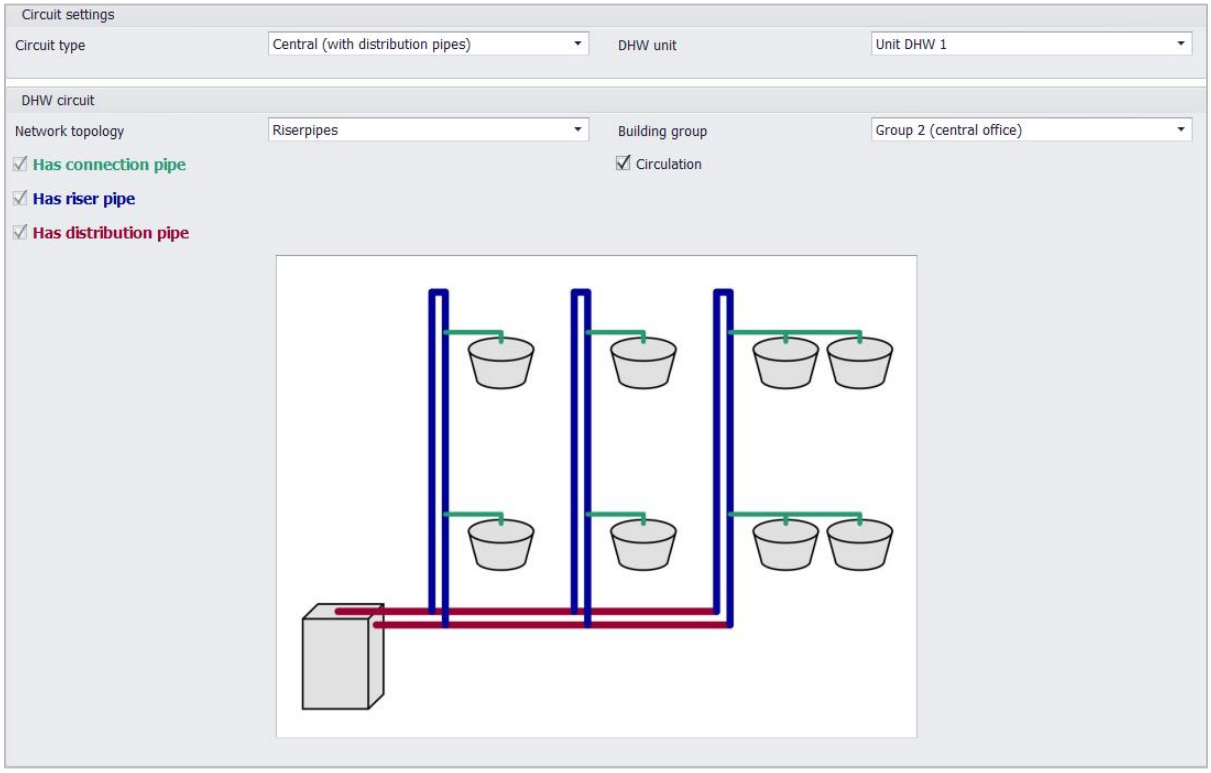


Figure 69: Input screen for defining DHW circuit

Circuit settings

Circuit type
Circuit type is selected from the drop-down menu. There are two types of DHW circuit: decentral (electric/gas water heaters, storage/flow heaters), and central (central generation and distribution via hot water pipe network).

DHW unit
Heat generation unit that provides the heat for this circuit is selected from the drop-down menu (and previously defined in **DHW** screen).

DHW circuit

The parameters defined in this window depend on the selection of the network type (central or decentral circuit type).

Network topology
For central circuit type selected, one of two standard network types (riser type and storey (level) type) can be selected from the drop-down menu, thus allowing standard pipe lengths to be assumed for calculation of distribution losses. For decentral circuit type selected, one standard network type (decentralized supply) can be selected. To help identify the type of network, images of all types have been inserted, so when selecting the option from the drop-down menu, the image changes accordingly. Besides these standard network types, the user is able to enter its own values for pipe lengths by selecting the option **Custom** from the menu (for both options – central and decentral).

Average pipe network (central) comprises three different pipeline sections: horizontal distribution of heat from the generator to the main supply pipes (**Distribution pipe**), main supply pipes (**Riser pipe**), and branching pipes to the user outlets within the building (**Connection pipe**). Decentral circuit type has only connection pipes. When selecting options for standard network types, the checkboxes related to these pipeline sections (**Has distribution pipe**, **Has riser pipe**, **Has connection pipe**) are automatically checked or unchecked. In the case of user defined network topology (option **Custom** from the menu), these checkboxes should be checked or unchecked manually. According to the selections made, the tabs related to these pipeline sections appear or disappear in this screen.

Building group
Besides the type of network, the building group is also used for determination of the standard pipe lengths. Building groups are classified in four categories related to the type of use:

1) Group 1: residential, bedrooms, hotels, kindergarten, surgeries, nursing homes, dormitories;
2) Group 2: offices, medical practices, conference/seminar, laboratories, sales facilities, restaurants and kitchens, canteens, workshops, butcher shop, bakery, hairdressers;
3) Group 3: auditorium, museum, school, theatre, event halls, libraries, airport;
4) Group 4: swimming hall, gym, locker rooms, changing rooms of production facilities.

If DHW distribution pipe system is with circulation facility, this option should be selected by clicking in the checkbox **Circulation**. This information is important for calculation of the pipe lengths and distribution losses, as well as the auxiliary energy (for operating circulation pumps).

Serviced area

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. The characteristic energy values or energy balance shares are determined for a serviced area (and later divided among the zones of the building).

Figure 70: Input screen for defining serviced area for DHW circuit

Serviced area for this DHW circuit can be calculated in three ways:

- **Inherit from the building**: reference geometry dimensions are taken from the building (the case when a building is served by one DHW system/distribution network).

- **Simplified**: this approach is a simplification of the third method (**Exact input**), and it does not require any input data, since it include standard values for geometric factors depending on usage type (more data on this can be found in the Calculation methodology in Chapter 11).

- **Exact input**: serviced area is calculated based on the calculated values for **characteristic length** and **characteristic width**. Besides characteristic length and width (that need to be previously calculated), the **number of floors** and **storey height** need to be entered as well for the calculation of serviced area. Determination of characteristic width and length can be found in the Calculation methodology in Chapter 11.

11.1.2 DHW circuit: Heating pipes (connection pipe, riser pipe, distribution pipe)

Connection pipe refers to branching pipes to the user outlets within the building (connection between the circulating pipe sections and the user outlets). **Riser pipe** refers to main supply pipes (vertical and, in some cases, horizonal). **Distribution pipe** refers to pipe section between heat generator and main supply pipes (risers).

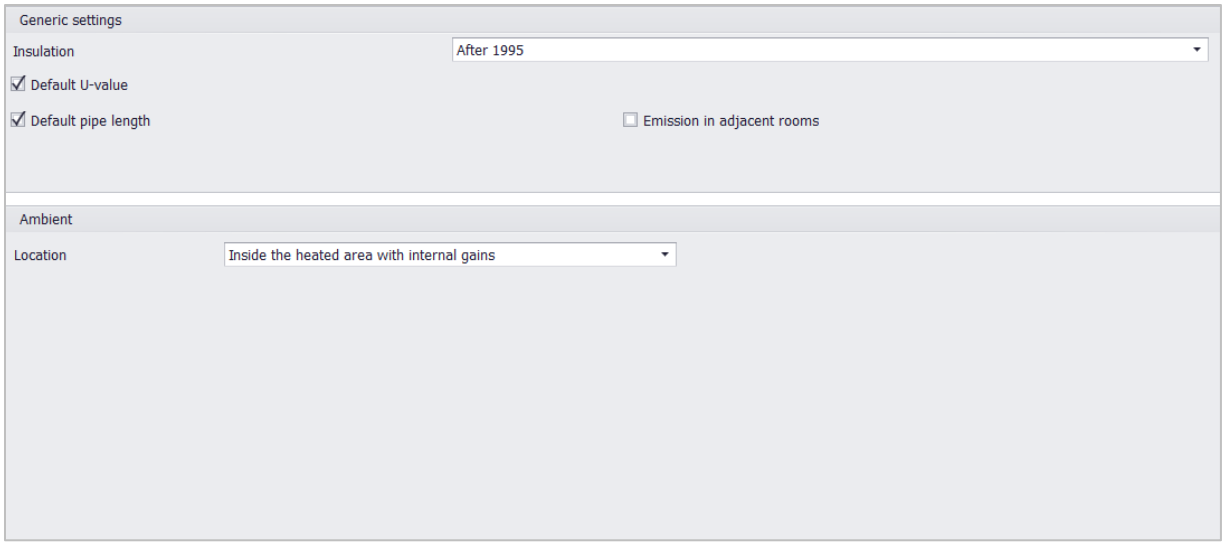


Figure 71: Input screen for defining pipeline sections in DHW circuit

For each of these pipeline sections, the following data need to be defined:

Generic settings

Insulation
Insulation of the pipe is defined by selecting one of the options from the drop-down menu. These options refer to the age class of building (before 1980, between 1980 and 1995, and after 1995), which imply use of the standard values for heat transfer coefficients (U-values).

In case the value for heat transfer coefficient (U-value) is known, then the checkbox **Default U-value** should be unchecked and the U-value need to be entered in [W/(mK)].

Pipe length
Pipe length is determined based on the selected network type, building group, pipeline section (horizontal distribution, risers and connection lines), and geometric parameters of building (net floor area, storey height, number of storeys, etc.).

In case the value for pipe length is known, then the checkbox **Default pipe length** should be unchecked and the pipe length value need to be entered in [m].

In cases of emission to adjacent rooms with a common installation wall, this option for connection pipe should be selected by clicking in the checkbox **Emission in adjacent rooms**.

Ambient

Location
For the calculation of the distribution losses, the location of the pipe needs to be selected from the drop-down menu: **Outside the heated area** or **Inside the heated area** (two options: (i) **with internal gains**, i.e. pipe is located in the heated area within the building envelope, or (ii) **without internal gains**, i.e. pipe is located in the heated area outside the building envelope, such as the area of the adjacent building that is heated). In case the pipeline is located within certain zone(s), this option can be selected from the drop-down menu (option: **Within a zone**), whereby a new menu with a checkbox next to each zone in the building opens automatically. In addition, it is possible to enter the ambient temperature, if known, either as an annual value, or as seasonal (winter and summer) values (options: **Custom annual temperature** and **Custom seasonal temperatures**).

11.1.3 DHW circuit: Pumps

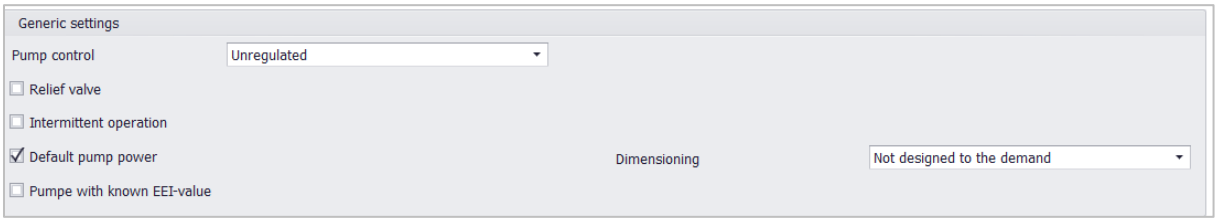


Figure 72: Input screen for defining pump parameters in DHW circuit

The following parameters need to be defined for calculation of the auxiliary energy expenditure required to operate circulation pumps in DHW system.

Pump control
Pump control should be defined by selecting one of the options from the drop-down menu: unregulated or regulated.

Relief valve
A relief valve is used to control or limit the pressure in a system, and it has effect on the average hydraulic demand. In case it exists in the system, this option should be selected by clicking in the related checkbox.

Intermittent operation
The pump operates in the intermittent mode if it is operated outside the usage time at limited power or is switched off. In these cases, the calculation of the electrical energy expenditure of the circulation pumps has to take into account the correction factor for set-back or switch-off of the pump. Therefore, in case of intermittent mode of pump operation, this option should be selected by clicking in the related checkbox.

Default pump power
In case electrical power consumption of the pump from manufacturer's data is available, this value should be entered in [W]. In case this value is not available, the default pump power should be used and this option should be selected by clicking in the related checkbox.

Dimensioning

To assess the performance of the circulation pump, from the drop-down menu there should be selected whether pumps are designed to meet the demand or not.

Pump with known EEI-value
In case that energy efficiency index (EEI) for the pump is known, this option should be selected by clicking in the checkbox and entering the known value.

11.1.4 DHW circuit: DHW emissions

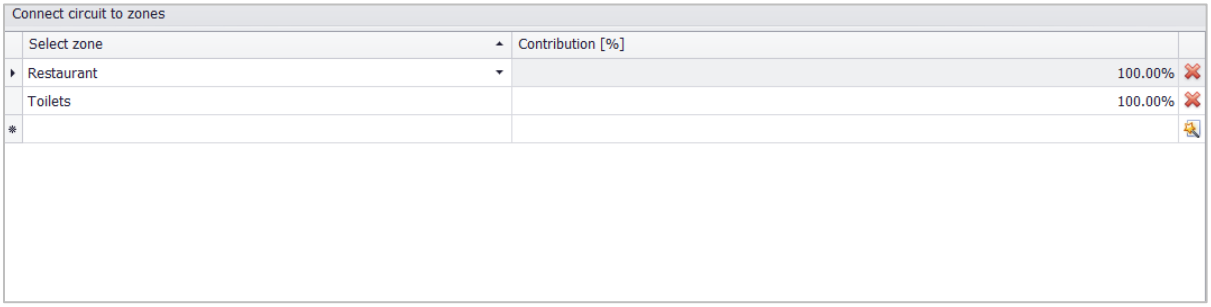


Figure 73: Input screen for defining DHW emissions (connection to zones)

In this window all zones in which these DHW emissions (user outlets) are represented need to be selected from the drop-down list that appears when clicking each empty field in the column **Select zone**. After that, it is necessary to specify the share (in percentages) of the respective DHW emissions in this zone.

DHW demand for each zone that is marked as the zone in which the user outlets are located (in **DHW demand** screen) need to be fulfilled, which means that if different DHW circuits provide DHW heating for a certain zone, then total share of all DHW emissions for this zone has to be 100 %. If this is not the case, the programme sends the warning message that the DHW demand is not fulfilled or it is overfulfilled for this zone, and further action in this regard is required.

For easier entry of data for contribution of respective DHW emissions to the zones, there is a wizard icon (just below the listed zones and related contributions), that allows the programme to automatically adjust DHW demand requirement for this DHW circuit.

11.1.5 DHW circuit: Detail results

The calculation results for this DHW circuit are displayed in details.

Energy results for this DHW circuit overview the energy need, system losses due to control and emission, and system losses due to distribution. The total values on an annual basis are given, as well as a small graph representing their distibution over the course of the year.

Auxiliary energy quantities of control and emission, and distribution are determined and presented individually.

11.2 DHW unit

Generation unit that provides heat for this DHW circuit has been added previously in **DHW** screen (as **DHW unit**), but the unit's configuration (generator with or without storage, additional generator if any), the type of generator and related serviced area need to be defined here.

The following options are available for defining generator for DHW heating:

- Boiler (central systems);
- District heating (central systems);
- Heat pump (central systems);
- Solar thermal (central systems);
- Electric heating – storage or flow heater (decentralised systems using electricity as a fuel);
- Gas heated storage (decentralised systems using gas as a fuel).

Solar thermal system can be added only as an additional generator (only for DHW heating or in combination with space heating).

In case that generator defined for space heating (in **Heating** screen) is used for DHW heating as well, an easier way to enter the generator and its connections to the related circuits, is by pressing the button **Link existing generator for heating as combined generator**, and selecting the generator already defined for heating.

Generators for DHW systems can be defined separately from heating by clicking the **Add new generators** button. Generators used in central systems are already described in **Heating unit** section. Decentralised systems for DHW preparation (electric heating (storage or flow heater) and gas heated storage) will be described separately in this section.

Contribution of each added generator for DHW heating to this DHW unit is presented in percentages in the generators overview.

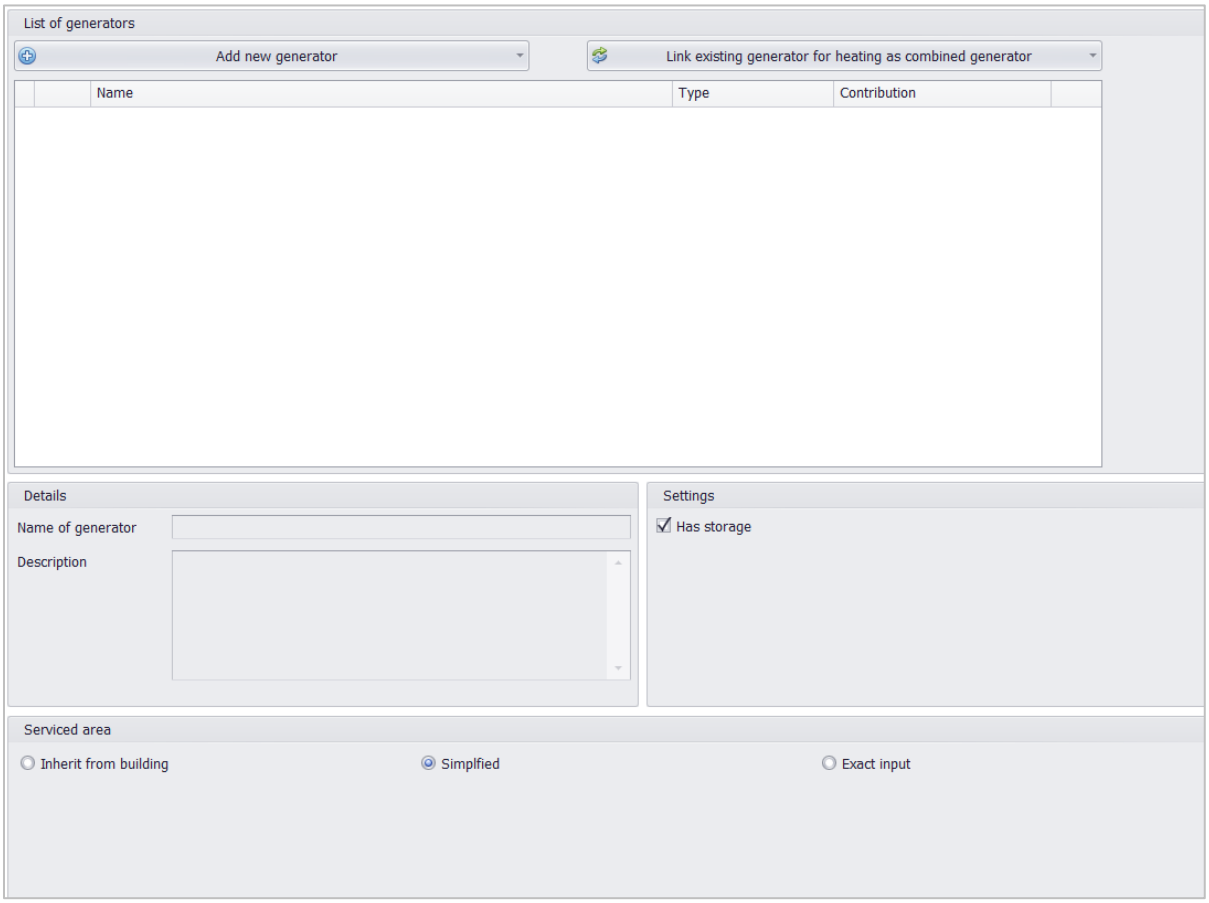


Figure 74: Input screen for defining DHW generator

Details

Name of generator
Enter the name of the added generator for DHW heating.

Description
Some short description of the added generator for DHW heating can be entered in this field (e.g. type of fuel used, capacity, name of manufacturer, etc.).

More information and parameters of the added generator for DHW heating are defined afterwards in the separate screen (one lower level in navigation tree structure).

Storage

In case the DHW unit has a storage tank connected, then this option should be selected by clicking in the checkbox **Has storage**. When selecting this option, the screen related to a storage tank appears in navigation tree structure (just below the connected generator for DHW heating).

Serviced area

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. The characteristic energy values or energy balance shares are determined for a serviced area (and later divided among the zones of the building).

Serviced area covered by this DHW unit can be calculated in three ways:

- **Inherit from the building**: reference geometry dimensions are taken from the building (the case when a building is served by one DHW unit).

- **Simplified**: this approach is a simplification of the third method (**Exact input**), and it does not require any input data, since it include standard values for geometric factors depending on usage type (more data on this can be found in the Calculation methodology in Chapter 11).

- **Exact input**: serviced area is calculated based on the calculated values for **characteristic length** and **characteristic width**. Besides characteristic length and width (that need to be previously calculated), the **number of floors** and **storey height** need to be entered as well for the calculation of serviced area. Determination of characteristic width and length can be found in the Calculation methodology in Chapter 11.

Detail results

The calculation results for this DHW unit are displayed in details.

Delivered energy for DHW is the sum of the energy need, system losses due to control and emission, distribution and storage (sub-total: generator heat output) and heat generation losses. Therefore, an overview of all mentioned energy items that constitute delivered energy is given, including also produced or regenerative energy used for the heat supply (environmental heat for the DHW system).

Separately from the calculation of delivered energy for DHW, the delivered energy for auxiliary energy (energy additionally required by the DHW system in order to provide energy supply, e.g. energy for pumps, control, etc.) is also calculated and presented for all subsystems individually (control and emission, distribution, storage, generation).

11.2.1 DHW generator: Electric flow/storage heater

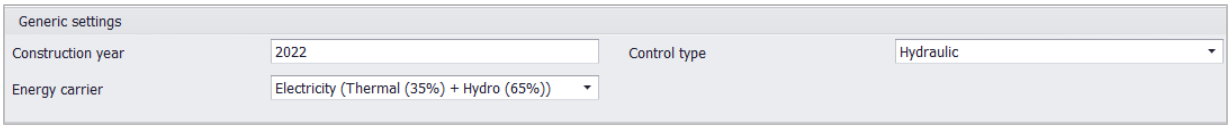


Figure 75: Input screen for defining electric flow/storage heater

Year of construction
Enter the year of construction for the electric heater.

Control type
Type of control of electric heater is selected from the drop-down menu: hydraulic or electronic.

Energy carrier
Energy carrier used by electric heater (storage/flow) is selected from the drop-down menu.

11.2.2 DHW generator: Gas heated storage

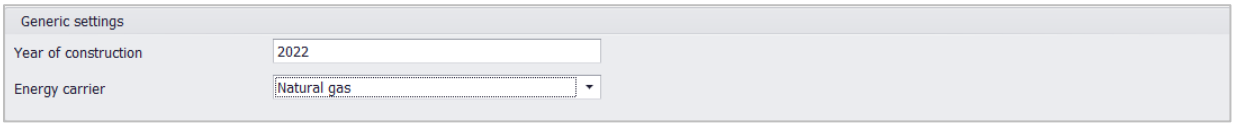


Figure 76: Input screen for defining gas heated storage

Year of construction
Enter the year of construction for the gas heated storage.

Energy carrier
Energy carrier used by gas heated storage is selected from the drop-down menu (natural gas, LPG, bio-gas).

11.3 DHW storage

Generic settings

System losses and auxiliary energy due to installed storage tanks are calculated based on the following parameters and information:

Year of construction of the storage tank needs to be specified.

The heat loss from the pipe between heat generator and storage tank depends on their location/configuration. In case they are located in the same room, the checkbox for option **Storage and generation in the same room** needs to be selected.

In case that separate circulation pump is needed for the storage system, the checkbox for option **Separate circulation pump needed** needs to be selected.

If the stand-by heat losses per day are known, this value should be entered when unchecking the option **Default standby losses per day**. In case this value is not known, then this option should be left checked and the default value (from the standard) is assumed.

If the nominal capacity of the storage tank is known, this value should be entered when unchecking the option **Default storage size**. In case this value is not known, then this option should be left checked and the default value (from the standard) is assumed. In case of bivalent solar storage tanks, there are two separate storage sections: lower (exclusively for the storage of solar heat) and upper (stand-by part). In case the nominal capacities for both sections are known, then these values should be entered when unchecking the options **Default nominal storage capacity – solar part** and **Default nominal storage capacity – stand-by part**. In case these values are not known, then these options should be left checked and the default values (from the standard) are assumed.

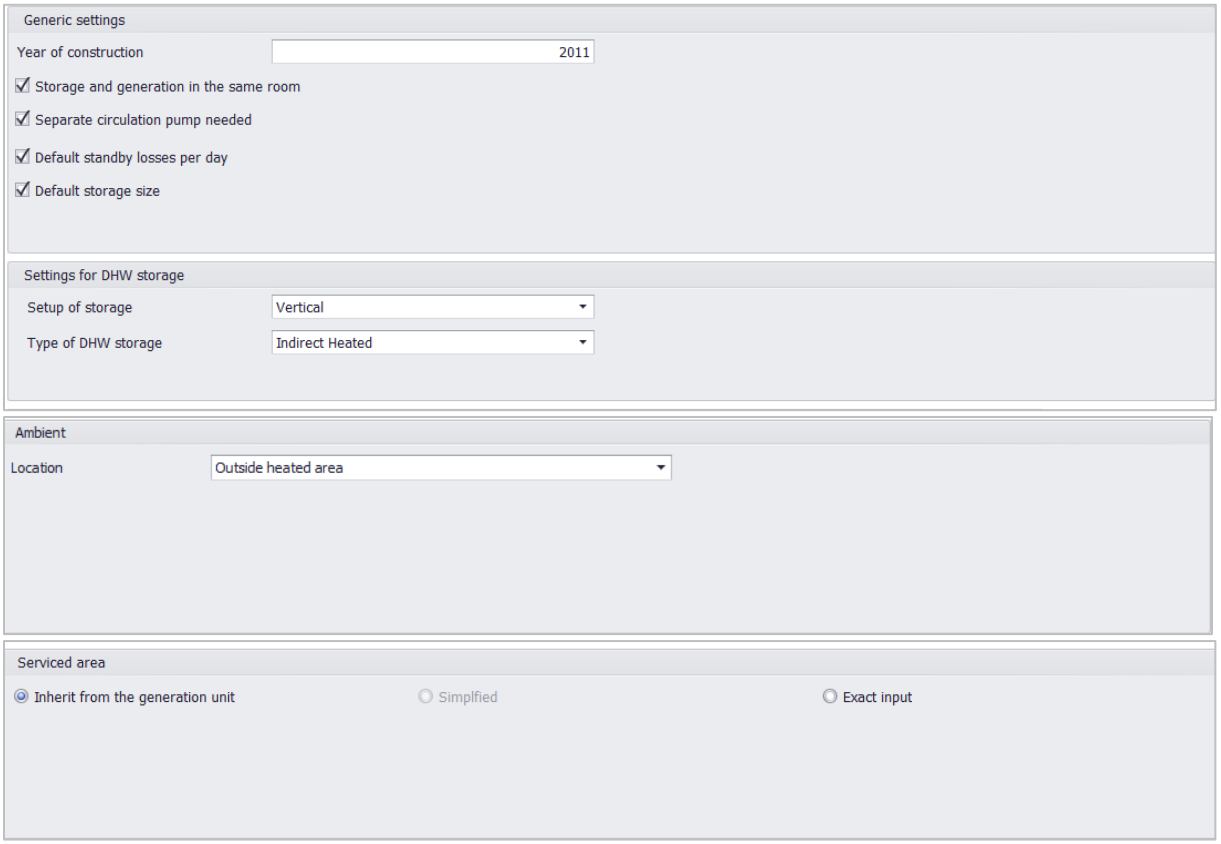


Figure 77: Input screen for defining DHW storage

Settings for DHW storage

Set-up of storage
Type of storage tank related to its set-up (vertical or horizontal) needs to be selected from the drop-down menu.

Type of DHW storage
Type of DHW storage related to the way it is heated needs to be selected from the drop-down menu: indirectly heated, electrically heated, gas-fired or bivalent solar tanks. Selection of type of storage affects the specification of parameters in the window **Generic settings** (above).

Type of electrical storage
In case of selected electrically heated storage, then the type of electrical storage needs to be selected (night or day storage).

In case of selecting bivalent solar storage tank which is used both for DHW and space heating, then this option can be entered by clicking in the checkbox **Combined solar storage**.

Ambient

Location
For the calculation of the storage losses, the location of the storage tank needs to be selected from the drop-down menu: **Outside the heated area** or **Inside the heated area** (two options: (i) **with internal gains**, i.e. storage tank is located in the heated area within the building envelope, or (ii) **without internal gains**, i.e. storage tank is located in the heated area outside the building envelope, such as the area of the adjacent building that is heated). In case the storage tank is located within certain zone(s), this option can be selected from the drop-down menu (option: **Within a zone**), whereby a new menu with a checkbox next to each zone in the building opens automatically. In addition, it is possible to enter the ambient temperature, if known, either as an annual value, or as seasonal (winter and summer) values (options: **Custom annual temperature** and **Custom seasonal temperatures**).

Serviced area

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. The characteristic energy values or energy balance shares are determined for a serviced area (and later divided among the zones of the building).

Serviced area covered by this storage system can be calculated in two ways:

- **Inherit from the generation unit**: reference geometry dimensions are taken as for the generation unit for DHW heating.

- **Exact input**: serviced area is calculated based on the calculated values for **characteristic length** and **characteristic width**. Besides characteristic length and width (that need to be previously calculated), the **number of floors** and **storey height** need to be entered as well for the calculation of serviced area. Determination of characteristic width and length can be found in the Calculation methodology in Chapter 11.

