EPSRC and SFI Centre for Doctoral Training in Energy Resilience and the Built Environment

Loughborough University

Fully-funded 4-year PhD Project at Loughborough University – Electrification of domestic space heating

Project Title	Electrification of domestic space heating
Supervisor(s)	Dr David Allinson, Prof. Kevin Lomas
Context (what is the wider social, political and technical context that leads to this work, why is it important)	Decarbonising the heating of homes is essential to a zero-carbon future. Replacing gas boilers with heat pumps driven by low-carbon electricity is a viable route forward. However, heat pumps have different characteristics to gas boilers and selecting the best alternative is not trivial. The choice will depend on technical factors such as the size of the home, the rate that it loses heat, and the availability of space inside and outside. It will also depend on social factors such as the size of the household, their heating preferences, and the amount of time they spend in their home. Selecting the right heat pump for a particular home and the household that live there is a complicated socio-technical problem. A good choice will result in a satisfied household and an advocate for heat pumps, while a poor choice could lead to thermal discomfort, high bills, and bad publicity.
Project Description	There are many different heat pump systems and many more different households. This project will start by identifying already-known problems and solutions. This could include speaking with installers and manufacturers of heat pumps, as well as households that have experience (good and bad) of living with them. This knowledge will form the basis of a new set of tools that can help a household to make the right choice for their home. The data required to use such tools should not be onerous, and so secondary data sources may be used to augment the process. For example, the size of homes and gardens could be extracted from google maps and the heat loss of the building

	fabric from existing EPCs. Questionnaires could be used to understand what the household wants from the system and anything they especially wish to avoid. For example, some households are particularly sensitive to noise or may have restrictions on the space that could be used. Evaluation of the tools developed through a real-world trial would complete the research, make a valuable contribution to the electrification of space heating and provide valuable insight for households, government, and the industry.
Aims and Objectives	The aim is to develop and evaluate the tools and techniques required to identify suitable electrical heating solutions for different homes and households. The objectives are: 1. To review the literature academic and grey literature on electrification of domestic heating and the performance of heat pumps. 2. To engage with a wide range of stakeholders to better understand the potential enablers and barriers to electrification of heating. 3. To gather primary and secondary data that can help identify the most effective heat pump system for different homes and households. 4. To optimise and validate the approach using real world cases. To publish the work in leading journals and as a PhD thesis.
Methods: (Measurements, data sources, methods of analysis, etc)	The research will take apply a range of methods. Depending on the interests and skills of the applicant, these could include literature review, stakeholder engagement, analysis of secondary data, modelling of building performance, measuring building performance, experiments in test houses, and/or field trials.

Expected Outcomes	Government policy advisors, heat pump installation companies, and households will be better able to make informed choices about how to decarbonise home heating.
Multidisciplinary Aspects (what different skills and knowledge will this project develop)	The work will take a socio-technical approach – developing knowledge of building physics alongside an understanding of what households need from their systems.
Skills and Interest Required of Student	A keen interest in the technical and socio-technical aspects of domestic space heating.