

Bridging the gap between predicted and actual energy consumption in non-domestic buildings

With an increasing demand for more energy-efficient buildings, the construction industry is faced with the challenge of ensuring that the energy performance predicted during the design stage is achieved once a building is in use. However, there is significant evidence to suggest that buildings are not performing as well as expected. Initiatives such as the Technology Strategy Board's Building Performance Evaluation Programme and CarbonBuzz, an initiative of RIBA and CIBSE, aim to illustrate – and ultimately try to reduce – the extent of this so called 'performance gap'.

Previous research demonstrated that in-use energy consumption can usually be twice as much as predicted in compliance calculations. Figure 1 (The reality of predicted and actual energy consumption) illustrates some of the main causes that lead to this performance gap. As the figure indicates, 'unregulated' energy loads can represent a significant proportion of the total energy consumption in a building. Yet they are not considered in Part L of the Building Regulations and are thus disregarded in compliance calculations. So it is perhaps not surprising that there is such a discrepancy between predicted and actual energy performance, since they are calculated on different bases.

A research project conducted on behalf of the Centre for Innovative and Collaborative Construction Engineering at Loughborough University, and AECOM, is aiming to shed some light onto the impact of unregulated energy use in office buildings. This collaboration – under the EPSRC Engineering Doctorate programme – is currently investigating the extent and nature of unregulated loads in a number of office buildings around the country. Preliminary findings have already demon-

strated a large variation in electricity consumption, due to small power equipment used by different tenants occupying the same office building. These variations can be attributed to a number of factors including:

- hours of occupation;
- workstation density;
- installed equipment loads; and
- occupant behaviour.

Management decisions, such as running IT updates outside working hours that required employees to leave their computers switched on during evening and weekends, were also observed to have significant impact on electricity consumption.

The overall aim of the study is to understand the impact of each of these individual elements on unregulated electricity consumption within office buildings. Currently, the research is focusing on the impact of occupant behaviour, aiming to establish the extent to which building occupants affect electricity consumption due to small power equipment.

A survey is also being undertaken based on the Theory of Planned Behaviour, illustrated in Figure 2. The assessment focuses

on the behavioural intent of occupants to switch off appliances when not in use and investigates the precursors to behaviour individually: 1) attitude; 2) subjective norm; 3) perceived behavioural control. Findings will help inform which of these precursors have the greatest influence on electricity consumption (see Figure 2: Theory of Planned Behaviour).

Future work will build on this study and aim to develop evidence-based benchmarks for unregulated electricity consumption in office buildings. It will include a "tailoring" component allowing the benchmarks to be adjusted according to profiles of occupancy and management behaviour, as well as workstation density, and the specification of energy consuming equipment. It is expected that such benchmarks will inform designers about the impact of each of these parameters on the measured energy consumption of buildings, going some way toward explaining the performance gap.

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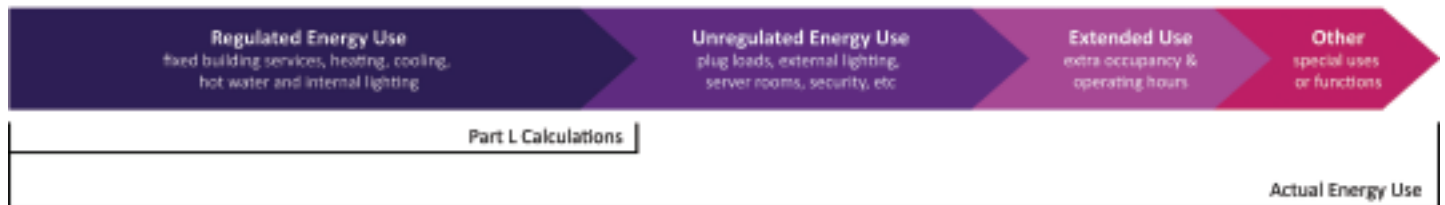


Figure 1: The reality of predicted and actual energy consumption.

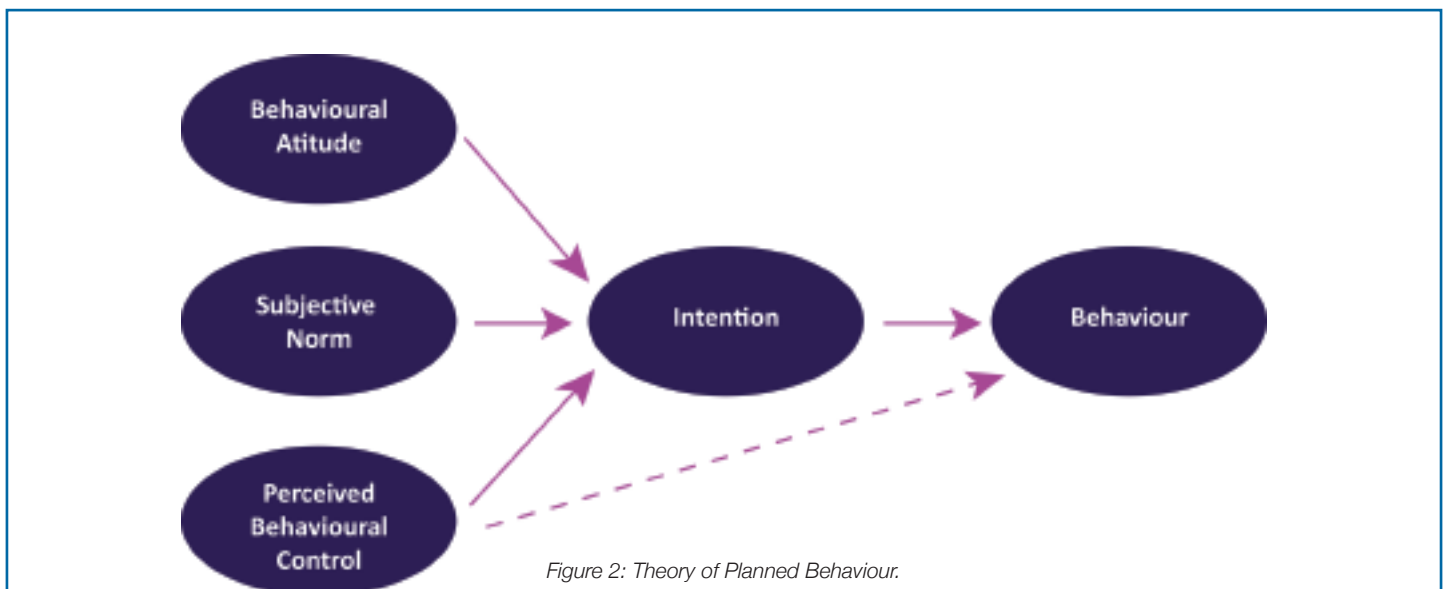


Figure 2: Theory of Planned Behaviour.