12 Input screens for the cooling systems

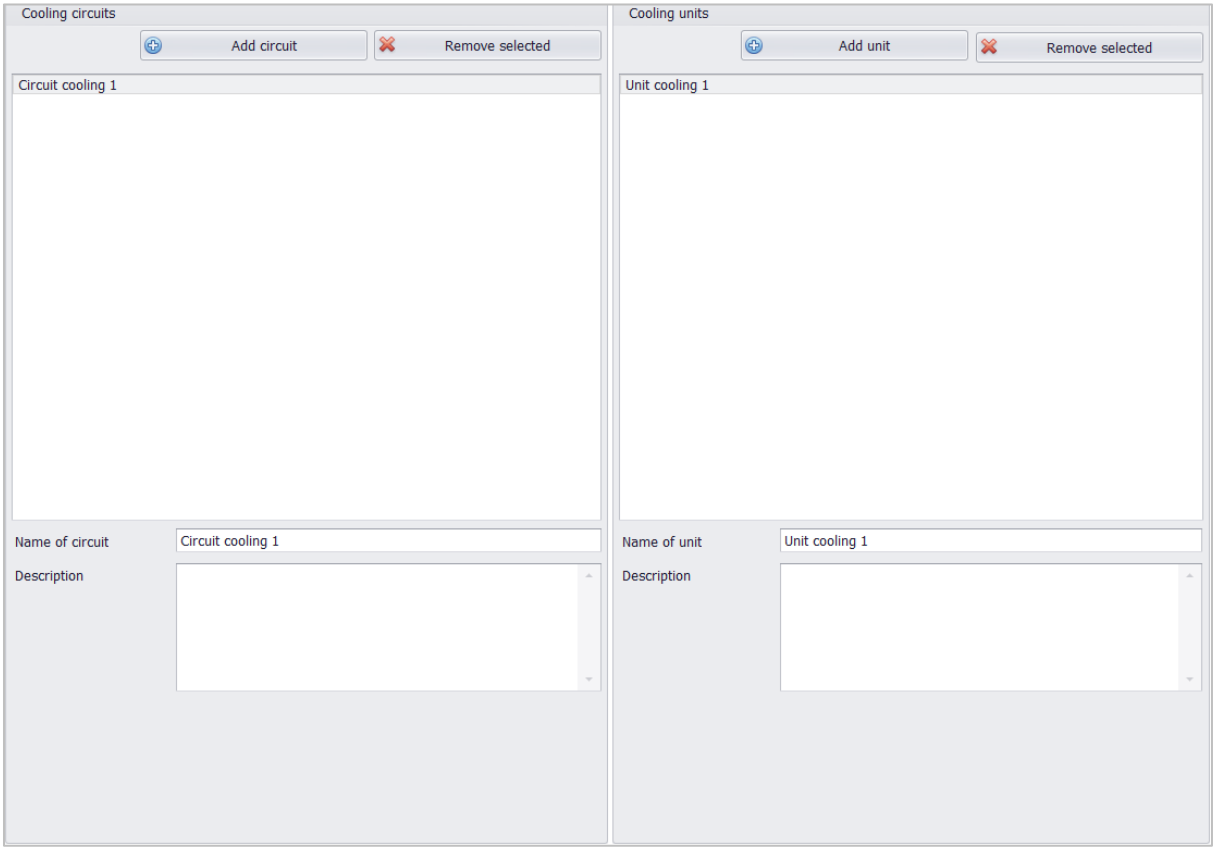


Figure 78: Input screen for defining cooling system

The cooling system configuration starts with defining the **Cooling circuit** and the related **Cooling unit**.

The cooling circuit actually represents the connection of the cooling energy generation with the zones in the building through the distribution network and related cooling emissions. The cooling circuit is defined regardless of whether it is an indirect cooling system (e.g. chilled water distribution system with fan-coil units) or direct expansion system (room air conditioning system, e.g. split systems).

The cooling unit refers to the generation of cooling energy, whether it is a central cooling energy generation (e.g. chillers), or decentral (direct expansion system, e.g. split systems).

NOTE: One cooling unit can provide the cooling energy for several cooling circuits. One cooling circuit can not be connected with several cooling units.

The cooling circuit is entered by clicking **Add circuit** button.

The name of the added cooling circuit is entered in **Name of circuit**.

Some short description of the added cooling circuit can be entered in the **Description** field.

More information and parameters of the added cooling circuit are defined afterwards in the separate screen (one lower level in navigation tree structure).

The cooling unit is entered by clicking **Add unit** button.

The name of the added cooling unit is entered in **Name of unit**.

Some short description of the added cooling unit can be entered in the **Description** field.

More information and parameters of the added cooling unit are defined afterwards in the separate screen (one lower level in navigation tree structure).

Each added cooling circuit and cooling unit may be deleted by clicking **Remove selected** button.

12.1 Cooling circuit

12.1.1 Circuit

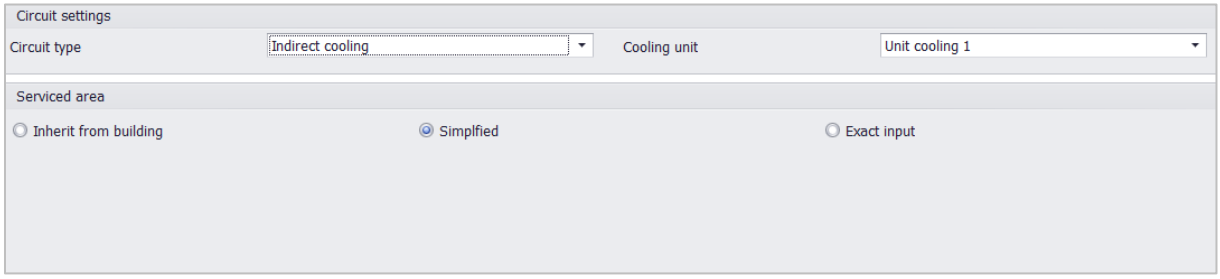


Figure 79: Input screen for defining cooling circuit

Circuit settings

Circuit type
Circuit type is selected from the drop-down menu. There are two types of cooling circuit: indirect cooling (e.g. chilled water distribution system with fan-coil units), or direct expansion system (room air conditioning system, e.g. split systems).

Cooling unit
Cooling energy generation unit that provides the cooling energy for this circuit is selected from the drop-down menu (and previously defined in **Cooling** screen).

Serviced area

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. The characteristic energy values or energy balance shares are determined for a serviced area (and later divided among the zones of the building).

Serviced area for this cooling circuit can be calculated in three ways:

- **Inherit from the building**: reference geometry dimensions are taken from the building (the case when a building is served by one cooling system/distribution network).
- **Simplified**: this approach is a simplification of the third method (**Exact input**), and it does not require any input data, since it include standard values for geometric factors depending on usage type (more data on this can be found in the Calculation methodology in Chapter 11).
- **Exact input**: serviced area is calculated based on the calculated values for **characteristic length** and **characteristic width**. Besides characteristic length and width (that need to be previously calculated), the **number of floors** and **storey height** need to be entered as well

for the calculation of serviced area. Determination of characteristic width and length can be found in the Calculation methodology in Chapter 11.

12.1.2 Cooling circuit: Pump

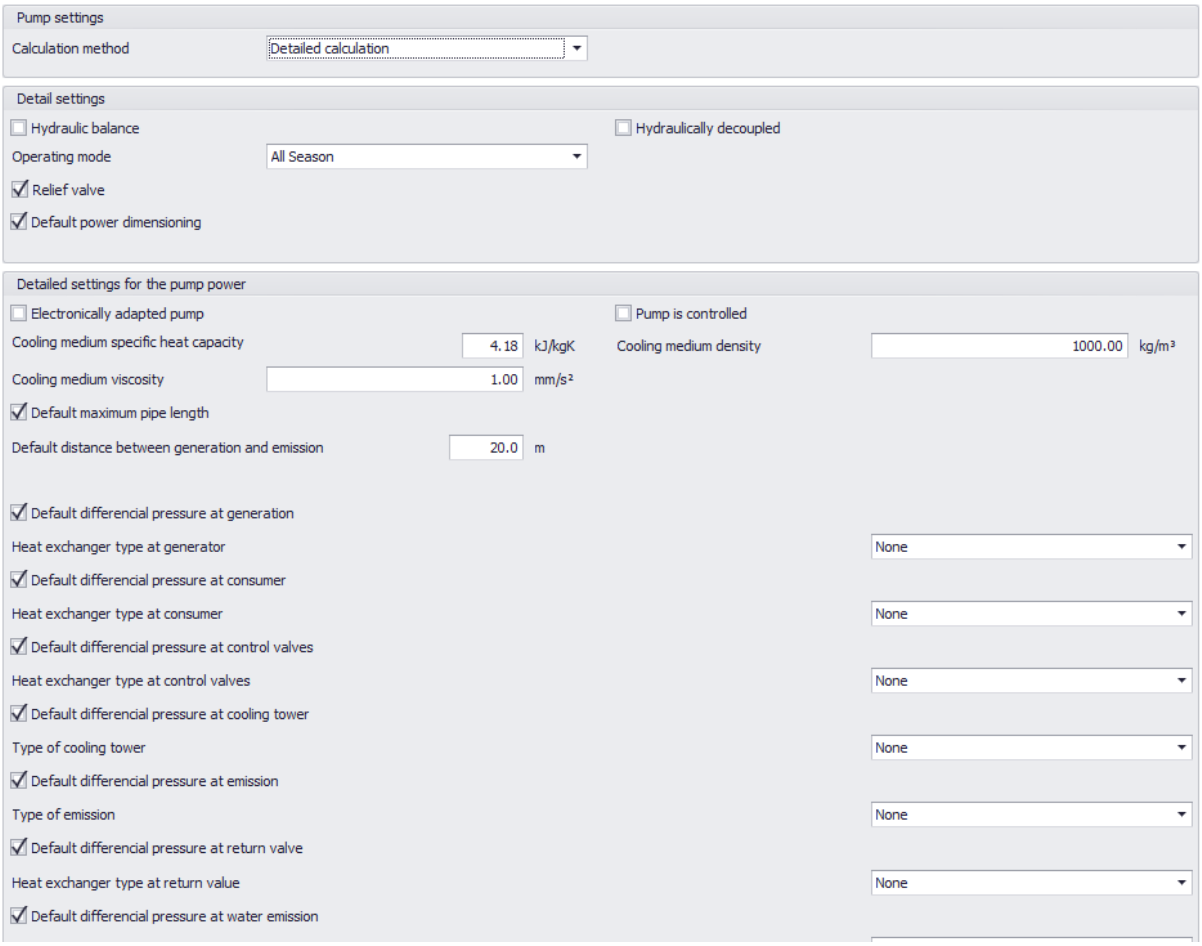


Figure 80: Input screen for defining pump in cooling circuit

In case of indirect cooling systems, the auxiliary energy demand for cooling or chilled water distribution is calculated according to the detailed procedure or, in simplified way, according to the simplified calculation.

Calculation method
Type of calculation method (detailed or simplified) is selected from the drop-down menu.

Simplified method type
In case of simplified calculation method selected, the specific electrical energy consumption is determined from the default values. The only parameter to be defined for further evaluation of the hydraulic energy requirement for distribution is selection from the drop-down menu referring to pump efficiency (low efficiency pump, medium efficiency pump, high efficiency pump). Low efficiency pump refers to distribution network with high resistance, and is characterized by seasonal operating time, unregulated pump operation, no pump adaptation, no hydraulic balancing. Medium efficiency pump refers to distribution network with average resistance, and is characterized by intermittent operating time, regulated or unregulated pump operation (standard case, usually applied in existing buildings). High efficiency pump refers to energy optimized distribution network, and is characterized by demand-driven, regulated pump operation (usually applied in new buildings).

Detailed settings

In case of selecting a detailed calculation method, a number of input data have to be defined for calculation of electrical and hydraulic energy consumption.

Hydraulic balance
In case the network is hydraulically balanced, this option should be selected by clicking in the related checkbox.

Hydraulically decoupled
In case that circuits are hydraulically decoupled, which stops water from mixing, as well as enable individual and precise control of both circuits, this option should be selected by clicking in the related checkbox.

Operating mode
Operational mode of the pump is selected from the drop-down menu. Four operating modes are distinguished: fully automated (demand-controlled operation); seasonal, night and weekend shutdown; seasonal switch-off in months without cooling demand; year-round operation of the pumps (also in periods without demand).

Relief valve
A relief valve is used to control or limit the pressure in a system, and it has effect on the average hydraulic demand. In case it exists in the system, this option should be selected by clicking in the related checkbox.

Overflow ratio
In case that relief valve exists in the system, the overflow ratio needs to be specified.

Power dimensioning
In case that electrical power consumption of the pump is known, the checkbox **Default power dimensioning** needs to be unchecked and the value for the power should be entered in [W]. In case this value is not available, the checkbox should remain checked and the default pump power dimensioning will take place (window for detailed settings for the pump power shows up).

Detailed settings for the pump power

Electronically adapted pump
If the pump is electronically adapted, which means that it adjusts its efficiency and energy consumption in such a way as to optimize the correct operation of the system, then this option needs to be selected by clicking in the related checkbox.

Pump is controlled
If pump operation is controlled, then this option needs to be selected by clicking in the related checkbox.

Cooling medium specific heat capacity
Specific heat capacity of the cooling medium need to be entered in [kJ/kg·K].

Cooling medium density
Density of the cooling medium need to be entered in [kg/m^3].

Cooling medium viscosity
Viscosity of the cooling medium need to be entered in [mm/s^2].

Default maximum pipe length
If maximum pipe length in distribution circuit is known, then this checkbox needs to be unchecked and the value for the maximum pipe length should be entered in [m]. In case this value is not available, the checkbox should remain checked, and the default value is assumed.

Default distance between generation and emission
If distance between generation and emission of cooling energy is known, then this checkbox needs to be unchecked and the value for the distance should be entered in [m]. In case this value is not available, the checkbox should remain checked, and the default value is assumed.

For each of the distribution circuit components (heat exchangers at **generator**, **consumer**, **control valve**, **cooling tower**, **emission**, **return valve**, **water emission**), if default values for **differential pressure** are assumed, then the related checkboxes should be selected (checked). In addition, from the drop-down menu related to each of these components, the adequate option needs to be selected (please see below). In case that default values for differential pressures are not used, then related checkboxes need to be unchecked and the known values should be entered in [kPa].

Heat exchanger type at generator
The type of heat exchanger at the cooling energy generator needs to be selected from the drop-down menu (plate evaporator, tube evaporator, condenser). If it does not exist, the option "none" should be selected.

Heat exchanger type at consumer
The type of heat exchanger at the consumer needs to be selected from the drop-down menu (central air heater, central air cooler, induction units, cooling ceilings convectors). If it does not exist, the option "none" should be selected.

Type of control valves
The type of control valve needs to be selected from the drop-down menu (throttle valve – open/closed, throttle valve – continuous, three-way valve – diverter). If it does not exist, the option "none" should be selected.

Type of cooling tower
The type of cooling tower needs to be selected from the drop-down menu (open, closed). If it does not exist, the option "none" should be selected.

Type of emission
The option for emission needs to be selected from the drop-down menu (none/hydraulic transfer).

Type of return value
The option for return value needs to be selected from the drop-down menu (none, non-return valve).

Type of water emission
The option for water emission needs to be selected from the drop-down menu (none, water/water).

12.1.3 Cooling circuit: Cooling emissions

All cooling emissions that belong to this cooling circuit should be added in this screen.

The cooling emission is entered by clicking **Add emission** button.

The name of the added cooling emission is entered in **Name of emission**.

Some short description of the added cooling emission can be entered in the **Description** field.

More information and parameters of the added cooling emission are defined afterwards in the separate window (one lower level in navigation tree structure).

Each added cooling emission may be deleted by clicking **Remove selected** button.

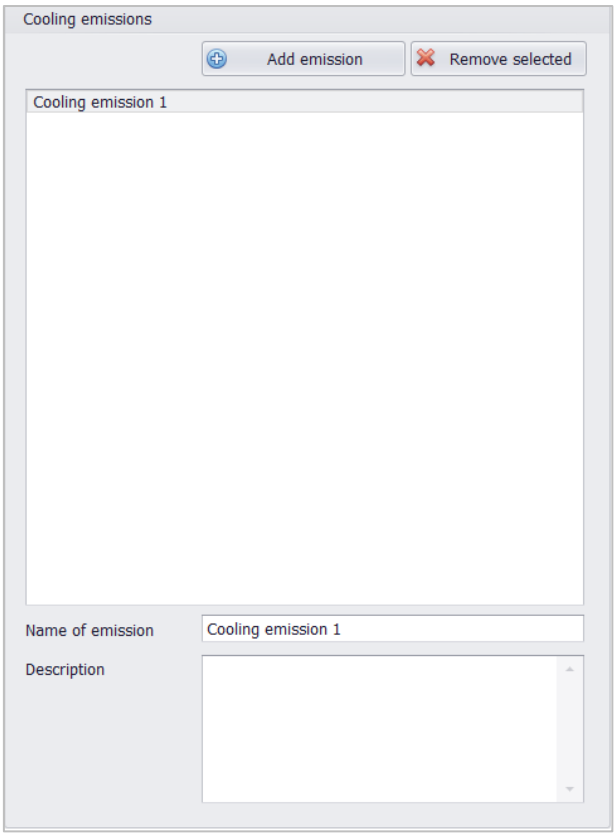


Figure 81: Input screen for adding cooling emissions in the circuit

12.1.4 Cooling circuit: Detail results

The calculation results for this cooling circuit are displayed in details.

Energy results for this cooling circuit overview the energy need, system losses due to control and emission, and system losses due to distribution. These results refer to the conventional cooling systems (panel cooling, fan coil units, split units, etc.). The total values on an annual basis are given, as well as a small graph representing their distibution over the course of the year.

Delivered energy for auxiliary energy (energy additionally required by the cooling system in order to provide energy supply, e.g. energy for pumps, fans, control, electronics etc.) is also calculated. Auxiliary energy quantities of control and emission, and distribution are determined and presented individually.

12.2 Cooling emission

Emission settings

Type of emission
Type of emission added in **Cooling circuit** screen (one level up in the navigation tree structure) needs to be defined by selecting one of the options from the drop-down menu: chilled water of different flow/return temperatures: 6/12°, 14/18° and 18/20° (for indirect cooling systems) or split/multi-split units (for direct expansion systems).

System temperatures (flow/return)

If default values for flow and return temperatures are assumed then this option should be selected by clicking in the checkbox **Default system temperatures (flow/return)**. If this is not the case, this box should be unchecked and the flow and return temperatures should be entered in °C.

Specific auxiliary energy
If default value for specific auxiliary energy for the control system is assumed then this option should be selected by clicking in the checkbox **Default specific auxiliary energy**. If this is not the case, this box should be unchecked and the value for specific auxiliary energy should be entered in kW/kW.

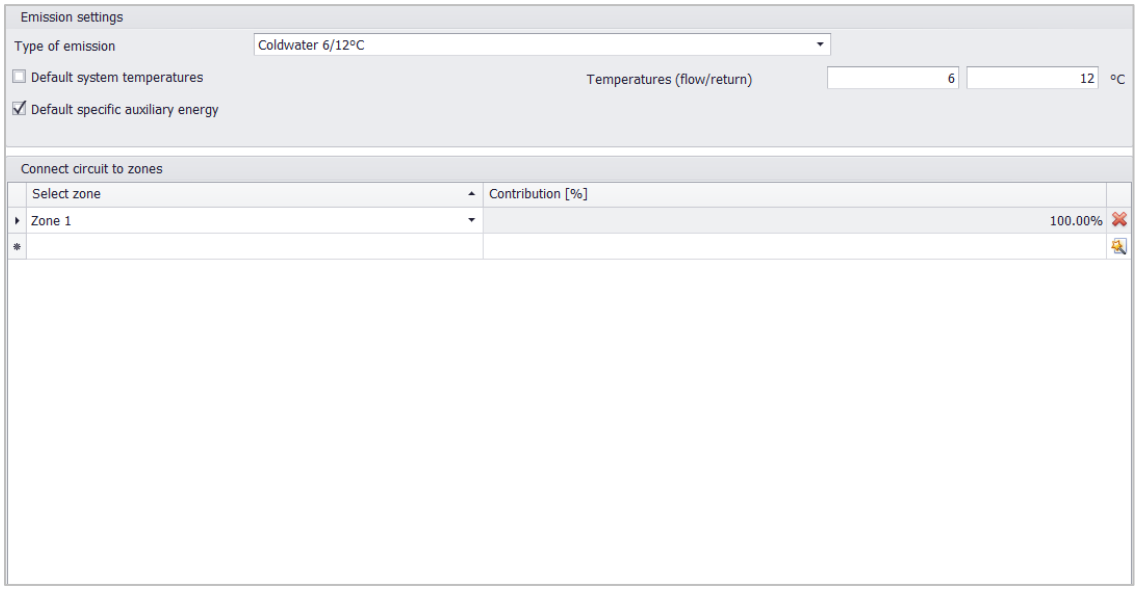


Figure 82: Input screen for defining cooling emissions and connection to zones

Connect circuit to zones

In this window all zones in which these cooling emissions are represented need to be selected from the drop-down list that appears when clicking each empty field in the column **Select zone**. After that, it is necessary to specify the share (in percentages) of the respective cooling emissions in this zone.

Cooling demand for each zone that is designated as cooled (in **Zone data** screen) need to be fulfilled, which means that if different cooling emissions from the same cooling circuit, or cooling emissions from different cooling circuits provide cooling for a certain zone, then total share of all cooling emissions for this zone has to be 100 %. If this is not the case, the programme sends the warning message that the cooling demand is not fulfilled or it is overfulfilled for this zone, and further action in this regard is required.

For easier entry of data for contribution of respective cooling emissions to the zones, there is a wizard icon (just below the listed zones and connected cooling emissions), that allows the programme to automatically adjust cooling demand requirement for this cooling circuit.

12.3 Cooling unit

Cooling generation unit that provides cooling energy for this cooling circuit has been added previously in **Cooling** screen (as **Cooling unit**), but the unit's configuration (generator with or without storage; primary and recooling circuit, if any), the type of generator and related serviced area need to be defined here.

Cooling generator is selected from the dropdown menu, where the following options are available:

- Split/multi-split unit (direct expansion systems);
- Compression chiller (indirect cooling systems);
- Absorption chiller (indirect cooling systems);
- Geothermal cooling with ground water (indirect cooling systems);
- Geothermal cooling with ground probes (indirect cooling systems).

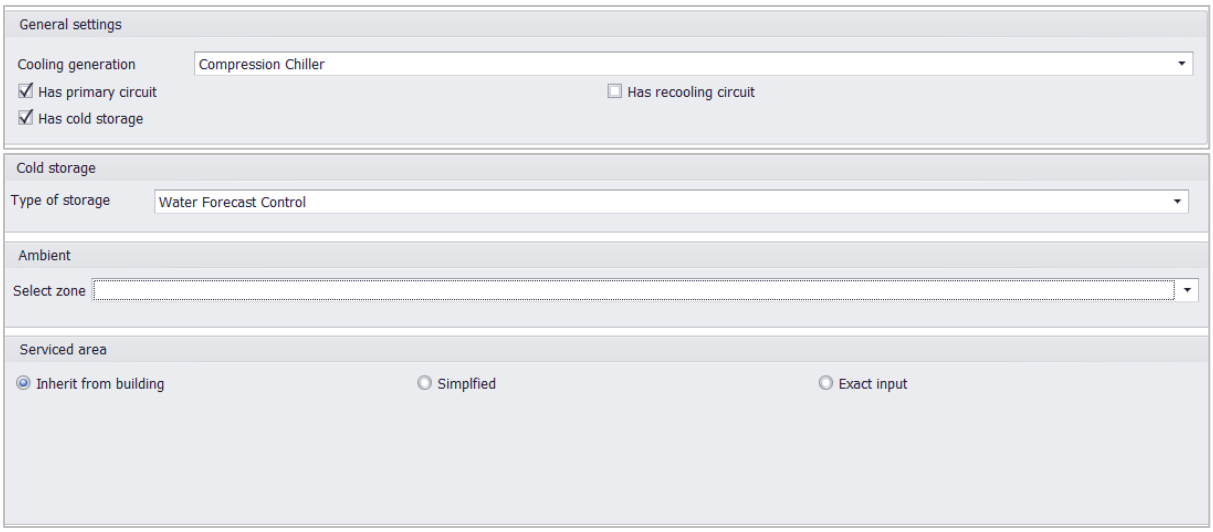


Figure 83: Input screen for defining cooling generator

In case of cooling system with primary side, i.e. containing the chillers and the primary pumps, this option should be selected by clicking in the checkbox **Has primary circuit**. A new tab related to the primary pumps automatically appear (tab **Primary pump**).

Generally, the delivered energy for cooling is the sum of the energy use of the cooling generator and the energy use of the recooling process. **Recooling** refers to the cooling of the cooling water output temperature before it is further cooled down in the chiller (e.g. evaporative cooling towers with open or closed cooling circuit, air/water dry coolers, etc.). In case the recooling process is present in the cooling system, then this option should be selected by clicking in the checkbox **Has recooling circuit**. A new tab related to the pumps for recooling process automatically appear (tab **Recooling pump**).

In case that cold storage systems are used for load management and control of the generator (chiller), then this option should be selected by clicking in the checkbox **Has cold storage**. When selecting this option, the window related to a cold storage appears (below the **General settings**).

Cold storage

In case the cold storage systems are used, the **Type of storage** needs to be selected from the drop-down menu. It refers to different options for operating modes/control concepts (weather forecast control, storage tank discharge on the following day in parallel with chiller, peak load storage, and back-up storage – either for water reservoir or ice storage).

Ambient

In case the cold storage systems are used, the location of the storage needs to be defined by selecting the adequate zone from the drop-down menu **Select zone**.

Serviced area

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. The characteristic energy values or energy balance shares are determined for a serviced area (and later divided among the zones of the building).

Serviced area covered by this cooling unit can be calculated in three ways:

- **Inherit from the building**: reference geometry dimensions are taken from the building (the case when a building is served by one cooling unit).

- **Simplified**: this approach is a simplification of the third method (**Exact input**), and it does not require any input data, since it include standard values for geometric factors depending on usage type (more data on this can be found in the Calculation methodology in Chapter 11).

- **Exact input**: serviced area is calculated based on the calculated values for **characteristic length** and **characteristic width**. Besides characteristic length and width (that need to be previously calculated), the **number of floors** and **storey height** need to be entered as well for the calculation of serviced area. Determination of characteristic width and length can be found in the Calculation methodology in Chapter 11.

12.3.1 Cooling generator: Split/Multi-split/VRF

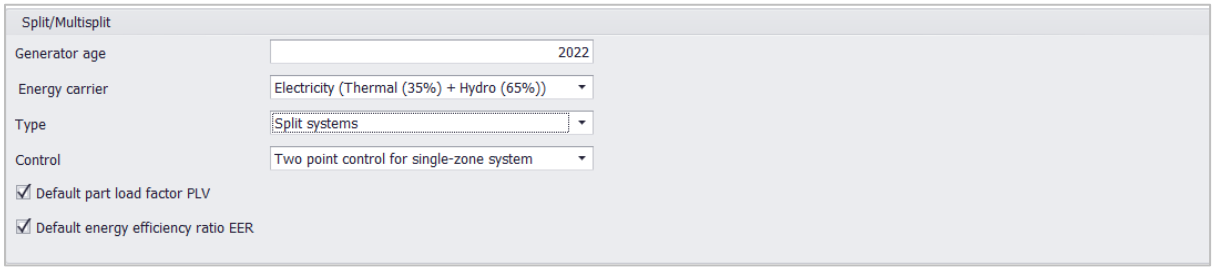


Figure 84: Input screen for defining cooling generator – split/multi-split/VRF

Generator age
Enter the year of construction for the generation unit/system.

Energy carrier
Energy carrier used by the generation unit/system is selected from the drop-down menu.

Type
Type of generation unit/system is selected from the drop-down menu: compact unit, split system, multi-split system and VRF system.

Control
Type of control of the unit/system is selected from the drop-down menu: two-point control (ON/OFF) or continous control, for single-zone and multi-zone systems.

The **energy efficiency ratio** of cooling (**EER**) indicates the ratio of the cooling output provided by a generation unit relative to the amount of electricity input required to generate it (under design operating conditions). If a default value for energy efficiency ratio is to be used, then this option should be selected by clicking in the checkbox **Default energy efficiency ratio (EER)**. If this is not the case, this box should be unchecked and the known EER value for this generation unit should be entered.

The energy efficiency ratio of cooling generation units varies under partial load conditions. The variable conditions are represented by the technology-dependent **part load value** (**PLV**). If a default value for part load value is to be used, then this option should be selected by clicking in the checkbox **Default**

part load factor (PLV). If this is not the case, this box should be unchecked and the known PLV value for this generation unit should be entered.

