

KI-Calculus® Manual

Overview

AI-Calculus® is an AI-based web tool for predicting differences in indoor temperatures and estimating potential energy savings when walls and/or roofs are coated with the ClimateCoating® products ThermoProtect and ThermoActive.

Artificial intelligence (AI) has been and continues to be trained using large amounts of data from real-world applications worldwide, including in very hot climates. The algorithm draws on data from building physics, specifically the reflection of solar radiation.

With the help of AI-Calculus®, the costs and energy efficiency of buildings can be calculated more accurately.

This simplifies the planning of energy concepts for various building types under diverse climatic conditions.

The web tool is continuously being developed. We welcome your suggestions and questions. Please use the form on the website <https://www.climatecoating.com/calculus/>

Data Entry - Here's How to Do It.

First, select the language: German or English.

(Note: Your entries will be cleared if you change the language while typing.)

Enter the desired location and address.

Select the appropriate building type.

Indicate whether the building is air-conditioned or not. If you select >air-conditioned<, please select the target temperature. The default values range from 15 °C to 35 °C.

By entering the annual heating data in the form of heating degree days, the fuel used, and the cost per kWh, heating demand and costs can be calculated. Heating degree days according to GEG are a measure of heating demand. The GEG heating degree days for European countries are proportionally scaled EUROSTAT HGT values.

country	GEG-HGT
Belgium	68

Bulgaria	67
Czech Republic	64
Denmark	72
Germany	66
Estonia	65
Ireland	62
Greece	60
Spain	58
France	58
Croatia	54
Italy	64
Cyprus	55
Latvia	55
Lithuania	55
Luxembourg	58
Hungary	54
Malta	50
Netherlands	52
Austria	58
Poland	53
Portugal	48
Romania	49
Slovenia	69
Slovakia	69
Finland	71
Sweden	80
Norway	71

The air conditioning data can only be entered if “climatized” is selected. Here, you must enter the target temperature of the air conditioning system, the historical annual energy consumption in kWh, the current electricity price per kWh, and the CO2 emissions specific to the electricity mix in g/kWh. Based on this information, the web tool calculates the energy, cost, and CO2 savings for the air conditioning systems.

Entering Dimensions

This refers to the exterior surfaces of the building. In the simplest case, these consist of a flat roof (without a specific orientation) and four walls.

For the dimensions (width, height), you can manually enter two decimal places, e.g., 5.35.

Entering the Wall Construction

Clicking in the U-value input field for the building component opens a window for describing the component's construction. Fields with a white background are input fields. Selecting a material in the "Layer" column automatically populates the material-specific parameters. This is done for each layer of the wall construction, starting from the inside and moving outward. The material thickness is entered in the d[m] column.

In the R [m²K/W] column, the internal and external thermal resistance values are defined according to the direction of heat flow. According to DIN EN ISO 6946, the thermal resistance values are defined as follows:

	Direction of heat flow		
	upward	horizontal	downward
R_{s_i} (m ² ·K/W)	0,10	0,13	0,17
R_{s_e} (m ² ·K/W)	0,04	0,04	0,04

For roof components, upward heat flows are used; for walls, horizontal heat flows are used.

The table can be expanded using the Plus (+) and Minus (-) buttons.

For example, if the roof surface cannot be fully coated for structural reasons, you should create two sub-surfaces and distinguish between the coated and uncoated areas. This principle also applies to multi-section structures.

Caution: The button with the circular arrow (↻) deletes all entries!

Use the slider at the bottom of the window to specify whether the building component has been coated with ClimateCoating on the exterior. If a coating has been selected, the web tool can calculate an improved U-value.

Forecast

Clicking the >Forecast< button below the table will generate the results in the form of an annual trend curve.

If you now change the parameters in the table—for example, by checking more or fewer boxes under "Coat" (or adjusting the area measurements)—and click >Predict< again, the curve will be recalculated and displayed accordingly.

Results Display – Here's what you'll see.

General Information

Temperature trend curves for an entire year are displayed.

Orange curve = uncoated.

Blue curve = coated (with ClimateCoating® products).

Additional values are also displayed in % or °C. This results display depends on whether the building is air-conditioned or not.

Non-Air-Conditioned Buildings

If the structure (building or container) is not air-conditioned, it is not possible to save cooling energy; rather, only the indoor temperature can be lowered (through ClimateCoating® coating).

If you click the slider for ThermoActive or ThermoProtect in the table, two temperature curves are displayed showing the annual trend. In addition, the nominal average annual value of the reduction in indoor temperature is displayed.

The term MKT refers to the Mean Kinetic Temperature, an important parameter for professionals, particularly in the food and pharmaceutical industries. It is a non-arithmetic average that takes into account the overall impact of temperature fluctuations during the storage or transport of a product, with higher temperatures being given greater weight than lower temperatures in terms of perishability.

Air-Conditioned Buildings

If the building is air-conditioned, a target temperature is specified (15–35 °C). The result shows the percentage savings in cooling energy over the course of the year due to reduced cooling loads. This is visually illustrated by the two different curves representing the utilization of the cooling units. The percentages represent the proportion of the day during which the cooling units are turned on.

Example:

For the variant >Container, air-conditioned, 20 °C, uncoated<, a reduction in the cooling load of 0% is displayed because this is the baseline condition with no comparison. Nevertheless, a consumption curve is displayed that spans the year in an arc within a specific range: this represents the load at which the air conditioning system operates. The air conditioning system does not run continuously; depending on the control system's specifications, it is turned on and off.

The inputs and results are compiled into a PDF that can be downloaded from the website.

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Visit our website

www.climatecoating.com/calculus

Do you have any questions?

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