Theme:
Monitoring Energy

Overview

All of the TEDDINET projects aim to reduce energy demand in buildings. Energy use depends on a number of factors including: building characteristics, technology, socio-economic factors and occupant behaviour. Total energy use from groups of buildings is known but we need to understand more about energy use in individual buildings. Many of the TEDDINET projects have monitored energy use and environmental conditions in individual homes. Researchers have found monitoring energy use in homes is challenging, time consuming and expensive. That said the data has provided researchers the tools to gain new insights into home energy use. The monitored data has been used to:

- Build models to predict energy savings
- Identify occupant behaviours
- Give tailored energy feedback
- Develop new analysis techniques.

Key Messages

Understanding technology - Significant forward steps have been made in understanding the role of technology and know-how in the field of energy monitoring. Continued research, however, is required to understanding how best to apply this knowledge at large scales, for example with the UK government Smart Meter rollout.

Data availability - The formation of the Data Communications Company (DCC), which will manage Smart Meter data, will lead to easier and cheaper access to large energy use datasets. Continued detailed monitoring in small samples is however required to fully understand how people interact with technology in their homes because significant variation in energy use behaviours have been observed.

Example: LEEDr

The LEEDr project carried out a detailed technical and social study of 20 homes. Researchers made visits to the homes to ask questions about household use energy and to understand how activities in the home affect appliance energy use. The technical data was collected by installing monitoring equipment and resulted in an average of 53 different distinct types of data per home. The monitoring equipment included some off-the-shelf smart home sensors and some bespoke sensors which collected data on:

- Gas and electricity consumption
- Hot water use
- Occupancy
- Appliance energy consumption
- Indoor temperatures
- Window and door opening.

Researchers interviewed the people living in the homes to gather information about the physical characteristics of the houses. Researchers found that the gas consumption data was particularly challenging to collect. The researcher time required to carry out the data collection was 429 hours per home and the each participants gave 217 hours of their time to the study. The total cost of data gathering was £46,000 per home and it was estimated that if more reliable methods were used it would still cost £22,000 - £27,000 per home.

A selection of monitoring equipment used to gather energy and environmental data

http://www.teddinet.org/project.php?s=leedr

Information gathered from

Buswell R., Webb, W., Mitchell V. &Leder Mackley K. (2016) Multidisciplinary research: should effort be themeasure of success? Building Research & Information

Cosar-Jorda P., Buswell R. & Mitchell V. (2016) Quantifying likely energy reduction opportunities in family homes

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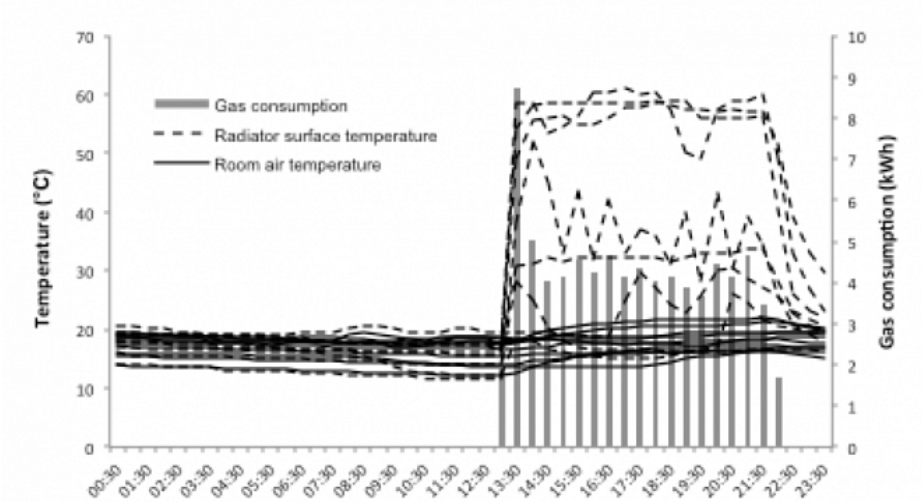
Example: Refit