12.3.2 Cooling generator: Compression chiller

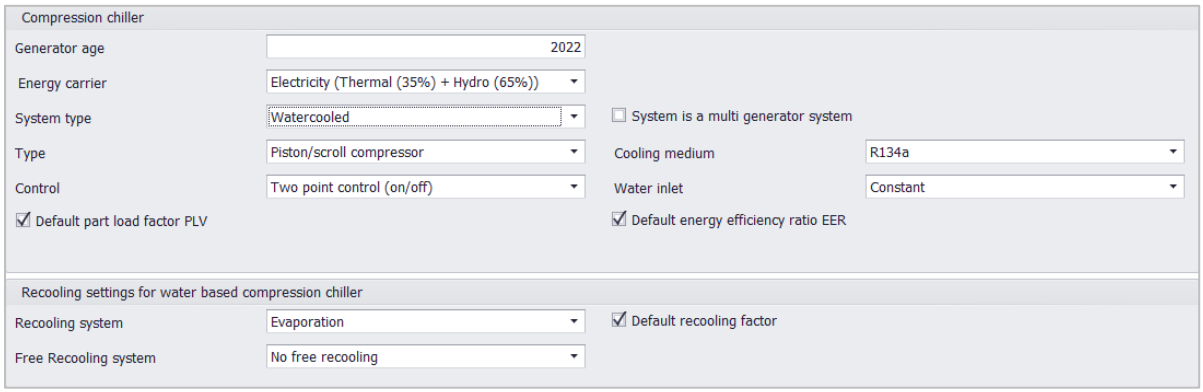


Figure 85: Input screen for defining cooling generator – compression chiller

Generator age
Enter the year of construction for the compression chiller.

Energy carrier
Energy carrier used by the compression chiller is selected from the drop-down menu.

System type
Compressor-type cooling unit is selected from the drop-down menu: water-cooler and air-cooled.

Type
Type of compressor is selected from the drop-down menu: piston/scroll compressor, screw compressor and turbo compressor.

Control
For selected type of compressor, a type of control is selected from the drop-down menu: two-point control (ON/OFF), multi-stage control, individual cylinder shut-off, hot-gas bypass control and inverter control.

Cooling medium
Type of refrigerant used in the chiller plant is selected from the drop-down menu.

Water inlet
Cooling water conditions (control) is defined by selecting an option from the drop-down menu (constant or variable).

In case of multiple-generation units in parallel or sequential operation, this option should be selected by clicking in the checkbox **System is a multi-generator system**. If selecting this option, the window **Multi-generator settings** appear below.

The **energy efficiency ratio** of cooling (**EER**) indicates the ratio of the cooling output provided by a generation unit relative to the amount of electricity input required to generate it (under design operating conditions). If a default value for energy efficiency ratio is to be used, then this option should be selected by clicking in the checkbox **Default energy efficiency ratio (EER)**. If this is not the case, this checkbox should be unchecked and the known EER value for this generation unit should be entered.

The energy efficiency ratio of cooling generation units varies under partial load conditions. The variable conditions are represented by the technology-dependent **part load value** (**PLV**). If a default value for

part load value is to be used, then this option should be selected by clicking in the checkbox **Default part load factor (PLV)**. If this is not the case, this checkbox should be unchecked and the known PLV value for this generation unit should be entered.

Recooling settings for water-based compression chiller

Recooling system
Type of recooling system (evaporative/dry) is selected from the drop-down menu.

Free recooling system
The option for free coolling in recooling system needs to be selected from the drop-down menu (no free cooling, or free cooling in alternaltive/parallel operating mode).

If a default value for recooling factor is to be used, then this option should be selected by clicking in the checkbox **Default recooling factor**. If this is not the case, this box should be unchecked and the known value for recooling factor should be entered.

Free cooling settings for air-based compression chiller

Free cooling system
The option for free coolling with air-cooled compression chillers needs to be selected from the drop-down menu (no free cooling, or free cooling with heat exchangers).

If a default value for free cooling factor is to be used, then this option should be selected by clicking in the checkbox **Default free cooling factor**. If this is not the case, this box should be unchecked and the known value for free cooling factor should be entered.

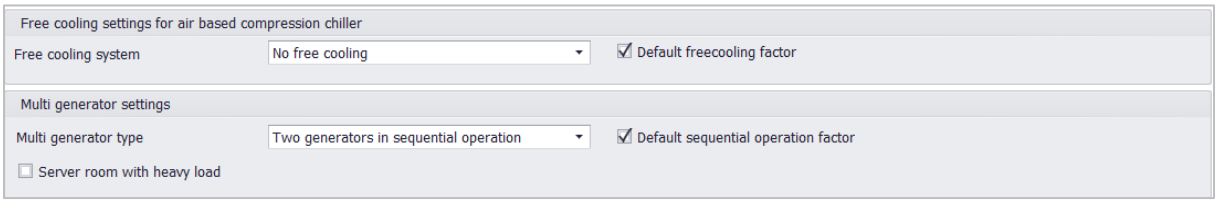


Figure 86: Input screen for defining free cooling for air-based compression chiller

Multi-generator settings

Multi generator type
Type of multi-generator system in relation to the number of generators and the nominal power ratio (P_{max}/P_{min}), as well as the operation mode (parallel/sequential), is selected from the drop-down menu.

In case of parallel operation, the factor influenced by parallel operation (dependent on partial load control) needs to be defined, either by entering the known value, or by using the default value (from the standard). If later is the case, then this option is selected by clicking in the checkbox **Default parallel operation factor**.

In case of sequential operation, the factor influenced by sequential operation (dependent on partial load control) needs to be defined, either by entering the known value, or by using the default value (from the standard). If later is the case, then this option is selected by clicking in the checkbox **Default sequential operation factor**.

In case that location of the system is server room with heavy load (500 W/m^2), then this option should be selected by clicking in the checkbox **Server room with heavy load**.

12.3.3 Cooling generator: Geothermal cooling with ground probes

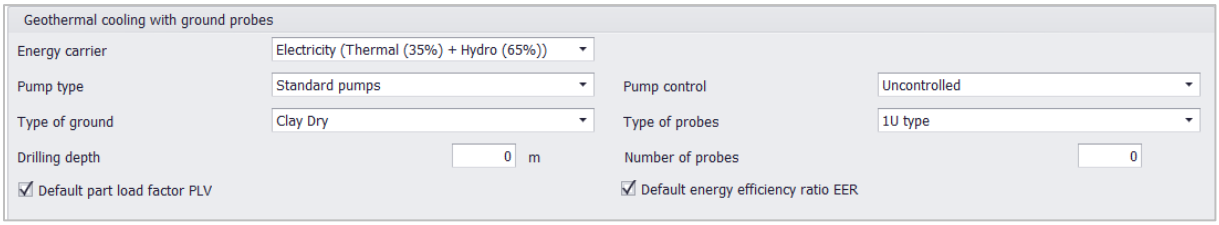


Figure 87: Input screen for defining cooling generator – geothermal cooling with ground probes

Energy carrier
Energy carrier used by the geothermal cooling system is selected from the drop-down menu.

Pump type
Efficiency of the pumps used in geothermal probe system is selected from the drop-down menu (standard pumps, high-efficiency pumps).

Pump control
The option for the control of the pumps used in geothermal probe system is selected from the drop-down menu (uncontrolled, controlled).

Type of ground
Type of ground is selected from the drop-down menu (clay dry, limestone, quarzit).

Type of probes
Type of geothermal probes is selected from the drop-down menu (1U, 2U).

Drilling depth
Drilling depth of the geothermal probe field needs to be entered in [m].

Number of probes
Number of installed geothermal probes needs to be entered.

The **energy efficiency ratio** of cooling (**EER**) indicates the ratio of the cooling output provided by a generation unit relative to the amount of electricity input required to generate it (under design operating conditions). If a default value for energy efficiency ratio is to be used, then this option should be selected by clicking in the checkbox **Default energy efficiency ratio (EER)**. If this is not the case, this checkbox should be unchecked and the known EER value for this generation unit should be entered.

The energy efficiency ratio of cooling generation units varies under partial load conditions. The variable conditions are represented by the technology-dependent **part load value** (**PLV**). If a default value for part load value is to be used, then this option should be selected by clicking in the checkbox **Default part load factor (PLV)**. If this is not the case, this checkbox should be unchecked and the known PLV value for this generation unit should be entered.

12.3.4 Cooling generator: Geothermal cooling with ground water

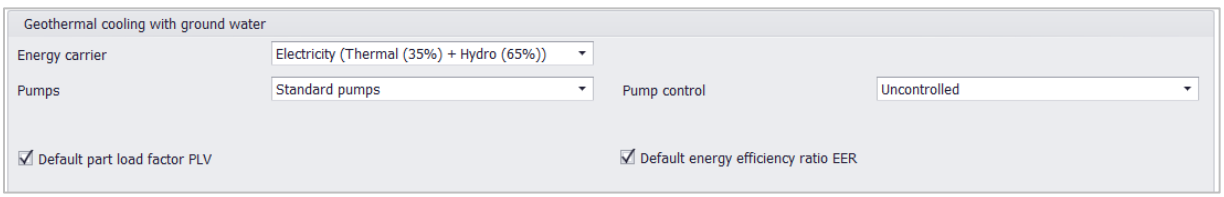


Figure 88: Input screen for defining cooling generator – geothermal cooling with ground water

Energy carrier
Energy carrier used by the geothermal cooling system is selected from the drop-down menu.

Pumps
Efficiency of the pumps used in geothermal cooling system with groundwater is selected from the drop-down menu (standard pumps, high-efficiency pumps).

Pump control
The option for the control of the pumps used in geothermal cooling system with groundwater is selected from the drop-down menu (uncontrolled, controlled).

Approved return temperature of the water
Permitted return temperature of the water needs to be entered in [°C].

The **energy efficiency ratio** of cooling (**EER**) indicates the ratio of the cooling output provided by a generation unit relative to the amount of electricity input required to generate it (under design operating conditions). If a default value for energy efficiency ratio is to be used, then this option should be selected by clicking in the checkbox **Default energy efficiency ratio (EER)**. If this is not the case, this checkbox should be unchecked and the known EER value for this generation unit should be entered.

The energy efficiency ratio of cooling generation units varies under partial load conditions. The variable conditions are represented by the technology-dependent **part load value** (**PLV**). If a default value for part load value is to be used, then this option should be selected by clicking in the checkbox **Default part load factor (PLV)**. If this is not the case, this checkbox should be unchecked and the known PLV value for this generation unit should be entered.

12.3.5 Cooling generator: Absorption chiller

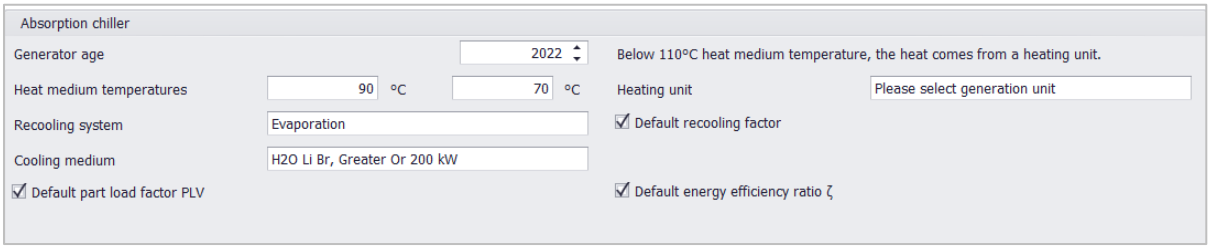


Figure 89: Input screen for defining cooling generator – absorption chiller

Generator age
Enter the year of construction for the absorption chiller.

Cooling medium
Type of refrigerant used in the chiller plant is selected from the drop-down menu.

Heat medium temperatures
Temperatures of the heat medium (flow and return) need to be entered.
For heat medium temperature below 110°C, the heat is provided by a heating unit (defined in **Heating** screen). For heat medium temperature over 110°C, the steam is generated.

Heating unit
Generation unit that is providing heat for this absorption chiller needs to be selected from the drop-down menu. The menu contains heating units defined in **Heating** screen.

Recooling system
Type of recooling system (evaporative/dry) is selected from the drop-down menu.

If a default value for recooling factor is to be used, then this option should be selected by clicking in the checkbox **Default recooling factor**. If this is not the case, this box should be unchecked and the known value for recooling factor should be entered.

The efficiency of an absorption chiller is measured by the **nominal heat ratio** (ζ), which represents the ratio of the nominal cooling output provided by a generation unit relative to the amount of the thermal power (under design operating conditions). If a default value for nominal heat ratio is to be used, then this option should be selected by clicking in the checkbox **Default nominal heat ratio** (ζ). If this is not the case, this checkbox should be unchecked and the known ζ value for this generation unit should be entered.

The energy efficiency ratio of cooling generation units varies under partial load conditions. The variable conditions are represented by the technology-dependent **part load value** (**PLV**). If a default value for part load value is to be used, then this option should be selected by clicking in the checkbox **Default part load factor (PLV)**. If this is not the case, this checkbox should be unchecked and the known PLV value for this generation unit should be entered.

12.3.6 Cooling unit: Primary pump

In case of cooling system with primary side (i.e. containing the chillers and the primary pumps), the auxiliary energy demand for chilled water distribution is calculated according to the detailed procedure or, in simplified way, according to the simplified calculation.

Calculation method
Type of calculation method (detailed or simplified) is selected from the drop-down menu.

Simplified method type
In case of simplified calculation method selected, the specific electrical energy consumption is determined from the default values. The only parameter to be defined for further evaluation of the hydraulic energy requirement for distribution is selection from the drop-down menu referring to pump efficiency (low efficiency pump, medium efficiency pump, high efficiency pump). Low efficiency pump refers to distribution network with high resistance, and is characterized by seasonal operating time, unregulated pump operation, no pump adaptation, no hydraulic balancing. Medium efficiency pump refers to distribution network with average resistance, and is characterized by intermittent operating time, regulated or unregulated pump operation (standard case, usually applied in existing buildings). High efficiency pump refers to energy optimized distribution network, and is characterized by demand-driven, regulated pump operation (usually applied in new buildings).

Detailed settings

In case of selecting a detailed calculation method, a number of input data have to be defined for calculation of electrical and hydraulic energy consumption.

Hydraulic balance
In case the network is hydraulically balanced, this option should be selected by clicking in the related checkbox.

Hydraulically decoupled
In case that circuits are hydraulically decoupled, which stops water from mixing, as well as enable individual and precise control of both circuits, this option should be selected by clicking in the related checkbox.

Operating mode
Operational mode of the pump is selected from the drop-down menu. Four operating modes are distinguished: fully automated (demand-controlled operation); seasonal, night and weekend shutdown; seasonal switch-off in months without cooling demand; year-round operation of the pumps (also in periods without demand).

Relief valve
A relief valve is used to control or limit the pressure in a system, and it has effect on the average hydraulic demand. In case it exists in the system, this option should be selected by clicking in the related checkbox.

Overflow ratio
In case that relief valve exists in the system, the overflow ratio needs to be specified.

Power dimensioning
In case that electrical power consumption of the pump is known, the checkbox **Default power dimensioning** needs to be unchecked and the value for the power should be entered in [W]. In case this value is not available, the checkbox should remain checked and the default pump power dimensioning will take place (window for detailed settings for the pump power shows up).

Detailed settings for the pump power

Electronically adapted pump
If the pump is electronically adapted, which means that it adjusts its efficiency and energy consumption in such a way as to optimize the correct operation of the system, then this option needs to be selected by clicking in the related checkbox.

Pump is controlled
If pump operation is controlled, then this option needs to be selected by clicking in the related checkbox.

Cooling medium specific heat capacity
Specific heat capacity of the cooling medium need to be entered in [kJ/kg·K].

Cooling medium density
Density of the cooling medium need to be entered in [kg/m^3].

Cooling medium viscosity
Viscosity of the cooling medium need to be entered in [mm/s^2].

Default maximum pipe length
If maximum pipe length in distribution circuit is known, then this checkbox needs to be unchecked and the value for the maximum pipe length should be entered in [m]. In case this value is not available, the checkbox should remain checked, and the default value is assumed.

Default distance between generation and emission
If distance between generation and emission of cooling energy is known, then this checkbox needs to be unchecked and the value for the distance should be entered in [m]. In case this value is not available, the checkbox should remain checked, and the default value is assumed.

For each of the distribution circuit components (heat exchangers at **generator**, **consumer**, **control valve**, **cooling tower**, **emission**, **return valve**, **water emission**), if default values for **differential pressure** are assumed, then the related checkboxes should be selected (checked). In addition, from the drop-down menu related to each of these components, the adequate option needs to be selected (please see below). In case that default values for differential pressures are not used, then related checkboxes need to be unchecked and the known values should be entered in [kPa].

Heat exchanger type at generator
The type of heat exchanger at the cooling energy generator needs to be selected from the drop-down menu (plate evaporator, tube evaporator, condenser). If it does not exist, the option "none" should be selected.

Heat exchanger type at consumer

The type of heat exchanger at the consumer needs to be selected from the drop-down menu (central air heater, central air cooler, induction units, cooling ceilings convectors). If it does not exist, the option "none" should be selected.

Type of control valves
The type of control valve needs to be selected from the drop-down menu (throttle valve – open/closed, throttle valve – continuous, three-way valve – diverter). If it does not exist, the option "none" should be selected.

Type of cooling tower
The type of cooling tower needs to be selected from the drop-down menu (open, closed). If it does not exist, the option "none" should be selected.

Type of emission
The option for emission needs to be selected from the drop-down menu (none/hydraulic transfer).

Type of return value
The option for return value needs to be selected from the drop-down menu (none, non-return valve).

Type of water emission
The option for water emission needs to be selected from the drop-down menu (none, water/water).

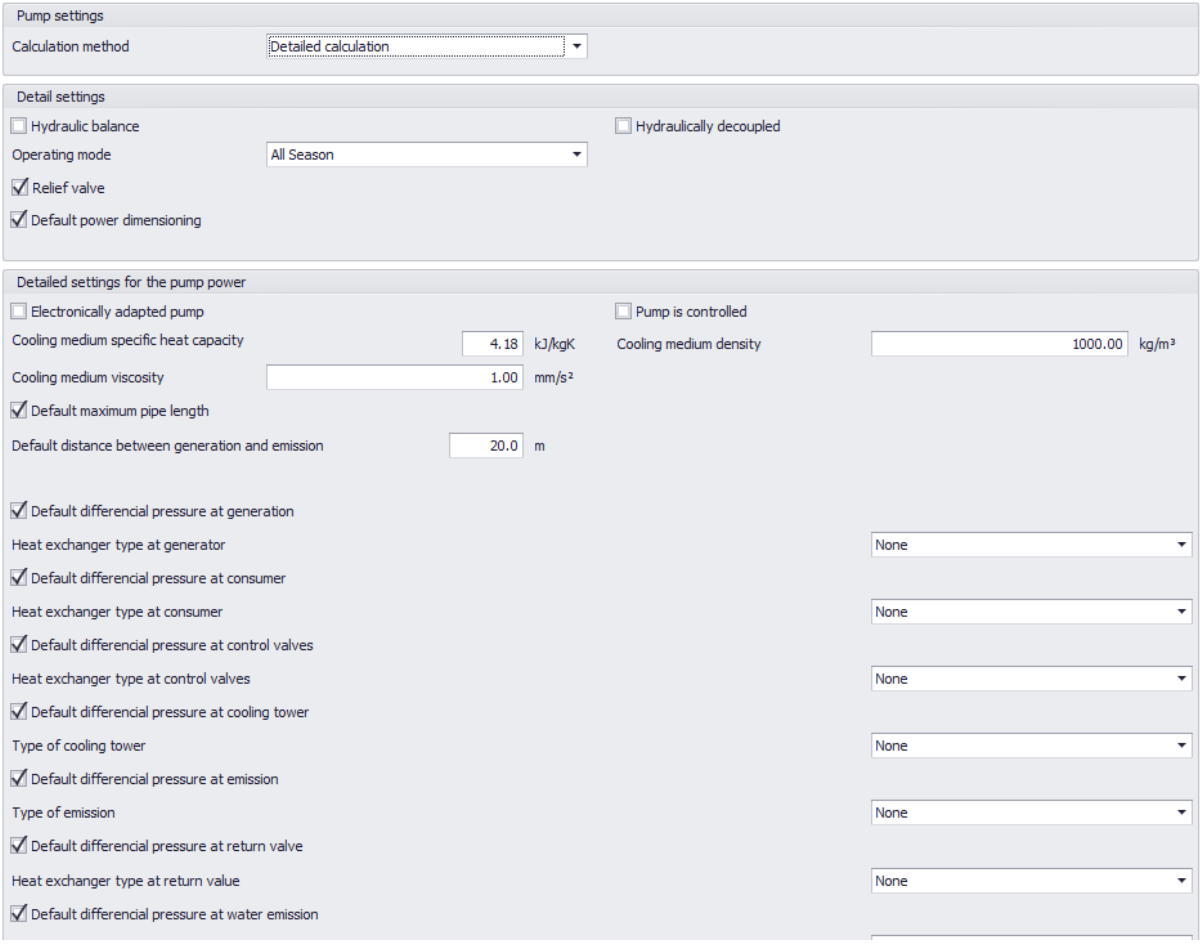


Figure 90: Input screen for defining pump in cooling systems

12.3.7 Cooling unit: Recooling pump

In case that recooling process is present in the cooling system, the auxiliary energy demand for recooling pump is calculated according to the detailed procedure or, in simplified way, according to the simplified calculation.

Calculation method
Type of calculation method (detailed or simplified) is selected from the drop-down menu.

Simplified method type
In case of simplified calculation method selected, the specific electrical energy consumption is determined from the default values. The only parameter to be defined for further evaluation of the hydraulic energy requirement for distribution is selection from the drop-down menu referring to pump efficiency (low efficiency pump, medium efficiency pump, high efficiency pump). Low efficiency pump refers to distribution network with high resistance, and is characterized by seasonal operating time, unregulated pump operation, no pump adaptation, no hydraulic balancing. Medium efficiency pump refers to distribution network with average resistance, and is characterized by intermittent operating time, regulated or unregulated pump operation (standard case, usually applied in existing buildings). High efficiency pump refers to energy optimized distribution network, and is characterized by demand-driven, regulated pump operation (usually applied in new buildings).

Detailed settings

In case of selecting a detailed calculation method, a number of input data have to be defined for calculation of electrical and hydraulic energy consumption.

Hydraulic balance
In case the network is hydraulically balanced, this option should be selected by clicking in the related checkbox.

Hydraulically decoupled
In case that circuits are hydraulically decoupled, which stops water from mixing, as well as enable individual and precise control of both circuits, this option should be selected by clicking in the related checkbox.

Operating mode
Operational mode of the pump is selected from the drop-down menu. Four operating modes are distinguished: fully automated (demand-controlled operation); seasonal, night and weekend shutdown; seasonal switch-off in months without cooling demand; year-round operation of the pumps (also in periods without demand).

Relief valve
A relief valve is used to control or limit the pressure in a system, and it has effect on the average hydraulic demand. In case it exists in the system, this option should be selected by clicking in the related checkbox.

Overflow ratio
In case that relief valve exists in the system, the overflow ratio needs to be specified.

Power dimensioning
In case that electrical power consumption of the pump is known, the checkbox **Default power dimensioning** needs to be unchecked and the value for the power should be entered in [W]. In case this value is not available, the checkbox should remain checked and the default pump power dimensioning will take place (window for detailed settings for the pump power shows up).

Detailed settings for the pump power

Electronically adapted pump
If the pump is electronically adapted, which means that it adjusts its efficiency and energy consumption in such a way as to optimize the correct operation of the system, then this option needs to be selected by clicking in the related checkbox.

Pump is controlled
If pump operation is controlled, then this option needs to be selected by clicking in the related checkbox.

Cooling medium specific heat capacity
Specific heat capacity of the cooling medium need to be entered in [kJ/kg·K].

Cooling medium density
Density of the cooling medium need to be entered in [kg/m^3].

Cooling medium viscosity
Viscosity of the cooling medium need to be entered in [mm/s^2].

Default maximum pipe length
If maximum pipe length in distribution circuit is known, then this checkbox needs to be unchecked and the value for the maximum pipe length should be entered in [m]. In case this value is not available, the checkbox should remain checked, and the default value is assumed.

Default distance between generation and emission
If distance between generation and emission of cooling energy is known, then this checkbox needs to be unchecked and the value for the distance should be entered in [m]. In case this value is not available, the checkbox should remain checked, and the default value is assumed.

For each of the distribution circuit components (heat exchangers at **generator**, **consumer**, **control valve**, **cooling tower**, **emission**, **return valve**, **water emission**), if default values for **differential pressure** are assumed, then the related checkboxes should be selected (checked). In addition, from the drop-down menu related to each of these components, the adequate option needs to be selected (please see below). In case that default values for differential pressures are not used, then related checkboxes need to be unchecked and the known values should be entered in [kPa].

Heat exchanger type at generator
The type of heat exchanger at the cooling energy generator needs to be selected from the drop-down menu (plate evaporator, tube evaporator, condenser). If it does not exist, the option "none" should be selected.

Heat exchanger type at consumer
The type of heat exchanger at the consumer needs to be selected from the drop-down menu (central air heater, central air cooler, induction units, cooling ceilings convectors). If it does not exist, the option "none" should be selected.

Type of control valves
The type of control valve needs to be selected from the drop-down menu (throttle valve – open/closed, throttle valve – continuous, three-way valve – diverter). If it does not exist, the option "none" should be selected.

Type of cooling tower
The type of cooling tower needs to be selected from the drop-down menu (open, closed). If it does not exist, the option "none" should be selected.

Type of emission
The option for emission needs to be selected from the drop-down menu (none/hydraulic transfer).

Type of return value

The option for return value needs to be selected from the drop-down menu (none, non-return valve).

Type of water emission
The option for water emission needs to be selected from the drop-down menu (none, water/water).

12.3.8 Cooling unit: Detail results

The calculation results for this cooling unit are displayed in details.

The results represent an overview of all energy components calculated separately for each type of cooling energy supply provided by this cooling unit (where applicable): conventional cooling systems (panel cooling, fan coil units, split units, etc.), cooling energy delivered by the cooling function of an HVAC system, and for residential cooling systems. Delivered energy is the sum of the energy need, system losses due to control and emission, distribution and storage (sub-total: generator cooling energy output) and losses due to generation of cooling energy. Therefore, an overview of all mentioned energy items that constitute delivered energy is given, including also regenerative energy used for the cooling energy supply.

Separately from the calculation of delivered energy for cooling, the delivered energy for auxiliary energy (energy additionally required by the cooling system in order to provide energy supply, e.g. energy for pumps, fans, control, electronics etc.) is also calculated and presented for each type of cooling energy supply above-mentioned. Auxiliary energy quantities of all subsystems (control and emission, distribution, storage, generation) are determined and presented individually.

13 Input screens for the ventilation/air-conditioning systems

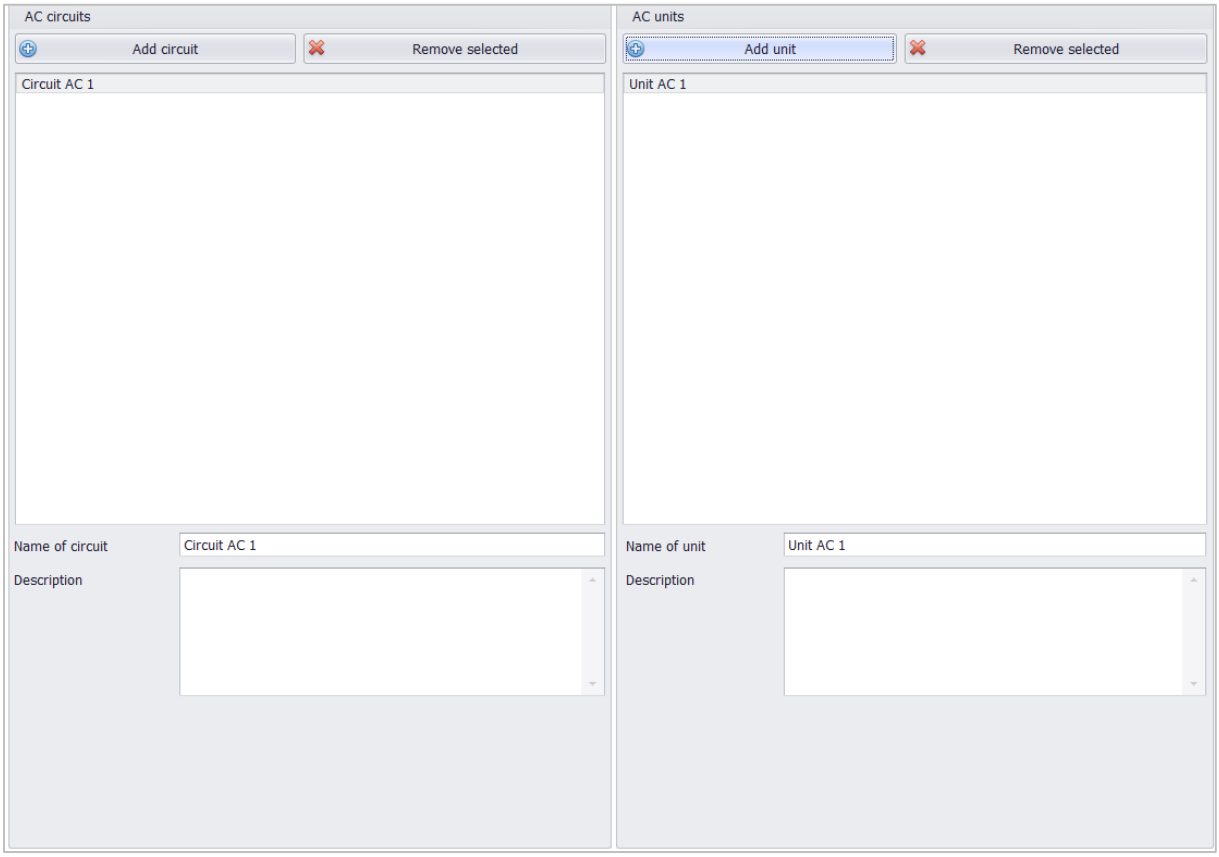


Figure 91: Input screen for defining ventilation/AC systems

The ventilation and air conditioning system (in further text: AC system) configuration starts with defining the **AC circuit** and the related **AC unit**.

