Passive House and the energy crisis

What happens if there is little or no energy available? This question arose with alarming urgency in 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 regulation 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 actual simulation results for a 120 m² end-of-terrace house built as a solid construction. The scenario: at the end of January, right 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 be used.

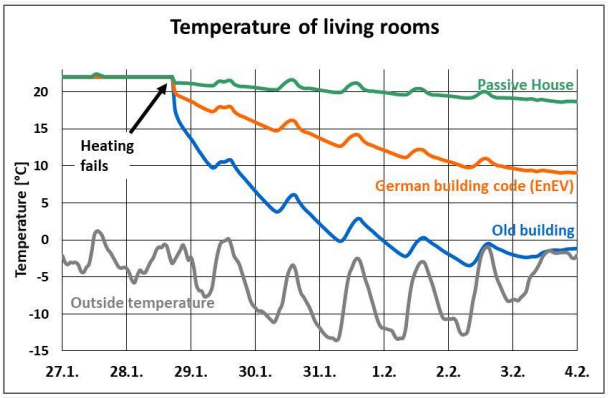

Figure 1: Simulation of the heating system failure during a cold period. In the existing building, the room temperature falls quickly, in the Passive House building it remains high. © PHI

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 standard, 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. Only after more than a week the temperature gets colder than 18 °C. Solar and internal heat gains contribute significantly here.

Even if the heat supply should fail for an extended period of time, the Passive House building remains habitable, in the example simulated here, the minimum temperature is 15 °C. Some Passive House buildings might even stay warmer than 18 °C. Less efficient buildings are colder than 10 °C for months at a time; only from May onwards, the room temperatures rise permanently above 15 °C again.

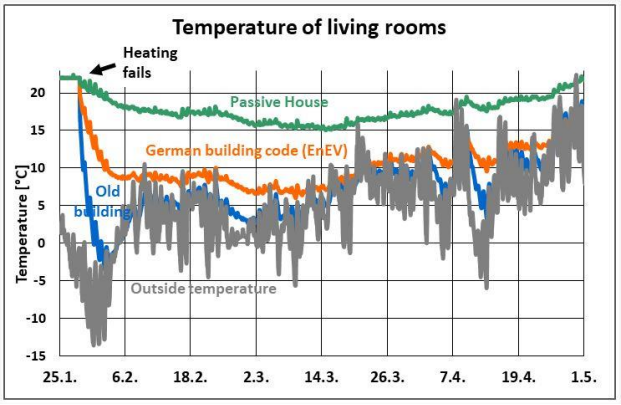

Figure 2: Temperature of living areas in case of failure of the heating system over a longer period of time. Highly energy efficient buildings are still inhabitable. © Passive House Institute

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 at the beginning of 2022 before the start of the war in Ukraine, and briefly went up to 40 cents in September 2022, 80% of which has now been capped at 12 cents (since the start of 2023) due to the gas price brake in Germany. 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. Extremely low energy consumption is therefore an effective insurance against rising energy prices (not only in times of crisis).

Economically, the construction of Passive House buildings as well as building retrofits to the EnerPHit standard using Passive House components 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.