## outPHit Verified Performance – monitoring made easy

The success of retrofits implemented within the outPHit project will be proven in the field by a simplified monitoring approach. This way the enormous reduction in energy demand can be substantiated as well as the improved living quality, including high indoor air quality.

To this end the buildings are temporarily (for approx. 2 years) equipped with battery-powered wireless sensors (LoRa low power radio standard). All data is received by a data acquisition unit and forwarded to an online platform.

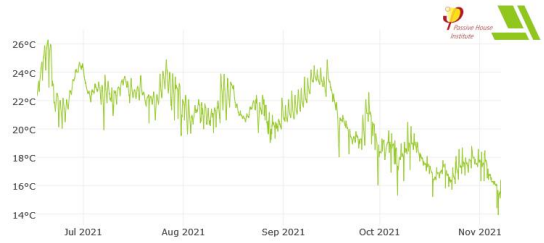


Abb. 1: History of room temperature

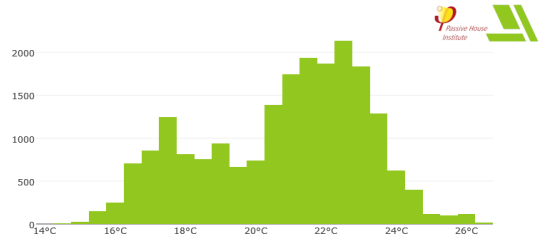


Abb. 2: Frequency distribution of room temperature

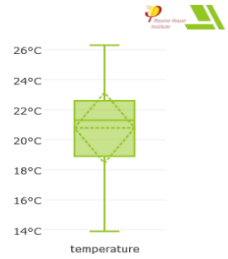


Abb. 3: Statistical figures of the room temperature series

Visualisation within the data base facilitates a continuous observation of the building's performance; unsatisfactory conditions can be spotted early on and eliminated within the first year of operation. The second year can then be used to acquire an undisturbed data set for quantitative analysis.

Data is analysed similar to the tools and methods provided in the newly launched PHPP10 (MONI worksheet). Within the online platform pre-processing of data is done largely automatically and does not require special skills or experience from the users. Moreover, in this context it is easy to employ - behind the scene - more complex tools, such as a sky model, to process irradiation data.

After input data has been uploaded from the PHPP design calculations (that have been thoroughly reviewed as part of the Passive House building certification), the energy balance can be updated based on actual boundary conditions during use of the building. Climate data from the design phase are replaced by weather data from the period under consideration, measured room temperatures replace the design assumption of 20°C etc.

The adjusted energy balance calculation thus yields the *expected* consumption of energy (on condition that the building model agrees with the real situation as far as possible).

This result is then compared to the consumption data from the energy meters. Due to some remaining uncertainties (e.g. uncertainties regarding dimensions and thermal conductivity values in building components, sensor and meter uncertainty) it cannot be expected that calculation and measurement completely align. A range of uncertainty on the order of ±3 kWh/(m²a) remains. If the *expected* consumption matches the *metered* consumption within this uncertainty range, the design goal has been met and there are no indications of substantial mistakes or misoperation. If the values do not align, the process will be helpful in identifying the sector where expectation and metered figures differ and thus assist targeted action for correction.

outPHit

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