The AC circuit refers to central air handling of external air to obtain supply air (for an entire building, building sections or individual storeys) and distribution of the supply air via ventilation ducts.

The AC unit refers to a central air conditioning unit (AHU unit), which besides providing proper ventilation of the interior with outside air, it can also perform some other functions such as heating, cooling and humidification.

NOTE: One AC unit can provide the heat for several AC circuits. One AC circuit can not be connected with several AC units.

The AC circuit is entered by clicking **Add circuit** button.

The name of the added AC circuit is entered in **Name of circuit**.

Some short description of the added AC circuit can be entered in the **Description** field.

More information and parameters of the added AC circuit are defined afterwards in the separate screen (one lower level in navigation tree structure).

The AC unit is entered by clicking **Add unit** button.

The name of the added AC unit is entered in **Name of unit**.

Some short description of the added AC unit can be entered in the **Description** field.

More information and parameters of the added AC unit are defined afterwards in the separate screen (one lower level in navigation tree structure).

Each added AC circuit and AC unit may be deleted by clicking **Remove selected** button.

13.1 AC circuit

13.1.1 Circuit

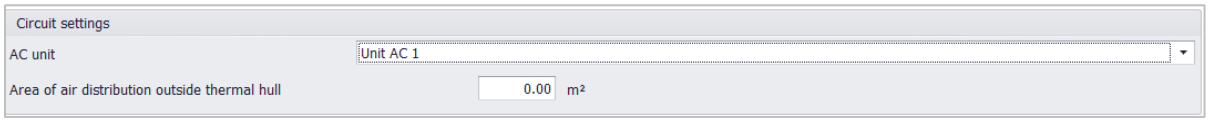


Figure 92: Input screen for defining AC circuit

AC unit
AC unit that provides air conditioning for this circuit is selected from the drop-down menu (and previously defined in **Ventilation** screen).

Area of air distribution outside thermal hull
Area of air distribution system (i.e. ventilation ducts) that is located outside the building envelope need to be calculated and entered in [m^2].

13.1.2 AC circuit: Emission

All AC emissions (grilles, registers, diffusers, etc.) that belong to this AC circuit should be added in this screen.

The AC emission is entered by clicking **Add emission** button.

The name of the added AC emission is entered in **Name of emission**.

Some short description of the added AC emission can be entered in the **Description** field.

More information and parameters of the added AC emission are defined afterwards in the separate window (one lower level in navigation tree structure).

Each added AC emission may be deleted by clicking **Remove selected** button.

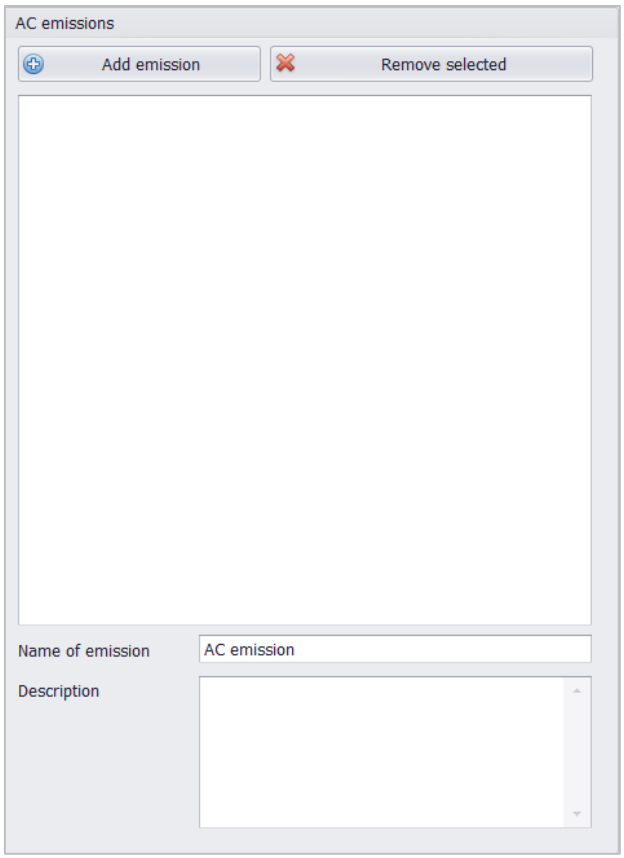


Figure 93: Input screen for adding AC emission

13.1.3 AC circuit: Detail results

The calculation results for this AC circuit are displayed in details.

Energy results for this AC circuit overview the energy need, system losses due to control and emission, and system losses due to distribution. These results are calculated and presented separately for all functions provided for this circuit (heating, cooling and humidification), where applicable. The total values on an annual basis are given, as well as a small graph representing their distibution over the course of the year.

Delivered energy for auxiliary energy (energy additionally required by the ventilation/air conditioning system in order to provide energy supply, e.g. energy for pumps, fans, control, electronics etc.) is also calculated.

13.2 AC emissions

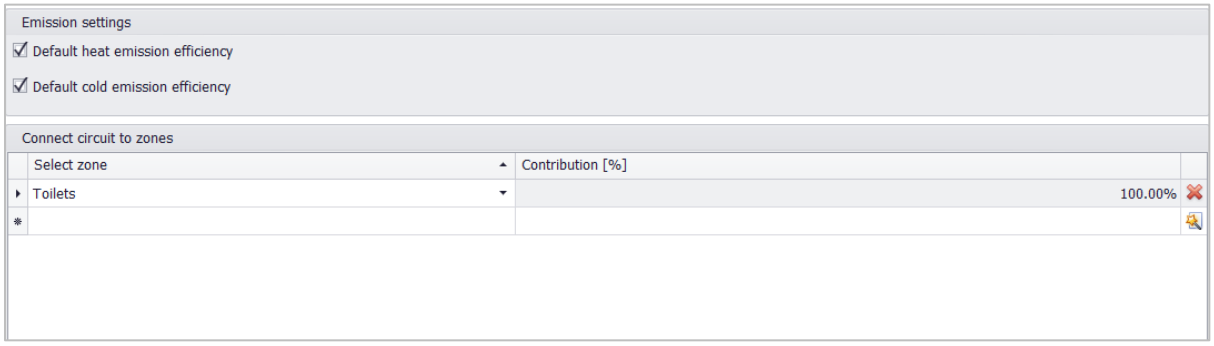


Figure 94: Input screen for defining AC emission and connection to zones

Emission settings

If default value for efficiency of heat control and emission to the room (heating air transport and distribution) is to be used, then this option should be selected by clicking in the checkbox **Default heat emission efficiency**. If this is not the case, this box should be unchecked and the known value for the emission efficiency should be entered.

If default value for efficiency of heat control and emission to the room (cooling air transport and distribution) is to be used, then this option should be selected by clicking in the checkbox **Default cold emission efficiency**. If this is not the case, this box should be unchecked and the known value for the emission efficiency should be entered.

Connect circuit to zones

In this window all zones in which these AC emissions are represented need to be selected from the drop-down list that appears when clicking each empty field in the column **Select zone**. After that, it is necessary to specify the share (in percentages) of the respective AC emissions in this zone.

Ventilation demand for each zone that is designated as ventilated/conditioned (in **Zone data** screen) need to be fulfilled, which means that if different AC emissions from the same AC circuit, or AC emissions from different AC circuits provide ventilation/air conditioning for a certain zone, then total share of all AC emissions for this zone has to be 100 %. If this is not the case, the programme sends the warning message that the ventilation demand is not fulfilled or it is overfulfilled for this zone, and further action in this regard is required.

For easier entry of data for contribution of respective AC emissions to the zones, there is a wizard icon (just below the listed zones and connected AC emissions), that allows the programme to automatically adjust ventilation demand requirement for this AC circuit.

13.3 AC unit

13.3.1 AC unit

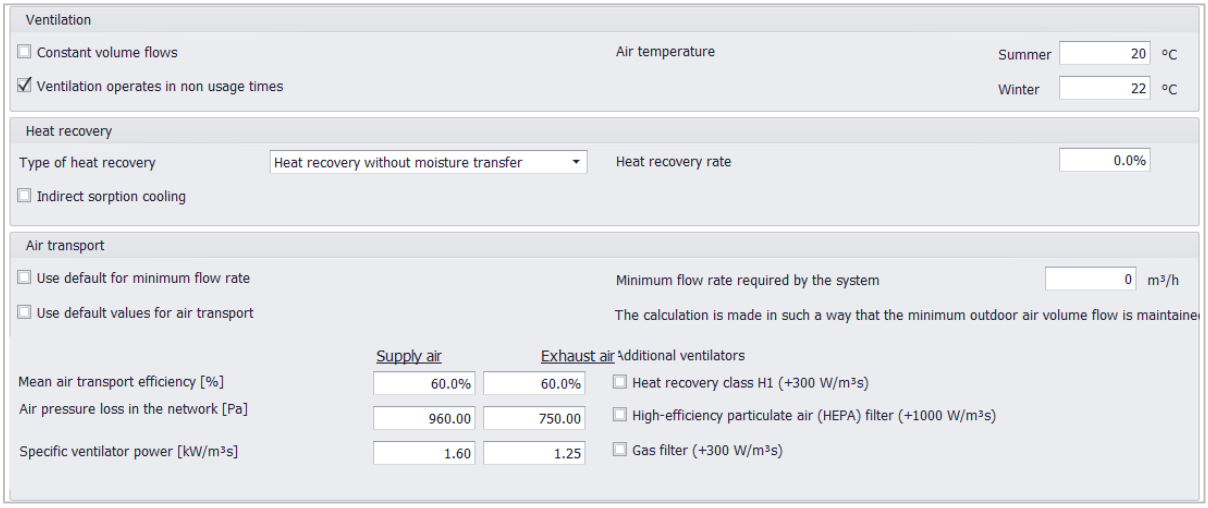


Figure 95: Input screen for defining AC unit

Ventilation

For the calculation of the energy required for air transport, it is necessary to indicate the type of ventilation system control, i.e. whether the system is with constant or variable air volume flows. In case of the system with constant air volume flow, this option should be selected by clicking in the checkbox **Constant volume flows**.

In case the ventilation system is operated also on days on which the building/zone is not used, this option should be selected by clicking in the checkbox **Ventilation operates in non-usage times**.

Supply **air temperature** set-point for **winter** and **summer** period needs to be defined (entered).

Heat recovery

Type of heat recovery
The option for heat recovery in the ventilation system is defined from the drop-down menu (no heat recovery, heat recovery with/without moisture transfer).

Heat recovery rate
In case there is a heat recovery in the ventilation system, its rate needs to be specified (entered in [%]).

In case of a system with the indirect sorption cooling, in order to take into account the change in exhaust air conditions, this option should be selected by clicking in the checkbox **Indirect sorption cooling**.

Air transport

Minimum air volume flow rate required by the system can be defined either by entering the value in related field in [m^3/h], or by using default value (from the standard). If the later is the case, this option should be selected by clicking in the checkbox **Use default for minimum flow rate**.

For the calculations, the minimum outdoor air volume flow (as defined in **User profile**) is ensured independently of the control and regulation during the time of use.

The main parameters required for the calculation of energy for air transport can be assumed as default values (from the standard), and this option should be selected by clicking in the checkbox **Use default for air transport**. In case not using the default values, the following parameters need to be defined, both for **supply** and **exhaust air**:

- **mean overall efficiency of the air transport** (fans, transmission system, motor and speed control circuitry) in [%];
- **total pressure loss across the air ductwork** at design volume flow in [Pa];
- **specific electrical power of fan** in [$kW/(m^3/s)$].

In case of special requirements regarding indoor air quality (i.e. use of HEPA filters, gas filters, heat exchanger class N1), then this increased consumption for fans operation must be included. This option should be seleced by clicking the relevant checkboxes in **Additional ventilators**.

Heating

In case that AC unit provides heating, this option should be selected by clicking in the checkbox **HVAC provides heating**.

Generation unit that is providing heat for this AC unit needs to be selected from the drop-down menu. The menu contains heating units defined in **Heating** screen.

In case that heating for this AC unit is provided by means of pipes, this option is selected by clicking in the checkbox **Heating water pipe**. According to this selection, a separate tab related to the heating pipe appear in this screen.

In case that pumps are used for providing heating for this AC unit, this option is selected by clicking in the checkbox **Pump for AC heating**. According to this selection, a separate tab related to the pump appear in this screen.

If the flow and return temperatures defined for the heating circuit are assumed for the pipe system providing heating for the AC unit, then this option should be selected by clicking in the checkbox **Apply flow/return temperatures from heating circuit**. If this is not the case, this box should be unchecked and the flow and return temperatures should be entered in °C.

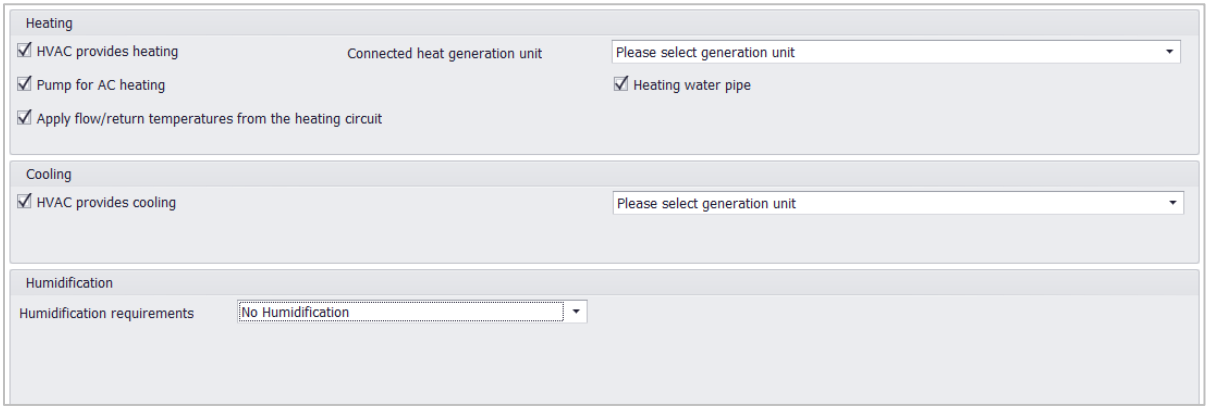


Figure 96: Input screen for defining heating provided by AC unit

Cooling

In case that AC unit provides cooling, this option should be selected by clicking in the checkbox **HVAC provides cooling**.

Generation unit that is providing cooling energy for this AC unit needs to be selected from the drop-down menu. The menu contains cooling units defined in **Cooling** screen.

In case that pumps are used for providing cooling for this AC unit, this option is selected by clicking in the checkbox **Pump for AC cooling**. According to this selection, a separate tab related to the pump appear in this screen.

Humidification

Humidification requirements
The option for humidification requirements is selected from the drop-down menu (no humidification, evaporative humidifier controllable/not controllable, steam humidifier).

Type of water humidifier
In case of evaporative humidification, the type of water humidifier is selected from the drop-down menu (contact and drip humidifier, spray humidifier, high-pressure humidifier, hybrid humidifier).

Dimensioning
Water vapour content of the supply air is selected from the drop-down menu (6 g/kg, 8 g/kg).

Humidifier control
Type of control for selected controllable evaporative humidifier is selected from the drop-down menu (valve controlled, pulsed operation (proportionally ON/OFF), speed control).

Type of steam humidifier
In case of steam humidification, the type of steam humidifier is selected from the drop-down menu (heating by electrodes or electrical resistance heating - raw water, gas fired – raw water, oil fired – raw water, district heating steam with/without jacket heating).

Energy carrier
Energy carrier for the steam humidifier is selected from the drop-down menu. The specification of options for energy carriers in the drop-down menu is affected by selection of the type of steam humidifier.

13.3.2 AC unit: Pump for AC heating

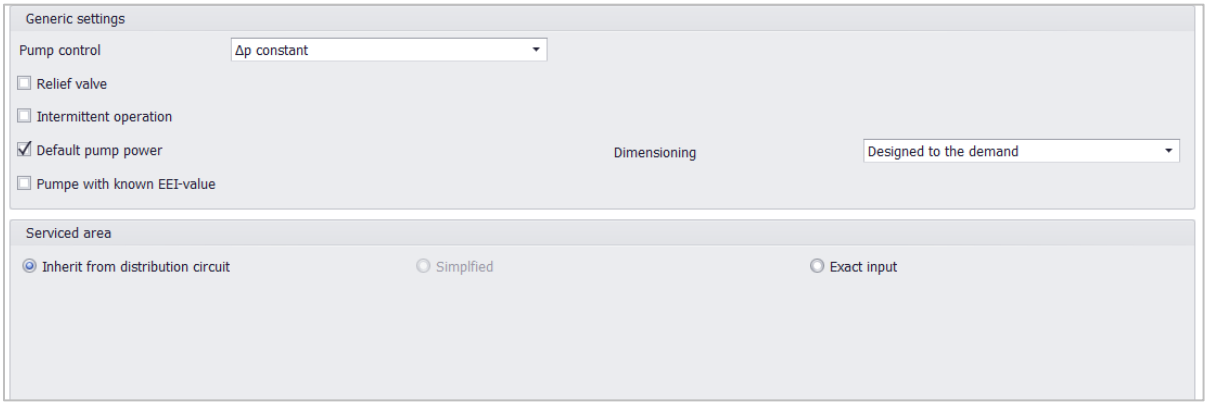


Figure 97: Input screen for defining pump for AC heating

The following parameters need to be defined for calculation of the auxiliary energy expenditure required to operate the pump used for providing heating for AC unit.

Pump control
Pump control should be defined by selecting one of the options from the drop-down menu: unregulated or regulated (with Δp=constant or Δp=variable).

Relief valve
A relief valve is used to control or limit the pressure in a system, and it has effect on the average hydraulic demand. In case it exists in the system, this option should be selected by clicking in the related checkbox.

Intermittent operation
The pump operates in the intermittent mode if it is operated outside the usage time at limited power or is switched off. In these cases, the calculation of the electrical energy expenditure of the circulation pumps has to take into account the correction factor for set-back or switch-off of the pump. Therefore, in case of intermittent mode of pump operation, this option should be selected by clicking in the related checkbox.

Default pump power
In case electrical power consumption of the pump from manufacturer's data is available, this value should be entered in [W]. In case this value is not available, the default pump power should be used and this option should be selected by clicking in the related checkbox.

Dimensioning
To assess the performance of the circulation pump, from the drop-down menu there should be selected whether pumps are designed to meet the demand or not.

Pump with known EEI-value
In case that energy efficiency index (EEI) for the pump is known, this option should be selected by clicking in the checkbox and entering the known value.

13.3.3 AC unit: Pipe for AC heating

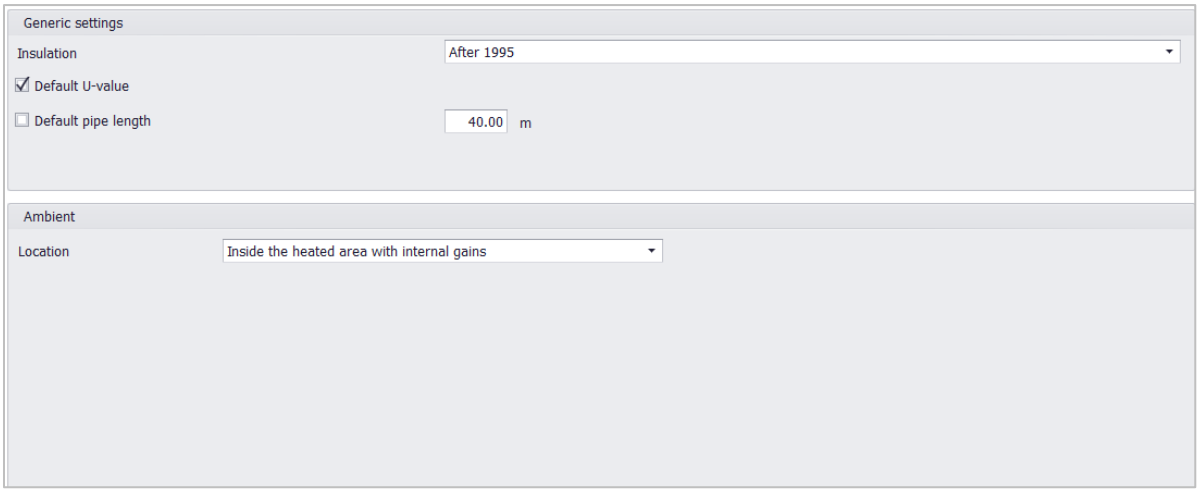


Figure 98: Input screen for defining pipeline for AC heating

Pipe for AC heating refers to pipeline providing heating for AC unit (i.e. heating coil in air handling unit).

Insulation
Insulation of the pipe is defined by selecting one of the options from the drop-down menu. These options refer to the age class of building (before 1980, between 1980 and 1995, and after 1995), which imply use of the standard values for heat transfer coefficients (U-values).

In case the value for heat transfer coefficient (U-value) is known, then the checkbox **Default U-value** should be unchecked and the U-value need to be entered in [W/(mK)].

Pipe length
Default value for pipe length can be assumed, and this option is selected by clicking in the checkbox **Default pipe length**. In case the value for pipe length is known, then the checkbox should be unchecked and the pipe length value need to be entered in [m].

Ambient

Location
For the calculation of the distribution losses, the location of the pipe needs to be selected from the drop-down menu: **Outside the heated area** or **Inside the heated area** (two options: (i) **with internal gains**, i.e. pipe is located in the heated area within the building envelope, or (ii) **without internal gains**, i.e. pipe is located in the heated area outside the building envelope, such as the area of the adjacent building that is heated). In case the pipeline is located within certain zone(s), this option can be selected from the drop-down menu (option: **Within a zone**), whereby a new menu with a checkbox next to each zone in the building opens automatically. In addition, it is possible to enter the ambient temperature, if known, either as an annual value, or as seasonal (winter and summer) values (options: **Custom annual temperature** and **Custom seasonal temperatures**).

13.3.4 AC unit: Pump for AC cooling

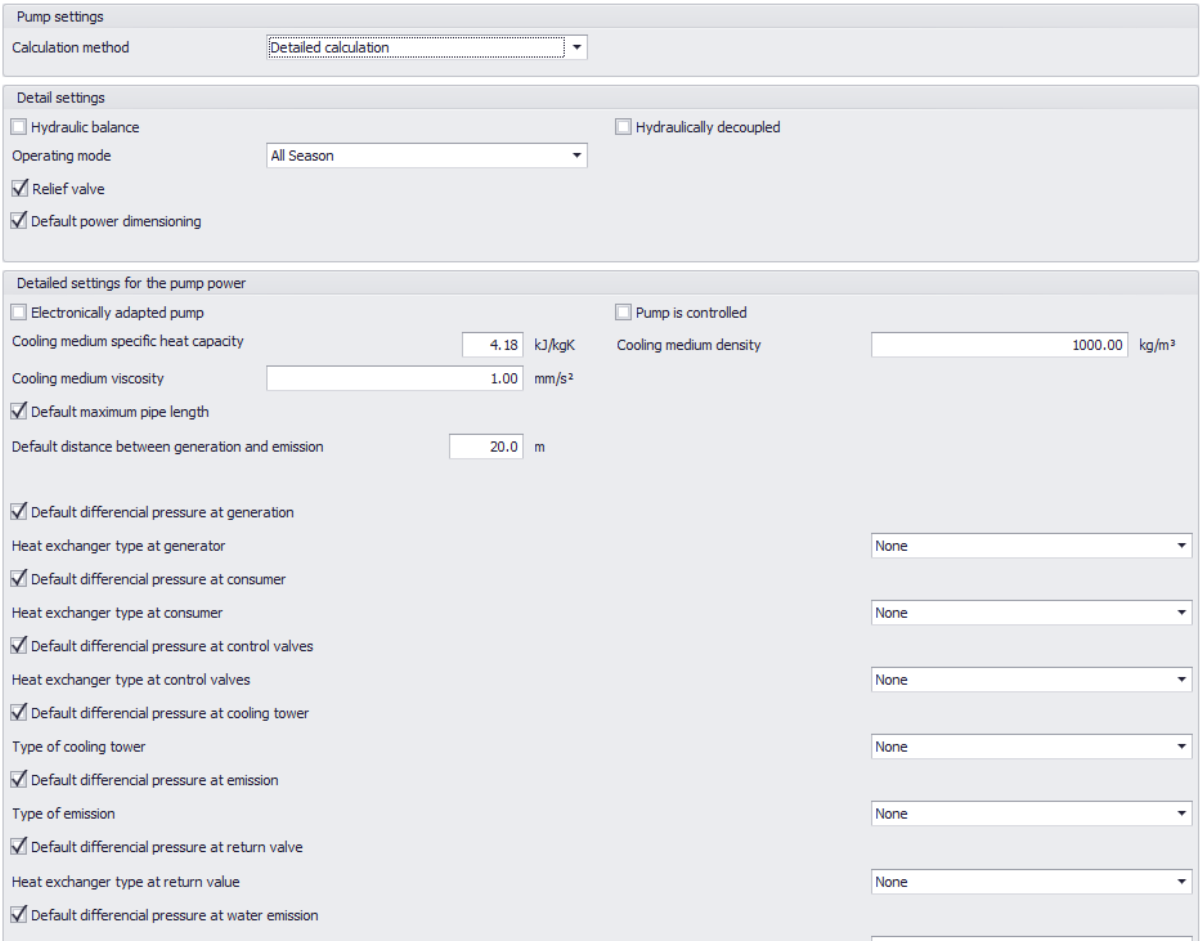


Figure 99: Input screen for defining pump for AC cooling

The auxiliary energy expenditure required to operate the pump used for providing cooling for AC unit is calculated according to the detailed procedure or, in simplified way, according to the simplified calculation.

Calculation method
Type of calculation method (detailed or simplified) is selected from the drop-down menu.

Simplified method type
In case of simplified calculation method selected, the specific electrical energy consumption is determined from the default values. The only parameter to be defined for further evaluation of the hydraulic energy requirement for distribution is selection from the drop-down menu referring to pump efficiency (low efficiency pump, medium efficiency pump, high efficiency pump). Low efficiency pump refers to distribution network with high resistance, and is characterized by seasonal operating time, unregulated pump operation, no pump adaptation, no hydraulic balancing. Medium efficiency pump refers to distribution network with average resistance, and is characterized by intermittent operating time, regulated or unregulated pump operation (standard case, usually applied in existing buildings). High efficiency pump refers to energy optimized distribution network, and is characterized by demand-driven, regulated pump operation (usually applied in new buildings).

Detailed settings

In case of selecting a detailed calculation method, a number of input data have to be defined for calculation of electrical and hydraulic energy consumption.

Hydraulic balance
In case the network is hydraulically balanced, this option should be selected by clicking in the related checkbox.

Hydraulically decoupled
In case that circuits are hydraulically decoupled, which stops water from mixing, as well as enable individual and precise control of both circuits, this option should be selected by clicking in the related checkbox.

Operating mode
Operational mode of the pump is selected from the drop-down menu. Four operating modes are distinguished: fully automated (demand-controlled operation); seasonal, night and weekend shutdown; seasonal switch-off in months without cooling demand; year-round operation of the pumps (also in periods without demand).

Relief valve
A relief valve is used to control or limit the pressure in a system, and it has effect on the average hydraulic demand. In case it exists in the system, this option should be selected by clicking in the related checkbox.

Overflow ratio
In case that relief valve exists in the system, the overflow ratio needs to be specified.

Power dimensioning
In case that electrical power consumption of the pump is known, the checkbox **Default power dimensioning** needs to be unchecked and the value for the power should be entered in [W]. In case this value is not available, the checkbox should remain checked and the default pump power dimensioning will take place (window for detailed settings for the pump power shows up).

Detailed settings for the pump power

Electronically adapted pump
If the pump is electronically adapted, which means that it adjusts its efficiency and energy consumption in such a way as to optimize the correct operation of the system, then this option needs to be selected by clicking in the related checkbox.

Pump is controlled
If pump operation is controlled, then this option needs to be selected by clicking in the related checkbox.

Cooling medium specific heat capacity
Specific heat capacity of the cooling medium need to be entered in [kJ/kg·K].

Cooling medium density
Density of the cooling medium need to be entered in [kg/m^3].

Cooling medium viscosity
Viscosity of the cooling medium need to be entered in [mm/s^2].

Default maximum pipe length
If maximum pipe length in distribution circuit is known, then this checkbox needs to be unchecked and the value for the maximum pipe length should be entered in [m]. In case this value is not available, the checkbox should remain checked, and the default value is assumed.

Default distance between generation and emission

If distance between generation and emission of cooling energy is known, then this checkbox needs to be unchecked and the value for the distance should be entered in [m]. In case this value is not available, the checkbox should remain checked, and the default value is assumed.

For each of the distribution circuit components (heat exchangers at **generator**, **consumer**, **control valve**, **cooling tower**, **emission**, **return valve**, **water emission**), if default values for **differential pressure** are assumed, then the related checkboxes should be selected (checked). In addition, from the drop-down menu related to each of these components, the adequate option needs to be selected (please see below). In case that default values for differential pressures are not used, then related checkboxes need to be unchecked and the known values should be entered in [kPa].

Heat exchanger type at generator
The type of heat exchanger at the cooling energy generator needs to be selected from the drop-down menu (plate evaporator, tube evaporator, condenser). If it does not exist, the option "none" should be selected.

Heat exchanger type at consumer
The type of heat exchanger at the consumer needs to be selected from the drop-down menu (central air heater, central air cooler, induction units, cooling ceilings convectors). If it does not exist, the option "none" should be selected.

