Users and practices in heating and ventilating homes – why do they behave different than we think?

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SUMMARY

We need to improve the indoor air quality for the health of the building users, and we need to optimize and reduce energy consumption for heating, cooling, and ventilation for the sake of the global climate. In both cases the interplay between buildings, HVAC (heating, cooling, and ventilations) technologies and the users are central. Research show that technical optimization without considering the interaction and behaviour of the users may end in sub-optimal technical solutions, neither resulting in reduced energy consumption nor improved indoor air quality. This keynote will bring insight on how to understand users in the interaction between buildings and technologies, and it will provide a collection of research showing how users behaving different than what was expected, negatively impact the outcome related to either energy consumption or indoor air quality.

Understanding human behaviour has in some research traditions focused exclusively on the minds and attitudes of individuals. Research in relations between users, buildings, and technologies, however, shift this focus to understand how different types of technologies and buildings impact the practices of people in a more collective way where unconscious routines are in focus (Gram-Hanssen, 2014). A recent study comparing actual and calculated heating demand for residential buildings demonstrate how people in new efficient buildings in general over-consume whereas people in old inefficient home in general under-consume (Hansen & Gram-Hanssen, 2023). There is difference related to the socioeconomics of the residents, however, it is also clear how the buildings and technologies impact on the practices and comfort norms of the residents. This is also backed up in a large survey relating peoples heating and ventilation behaviour with their building type (Hansen et al., 2018).

From both policy and research, the optimization of indoor air quality and energy consumption is expected to be achieved by an increased use of smart technology assisting users in managing and controlling their indoor climate as well as their energy consumption. This keynote will bring insight from studies of how technology designers expect new smart technology to assist users in their everyday life (Aagaard, 2021) and compare this to the actual use by different types of residents (Larsen et al., 2023). Studies include gender difference in engagements with new technology (Strengers et al., 2022) as well as difference in competences, especially related to the age of resident (Larsen & Gram-Hanssen, 2020). Technological visons of managing indoor climate without the involvement of the resident is also compared to how occupants make workarounds to prevent technologies from working as intended if they do not understand or dislike their function.

Smart technology and digitalisation, including indoor air quality measurements, can also be used to give feedback to occupant, and be combined with incentives for residents to change their heating and ventilation behaviour. An experiment using this opportunity provide results on the possibilities and limitations of engaging residents (Gram-Hanssen et al., 2021). Economic incentives are often thought of as an efficient way to impact users' behaviour, however, research into studies of heating and ventilation behaviour show possible limitations and shortcomings. If people don't understand relations between their practices and the effect on energy consumption and indoor climate the incentives may not work as intended. Also, research into the consequences of the energy crisis with its rapidly increasing energy costs has showed how some resident may feel obliged to use unhealthy means of heating as well and reduce ventilation to save energy.

This keynote will conclude by relevant takeaways for technical research, design, and policy, when it comes to include user perspectives related to heating and ventilation.

KEYWORDS

User practices; smart home technology; residential heating; residential ventilation; human-building interaction

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