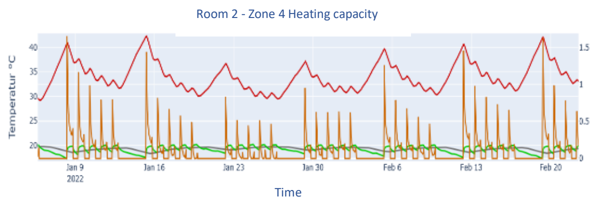
Building automation for non-residential Passive House buildings

Nowadays, building automation is indispensable and necessary for building operations, but in Passive House buildings, this can only achieve very small energy savings. Thus, a low auxiliary energy demand of the systems is of enormous importance for the energy balance. Today's systems often leave much to be desired in this respect, with a power consumption of over 10 kWh/(m²a) having been determined through various monitoring surveys. Planners are required to take a closer look and ask questions. Devices with identical functions may differ significantly in terms of auxiliary energy demands. Clever planning that makes full use of the equipment can also contribute significantly to reducing electricity consumption. In addition, assuming appropriate planning of power grids, significant parts of the automation system can be switched off at night, on weekends and during vacation periods. This is a task for manufacturers of building automation systems in particular.

The usual approach of integrating ventilation units into a cascade control system of the room temperature is unsuitable for Passive House buildings because it leads to the restriction of solar heat gains in winter and prevents the building from cooling down on cool summer mornings. Beyond the comfort limit of $\vartheta_{SUP} > 16°C$, there is no requirement for a fixed and constant supply air temperature, and the room temperature may also fluctuate within the comfortable range. In fact, it must do so, as otherwise, solar heat gains would not be achievable at all, for example. It is, therefore, a matter of fully utilising heat recovery in winter and bypassing it as soon as temperatures in the building rise. The outside temperature is unsuitable for controlling building services systems in Passive House buildings since solar radiation and internal heat gains have a considerable influence on what happens to the temperature inside the building. It can, therefore, hardly be used to switch the bypass damper of a ventilation unit and is also inadequate for enabling and adjusting the supply temperature of the heating system.

Regulation based on the *thermal state* of the building, that is the average temperature of the deep building masses, is suitable. The thermal state can be derived arithmetically from the room temperatures that are measured anyway, so that no additional metrological effort is required. If the thermal state for any point in time is known, it is suitable not only for controlling the bypass damper of the ventilation unit, but also for enabling heating and cooling systems and for the regulation of optimised supply temperatures, night ventilation for heat removal, and shading systems. These are activated as soon as it becomes correspondingly warm inside the building, but they let the sun in as soon as there is a heat requirement. Such a concept allows for automatic dynamic adaptation of the building's functions to changing and even unusual weather conditions.



Control of the supply temperature (red) according to the thermal state (grey) in comparison with the required heating power (orange). The room temperature (weekend setback) is shown in green. *© Passive House Institute*

Interdisciplinary planning and implementation of the automation system is usually necessary for finding a good solution. Only then will all the necessary information be available to all subsystems, for example, the thermal state as the basis for the seasonally differing shading functions. Concepts for field instruments not tied to one specific manufacturer prevent unilateral and expensive dependencies on individual suppliers. It should also be noted that the central management and operation software can create similar dependencies, for instance, if there is no longer any further development, if there are no security updates, or if current operating systems are not supported. The usage times of building systems are typically much longer than those in IT, so provisions must be made to ensure good functioning in the long term.

In any case, the requisites for systematic operation monitoring and optimisation should be considered right from the beginning and integrated into the automation system. A measurement technology with a sufficiently low measurement uncertainty is a prerequisite, especially for temperature measurements. Experiences gained during the installation demand transparent solutions. Viewing and adjusting control algorithms and their parameters should easily be possible at any time. Evaluation of the measurement data with the help of the energy balancing tool PHPP enables targeted monitoring of a building's operation.

Information and sources: **Protocol Volume 59 – Research Group for Cost-effective Passive Houses** (in German; free download)