Type of control valves
The type of control valve needs to be selected from the drop-down menu (throttle valve – open/closed, throttle valve – continuous, three-way valve – diverter). If it does not exist, the option "none" should be selected.

Type of cooling tower
The type of cooling tower needs to be selected from the drop-down menu (open, closed). If it does not exist, the option "none" should be selected.

Type of emission
The option for emission needs to be selected from the drop-down menu (none/hydraulic transfer).

Type of return value
The option for return value needs to be selected from the drop-down menu (none, non-return valve).

Type of water emission
The option for water emission needs to be selected from the drop-down menu (none, water/water).

13.3.5 AC unit: Detail results

The calculation results for this AC unit are displayed in details.

Energy results overview the energy need, system losses due to control and emission, and system losses due to distribution. These results are calculated and presented separately for all functions provided by this AC unit (heating, cooling and humidification), where applicable. The total values on an annual basis are given, as well as a small graph representing their distibution over the course of the year.

Delivered energy for auxiliary energy (energy additionally required by the ventilation/air conditioning system in order to provide energy supply, e.g. energy for pumps, fans, control, electronics etc.) is also calculated.

14 Input screens for the residential ventilation systems

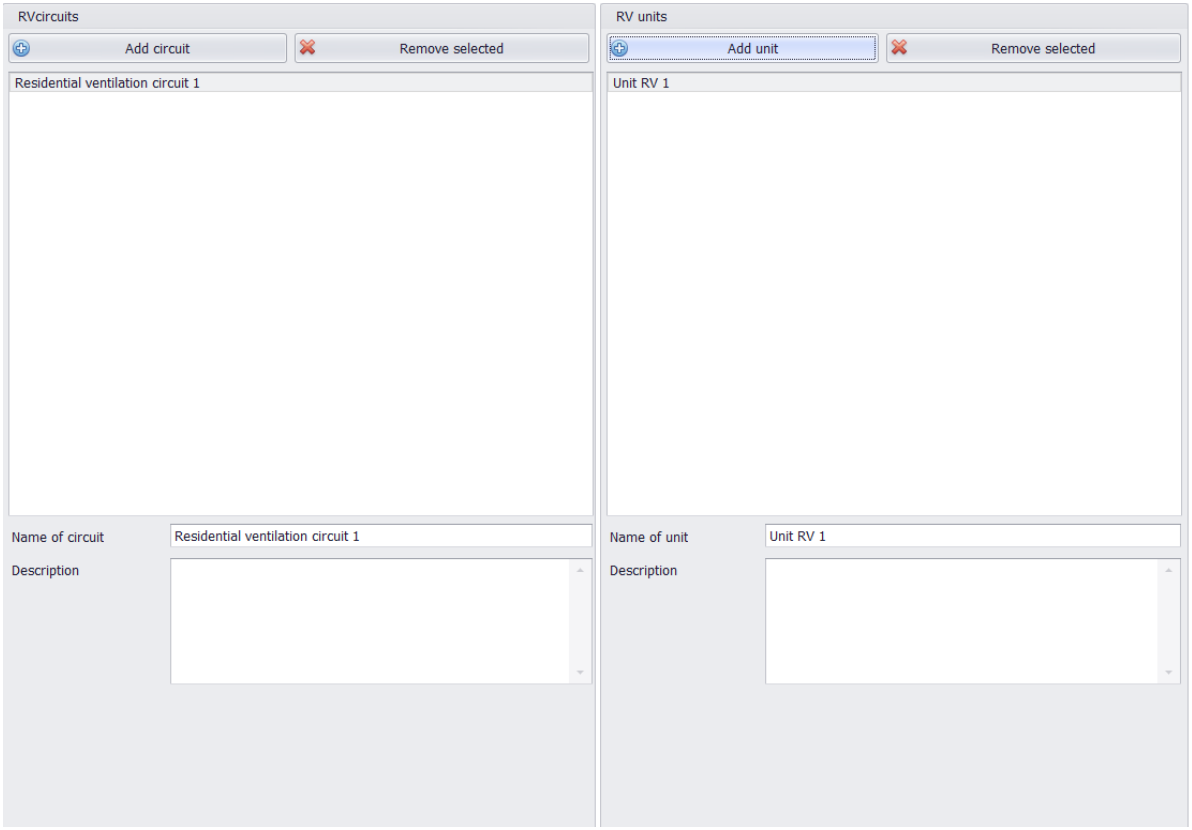


Figure 100: Input screen for defining RV system

The ventilation and air heating system in residential building (in further text: RV system) configuration starts with defining the **RV circuit** and the related **RV unit**.

Residential ventilation system is a system for supplying fresh air and/or removing exhaust air which conveys external air into the building, and which may include heat recovery and air conditioning. Systems for supplying fresh air and/or removing exhaust air may be decentralized systems intended for a single room or central supply and/or exhaust ventilation systems. Therefore, RV circuit and RV unit are defined regardless of whether it is a central or decentralized system.

Air heating system for residential buildings is a heating system which supplies heat to a zone using only air as the heat carrier. Air heating systems have at least one heat generator (e.g. a heat pump for extract air heat recovery). 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.

The RV circuit is entered by clicking **Add circuit** button.

The name of the added RV circuit is entered in **Name of circuit**.

Some short description of the added RV circuit can be entered in the **Description** field.

More information and parameters of the added RV circuit are defined afterwards in the separate screen (one lower level in navigation tree structure).

The RV unit is entered by clicking **Add unit** button.

The name of the added RV unit is entered in **Name of unit**.

Some short description of the added RV unit can be entered in the **Description** field.

More information and parameters of the added RV unit are defined afterwards in the separate screen (one lower level in navigation tree structure).

Each added RV circuit and RV unit may be deleted by clicking **Remove selected** button.

14.1 RV circuit

14.1.1 Circuit

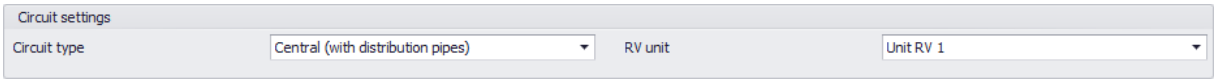


Figure 101: Input screen for defining RV circuit

Circuit type
Systems for supplying fresh air and/or removing exhaust air may be decentralized systems intended for a single room, or central supply and/or exhaust ventilation systems. Therefore, the circuit is defined by selecting one of two options from drop-down menu: central (with distribution pipes) and decentral (direct emission).

RV unit
RV unit that provides ventilation/air heating for this circuit is selected from the drop-down menu (and previously defined in **Residential ventilation** screen).

14.1.2 RV circuit: Emission

All RV emissions that belong to this RV circuit should be added in this screen.

The RV emission is entered by clicking **Add emission** button.

The name of the added RV emission is entered in **Name of emission**.

Some short description of the added RV emission can be entered in the **Description** field.

More information and parameters of the added RV emission are defined afterwards in the separate window (one lower level in navigation tree structure).

Each added RV emission may be deleted by clicking **Remove selected** button.

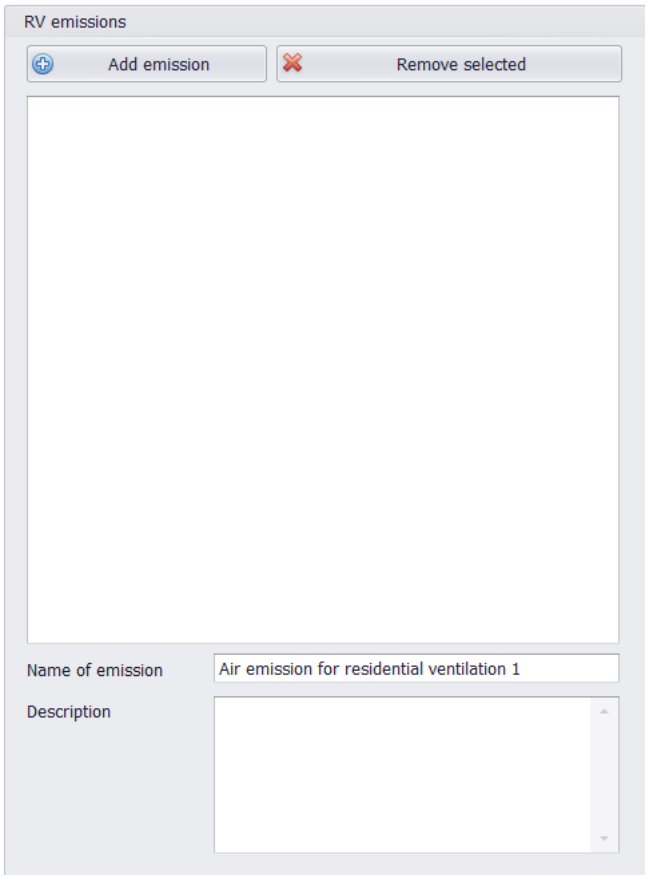


Figure 102: Input screen for adding RV emissions in circuit

14.1.3 RV circuit: Detail results

Delivered energy for auxiliary energy (energy additionally required by the RV system in order to provide energy supply, e.g. energy for pumps, fans, control, electronics etc.) is calculated and presented individually for control and emission, distribution and generation.

14.2 RV emission

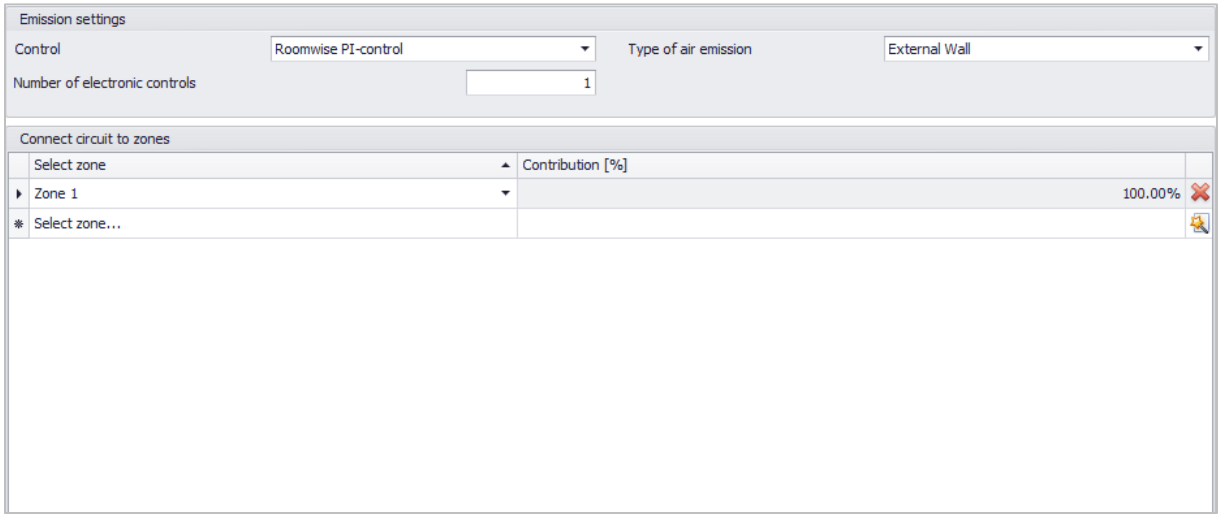


Figure 103: Input screen for defining RV emissions and connection to zones

Emission settings

Auxiliary energy for the control system is determined based on the **type of control** (to be selected from the drop-down menu: single-room control (P/PI-controllers), zone control (P-controller) or extract air/supply air heat pump), and the **number of electronic controls** (to be entered).

Type of air emission
Type of air emission refers to the position of the air terminal devices, and it should be selected from the drop-down menu (internal or external wall).

Connect circuit to zones

In this window all zones in which these RV emissions are represented need to be selected from the drop-down list that appears when clicking each empty field in the column **Select zone**. After that, it is necessary to specify the share (in percentages) of the respective RV emissions in this zone.

Ventilation demand for each zone that is designated as ventilated (in **Zone data** screen) need to be fulfilled, which means that if different RV emissions from the same RV circuit, or RV emissions from different RV circuits provide ventilation for a certain zone, then total share of all RV emissions for this zone has to be 100 %. If this is not the case, the programme sends the warning message that the ventilation demand is not fulfilled or it is overfulfilled for this zone, and further action in this regard is required.

For easier entry of data for contribution of respective RV emissions to the zones, there is a wizard icon (just below the listed zones and connected RV emissions), that allows the programme to automatically adjust ventilation demand requirement for this RV circuit.

14.3 RV unit

14.3.1 RV unit

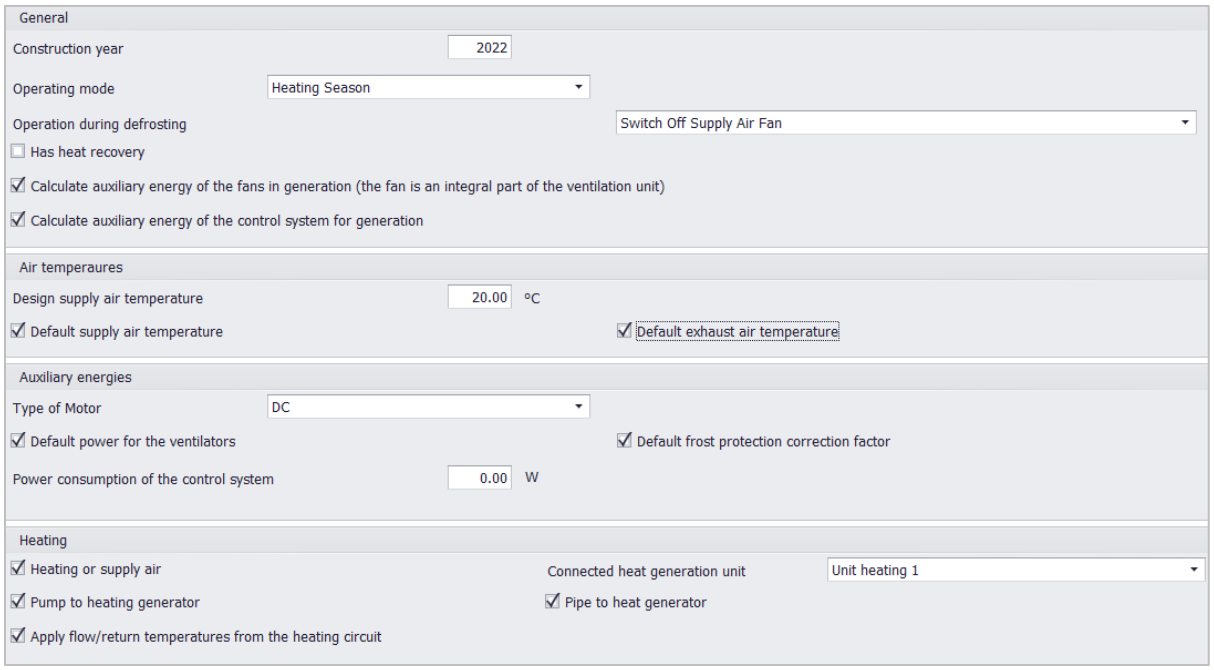


Figure 104: Input screen for defining RV unit

General

Construction year
Enter the year of construction for the ventilation unit.

Operating mode
For operating time of ventilation systems in residential buildings, a distinction is made between year-round operation and heating season operation. One of these two options need to be selected from the drop-down menu.

Operation during defrosting
Behaviour of the ventilation unit in defrost mode is taken into account in calculations. In this regard, one of the following cases that can be generally distinguished, need to be selected from the drop-down menu: switching off or reducing the speed of the supply air fan, pre-heating the external air with a ground/supply air heat exchanger, and preheating the external air with a heating coil (heated by electricity or water).

In case of a ventilation system with heat recovery, this option is selected by clicking in the checkbox **Has heat recovery**. According to this selection, a separate window related to the heat recovery appears in this screen, requiring more information and parameters to be defined.

The auxiliary energy required by the fans for distributing the air through the ventilation ductwork is calculated either separately, or in conjunction with the auxiliary energy 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 the latter is the case, then this option has to be selected by clicking in the checkbox **Calculate auxiliary energy of the fan in generation (the fan is an integral part of the ventilation unit)**. According to this selection, a separate window related to the calculation of auxiliary energy appears.

In case the auxiliary energy of the control devices is to be taken into account in calculating the auxiliary energy for heat generation, this option should be selected by clicking in the checkbox **Calculate auxiliary energy of the control system for generation**.

Heat recovery

For heat recovery efficiency, the default value or improved default value can be used. This selection is made by clicking in the related checkboxes: **Default heat recovery factor** or **Improved heat recovery factor**.

In case of not using the default values, the **heat recovery efficiency** needs to be entered in [%]. In addition, the correction factors taking into account the following parameters have to be defined:

- Temperature limit/defrost mode (when outdoor temperature is: above – 6 °C, below – 6 °C, below – 9 °C, below – 12 °C);
- Air tightness of the ventilation unit (high/low);
- Heat losses in the ventilation unit (low/medium/high).

More information on heat recovery efficiency and correction factors can be found in the Calculation methodology in Annex C.

Air temperatures

In case **Design supply air temperature** is entered in [°C], then default values for mean air temperature of supply and exhaust air distribution ductwork need to be used, i.e. the checkboxes **Default supply air temperature** and **Default exhaust air temperature** should remain checked. In case of not using default values, these checkboxes need to be unchecked and the actual known

values need to be entered in [°C]. Design supply air temperature in that case is not relevant and no longer figures as a parameter in the calculation.

Auxiliary energies

In case that auxiliary energy required by the fans for distributing the air through the ventilation ductwork is calculated in conjunction with the auxiliary energy for the residential ventilation unit (the fan is an integral part of the ventilation unit), the following parameters need to be defined:

Type of motor
The type of motor of the fan is selected from the drop-down menu (AC, DC).

In case that default value for power consumption of the fan is assumed, then this option is selected by clicking in the checkbox **Default power for the ventilators**. If not using the default value, then the known value for volume flow-related power consumption of the fan need to be entered in [W/(m^3/h)].

The correction factor that takes into account defrosting of the ventilation unit can either be entered (in case of known value), or the default value can be assumed. If the latter is the case, then this option is selected by clicking in the checkbox **Default frost protection correction factor.**

Power consumption of the control system
Power consumption of the control system need to be entered in [W].

Heating

In case that residential ventilation system provides heating as well, this option should be selected by clicking in the checkbox **Heating of supply air**.

Connected heat generation unit
Generation unit that is providing heat for this RV unit needs to be selected from the drop-down menu. The menu contains heating units defined in **Heating** screen.

In case that pumps are used for providing heating for this RV unit, this option is selected by clicking in the checkbox **Pump to heating generator**. According to this selection, a separate tab related to the pump appear in this screen.

In case that heating for this RV unit is provided by means of pipes, this option is selected by clicking in the checkbox **Pipe to heat generator**. According to this selection, a separate tab related to the heating pipe appear in this screen.

If the flow and return temperatures defined for the heating circuit are assumed for the pipe system providing heating for the RV unit, then this option should be selected by clicking in the checkbox **Apply flow/return temperatures from heating circuit**. If this is not the case, this box should be unchecked and the flow and return temperatures should be entered in °C.

14.3.2 RV unit: Pump for RV heating

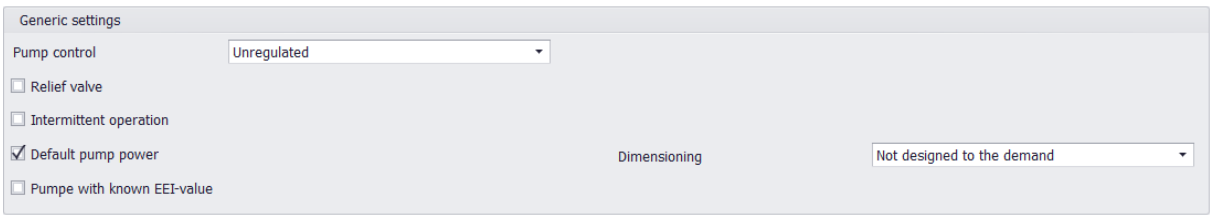


Figure 105: Input screen for defining pump for RV heating

The following parameters need to be defined for calculation of the auxiliary energy expenditure required to operate the pump used for providing heating for RV unit.

Pump control
Pump control should be defined by selecting one of the options from the drop-down menu: unregulated or regulated (with Δp=constant or Δp=variable).

Relief valve
A relief valve is used to control or limit the pressure in a system, and it has effect on the average hydraulic demand. In case it exists in the system, this option should be selected by clicking in the related checkbox.

Intermittent operation
The pump operates in the intermittent mode if it is operated outside the usage time at limited power or is switched off. In these cases, the calculation of the electrical energy expenditure of the circulation pumps has to take into account the correction factor for set-back or switch-off of the pump. Therefore, in case of intermittent mode of pump operation, this option should be selected by clicking in the related checkbox.

Default pump power
In case electrical power consumption of the pump from manufacturer's data is available, this value should be entered in [W]. In case this value is not available, the default pump power should be used and this option should be selected by clicking in the related checkbox.

Dimensioning
To assess the performance of the circulation pump, from the drop-down menu there should be selected whether pumps are designed to meet the demand or not.

Pump with known EEI-value
In case that energy efficiency index (EEI) for the pump is known, this option should be selected by clicking in the checkbox and entering the known value.

14.3.3 RV unit: Pipe for RV heating

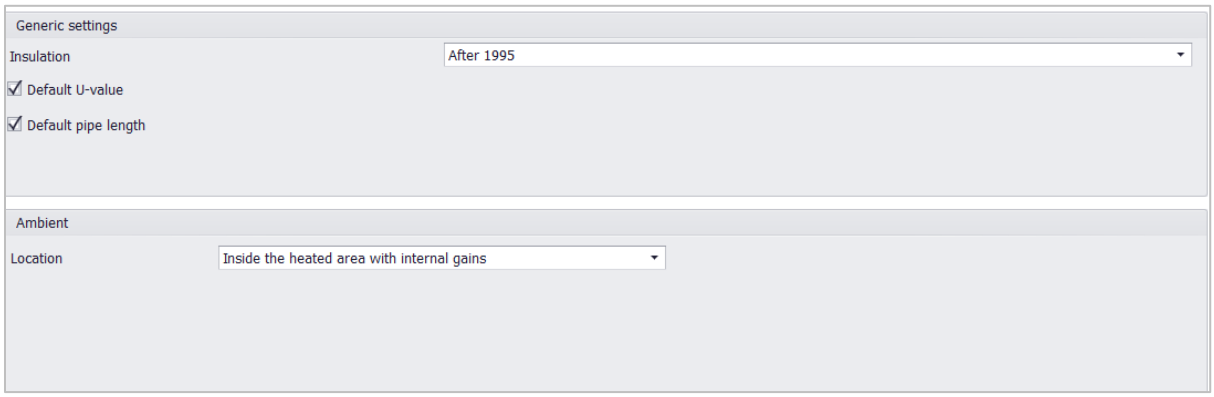


Figure 106: Input screen for defining pipeline for RV heating

Heating water pipe for RV unit refers to pipeline providing heating for RV unit.

Insulation
Insulation of the pipe is defined by selecting one of the options from the drop-down menu. These options refer to the age class of building (before 1980, between 1980 and 1995, and after 1995), which imply use of the standard values for heat transfer coefficients (U-values).

In case the value for heat transfer coefficient (U-value) is known, then the checkbox **Default U-value** should be unchecked and the U-value need to be entered in [W/(mK)].

Ambient

Location
For the calculation of the distribution losses, the location of the pipe needs to be selected from the drop-down menu: **Outside the heated area** or **Inside the heated area** (two options: (i) **with internal gains**, i.e. pipe is located in the heated area within the building envelope, or (ii) **without internal gains**, i.e. pipe is located in the heated area outside the building envelope, such as the area of the adjacent building that is heated). In case the pipeline is located within certain zone(s), this option can be selected from the drop-down menu (option: **Within a zone**), whereby a new menu with a checkbox next to each zone in the building opens automatically. In addition, it is possible to enter the ambient temperature, if known, either as an annual value, or as seasonal (winter and summer) values (options: **Custom annual temperature** and **Custom seasonal temperatures**).

14.3.4 RV unit: Detail results

Delivered energy for auxiliary energy (energy additionally required by the RV system in order to provide energy supply, e.g. energy for pumps, fans, control, electronics etc.) is calculated and presented individually for control and emission, distribution and generation.

15 Input screens for the renewable energy systems

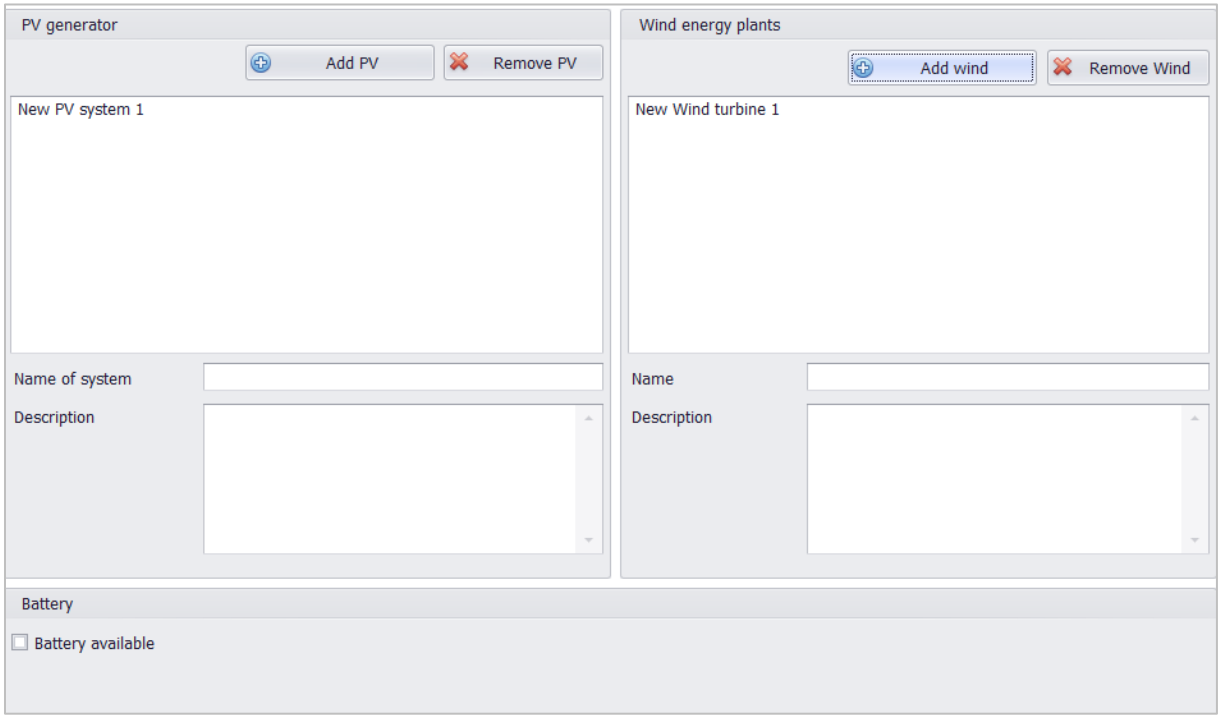


Figure 107: Input screen for defining renewable energy systems

Two types of systems for the production of electricity from renewable sources can be modelled in the software: photovoltaic systems and wind generators (installed on the facility). The electricity produced by these systems represents renewable energy produced on the site, thereby reducing the energy delivered to the building.

PV generator

The photovoltaic system is entered by clicking **Add PV** button.

The name of the added PV system is entered in **Name of system**.

Some short description of the added PV system can be entered in the **Description** field.

More information and parameters of the added PV system are defined afterwards in the separate screen (one lower level in navigation tree structure).

Each added photovoltaic system may be deleted by clicking **Remove PV** button.

Wind energy plants

The wind energy plant is entered by clicking **Add wind** button.

The name of the added wind energy plant is entered in **Name**.

Some short description of the added wind energy plant can be entered in the **Description** field.

More information and parameters of the added wind energy plant are defined afterwards in the separate screen (one lower level in navigation tree structure).

Each added wind energy plant unit may be deleted by clicking **Remove wind** button.

Battery

In case that defined photovoltaic system has battery back-up system, then this option needs to be selected by clicking in the checkbox **Battery available**. Thereupon, the **capacity** of the battery has to be entered in [kWh], as well as the **system efficiency** of the battery in [%].

15.1 Renewable energy: Photovoltaic system

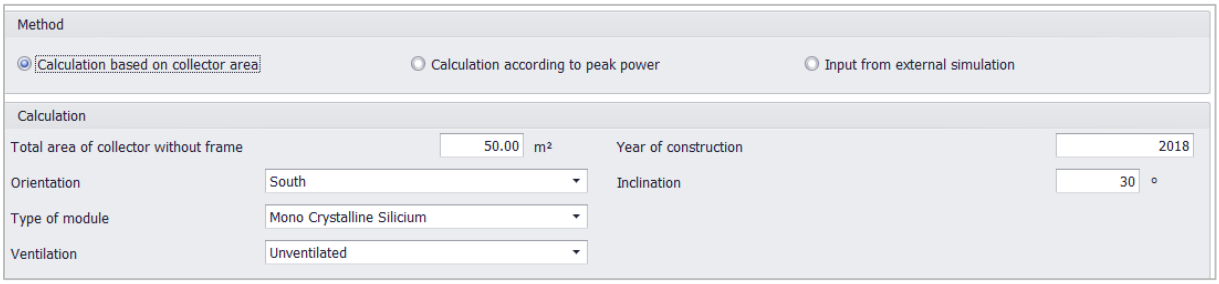


Figure 108: Input screen for defining PV system – calculation method

Method

There are three ways to define photovoltaic system: (i) calculation is made according to the area of the solar panels; (ii) calculation is made according to the peak power; (iii) input of data on electricity consumption from external simulations.

