

A POST-OCCUPANCY EVALUATION FRAMEWORK LINKING OCCUPANT BEHAVIOUR AND ENERGY CONSUMPTION

USING DESIGN THINKING TO ASSESS OCCUPANT BEHAVIOUR IN RETROFITTED BUILDINGS

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Context/Background

Improving energy efficiency in buildings has become a critical strategy to reduce greenhouse gas emissions (Yoshino et al., 2017) as the building sector is responsible for over 30% of the final energy consumption and close to 40% of total CO₂ emissions in its entire life cycle (International Energy Agency, 2020). Considering that the existing building stock will compose 70% of buildings in 2050 (Visscher et al., 2016), **building retrofit** will be the leading strategy to achieve projected energy savings and emissions reductions. However, evidence shows that there is a discrepancy between estimated and actual energy savings (Zou et al., 2018) strongly influenced by **occupant behaviour** (Hong et al., 2017).

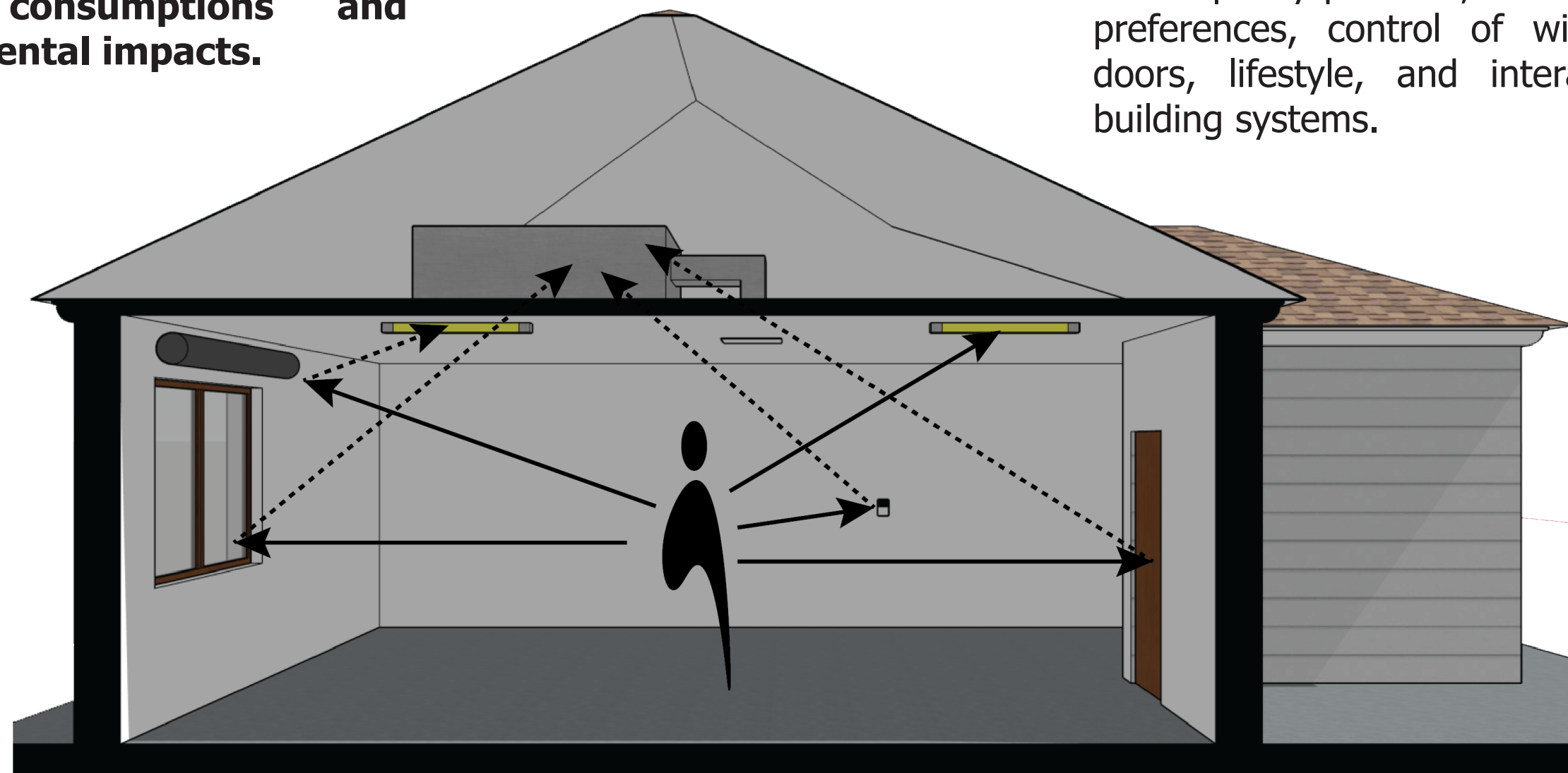
What do we know about the impact of occupant behaviour on energy consumption in buildings?

