Passive house renovated 10 years of CO2e experience

In Denmark, it has been politically decided to reduce emissions from all sectors by 70% until 2030. This paper looks at whether renovation of typical houses can make a contribution to reducing CO2 emissions based on measured values and compares measured values with calculated values over a measured period over 5 years (2016-2021).

In 2012, in the design studio, we renovated a typical house from the 1970s to passive house standard. The house's electricity consumption for household and operation has since been measured.

Photos before and after:

Measured and calculated values for area weighted person number of 4.5 P and projected 6 P are:

Area factor TFA/GROSS=158/196= 0.8	Operating electricity kWh/m2/year	Household electricity kWh/m2/year	Total electricity kWh/m2/year	Total kgCO2e/m2/year	Total Operation kgCO2e/m2/year	Material emission estimated value	Emission per person operation+household kgCO2e/P/year	Emission ready-cooked beef, fish, vegetarian kgCO2e/P/year
Passive house measured 5-year average (2017-2021)			40,03	8,45	6,15	4,00	275,91	1277,50
Passive house calculated standard person density 4.5 P	29,01	10,81	39,82	8,40	6,12	4,00	274,45	1277,50
calculated real person number 6 P	35,54	13,76	49,29	10,40	7,50	4,00	339,75	1277,50
BR18/reference Danish average (https://ny.sparenergi.dk/elforbrugsberegner)	35,10	33,87	68,97	14,55	7,41	12,00	475,42	1277,50

Results for operation CO2 emission are supplemented in Paper with a full LCA calculation of material emission. The preliminary results for operation based on measured values and calculated values show that the passive house is a robust concept. CO2 emission per person from the building's total operation incl. household amounts to 340 kg /P / year. Operating emission is approx. ¼ of emissions from 1 person emissions from one year's meals - assuming that the menu is equally divided between meat, fish and vegetarian dishes.

With this house renovated into a passive house, a robust low emission from people for operation and household is achieved. Measured values are 19% below the calculated value with a projected number of 6 people. Emissions for operation measured in a passive house are approximately 42% below the calculated Danish average. CO2 emission is based on a green energy mix with 68% VE.

The paper will also calculate the estimated material CO2 emission, which during renovation is limited to the insulation of the climate screen, windows and compact ventilation system.

Renovation of a typical house or newly built in 2022 to a passive house can contribute to a CO2 reduction of a total estimated 53%. Switching from a meat menu to fish gives the same reduction and moving on to fish and vegetarian dishes reduces by comparison 62.5%