In case of selection of the first two methods, the window **Calculation** appears, where a certain number of parameters must be defined. The specification of parameters is affected by the choice of the method (method based on solar panel area, or method based on peak power).

Calculation

Total area of collector without frame
Total area of solar panels without frame has to be entered in in [m^2].

Year of construction
Enter the year of construction for the solar panels.

Orientation
The orientation of solar panels needs to be selected from the drop-down menu (9 orientations: horizontal, N, E, S, W, NE, NW, SE, SW).

Inclination
The inclination of solar panels (for orientations other than horizontal) needs to be entered in [°].

Type of module
Technology used for solar panels need to be selected from the drop-down menu (monocrystalline or polycrystalline PV modules).

Ventilation
The type of solar panels in terms of ventilation needs to be selected from the drop-down (unventilated, moderately ventilated, heavily ventilated).

Peak power
Peak power at standard test conditions (at the beginning of the lifetime) needs to be entered in [kW].

External simulation

In addition to the two calculation methods for modelling PV system, there is a possibility of defining the system by entering values for energy yield from external simulation.

Production in kWh/mth:
The values for energy yield of the PV system need to be entered for each month in a year in [kWh].

Figure 109: Input screen for defining PV system – input from external simulation

15.2 Renewable energy: Wind energy plant

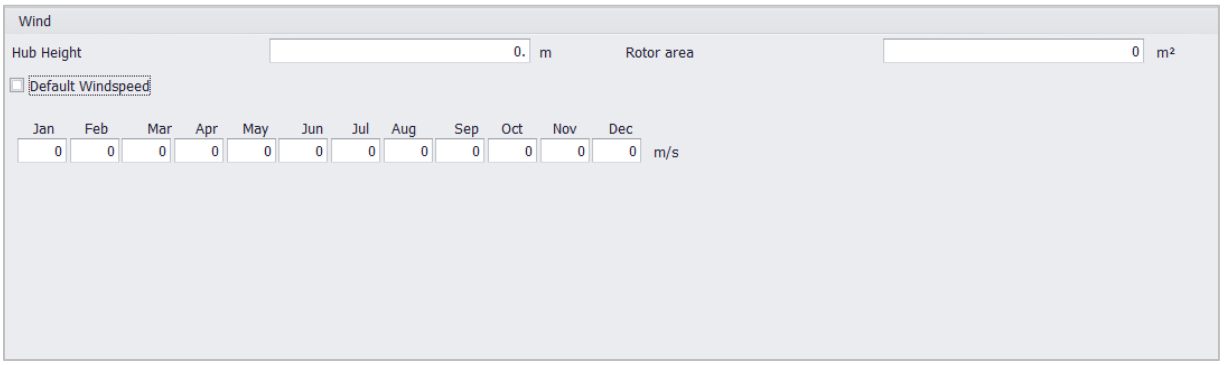


Figure 110: Input screen for defining wind energy plant

The wind power plant is defined based on the following parameters specified:

Hub height
The hub height of a wind turbine needs to be entered in [m].

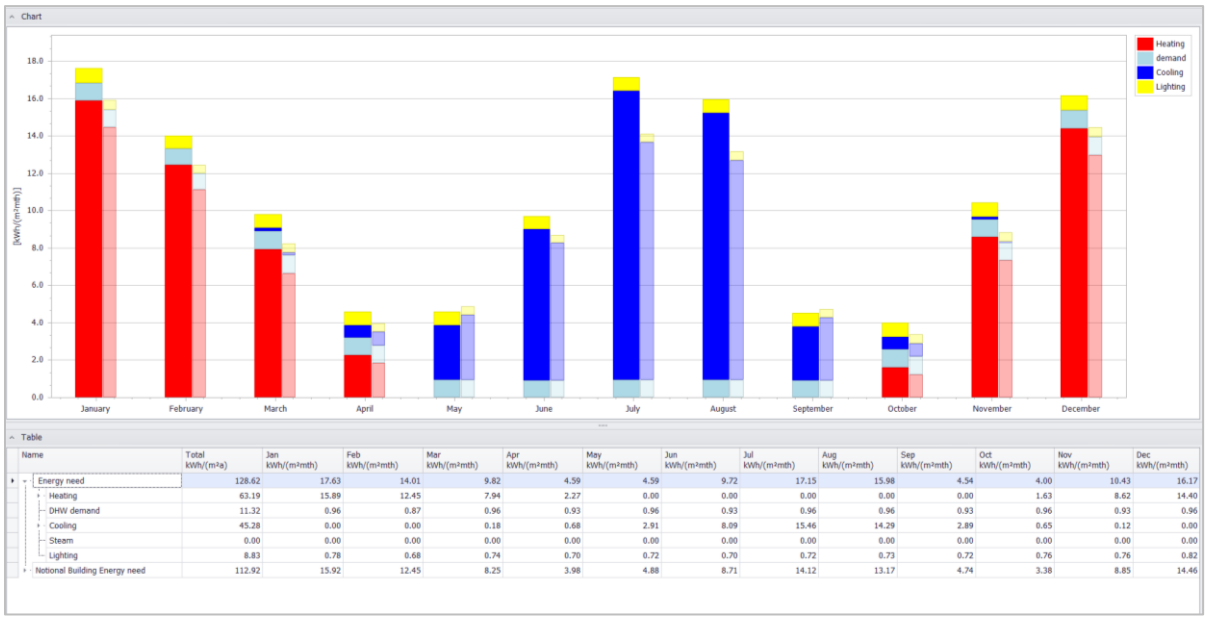
Rotor area
The area of the rotor of a wind turbine needs to be entered in [m^2].

The wind speed at hub height can be defined either by entering the known monthly values in [m/s], or by using default value (from the standard). If latter is the case, then this option is selected by clicking in the checkbox **Default wind speed**.

16 Results for the building

The calculation results are displayed at the building level.

The contents of the chart and table depend on the selections made in **Results options** in the main software menu, i.e. selection of the type of energy to be shown: energy need, delivered energy (total and by energy carrier) or primary energy. These energies can be shown as absolute values (in kWh) by clicking in the checkbox **Results as absolute values**. Otherwise, they will be expressed per unit of reference area (in kWh/m^2).



Name	Total kWh/(m²a)	Jan kWh/(m²mth)	Feb kWh/(m²mth)	Mar kWh/(m²mth)	Apr kWh/(m²mth)	May kWh/(m²mth)	Jun kWh/(m²mth)	Jul kWh/(m²mth)	Aug kWh/(m²mth)	Sep kWh/(m²mth)	Oct kWh/(m²mth)	Nov kWh/(m²mth)	Dec kWh/(m²mth)
Energy need	128.62	17.63	14.01	9.82	4.59	4.59	9.72	17.15	15.98	4.54	4.00	10.43	16.17
Heating	63.19	15.89	12.45	7.94	2.27	0.00	0.00	0.00	0.00	0.00	1.63	8.62	14.40
DHW demand	11.32	0.96	0.87	0.96	0.93	0.96	0.93	0.96	0.96	0.93	0.96	0.93	0.96
Cooling	45.28	0.00	0.00	0.18	0.68	2.91	8.09	15.46	14.29	2.89	0.65	0.12	0.00
Steam	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lighting	8.83	0.78	0.68	0.74	0.70	0.72	0.70	0.72	0.73	0.72	0.76	0.76	0.82
Notional Building Energy need	112.92	15.92	12.45	8.25	3.98	4.88	8.71	14.12	13.17	4.74	3.38	8.85	14.46

Figure 111: Display of results for the building – energy consumption

16.1 Chart

The shares of individual balance calculation items (heating, cooling, DHW, ventilation, lighting, auxiliary energy) in the total energy consumption are shown for each month, and they can be read from the chart by moving the cursor over the relevant item.

The shares for the same balance items are presented for the notional building (hypothetical building of the same size, shape, orientation and shading as the actual building, with the same activities, zoning and system types and exposed to the same weather data, but with pre-defined specified properties for the building fabric, fittings and services). The notional building can also be displayed on the chart next to the actual building, but in less intensive colors. By clicking on the icon **Show notional building** (in the upper right corner), the notional building appears/dissapears from the chart.

Charts can be exported by clicking on the icon **Export chart** (in the upper right corner) in one of the available formats (PDF, XTML, MHT, XLS, XLSX, RTF, Image (BMP, GIF, JPEG, PNG, TIFF), SVG), and saved to a file on a disc.

16.2 Table

The table shows the energy consumption for each individual balance calculation item (heating, cooling, DHW, ventilation, lighting, auxiliary energy) as monthly values, as well as in total (annual value). Some

balance items are divided into sub-categories, like heating (heating system, heating function of an HVAC system, heating via residential ventilation), cooling (cooling system, cooling function of an HVAC system, residential cooling), and auxiliary energy (for each of the balance items and sub-items, including automation).

The table also shows the energy consumption for the same balance items (and sub-items) for the notional building. By clicking on the icon **Show notional building** (in the upper right corner), the notional building appears/dissapears from the table.

Tables can be exported by clicking on the icon **Export table** (in the upper right corner) in one of the available formats (PDF, XLS, XLSX, CSV, XML, RTF).

16.3 Detail results

The detailed zoning balance is not available at building level for multi-zone buildings.

16.4 Transmission heat losses

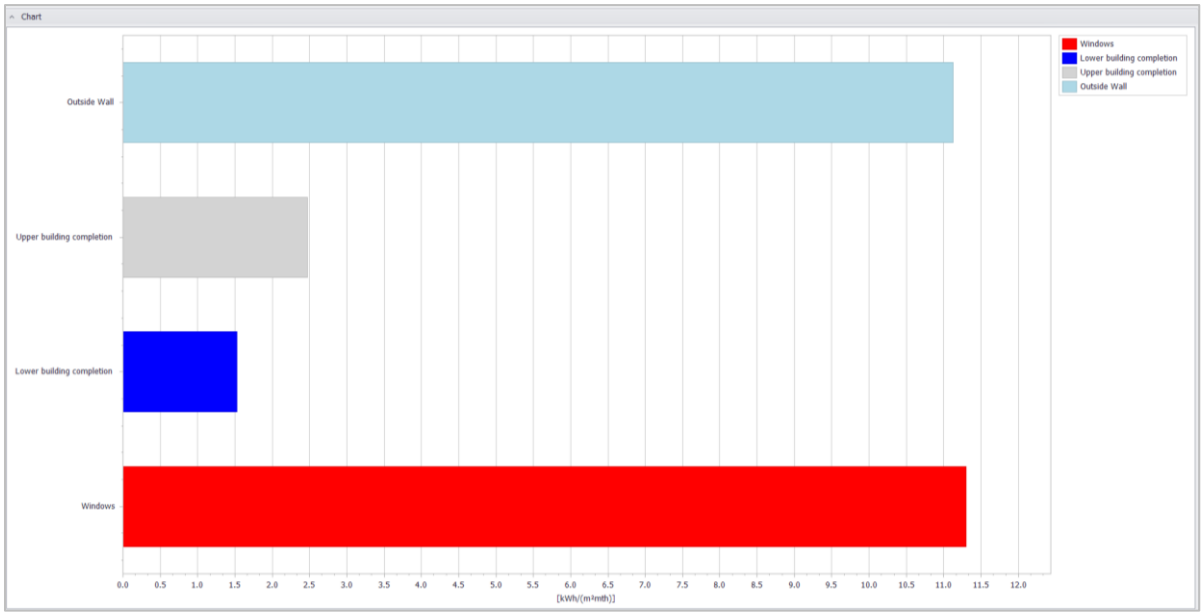


Figure 112: Display of results for the building – transmission heat losses

Building envelope elements are divided in four categories: ouside wall, upper building completion, lower building completion, and windows (please see **Building envelope** screen). Contribution of each category to the transmission heat losses in the building can be read from the chart by moving the cursor over the relevant item.

Charts can be exported by clicking on the icon **Export chart** (in the upper right corner) in one of the available formats (PDF, XTML, MHT, XLS, XLSX, RTF, Image (BMP, GIF, JPEG, PNG, TIFF), SVG), and saved to a file on a disc.

16.5 Heat balance

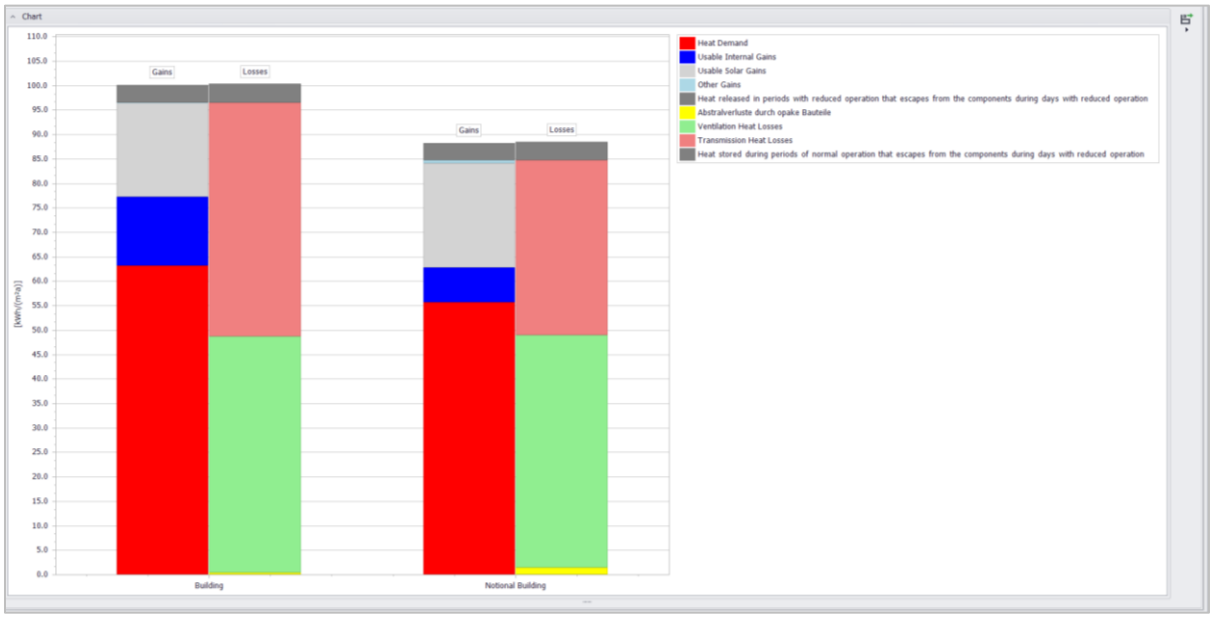


Figure 113: Display of results for the building – heat balance

Energy need balance calculation is represented on the chart. All energy balance items can be read from the chart by moving the cursor over the relevant item.

Energy need for heating/cooling represents the amount of heating/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.

The following heat sources and sinks are included in the energy balance:

- **Transmission heat sinks or sources** due to thermal conduction through building elements and heat transfer through the boundary surfaces of the building zone;
- **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;
- **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;
- **Solar heat sources** due to solar radiation entering the spaces through transparent building elements;
- Heat sinks or sources due to **solar radiation absorption and heat radiation** on the external surfaces of non-transparent building elements;
- **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;
- 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.

16.6 CO_2 emissions

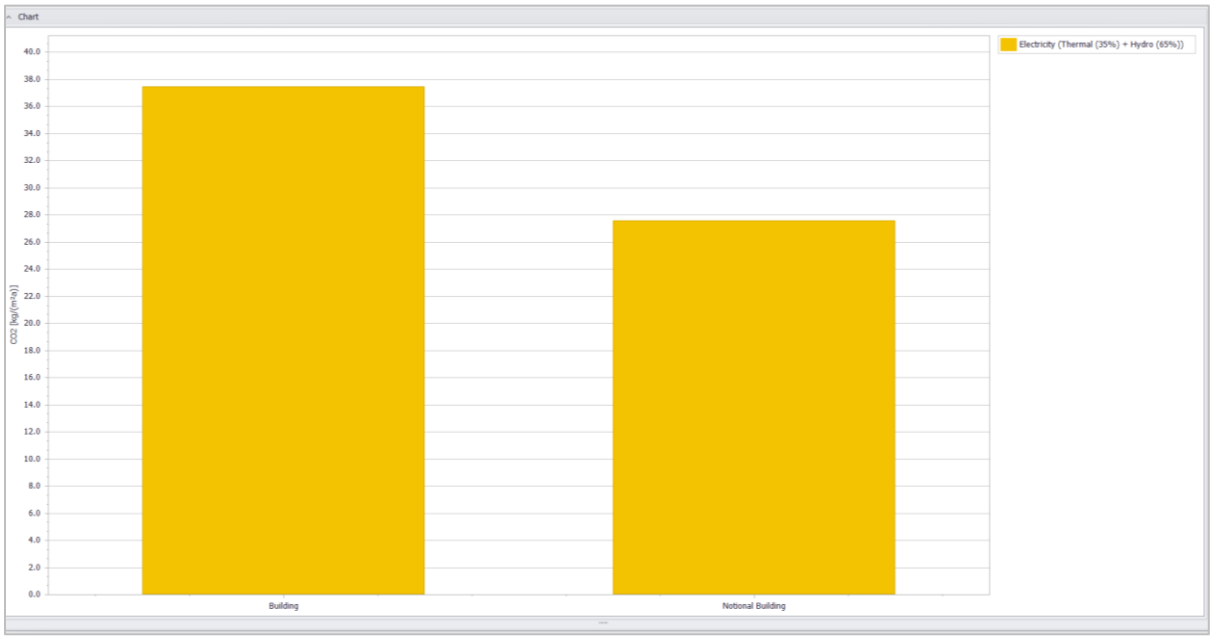


Figure 114: Display of results for the building – CO_2 emissions

Energy balance is transformed into a balance of CO_2 equivalent emissions.

CO_2 equivalent refers to a calculated quantity of greenhouse gases resulting from the delivered energy at the building boundary, whereby all individual emissions are weighted for the greenhouse effect of carbon dioxide and upstream process chains outside the building are also taken into account, for extraction, conversion and distribution of the fuels or materials used.

CO_2 equivalent emission is calculated based on the nationally defined CO_2 emission factor for each energy carrier. CO_2 emission factor indicates the relationship between greenhouse gases emissions and consumption of delivered energy (please see **Building**/**Energy carriers** screen).

For each energy carrier, CO_2 equivalent emission is calculated and presented in [kg/(kWh a)]. CO_2 equivalent emission for the notional building is also presented on the chart next to the actual building.

16.7 Iteration results

The energy needs for heating and cooling are determined by an iterative method. Since calculation of energy needs requires all heat sources to be compared with all heat sinks, these must first be calculated completely. The magnitude of heat sources and heat sinks depends, among other things, on the structural conditions of the building and its use. Most balance components can be determined once without iteration (e.g., internal heat sources from persons (metabolic heat), transmission, ventilation, solar heat sources, etc.). On the other hand, the technical systems-related heat sources and heat sinks (e.g., heat gains from heating distribution pipes) are dependent on the building energy needs itself. However, since the building energy needs are the objective of the comparison of heat sources and heat sinks, an iteration is necessary.

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 %**.

17 Energy efficiency measures

17.1 Energy efficiency measures

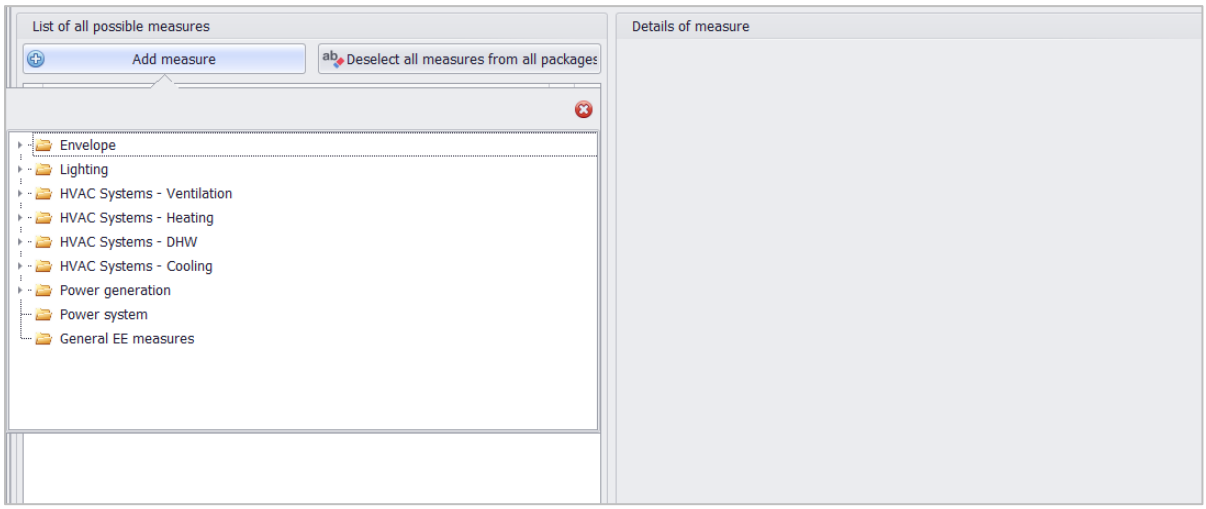


Figure 115: Input screen for adding energy efficiency measures

All energy efficiency measures being considered for implementation for the building are defined in this window. After defining measures here, they can be added to the measure packages that will be defined in the separate window **Packages of energy efficiency measures** (next tab).

Each measure is entered by clicking **Add measure** button and selecting one of specified options from the drop-down menu that appears. All the measures specified in the menu are grouped into several categories:

- **Envelope** (all measures related to building envelope: thermal insulation of envelope elements, replacement of existing constructions/windows/doors, improvement of thermal bridges, improvement of air tightness, etc.);
- **Lighting** (all measures related to the lighting system: installation of new lighting system, luminaries, control system, etc.);
- **HVAC system – Ventilation** (all measures related to the ventilation system: installation/replacement of air handling unit, heat recovery unit, fans, ducts, control system, etc.);
- **HVAC system – Heating** (all measures related to the heating system: installation/replacement of new heating system, generator, distribution system, emission system, hydraulic balancing, pipe insulation, set-back/switch off mode enabling, etc.);
- **HVAC system – DHW** (all measures related to the system for domestic hot water preparation: installation of central system, conversion to decentralized system, pipe insulation, installation of solar thermal system, installation of storage tank, etc.);
- **HVAC system – Cooling** (all measures related to the cooling system: chiller replacement/optimization, introduction of free cooling, evaporative cooling, recooling system replacement, control system improvement, etc.);
- **Power generation** (measures related to introduction of systems for electricity production from renewable energy sources: installation of photovoltaic system, installation of wind power plant);
- **Power system**
- **General EE measures**

More information and parameters for each measure is to be defined in **Details of measure** window.

Energy efficiency measures added in this window can be deleted from all packages of measures that will be later defined (in the tab **Packages of energy efficiency measures**) in a single swipe by clicking **Deselect all measures from all packages** button.

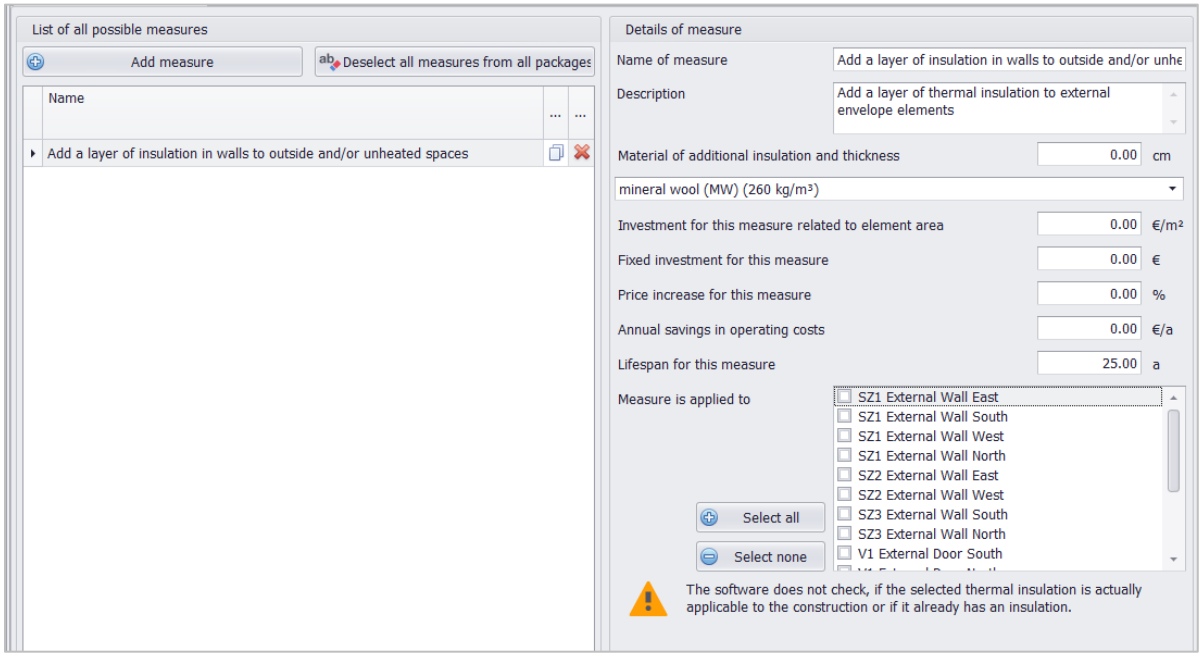


Figure 116: Input screen for defining energy efficiency measures

For all measures the following parameters need to be defined:

Name of measure
Enter the name of the added measure. Software automatically generates in this field a title (short specification) of the added measure. This text is editable and can be modified as preferred.

Description
Enter the description of the added measure. Software automatically generates a short description for the added measure. This text is editable and can be completed with more details as preferred.

Investment for this measure
The investment costs for the measure can be expressed in three ways: (i) investment related to the area, (ii) investment related to the load, and (iii) fixed investment.
The investment costs for the measure can be expressed in only one of the mentioned ways, or they can be expressed using two or even all three ways (please see below explanations for each way of expressing investment costs).
NOTE: When using two or three ways for expressing costs, it is assumed that investment costs for the measure are the sum of the costs entered for each item related to investment costs (each way of cost expression).
The investment costs, in any way(s) expressed, should include design, purchase of building elements, connection to suppliers, installation and commissioning processes (where applicable).

Investment for this measure related to the area
The investment costs are expressed in relation to the relevant element area (e.g. area of envelope element to be thermally insulated, area of solar panels, etc.) or net floor area (i.e. thermally conditioned net floor area of the building), in [EUR/m^2]. For each individual measure, please see the explanations below.

Investment for this measure related to the load

The investment costs are expressed in relation to the load (i.e. heating or cooling load of the generator), in [EUR/kW]. For each individual measure, please see the explanations below.

Fixed investment for this measure
The investment costs refer to the fixed investment for the measure (e.g. installation costs and additional equipment in technical room), and they are expressed in [EUR].

Price increase for this measure
Price increase for this measure refers to the development (increase) over time of prices for investment costs components (i.e. products, building systems, services, labour, etc.). This value is entered in [%], and it assumes the overall investment cost increase on an annual basis. This value can be different from the inflation rate.

Annual savings in operating costs
Savings in operational costs (all costs linked to the operation of the building including annual costs for insurance, utility charges and other standing charges and taxes), that would result from the implementation of this measure need to be estimated. These savings are estimated on annual basis and are expressed in [EUR/a].

Lifespan for this measure
A lifetime for the measure (assumed lifespan for building elements or technical systems) is entered in years [a]. It may differ from the calculation period (observation period), i.e. time period considered for the calculation, also expressed in years.

Explanations for each individual measures

- **Category: Envelope**
  EE measure: Add a layer of insulation in walls to outside and/or unheated spaces

  This measure refers to the thermal insulation of external walls and/or internal walls to unheated spaces, i.e. it implies adding a layer of thermal insulation to the existing constructions of building elements under consideration. In this regard, the **material of the added insulation layer** has to be selected from the drop-down menu, and the **thickness of the layer** needs to be entered in [cm].
  In a small window related to the item **Measure is applied to**, all external walls and internal walls defined in **Building envelope** screen are listed with a checkbox, so that all elements to which this measure applies can be selected.
  Investment for this measure can be expressed as an investment related to the element area (i.e. the area of the wall to be thermally insulated), and/or as fixed investment.

- **Category: Envelope**
  EE measure: Replace the construction of walls to outside and/or unheated spaces

  This measure refers to the replacement of existing constructions of external walls and/or internal walls to unheated spaces with another construction. This is the case when not only a layer of insulation has to be added, but also the existing construction needs to be replaced. In this regard, a construction that will replace the existing construction(s) needs to be previously defined in **Building**/**Constructions** screen, and in this window, it has to be to be selected from the drop-down menu (related to the item **Replacement construction**). In a small window related to the item **Measure is applied to**, all external walls and internal walls defined in **Building envelope** screen are listed with a checkbox, so that all elements to which this measure applies can be selected.
  Investment for this measure can be expressed as an investment related to the element area (i.e. the area of the wall to be replaced), and/or as fixed investment.

- **Category: Envelope**
  EE measure: Add a layer of thermal insulation to floor/lower completions

This measure refers to the thermal insulation of floor/lower completion elements, i.e. it implies adding a layer of thermal insulation to the existing constructions of building elements under consideration. In this regard, the **material of the added insulation layer** has to be selected from the drop-down menu, and the **thickness of the layer** needs to be entered in [cm].
In a small window related to the item **Measure is applied to**, all floors/lower completion elements defined in **Building envelope** screen are listed with a checkbox, so that all elements to which this measure applies can be selected.
Investment for this measure can be expressed as an investment related to the element area (i.e. the area of the floor/lower completion to be thermally insulated), and/or as fixed investment.