The way humans interact within buildings **strongly affect building energy consumptions and environmental impacts.**

The impact ranges from **30% to 89% increased consumption.** can be seen in occupancy patterns, thermal comfort preferences, control of windows and doors, lifestyle, and interaction with building systems.

It is **critical in residential buildings** as occupants have more control over control systems. Identical buildings could have different consumptions, due to the way of occupying buildings.

It is **difficult to predict** due to its ambiguity and complexity with multiple underlying factors.



Post-occupancy evaluations indicate that our buildings often **do not meet expectations of occupants.**

Focusing on occupant behaviour is more **cost-effective** than merely technological approaches.

What is Post-Occupancy Evaluation and why to incorporate Design Thinking?

Post-Occupancy Evaluation

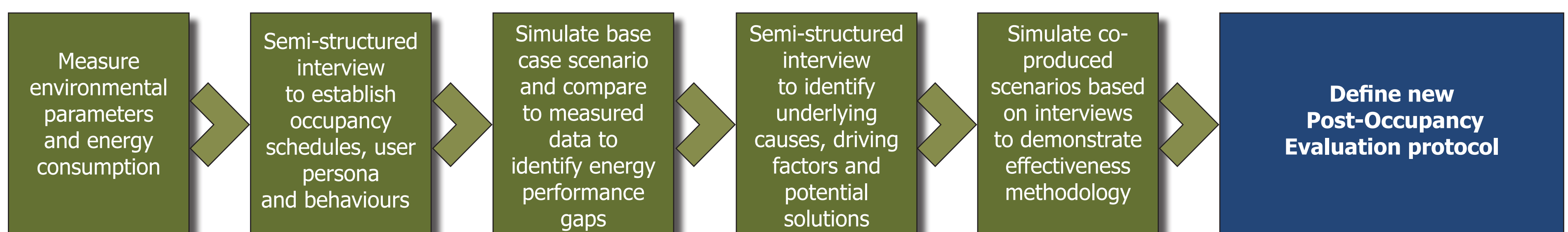
is the process of assessing buildings systematically after some time of their construction and operation by monitoring indoor environmental parameters and occupants' satisfaction (Preiser et al., 1988).

Design thinking

is as a framework linking analytical and creative reasoning for human-centred, cognitive and iterative problem-solving highlight the context and underlying causes of problems (Baum et al., 2021).

the resulting protocol will move away from just assessing satisfaction towards understanding why occupants behave in a certain way, and what is the impact of specific behaviours on the energy consumption.

Research methodology



Significance

This research will offer a **new Post-Occupancy Evaluation protocol** incorporating a design thinking principles to evaluate occupant-building interactions causing energy performance gaps. It will also contribute to a **paradigm shift in energy research** in buildings to consider occupants and buildings as mutually influencing entities, equally important for the energy performance of buildings. This research can **directly benefit** governmental agencies, and decision-makers involved in national and international retrofit programmes, and **indirectly benefit** Energy Service Companies (ESCOs), architectural firms, and construction involved in the development, design, and construction of retrofit projects and POE.

Acknowledgements

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References

1. Yoshino, H. et al. (2017), Energy and Buildings, 152, p. 124–136
2. International Energy Agency (2020), Tracking Buildings 2020
3. Visscher, H. et al. (2016), Energy and Buildings, 132, p. 1–3

4. Zou, P. et al. (2018), Energy and Buildings, 178, p. 165–181
5. Preiser et al., (1988), Post-Occupancy Evaluation, Routledge
6. Baum et al., (2021), Journal of Cleaner Production, 285