LONDON – LOUGHBOROUGH EPSRC CENTRE FOR DOCTORAL TRAINING IN ENERGY DEMAND (LOLO CDT)

LOUGHBOROUGH UNIVERSITY - PHD RESEARCH TOPICS

1. **Predicating summertime overheating risks in occupied dwellings using decision science**. Summertime overheating is a serious and growing risk to the health of UK citizens. This project will focus on the validation of alternative modelling methods and their application to forecasting using empirical data. The research will build-upon existing research being carried out at Loughborough University and utilise machine learning and deep learning techniques.
2. **Improving the prediction of overheating in complex urban dwellings**. Dynamic thermal simulation techniques are often used to predict summertime overheating risks. However, the modelling methodology is unproven and the simulation results unreliable. Using multiple simulation models, parallel computing, uncertainty analysis, and empirical validation, this project will seek to develop a more robust prediction methodology.
3. **Heat related sleep deprivation in summer and its prevention**. There is very limited, credible data about the impact of night-time temperatures on sleep quality. This project will, through field studies, seek to understand how temperature affects sleep and the way people adapt to elevated temperatures. This research will thus critically reassess existing night-time overheating criteria. The work will lead to improved guidelines and standards for provision of night-time temperatures in homes.
4. **Multi-vector modelling of community energy systems.** The UK is moving to a more heterogeneous energy supply system, with the incorporation of low carbon heat and embedded electrical generation. This research will use object orientated programming tools such as OpenModelica to model multi-vector community energy systems with the aim of understanding how future low carbon heat networks can be optimized to reduce energy demands and peak loads.
5. **Using big data to develop post-code level energy demand maps of the UK building stock.** Local authorities and others need to know where energy demand reduction campaigns will have the greatest impact. This research will use multiple data sets to construct a complex, layered data profile of the UK building stock. Techniques such as correlation clustering will be developed to extract useful information from this extended data-set and examine a range of energy demand intervention strategies.
6. **Evaluating indoor air quality in educational buildings.** The quality of the air in schools has an impact on health, learning and educational attainment. This project uses passive and active air sampling techniques coupled with gas chromatography and mass-spectrometry to quantify the levels of CO_2, volatile organic compounds (VOCs) and particulates in educational buildings. The research will develop new guidance to inform the development of improved air quality standards.
7. **The design of mechanical ventilation with heat recovery (MVHR) systems for low-energy buildings**. MVHR systems, which are increasingly used to provide adequate ventilation in well-insulated and air tight dwellings, often perform very poorly. The research will use validated CFD modelling and empirical date to quantify the impacts of the positioning of MVHR terminals, ductwork and units to reduce exhaust cross-contamination and unwanted heat pick-up. Global sensitivity analysis techniques will also be used to identify the critical design parameters. The work will inform the CIBSE and other institutions interested in improving the performance of MVHR systems
8. **Understanding window opening behaviour in modern dwellings.** This study will use field surveys and questionnaires to gain a detailed understanding and insight into how, why and when occupants use openable windows to ventilate single aspect dwellings. Dwelling design, personal and environmental factors will be considered. The aim is to generate a deeper understanding of the barriers and drivers governing occupant-window interaction in high-density dwellings in the urban context. Such information is critical to the reliable modelling of energy demand and internal temperatures.
9. **Building materials and whole of life decarbonisation of near zero energy buildings**. As the in-use energy demand of buildings decreases, so the energy of production and construction becomes more important. This research will involve Life Cycle Assessment of a range of extant and innovative construction typologies to quantify the net life cycle impacts (including energy, carbon and resources) associated with the transition to a low carbon, circular economy. The work will shed light on the various claims about the life-cycle benefits of alternative modern methods of construction.

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