- **Category: Envelope**
  EE measure: Replace the construction of floor/lower completions

  This measure refers to the replacement of existing constructions of floor/lower completion elements with another construction. This is the case when not only a layer of insulation has to be added, but also the existing construction needs to be replaced. In this regard, a construction that will replace the existing construction(s) needs to be previously defined in **Building**/**Constructions** screen, and in this window, it has to be to be selected from the drop-down menu (related to the item **Replacement construction**). In a small window related to the item **Measure is applied to**, all floors/lower completion elements defined in **Building envelope** screen are listed with a checkbox, so that all elements to which this measure applies can be selected.
  Investment for this measure can be expressed as an investment related to the element area (i.e. the area of the floor/lower completion to be replaced), and/or as fixed investment.

- **Category: Envelope**
  EE measure: Add a layer of thermal insulation to roof/upper elements

  This measure refers to the thermal insulation of roof/upper completion elements, i.e. it implies adding a layer of thermal insulation to the existing constructions of building elements under consideration. In this regard, the **material of the added insulation layer** has to be selected from the drop-down menu, and the **thickness of the layer** needs to be entered in [cm].
  In a small window related to the item **Measure is applied to**, all roofs/upper completion elements defined in **Building envelope** screen are listed with a checkbox, so that all elements to which this measure applies can be selected.
  Investment for this measure can be expressed as an investment related to the element area (i.e. the area of the roof/upper completion to be thermally insulated), and/or as fixed investment.

- **Category: Envelope**
  EE measure: Replace the construction of roof/upper elements

  This measure refers to the replacement of existing constructions of roof/upper completion elements with another construction. This is the case when not only a layer of insulation has to be added, but also the existing construction needs to be replaced. In this regard, a construction that will replace the existing construction(s) needs to be previously defined in **Building**/**Constructions** screen, and in this window, it has to be to be selected from the drop-down menu (related to the item **Replacement construction**). In a small window related to the item **Measure is applied to**, all roofs/upper completion elements defined in **Building envelope** screen are listed with a checkbox, so that all elements to which this measure applies can be selected.
  Investment for this measure can be expressed as an investment related to the element area (i.e. the area of the roof/upper completion to be replaced), and/or as fixed investment.

- **Category: Envelope**

EE measure: Replacement of windows/doors

This measure refers to the replacement of existing transparent elements (windows, doors, skylights) with new transparent elements. Transparent element (window/door/skylight) that will replace the existing transparent elements needs to be either previously defined in **Building**/**Windows** screen, or it can be defined directly in this window. In this regard, from the drop-down menu related to the item **Available windows for this measure**, one of the options needs to be selected. In a small window related to the item **Measure is applied to**, all transparent elements (windows, doors, skylights) defined in **Building envelope** screen are listed with a checkbox, so that all elements to which this measure applies can be selected.
Investment for this measure can be expressed as an investment related to the element area (i.e. the area of the transparent element to be replaced), and/or as fixed investment.

- **Category: Envelope**
  EE measure: Improvement of thermal bridges

  This measure refers to reducing the effects caused by thermal bridges. New value for thermal bridges (improved value compared to the value defined for thermal bridges in **Building**/**Building data** screen) needs to be entered in the field **Improved value for thermal bridges**.
  Investment for this measure can be expressed as an investment related to the façade area (i.e. the area of the façade to be improved), and/or as fixed investment.

- **Category: Envelope**
  EE measure: Improvement of air tightness

  This measure refers to increasing building air tightness, i.e. reducing air leakages through the building thermal envelope. New value for air changes per hour at 50 Pa, measured with Blower door (improved value compared to the value defined for infiltration based on Blower-door test in **Building**/**Building data** screen) needs to be entered in the field **Improved value for air tightness n50 (measured value)**.
  Investment for this measure can be expressed as an investment related to the façade area (i.e. the area of the façade to be improved), and/or as fixed investment.

- **Category: Lighting**
  EE measure: Installation of LEDs

  This measure refers to installation and/or replacement of existing luminaries with LEDs. Type of LED luminaires that will be installed needs to be selected from the drop-down menu **Luminaire**. In a small window related to the item **Measure is applied to**, all lighting domains defined in **Lighting** screen are listed with a checkbox, so that all lighting domains to which this measure applies can be selected.
  Investment for this measure can be expressed as an investment related to the lighting domain area (i.e. the area of the lighting domain where LEDs will be installed), and/or as fixed investment.

- **Category: Lighting**
  EE measure: Installation of different luminaries

  This measure refers to installation and/or replacement of existing luminaries with luminaires of different type. Type of luminaires that will be installed needs to be selected from the drop-down menu **Luminaire**. In a small window related to the item **Measure is applied to**, all lighting domains defined in **Lighting** screen are listed with a checkbox, so that all lighting domains to which this measure applies can be selected.
  Investment for this measure can be expressed as an investment related to the lighting domain area (i.e. the area of the lighting domain where different luminaires will be installed), and/or as fixed investment.

- **Category: Lighting**
  EE measure: Installation of automatic control system

  This measure refers to improvement of lighting control system that will provide the ability to automatically adjust the lighting device output based on daylight availability, occupancy, etc. This measure will be automatically reflected in the automation levels for lighting system (defined in **Building**/**Building data** screen).
  Investment for this measure can be expressed as an investment related to the net floor area, and/or as fixed investment.

- **Category: HVAC – Ventilation**
  EE measure: Add ventilation system with heat exchanger

  This measure refers to installation of ventilation system with air handling unit (AHU) which is supplying all building zones considered as ventilated. AHU contains heat recovery unit, and its type needs to be selected from the drop-down menu **Type of heat recovery**. **Heat recovery rate** needs to be entered as well.
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – Ventilation**
  EE measure: Replace central AC unit

  This measure refers to replacement of existing air handling unit (AHU) in ventilation system with the new one. New AHU contains heat recovery unit, and its type needs to be selected from the drop-down menu **Type of heat recovery**. **Heat recovery rate** needs to be entered as well.
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – Ventilation**
  EE measure: Installation or improvement of heat recovery unit

  This measure refers to installation of new heat recovery unit or improvement of the existing one in the ventilation system. The type of new heat recovery unit needs to be selected from the drop-down menu **Type of heat recovery**. **Heat recovery rate** needs to be entered as well.
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – Ventilation**
  EE measure: Installation of new fans

  This measure refers to installation of new fans in the existing ventilation system.
  This measure will be automatically reflected in the air transport parameters defined in **AC unit** screen (**Ventilation** section).
  Investment for this measure can be expressed as an investment related to the net floor area, and/or as fixed investment.

- **Category: HVAC – Ventilation**
  EE measure: Removal of humidifier

  This measure refers to removal of humidifiers from the existing ventilation system.
  This measure will be automatically reflected in the parameters defined for humidification in **AC unit** screen (**Ventilation** section).
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – Ventilation**
  EE measure: Installation of timer control, air quality, etc.

This measure refers to improvement of ventilation control system that will provide the ability to automatically adjust the ventilation in building in order to keep indoor air quality within preferred levels. It can be based on the occupancy control, CO_2 control, time-dependent control, etc.
Automation level for newly installed control system for ventilation needs to be selected from the drop-down menu **Ventilation control** (please see **Building automation** window in **Building** /**Building data** screen).
Investment for this measure is expressed as fixed investment.

- **Category: HVAC – Ventilation**
  EE measure: Improving air ducts insulation

  This measure refers to improvement of air ducts insulation in the ventilation system in order to decrease the distribution losses.
  This measure will be automatically reflected in the distribution settings (**Ventilation** section).
  Investment for this measure can be expressed as an investment related to the net floor area, and/or as fixed investment.

- **Category: HVAC – Heating**
  EE measure: Installation of a new central heating and DHW system

  This measure refers to installation of a new central system envisaged both for space heating and DHW preparation. New system is assumed to cover all building zones considered as heated.
  For defining a new system, the selections regarding the heat generation, energy source and heating emissions need to be made from the relevant drop-down menus (**Heat generation**, **Energy source** and **Emission**).
  Investment for this measure can be expressed using any or all of these ways: investment related to the heated floor area, investment related to the heating load, and fixed investment.

- **Category: HVAC – Heating**
  EE measure: Installation of a new direct heating and cooling system

  This measure refers to replacing the existing heating and cooling systems with a new direct system envisaged both for heating and cooling. The new system is a direct system (split, multi-split or VRF system), and is assumed to cover all building zones considered as heated and cooled by the existing systems.
  For defining the new system, the option from the drop-down menu **System** needs to be selected.
  Investment for this measure can be expressed using any or all of these ways: investment related to the heated floor area, investment related to the maximum load (heat/cooling), and fixed investment.

- **Category: HVAC – Heating**
  EE measure: Installation of a new central heating, DHW and cooling system

  This measure refers to replacing the existing heating, DHW and cooling systems, with one new central system envisaged for all three services: heating, cooling and DHW preparation. The new system to be installed is a heat pump (using outdoor air or ground as a heat source) and is assumed to cover all building zones considered as heated and cooled by the existing systems.
  For defining the new system, the option from the drop-down menu **System** needs to be selected.
  Investment for this measure can be expressed using any or all of these ways: investment related to the heated floor area, investment related to the maximum load (heat/cooling), and fixed investment.

- **Category: HVAC – Heating**
  EE measure: Installation of a new generator

This measure refers to replacing the existing heat generator in a central heating system with the new generator of higher efficiency. It should be checked whether the new generator can be used with the heating system temperatures, since the software doesn't check it by itself.
The new generator is defined by selecting the appropriate options for generator type and energy source from the relevant drop-down menus (**Heat generation** and **Energy source**).
Investment for this measure can be expressed using any or all of these ways: investment related to the heated floor area, investment related to the heating load, and fixed investment.

- **Category: HVAC – Heating**
  EE measure: Installation of a new heating distribution system

  This measure refers to replacing the existing distribution system of the heating system with the new distribution system.
  This measure will be automatically reflected in the settings for pipes and pumps in **Heating circuit** screen (**Heating** section).
  Investment for this measure can be expressed as an investment related to the net floor area, and/or as fixed investment.

- **Category: HVAC – Heating**
  EE measure: Installation of a new central heating emissions

  This measure refers to replacing the existing heating emissions in the central heating system with the new heating emissions (of the same type).
  This measure will be automatically reflected in the settings for heating emissions in **Heating emission** screen (**Heating** section).
  Investment for this measure can be expressed as an investment related to the net floor area, and/or as fixed investment.

- **Category: HVAC – Heating**
  EE measure: Hydraulic balancing of the heating system

  This measure refers to the introduction of hydraulic balancing in heating systems where it did not exist. This measure will be automatically reflected in the hydraulic balancing option in **Heating circuit** screen (**Heating** section).
  Investment for this measure can be expressed as an investment related to the net floor area, and/or as fixed investment.

- **Category: HVAC – Heating**
  EE measure: Insulation of heating pipes, valves, etc.

  This measure refers to the improvement of distribution efficiency in heating systems by thermally insulating the pipes, valves, fittings, etc. It is assumed that the value for heat transfer coefficient (U-value) of the pipes after insulation is 0,14 W/(mK).
  Investment for this measure can be expressed as an investment related to the net floor area, and/or as fixed investment.

- **Category: HVAC – Heating**
  EE measure: Replacement/installation of the buffer tank

  This measure refers to the replacement or installation of buffer tank in heating systems. This measure will be automatically reflected in heating storage option and relevant parameters in **Heating unit** and **Heating storage** screen (**Heating** section).
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – Heating**
  EE measure: Reducing the heating fluid temperature

This measure refers to the reducing the heating fluid temperatures in heating systems. This measure will be automatically reflected in the system temperatures defined in **Heating circuit** screen (**Heating** section).
Investment for this measure can be expressed as an investment related to the net floor area, and/or as fixed investment.

- **Category: HVAC – Heating**
  EE measure: Enable setback mode for heating

  This measure refers to lowering the heating supply temperature for a pre-specified period at night-time (i.e. enabling setback mode at night). Application of this measure refers to all building zones and it will be automatically reflected in the operating mode for heating defined in thermal conditioning of zone in **Building**/**Building data** screen.
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – Heating**
  EE measure: Enable switch off mode for heating

  This measure refers to shutting down the heating system for a pre-specified period at night-time (i.e. enabling switch off mode at night). Application of this measure refers to all building zones and it will be automatically reflected in the operating mode for heating defined in thermal conditioning of zone in **Building**/**Building data** screen.
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – Heating**
  EE measure: Installation of emission control, pumps, etc.

  This measure refers to improvement of heating system control (controlled operation of the pumps, optimization of heating emissions, etc.).
  Automation level for newly installed control system for heating needs to be selected from the drop-down menu **Heating control** (please see **Building automation** window in **Building**/**Building data** screen).
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – DHW**
  EE measure: Installation of separated central DHW system

  This measure refers to installation of new central system for DHW preparation (instead of existing decentralized systems). This system is used only for DHW preparation. In case of combined use with space heating, a measure **Installation of a new central heating and DHW system** is relevant (please see measures in **HVAC systems – Heating**).
  This measure will be automatically reflected in the settings for **DHW circuit** and **DHW unit** (**DHW** section).
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – DHW**
  EE measure: Installation of solar thermal system (DHW preparation)

  This measure refers to installation of solar thermal system for DHW preparation. The area of solar collectors needs to be entered in **Collector area**.
  This measure will be automatically reflected in the settings for solar heating in **DHW unit** (**DHW** section).
  Investment for this measure can be expressed as an investment related to the element area (i.e. the area of the solar collectors), and/or as fixed investment.

- **Category: HVAC – DHW**
  EE measure: Replacement/installation of hot water storage tank

This measure refers to the replacement or installation of hot water storage tank in DHW systems. This measure will be automatically reflected in the DHW storage option and relevant parameters in **DHW unit** and **DHW storage** screen (**DHW** section).
Investment for this measure is expressed as fixed investment.

- **Category: HVAC – DHW**
  EE measure: Conversion to decentralized DHW preparation

  This measure refers to the change from the existing central system for DHW preparation to the new decentralized systems. This measure will be automatically reflected in the parameters specified for **DHW circuit** and **DHW unit** (**DHW** section).
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – DHW**
  EE measure: Insulation of DHW pipes

  This measure refers to the improvement of distribution efficiency in DHW systems by thermally insulating the pipes, valves, storage, etc. It is assumed that the value for heat transfer coefficient (U-value) of the pipes after insulation is 0,14 W/(mK).
  Investment for this measure can be expressed as an investment related to the net floor area, and/or as fixed investment.

- **Category: HVAC – Cooling**
  EE measure: Cooling unit (chiller) replacement

  This measure refers to replacement of existing cooling unit (chiller) with the new one of higher efficiency. The type of cooling unit to replace the existing one needs to be selected from the drop-down menu **Type of cooling system**.
  Investment for this measure can be expressed using any or all of these ways: investment related to the cooled floor area, investment related to the cooling load, and fixed investment.

- **Category: HVAC – Cooling**
  EE measure: Chiller plant optimization

  This measure refers to optimization of operation in multi-generator systems. It will be automatically reflected in the multi-generator settings in **Cooling generation** (**Cooling unit** screen).
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – Cooling**
  EE measure: Replacement of recooling system

  This measure refers to replacement of existing recooling system with the new one (e.g. evaporative cooling towers with open or closed cooling circuit, air/water dry coolers, etc.). This measure will be automatically reflected in recooling settings in **Cooling generation** (**Cooling unit** screen).
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – Cooling**
  EE measure: Replacement/installation of cold accumulator

  This measure refers to replacement or installation of cold storage in cooling systems. This measure will be automatically reflected in the option for cold storage in **Cooling** (**Cooling unit** screen).
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – Cooling**
  EE measure: Installation of emission control, pumps, etc.

  This measure refers to improvement of cooling system control (controlled operation of the pumps, optimization of cooling energy distribution, etc.).
  Automation level for newly installed control system for cooling needs to be selected from the drop-down menu **Cooling control** (please see **Building automation** window in **Building**/**Building data** screen).
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – Cooling**
  EE measure: Use of inverter units for cooling

  This measure refers to using the inverter units for cooling, since their electricity consumption is lower and thus the efficiency is higher, with faster reaching of the desired temperature and more precise temperature control. This measure will be automatically reflected in control settings in **Cooling generation** (**Cooling unit** screen).
  Investment for this measure is expressed as fixed investment.

- **Category: HVAC – Cooling**
  EE measure: Introduction of free cooling

  This measure refers to possibility to introduce free cooling process in existing cooling system (process of using external ambient temperature to reject heat, rather than using the refrigeration process). If used within an optimised system, free cooling can provide significant energy savings. This measure will be automatically reflected in the free cooling settings in **Cooling generation** (**Cooling unit** screen).
  Investment for this measure can be expressed as an investment related to the cooling load, and/or as fixed investment.

- **Category: HVAC – Cooling**
  EE measure: Introduction of evaporative cooling

  This measure refers to possibility to introduce evaporative cooling process in existing cooling system. This measure will be automatically reflected in the parameters specified for recooling settings in **Cooling generation** (**Cooling unit** screen).
  Investment for this measure is expressed as fixed investment.

- **Category: Power generation**
  EE measure: Installation of photovoltaic plant

  This measure refers to installation of photovoltaic plant (rooftop system for electricity generation).
  Photovoltaic plant can be defined either by area of solar panels, or by peak power.
  In case of using peak power for defining PV system, this option needs to be selected by clicking in the checkbox **Input of peak power**, after which it is necessary to enter a value for **power**, as well as to select adequate options for the type of solar panels in terms of ventilation (**Ventilation** drop-down menu) and for panels orientation (**Orientation** drop-down menu).
  In case of defining PV system by solar panel area, it is necessary to enter the **total area of PV modules without frame**, as well as to select adequate options for the type of solar modules, their orientation (**Orientation** drop-down menu), inclination (**Inclination** drop-down menu), and the module type in terms of ventilation (**Ventilation** drop-down menu).
  Investment for this measure can be expressed as an investment related to the element area (i.e. the area of the solar panels), and/or as fixed investment.

- **Category: Power generation**
  EE measure: Installation of small wind turbine

This measure refers to installation of wind power plant (rooftop system for electricity generation).
This measure will be automatically reflected in the parameters specified for wind power plant settings (**Wind turbine** screen in **Renewable power** section).
Investment for this measure can be expressed as an investment related to the peak power, and/or as fixed investment.

17.2 Packages of energy efficiency measures

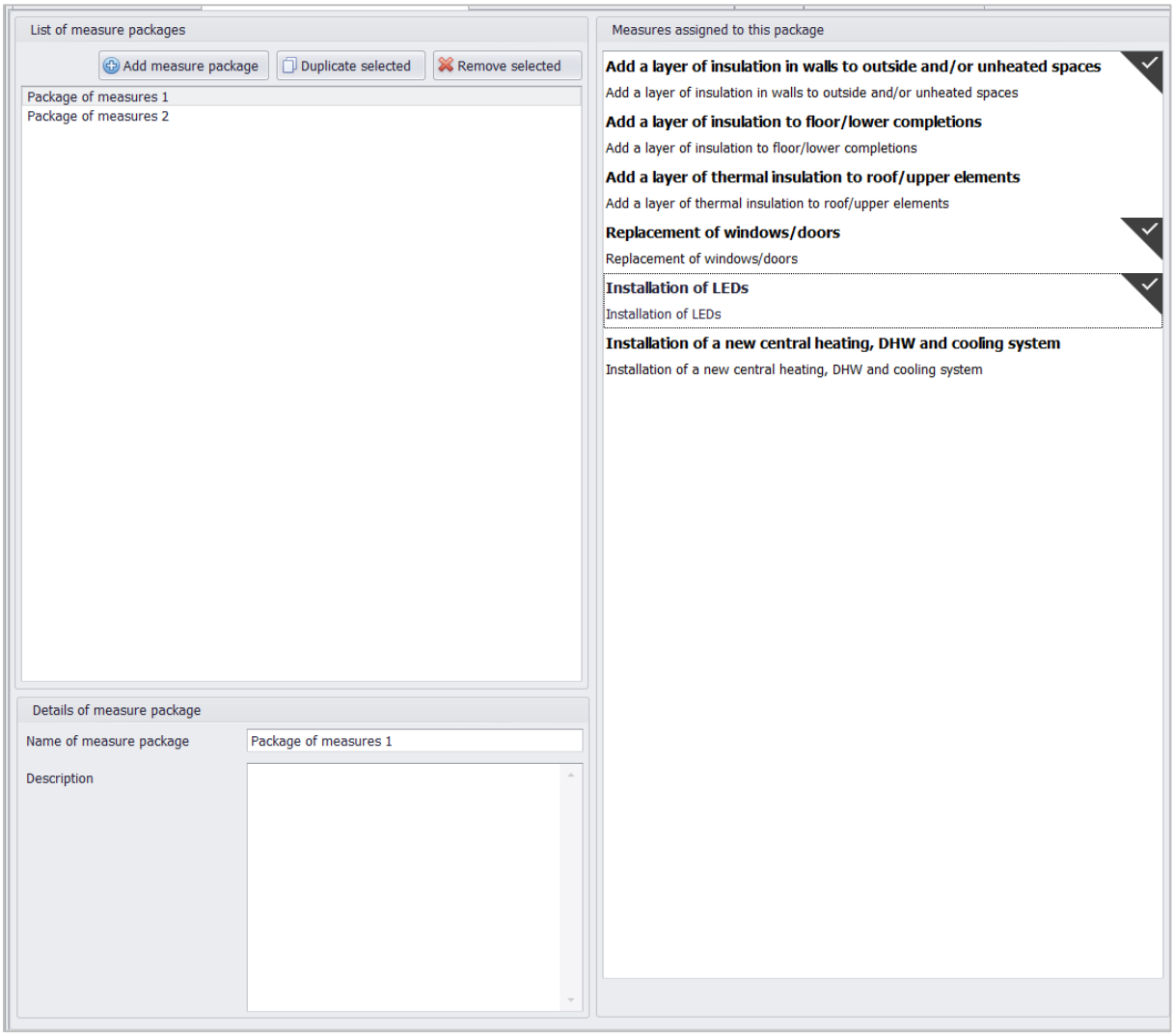


Figure 117: Input screen for defining packages of energy efficiency measures

List of measure packages

Each package of energy efficiency measures is entered by clicking **Add measure package** button.

Each added measure package may be duplicated by clicking **Duplicate selected** button.

Each added measure package may be deleted by clicking **Remove selected** button.

Details of measure package

The name of the added package of energy efficiency measures is entered in **Name of measure package**.

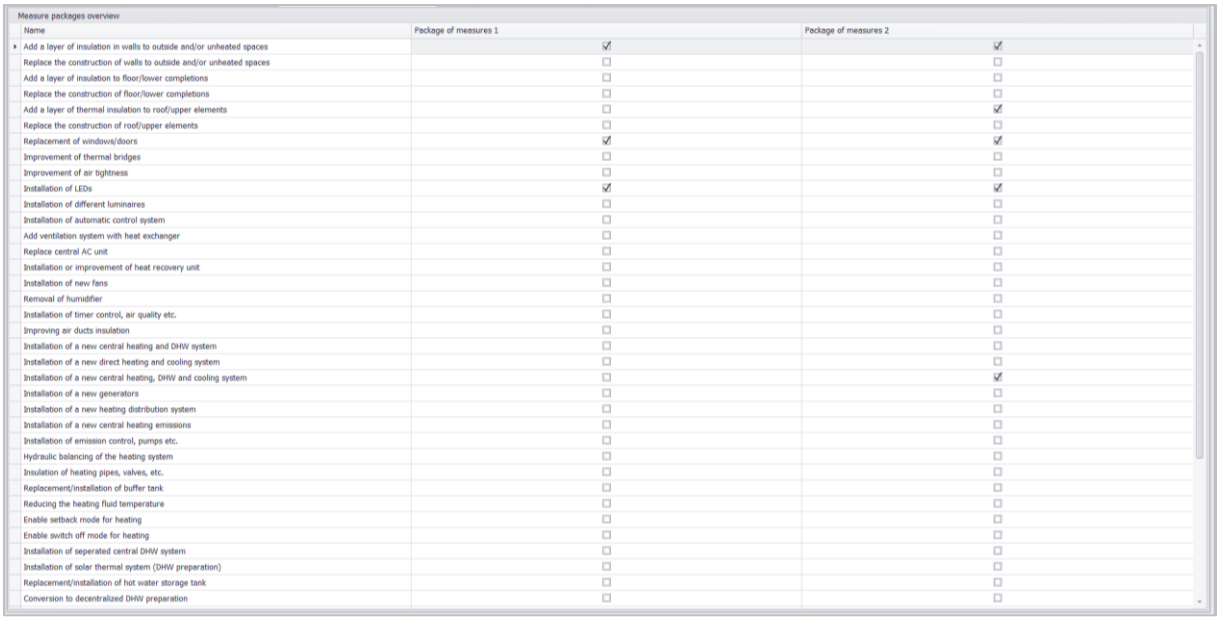
Some short description of the added measure package can be entered in the **Description** field.

Measures assigned to this package

All energy efficiency measures being considered for implementation for the building have been defined in window **Energy efficiency measures** (preceding tab). All these measures are listed in this window and it represents the basis for selecting the measures for each added package.

For each package of energy efficiency measures, those measures from the list to be included in the package need to be selected by clicking on them, and a checkmark will appear in the upper right corner.

17.3 Overview of energy efficiency measures



Measure packages overview

Name	Package of measures 1	Package of measures 2
Add a layer of insulation in walls to outside and/or unheated spaces	☑	☑
Replace the construction of walls to outside and/or unheated spaces	☐	☐
Add a layer of insulation to floor/lower completions	☐	☐
Replace the construction of floor/lower completions	☐	☐
Add a layer of thermal insulation to roof/upper elements	☐	☑
Replace the construction of roof/upper elements	☐	☐
Replacement of windows/doors	☑	☑
Improvement of thermal bridges	☐	☐
Improvement of air tightness	☐	☐
Installation of LEDs	☑	☑
Installation of different luminaires	☐	☐
Installation of automatic control system	☐	☐
Add ventilation system with heat exchanger	☐	☐
Replace central AC unit	☐	☐
Installation or improvement of heat recovery unit	☐	☐
Installation of new fans	☐	☐
Removal of humidifier	☐	☐
Installation of timer control, air quality etc.	☐	☐
Improving air ducts insulation	☐	☐
Installation of a new central heating and DHW system	☐	☐
Installation of a new direct heating and cooling system	☐	☐
Installation of a new central heating, DHW and cooling system	☐	☑
Installation of a new generators	☐	☐
Installation of a new heating distribution system	☐	☐
Installation of a new central heating emissions	☐	☐
Installation of emission control, pumps etc.	☐	☐
Hydraulic balancing of the heating system	☐	☐
Insulation of heating pipes, valves, etc.	☐	☐
Replacement/installation of buffer tank	☐	☐
Reducing the heating fluid temperature	☐	☐
Enable setback mode for heating	☐	☐
Enable switch off mode for heating	☐	☐
Installation of seperated central DHW system	☐	☐
Installation of solar thermal system (DHW preparation)	☐	☐
Replacement/installation of hot water storage tank	☐	☐
Conversion to decentralized DHW preparation	☐	☐

Figure 118: Overview of energy efficiency measures and defined packages

All energy efficiency measures that can be modelled in the software are listed in the left column.

All packages of energy efficiency measures that are defined for the building (in **Packages of energy efficiency measures** tab) are reflected in the table. Each package is presented in a separate column with checked options related to energy efficiency measures included in that package.

It is not possible to make selections in this window, it is just an overview. All selections and changes can be made in **Energy efficiency measures** and **Packages of energy efficiency measures** tabs.

Energy efficiency measures that can be modelled in the software are the following:

Add a layer of insulation in walls to outside and/or unheated spaces (Category: **Envelope**)
The measure refers to the thermal insulation of external walls and/or internal walls to unheated spaces, i.e. it implies adding a layer of thermal insulation to the existing constructions of building elements under consideration.

Replace the construction of walls to outside and/or unheated spaces (Category: **Envelope**)

The measure refers to the replacement of existing constructions of external walls and/or internal walls to unheated spaces with another construction. This is the case when not only a layer of insulation has to be added, but also the existing construction needs to be replaced.

Add a layer of thermal insulation to floor/lower completions (Category: **Envelope**)
The measure refers to the thermal insulation of floor/lower completion elements, i.e. it implies adding a layer of thermal insulation to the existing constructions of building elements under consideration

Replace the construction of floor/lower completions (Category: **Envelope**)
The measure refers to the replacement of existing constructions of floor/lower completion elements with another construction. This is the case when not only a layer of insulation has to be added, but also the existing construction needs to be replaced.

Add a layer of thermal insulation to roof/upper elements (Category: **Envelope**)
The measure refers to the thermal insulation of roof/upper completion elements, i.e. it implies adding a layer of thermal insulation to the existing constructions of building elements under consideration.

Replace the construction of roof/upper elements (Category: **Envelope**)
The measure refers to the replacement of existing constructions of roof/upper completion elements with another construction. This is the case when not only a layer of insulation has to be added, but also the existing construction needs to be replaced.

Replacement of windows/doors (Category: **Envelope**)
The measure refers to the replacement of existing transparent elements (windows, doors, skylights) with new transparent elements.

Improvement of thermal bridges (Category: **Envelope**)
The measure refers to reducing the effects caused by thermal bridges.

Improvement of air tightness (Category: **Envelope**)
The measure refers to increasing building air tightness, i.e. reducing air leakages through the building thermal envelope.