The REFIT project provided retrofit advice to 20homeowners using data collected by Smart Home technology Researchers collected gas consumption, room temperature and radiator sensor temperature data. An external company monitored gas consumption because of the complex safety regulations. Electrical data and some additional data from smart home sensors were downloaded via the internet. There is a risk of data loss when using wireless sensors because occupants sometimes turn off their routers. To avoid data losses researchers also used standalone sensors. More than 100 data streams were collected in each home. This resulted in over 100,000 data points per house per day. Significant researcher time was necessary to install and maintain the data collection. Storage of the electrical data was a challenge and required the building and maintenance of a dedicated database.

The sensor data has been used in publications about:

- User centred design
- The identification of heating behaviours
- Appliance energy use
- Smart home heating controls
- Energy modelling
- The disaggregation of electrical power data



Room temperature, radiator surface temperature and gas consumption measured on a single day in one home

Information gathered from

Heating behaviour in English homes: an assessment of calculation methods

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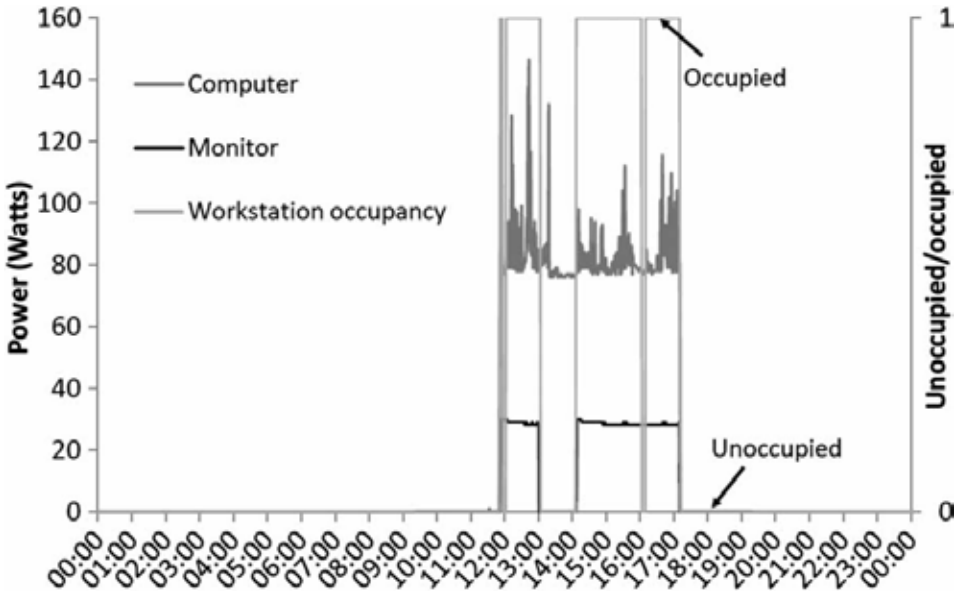
http://www.teddinet.org/project.php?s=refit

Example: Wi-be

Researchers on the Wi-Be projects used a wireless energy monitoring system to monitor electricity consumption and user locations in office buildings. The idea was to provide feedback of actual energy use to individuals within the workplace. Information about the occupancy of the office was also collected by getting workers to wear radiofrequency identification (RFID) badges. The wi-fi network that was already present in the buildings helped to ensure that the monitoring approach was both cost effective and robust. The feedback helped individuals identify ways they could save energy, but also highlighted a number of barriers that could stop behaviour change if not addressed.



An example of the electricity and occupancy monitoring data collected

http://www.teddinet.org/project.php?s=wi-be

Information gathered from

Shao, L., Coleman, M., Foster, R., Shipman, R., Gillott, M., Hao, Y., Irvine, K., Lemon, M. & Munoz, M. (2013) Reduction of energy demand in buildings through optimal use of wireless behaviour information (Wi-be) systems. International Conference on Applied Energy, ICAE 2013, Jul 1-4, 2013, Pretoria, South Africa.

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