



outPHit: Passive House and EnerPHit in the energy crisis

What happens if there is little or no energy available? This question arose in Germany with alarming urgency during the energy crisis of 2022. One thing is clear: a prolonged, widespread power outage would quickly have serious consequences. Commonly used heating systems – aside from fireplaces and the like – need electricity for controls and the installed pumps. Especially space heating and water heating systems come to a standstill if no more gas is available or if heating oil or wood pellets cannot be obtained. Fortunately, in the winter of 2022/23, this fear has not come true.

During an energy crisis, the change of temperature in a building depends on the level of its thermal insulation: the better insulated a building is, the slower it will cool down in the event of a heating system failure because the heat stored in the building mass escapes more slowly.

Figure 1 shows simulation results for a 120 m² end-ofterrace house built as a solid construction. The scenario: at the end of January, at the beginning of a severe cold period with temperatures down to -13 °C, the heating system fails in the simulation. The operative temperature in the house at this time is 22 °C. The ventilation system and other electric appliances continue to operate.



Figure 1: Simulation of a heating system failure in winter. In existing buildings, the room temperature falls quickly, in Passive House and EnerPHit buildings it remains high. © PHI

In a typical existing building – built to a level of thermal protection that was common in the mid-20th century but already with insulating glazing – it gets unpleasantly cold within hours. After just a few days, there is the fear that water pipes will freeze. In more recent buildings constructed in accordance with the German building code of the early 21st century, it takes one to two days for the temperature to drop below 15 °C. In contrast, in the Passive House building, the temperature remains almost within the comfortable range. A refurbishment with Passive House components, the EnerPHit case, shows a similarly stable indoor temperature. Only after about a week

the temperature gets colder than 15 °C. Solar and internal heat gains contribute significantly here.

Even if the heat supply should fail for an extended period of time, Passive House and EnerPHit buildings remains habitable. In the example simulated here, the minimum temperature in the Passive House is 15 °C, the EnerPHit retrofit drops to 10 °C. Less efficient buildings are colder than 10 °C for weeks at a time. Only from May onwards, room temperatures rise permanently above 15 C again.



Figure 2: Temperature of living areas in case of failure of the heating system over a longer period of time. Highly energy efficient buildings are still inhabitable. © Passive House Institute

Even if the electricity or gas supply does not fail completely, these resources may become scarce, and prices can rise dramatically in an energy crisis, as could be observed in 2022. For new customers, in Germany, the cost of a kilowatt hour of gas in mid-2021 was 5 cents. This rose to around 13 cents in early 2022, before the start of the war in Ukraine, and went up to 40 cents in September 2022. Electricity prices showed a similar trend.

Such price increases can have dramatic consequences. With an increase from 5 to 15 cents/kWh, heating the old building mentioned before would now cost € 5500 instead of € 1800 per year. In contrast, in the Passive House building, the annual heating costs only increase from € 100 to € 300, for an EnerPHit renovation from 150 to 450 €. Extremely low energy consumption is therefore an effective insurance against rising energy prices (not only in times of crisis).

The construction of Passive House buildings as well as EnerPHit retrofits has been economically viable for decades (see e.g. the Passipedia article on affordability). With higher energy prices and growing uncertainty in the long term, a future-proof investment in high energy efficiency becomes even more economically attractive.