Installation of LEDs (Category: **Lighting**)
The measure refers to installation and/or replacement of existing luminaries with LEDs.

Installation of different luminaries (Category: **Lighting**)
The measure refers to installation and/or replacement of existing luminaries with luminaires of different type.

Installation of automatic control system (Category: **Lighting**)
The measure refers to improvement of lighting control system that will provide the ability to automatically adjust the lighting device output based on daylight availability, occupancy, etc.

Add ventilation system with heat exchanger (Category: **HVAC – Ventilation**)
The measure refers to installation of ventilation system with air handling unit (AHU) which is supplying all building zones considered as ventilated. AHU contains heat recovery unit.

Replace central AC unit (Category: **HVAC – Ventilation**)
The measure refers to replacement of existing air handling unit (AHU) in ventilation system with the new one. New AHU contains heat recovery unit.

Installation or improvement of heat recovery unit (Category: **HVAC – Ventilation**)
The measure refers to installation of new heat recovery unit or improvement of the existing one in the ventilation system.

Installation of new fans (Category: **HVAC – Ventilation**)

The measure refers to installation of new fans in the existing ventilation system.

Removal of humidifier (Category: **HVAC – Ventilation**)
The measure refers to removal of humidifiers from the existing ventilation system.

Installation of timer control, air quality, etc. (Category: **HVAC – Ventilation**)
The measure refers to improvement of ventilation control system that will provide the ability to automatically adjust the ventilation in building in order to keep indoor air quality within preferred levels. It can be based on the occupancy control, CO_2 control, time-dependent control, etc.

Improving air ducts insulation (Category: **HVAC – Ventilation**)
The measure refers to improvement of air ducts insulation in the ventilation system in order to decrease the distribution losses.

Installation of a new central heating and DHW system (Category: **HVAC – Heating**)
The measure refers to installation of a new central system envisaged both for space heating and DHW preparation. New system is assumed to cover all building zones considered as heated.

Installation of a new direct heating and cooling system (Category: **HVAC – Heating**)
The measure refers to replacing the existing heating and cooling systems with a new direct system envisaged both for heating and cooling. The new system is a direct system (split, multi-split or VRF system), and is assumed to cover all building zones considered as heated and cooled by the existing systems.

Installation of a new central heating, DHW and cooling system (Category: **HVAC – Heating**)
The measure refers to replacing the existing heating, DHW and cooling systems, with one new central system envisaged for all three services: heating, cooling and DHW preparation. The new system to be installed is a heat pump (using outdoor air or ground as a heat source) and is assumed to cover all building zones considered as heated and cooled by the existing systems.

Installation of a new generator (Category: **HVAC – Heating**)
The measure refers to replacing the existing heat generator in a central heating system with the new generator of higher efficiency. It should be checked whether the new generator can be used with the heating system temperatures, since the software doesn't check it by itself.

Installation of a new heating distribution system (Category: **HVAC – Heating**)
The measure refers to replacing the existing distribution system of the heating system with the new distribution system.

Installation of a new central heating emissions (Category: **HVAC – Heating**)
The measure refers to replacing the existing heating emissions in the central heating system with the new heating emissions.

Hydraulic balancing of the heating system (Category: **HVAC – Heating**)
The measure refers to the introduction of hydraulic balancing in heating systems where it did not exist

Insulation of heating pipes, valves, etc. (Category: **HVAC – Heating**)
The measure refers to the improvement of distribution efficiency in heating systems by thermally insulating the pipes, valves, fittings, etc. It is assumed that the value for heat transfer coefficient (U-value) of the pipes after insulation is 0,14 W/(mK).

Replacement/installation of the buffer tank (Category: **HVAC – Heating**)
The measure refers to the replacement or installation of buffer tank in heating systems.

Reducing the heating fluid temperature (Category: **HVAC – Heating**)
The measure refers to the reducing the heating fluid temperatures in heating systems.

Enable setback mode for heating (Category: **HVAC – Heating**)
The measure refers to lowering the heating supply temperature for a pre-specified period at night-time (i.e. enabling setback mode at night).

Enable switch off mode for heating (Category: **HVAC – Heating**)
The measure refers to shutting down the heating system for a pre-specified period at night-time (i.e. enabling switch off mode at night).

Installation of emission control, pumps, etc. (Category: **HVAC – Heating**)
This measure refers to improvement of heating system control (controlled operation of the pumps, optimization of heating emissions, etc.).

Installation of separated central DHW system (Category: **HVAC – DHW**)
The measure refers to installation of new central system for DHW preparation (instead of existing decentralized systems). This system is used only for DHW preparation. In case of combined use with space heating, a measure **Installation of a new central heating and DHW system** is relevant (please see measure in **HVAC systems – Heating**).

Installation of solar thermal system (DHW preparation) (Category: **HVAC – DHW**)
The measure refers to installation of solar thermal system for DHW preparation.

Replacement/installation of hot water storage tank (Category: **HVAC – DHW**)
The measure refers to the replacement or installation of hot water storage tank in DHW systems.

Conversion to decentralized DHW preparation (Category: **HVAC – DHW**)
The measure refers to the change from the existing central system for DHW preparation to the new decentralized systems.

Insulation of DHW pipes (Category: **HVAC – DHW**)
The measure refers to the improvement of distribution efficiency in DHW systems by thermally insulating the pipes, valves, storage, etc. It is assumed that the value for heat transfer coefficient (U-value) of the pipes after insulation is 0,14 W/(mK).

Cooling unit (chiller) replacement (Category: **HVAC – Cooling**)
The measure refers to replacement of existing cooling unit (chiller) with the new one of higher efficiency.

Chiller plant optimization (Category: **HVAC – Cooling**)
This measure refers to optimization of operation in multi-generator systems.

Replacement of recooling system (Category: **HVAC – Cooling**)
The measure refers to replacement of existing recooling system with the new one (e.g. evaporative cooling towers with open or closed cooling circuit, air/water dry coolers, etc.).

Replacement/installation of cold accumulator (Category: **HVAC – Cooling**)
The measure refers to replacement or installation of cold storage in cooling systems.

Installation of emission control, pumps, etc. (Category: **HVAC – Cooling**)
This measure refers to improvement of cooling system control (controlled operation of the pumps, optimization of cooling energy distribution, etc.).

Use of inverter units for cooling (Category: **HVAC – Cooling**)
The measure refers to using the inverter units for cooling, since their electricity consumption is lower and thus the efficiency is higher, with faster reaching of the desired temperature and more precise temperature control.

Introduction of free cooling (Category: **HVAC – Cooling**)

The measure refers to possibility to introduce free cooling process in existing cooling system (process of using external ambient temperature to reject heat, rather than using the refrigeration process). If used within an optimised system, free cooling can provide significant energy savings.

Introduction of evaporative cooling (Category: **HVAC – Cooling**)
The measure refers to possibility to introduce evaporative cooling process in existing cooling system.

Installation of photovoltaic plant (Category: **Power generation**)
The measure refers to installation of photovoltaic plant (rooftop system for electricity generation).

Installation of small wind turbine (Category: **Power generation**)
The measure refers to installation of wind power plant (rooftop system for electricity generation).

17.4 Options

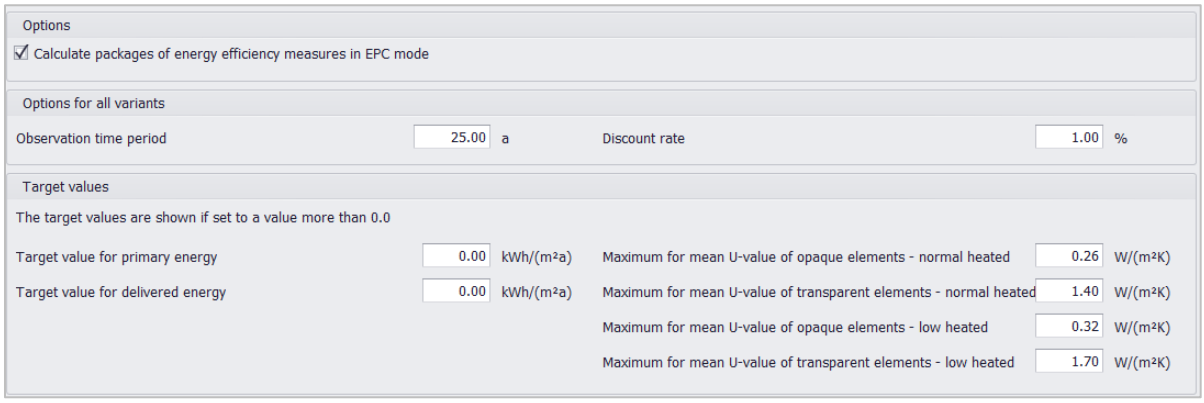


Figure 119: Input screen for defining options for implementation of packages of EE measures

Options

Implementation of packages of energy efficiency measures can be calculated either with standard user profiles (user profiles used in **Calculation for EPC** mode, i.e. mode for creating energy performance certificates), or with user profiles modified in order to reflect the actual use of the building (additional user profiles defined in **Building** screen and used in **Calculation of consumption** mode).

Selection of the first option (i.e. use of standard user profiles) is made by clicking in the checkbox **Calculate packages of energy efficiency measures in EPC mode**. In this regard, energy savings will be calculated in relation to the baseline energy consumption (i.e. energy consumption calculated in EPC mode).

Options for all variants

Observation time period
Observation or calculation period refers to the time period considered for the calculation. It needs to be entered in years.

Discount rate
Discount rate represents the definite value for comparison of the value of money at different times expressed in real terms. It correspondes to the interest rate which is charged or paid for the use of money for the calculation period considered. Discount rate needs to be entered in [%].

Target values

In case that for current projects there are some target values regarding energy consumption (delivered and primary energy) and mean U-value (for opaque and transparent elements – normally and low heated), they need to be entered in relevant fields.

Target value for primary energy
Target value for primary energy needs to be entered in [kWh/m^{2}a].

Target value for delivered energy
Target value for delivered energy needs to be entered in [kWh/m^{2}a].

Maximum for mean U-value of opaque elements - normal heated
Maximum allowed U-value of opaque elements (mean value) in normally heated spaces needs to be entered in [W/(m^{2}K)].

Maximum for mean U-value of transparent elements - normal heated
Maximum allowed U-value of transparent elements (mean value) in normally heated spaces needs to be entered in [W/(m^{2}K)].

Maximum for mean U-value of opaque elements - low heated
Maximum allowed U-value of opaque elements (mean value) in low-heated spaces needs to be entered in [W/(m^{2}K)].

Maximum for mean U-value of transparent elements - low heated
Maximum allowed U-value of transparent elements (mean value) in low-heated spaces needs to be entered in [W/(m^{2}K)].

17.5 Energy consumption costs

Energy prices

The energy costs are calculated with the delivered energy (inferior heating value -Hi). The default costs can be edited by clicking the cells.

Load default values | Load user defined values | Save user defined values

Name	Base price [€/a]	Consumption price [€ / unit]	Unit for consumption [-]	Energy content	Price change rate [%]
Fuel oil EL (Diesel)	0.00	0.00	l	9.960	2.00
Bio diesel	0.00	0.00	l	10.000	2.00
Natural gas	0.00	0.00	m³	9.770	2.00
LPG	0.00	1.66	kg	12.770	2.00
Bio gas (grid)	0.00	0.00	m³	9.960	2.00
Hard coal	0.00	0.00	kg	8.360	2.00
Lignite	0.00	0.00	kg	3.470	2.00
Firewood	0.00	0.00	kg	4.300	2.00
Biomass	0.00	0.00	kg	4.100	2.00
Biomass locally used	0.00	0.00	kg	4.100	2.00
Wood chips	0.00	0.00	kg	4.200	2.00
Pellets	0.00	0.20	kg	4.800	2.00
District heating - cogeneration	0.00	0.00	kWh	1.000	2.00
District heating - heating plant	0.00	0.00	kWh	1.000	2.00
Electricity (Thermal (35%) + Hydro (65%))	0.00	0.00	kWh	1.000	2.00

Figure 120: Input screen for defining energy consumption costs

In order to assess the economic efficiency of implemented packages of energy efficiency measures, for all energy carriers the energy **consumption price** per unit need to be defined in [EUR/unit]. By clicking the button **Load the default values**, the already defined prices for energy consumption will be displayed. The default values for energy prices can be edited by clicking the cells. Thus defined values can be saved by clicking the button **Save user defined values**, and used for later projects by clicking the button **Load user defined values**.

Unit for consumption is specified depending on the type of energy carrier ([kWh] for electricity, [l] for fuel oil, [kg] for LPG/ biomass/ firewood/ pellet/ lignite).

In case that for some energy carriers a certain ammount of costs for energy consumption is determined in advance on annual basis, it can be entered as a **base price** in [EUR/a].

Estimated price development for each energy carrier can be entered as **price change rate** in [%].

Energy content is amount of thermal energy which is output by complete combustion of a specific quantity of fuel at a constant pressure of 101320 Pa. When expressed as the **gross calorific value** (H_s), the energy content includes the latent heat liberated by condensation of water vapour. The **net calorific value** (H_i) does not include this latent heat. The energy costs are calculated with the delivered energy (net caloriffic value H_i).

18 Results of energy efficiency measures

18.1 Results of energy efficiency measures: Report

The results of implementation of energy efficiency measures and comparison of different packages are presented in the form of report.

Energy consumption (energy need, delivered energy and primary energy) is compared for the actual consumption of the building, the baseline case, and each implemented package of energy efficiency measures.

Actual consumption refers to the energy consumption calculated in accordance with the actual use of the building, i.e. the user is allowed ro change data predefined in user profiles (indoor temperatures, operating times, lighting levels, etc.). This mode of operation of the software is selected from the **Calculation mode** in the main menu: option **Calculation of consumption**.

Baseline case refers to the energy consumption calculated under standardized conditions, i.e. it is not possible to change data predefined in user profiles (indoor temperatures, operating times, lighting levels, etc.). Baseline case is used for creating energy performance certificates. This mode of operation of the software is selected from the **Calculation mode** in the main menu: option **Calculation for EPC**.

Packages of measures are defined in **Packages of energy efficiency measures** window.

Comparison of the results are presented in diagrams for each defined energy: **energy need**, **delivered energy** (based on net calorific value H_i) and **primary energy**. These energies are expressed in two ways separately: (i) energy consumprion **per unit of reference area** (i.e. useful floor area thermally conditioned), in [kWh/(m^2a)]; (ii) energy consumption shown as **absolute value**, in [MWh/a].

Similarly to the presented energy consumption, the **CO_2 equivalent emissions** are also compared for the actual consumption of the building, the baseline case, and each implemented package of energy efficiency measures. CO_2 equivalent emission is expressed two ways separately: (i) CO_2 equivalent emission **per unit of reference area** (i.e. useful floor area thermally conditioned), in [kg/(m^2a)]; (ii) CO_2 equivalent emission shown as **absolute value**, in [t/a].

Investment costs are presented for each package of energy efficiency measures in [EUR].

Energy costs are presented for the actual consumption of the building, the baseline case, and each implemented package of energy efficiency measures. Energy costs are presented in [EUR/a].

Reduction of energy costs (i.e. the diference of energy costs per year in comparison to baseline case), is presented for each implemented package of energy efficiency measures in [EUR/a].

Simple payback time is presented for each package of energy efficiency measures in [a].

Each implemented package of energy efficiency measures is presented with the following detailed information:

- Delivered energy, expressed in relation to reference area ([kWh/(m^2a)]) and as absolute value ([MWh/a]);
- Reduction of delivered energy compared to the baseline case, expressed in relation to reference area ([kWh/(m^2a)]) and as absolute value ([MWh/a]);
- CO_2 equivalent emission, expressed in relation to reference area ([kg/(m^2a)]) and as absolute value ([t/a]);
- Reduction in CO_2 equivalent emission compared to the baseline case, expressed in relation to reference area ([kg/(m^2a)]) and as absolute value ([t/a]);

- Annual energy costs, expressed in [EUR/a];
- Reduction of annual energy costs compared to the baseline case, expressed in [EUR/a];
- Investment costs for this package, expressed in [EUR];
- Simple payback period, expressed in [a];
- Specific energy costs, i.e. annual energy costs expressed in relation to reference area [EUR/m^2];
- Energy avoidance costs, i.e. investment costs divided by energy savings, expressed in [EUR/kWh].

In addition, all measures included in the package are listed with investment costs specified.

This report containing the results of implementation of energy efficiency measures can be further edited. The report can be exported by clicking on the icon **Export** (in the upper right corner) in one of the available formats (PDF, XTML, MHT, RFT, DOCS, XLS, XLSX, CSV, Text, Image), and saved to a file on a disc, or printed. In order to facilitate the exporting of the report in PDF, Word and Excel format, there are three icons related to each of these formats.

18.2 Results of energy efficiency measures: Table

The results of implementation of energy efficiency measures and comparison of different packages are presented in the form of table.

Energy consumption (energy need, delivered energy and primary energy) is compared for the actual consumption of the building, the baseline case, and each implemented package of energy efficiency measures.

Actual consumption refers to the energy consumption calculated in accordance with the actual use of the building, i.e. the user is allowed ro change data predefined in user profiles (indoor temperatures, operating times, lighting levels, etc.). This mode of operation of the software is selected from the **Calculation mode** in the main menu: option **Calculation of consumption**.

Baseline case refers to the energy consumption calculated under standardized conditions, i.e. it is not possible to change data predefined in user profiles (indoor temperatures, operating times, lighting levels, etc.). Baseline case is used for creating energy performance certificates. This mode of operation of the software is selected from the **Calculation mode** in the main menu: option **Calculation for EPC**.

Packages of measures are defined in **Packages of energy efficiency measures** window.

Comparison of the results are presented in tabular form for each defined energy: **energy need**, **delivered energy** (based on net calorific value H_i) and **primary energy**. These energies are expressed in two ways separately: (i) energy consumprion **per unit of reference area** (i.e. useful floor area thermally conditioned), in [kWh/(m^2a)]; (ii) energy consumption shown as **absolute value**, in [MWh/a]. Furthermore, each defined energy consumption (energy need, delivered energy (based on net calorific value H_i) and primary energy) is presented separately by each energy service: **heating**, **cooling**, **DHW**, **lighting** and **ventilation**.

Similarly to the presented energy consumption, the **CO_2 equivalent emissions** are also compared for the actual consumption of the building, the baseline case, and each implemented package of energy efficiency measures. CO_2 equivalent emission is expressed two ways separately: (i) CO_2 equivalent emission **per unit of reference area** (i.e. useful floor area thermally conditioned), in [kg/(m^2a)]; (ii) CO_2 equivalent emission shown as **absolute value**, in [t/a].

Investment costs are presented for each package of energy efficiency measures in [EUR].

Annual energy costs are presented for the actual consumption of the building, the baseline case, and each implemented package of energy efficiency measures. Energy costs are presented in [EUR/a].

Specific energy costs (i.e. annual energy costs expressed in relation to reference area) are presented in [EUR/m^2];

Simple payback time is presented for each package of energy efficiency measures in [a].

Net present value (NPV) is presented for each implemented package of energy efficiency measures in [EUR]. NPV for each measure package is calculated by comparing the sum of present values of the expected annual energy savings with the initial investment. In case the savings exceed the initial investment (NPV is positive), then the implemented package of energy efficiency measures is considered profitable.

Internal rate of return (IRR) is presented for each implemented package of energy efficiency measures in [%]. IRR refers to the rate that equates the net present value of expected annual energy savings/cash flow to the investment costs. If internal rate of return is higher than the discount rate, then the implemented package of energy efficiency measures is considered profitable.

In addition to the energy consumption presented in total values (comprising all energy carriers), the overview of energy consumption is also given **for each energy carrier** individually. Delivered energy is given for each energy carrier in total and separately for each energy service: heating, cooling, DHW, lighting and ventilation. Primary energy is given for each energy carrier in total value. CO_2 equivalent emission is also given for each energy carrier and it relates to total delivered energy (for the respective energy carrier). Annual energy costs related to the each energy carrier are also specified.

19 Certificates

19.1 Input screen for Energy Performance Certificate (EPC)

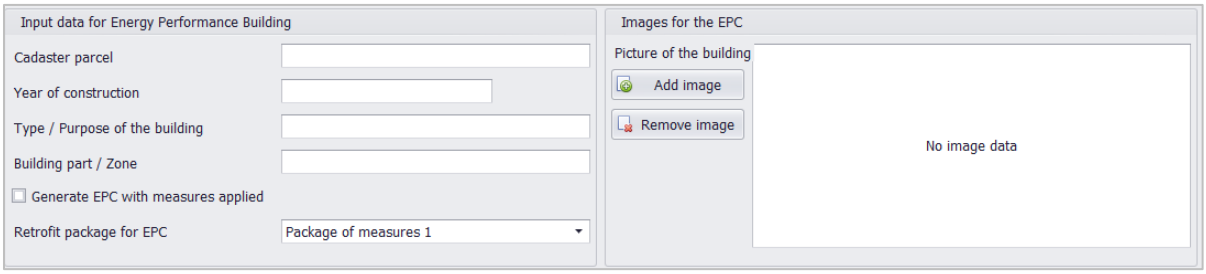


Figure 121: Input screen for defining EPC data

Input data for EPC

Cadastre parcel
Enter the cadastral parcel for the building.

Year of construction
Enter the year of construction for the building.

Type/purpose of the building
Enter the building category as defined in the Rulebook (family house, residential building, office building, kindergarten, school, university, hospital, hotel, recreational building, commercial building, cultural building, warehouse, light industry).

Building part/Zone
In case that EPC is issued for part of the building (building zone), it needs to be specified in this field.

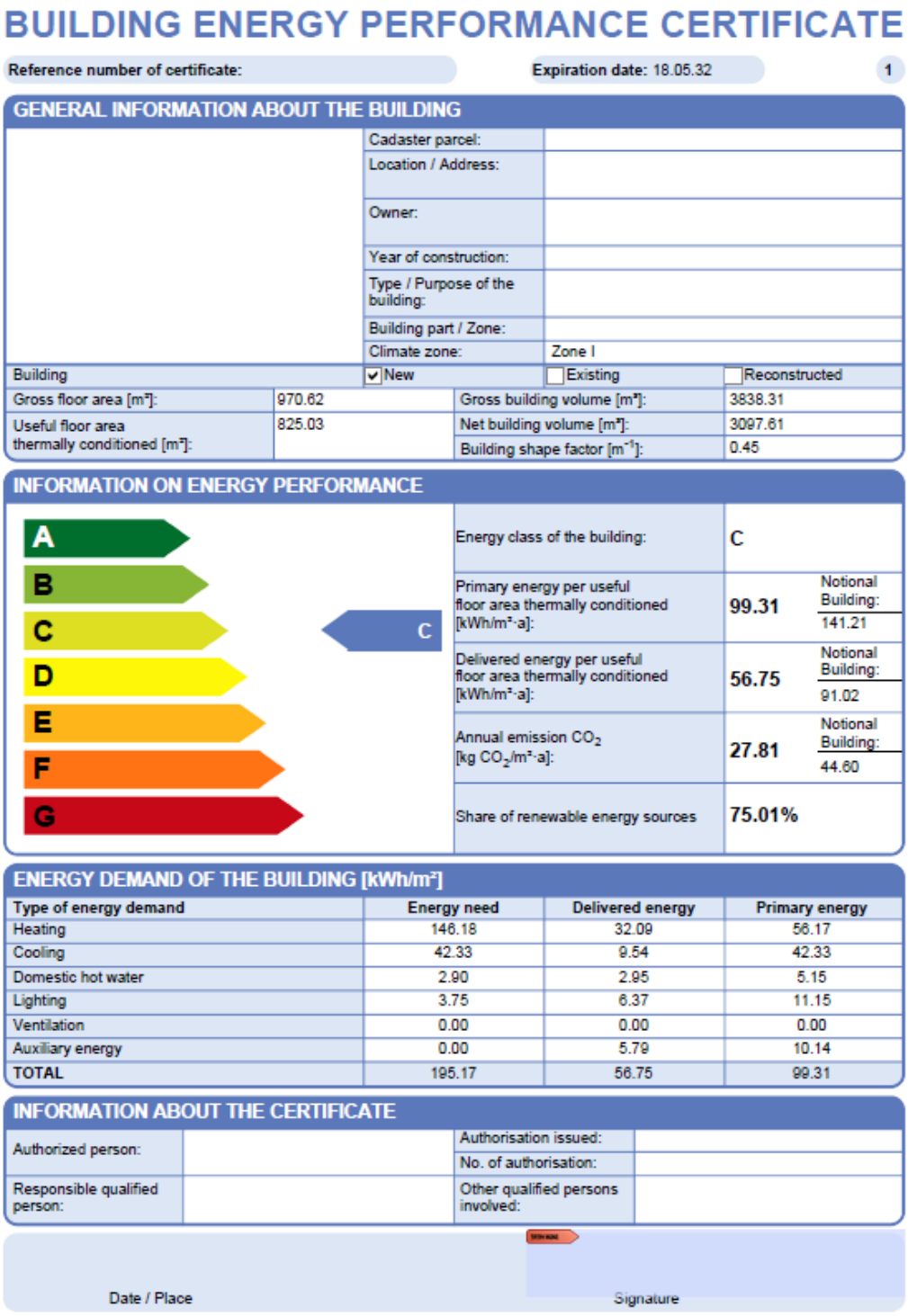
In case that certain package of energy efficiency measures defined in the **Energy efficiency measures** section is to be included in EPC, then this option should be selected by clicking in the checkbox **Generate EPC with measures applied** and selecting the appropriate measure package from the drop-down menu **Retrofit package for EPC**.

Images for the EPC

Picture of the building is inserted by clicking the button **Add image** and selecting from the appropriate location on PC.

Added picture can be deleted by clicking the button **Remove image**.

19.2 Energy Performance Certificate (EPC)



BUILDING ENERGY PERFORMANCE CERTIFICATE

Reference number of certificate: **Expiration date:** 18.05.32 1

GENERAL INFORMATION ABOUT THE BUILDING

Cadaster parcel:	
Location / Address:	
Owner:	
Year of construction:	
Type / Purpose of the building:	
Building part / Zone:	
Climate zone:	Zone I

Building	☑ New	☐ Existing	☐ Reconstructed
Gross floor area [m²]:	970.62	Gross building volume [m³]:	3838.31
Useful floor area thermally conditioned [m²]:	825.03	Net building volume [m³]:	3097.61
		Building shape factor [m⁻¹]:	0.45

INFORMATION ON ENERGY PERFORMANCE

A
B
C ← C
D
E
F
G

Energy class of the building:	C	
Primary energy per useful floor area thermally conditioned [kWh/m²·a]:	99.31	Notional Building: 141.21
Delivered energy per useful floor area thermally conditioned [kWh/m²·a]:	56.75	Notional Building: 91.02
Annual emission CO_2 [kg CO_2/m²·a]:	27.81	Notional Building: 44.60
Share of renewable energy sources	75.01%	

ENERGY DEMAND OF THE BUILDING [kWh/m²]

Type of energy demand	Energy need	Delivered energy	Primary energy
Heating	146.18	32.09	56.17
Cooling	42.33	9.54	42.33
Domestic hot water	2.90	2.95	5.15
Lighting	3.75	6.37	11.15
Ventilation	0.00	0.00	0.00
Auxiliary energy	0.00	5.79	10.14
TOTAL	195.17	56.75	99.31

INFORMATION ABOUT THE CERTIFICATE

Authorized person:		Authorisation issued:	
		No. of authorisation:	
Responsible qualified person:		Other qualified persons involved:	

Date / Place

Signature

Figure 122: Layout of Energy Performance Certificate (first page)

Energy performance certificate (EPC) is generated in **Calculation for EPC** mode, where energy consumption is calculated under standardized conditions, i.e. standard user profiles are used.

Generated EPC can be saved as PDF file and save to certain location on PC by clicking **Create final EPC** button.

Generated EPC can be saved in the appropriate format and uploaded to the register of EPCs by clicking **Create final EPC and upload it to register** button (not yet available).

EPC layout and content is in accordance with the national regulations. It consists of the following information:

General information about the building (cadaster parcel, location, year of construction, climate data, type of building, gross floor area, useful floor area thermally conditioned, gross/net building volume, etc.).

Information on energy performance:

- Energy class of the building
- Total primary energy per useful floor area thermally conditioned
- Total delivered energy per useful floor area thermally conditioned
- Annual emission of CO_2
- Share of renewable energy sources

Information on values for relevant notional building is also presented in order to have better understanding on energy performance of the actual building.

Energy demand of the building
Energy need, delivered energy and primary energy are presented in kWh/m^2 for different balance components (heating, cooling, ventilation, domestic hot water, lighting, auxiliary energy).

Information about the EPC (data on authorized person, signature, etc.)

Building envelope energy performance
Data on U-values of each relevant category of building envelope elements: average U-values and allowed U-values (minimum requirements from the national legislation).

Technical systems
Data on HVAC systems in building (heating, cooling, ventilation, DHW): type of system, energy carriers, etc.

Renewable energy
Data on renewable energy sources produced and used in the building (shares, fulfillment of requirements for solar collectors for DHW for climate zone 1, heat recovery requirements, etc.)

Energy efficiency improvement measures of the building and **recommended package of measures for energy efficiency improvement**
Selected package of energy efficiency measures and related **results** after its implementation will be displayed automatically (delivered energy, primary energy, CO_2 emissions, investments costs, payback period).

Explanation of the content of the EPC
Technical terms used in the EPC are explained.

A separate layout is defined for **public display** as well, containing only general information about the building, information on energy performance and energy demand of the building.

20 Contact

For any question, feedback, or problem, please use the contact information given below:

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