

Futureproofing the European building stock for upcoming low-temperature heating

Theme 1

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Motivation and key research question

The most common way to provide space heating today is by using high-temperature heating, which represents a key barrier to reduce the dependency on fossil fuels. As Europe needs to decarbonise the space heating sector, the heating temperature must decrease to meet the technical requirements of renewable sources. This paper analyses if the existing building stock, with its current radiators (i.e. Type22) in Central and Mediterranean Europe can maintain a comfortable temperature when the supply temperature of heating decreases to 45 °C and, if not, what are the necessary envelope improvements needed and their related costs.

Method

This work utilises OpenStudio to perform Dynamic Energy Building simulations to analyse how the building as a system responds to a lower temperature supply type, regardless of its source. The building stock for Central Europe is based on the case of Frankfurt (Griesheim-Mitte district) and uses data from TABULA to identify construction types, materials and perform calibration of the models. Matera (south Italy) represents the case for Mediterranean Europe. The latter is based on real cases of building renovations and utilises data gathered on the field with the cooperation of a local company that performs energy renovations. A simulation that utilises high-temperature heating ante-renovation serves as the baseline. Subsequently, the model tests low-temperature heating on the non-renovated building to verify its response and ability to maintain 20 °C in the inside areas. Later, various thicknesses of envelope insulation are applied to test its thermal response again.

Finally, this paper calculates the cost of all renovation measures and their economic viability. This work calculates the renovation costs by utilising data from the IWU institute and the Construction Cost Index to determine the costs for Italy. The Net Present Value (NPV) on a 25 years lifespan helps assess the investments' economic viability.

Results and conclusions

This study shows how the existing building stock is not yet ready to operate at low temperatures. When the supply temperature of heating is decreased, most buildings are not able to maintain a temperature of 20°C in the living areas, both in the case of Frankfurt and Matera. Most buildings require an insulation of a minimum of 5 cm. However, at least 10 cm are recommended to guarantee comfort with a degree of uncertainty due to more extreme meteorological events. This paper finds that combining regular building maintenance with energy renovations is an effective method of reducing living expenses in the long term. Furthermore, higher energy renovation levels further reduce long-term costs by enabling customers to access lower-cost heat sources, such as low-temperature district heating and heat pumps. These two methods are both key technologies that can help reduce carbon emissions in the heating sector for residential use. The full paper will explore and discuss more details for different building types and the economic comparison.