Theme:
Smart Heating Controls

Overview

Smart Heating controls could revolutionise home heating. New heating controls are expected to increase convenience and save energy, but there are questions about whether the new technologies will deliver the energy savings that have been promised. Researchers expect the introducing new complex technologies to influence interactions between family members TEDDINET researchers have been looking into three aspects of Smart Heating controls:

1) How Smart Home heating controls are used by occupants and how they are accepted into the home.
2) Understanding how much energy could be saved by using Smart Heating controls.
3) Developing and testing algorithms which could be used in future smart home heating controls.

Key Messages

Smart heating controls - Evidence shows that Smart thermostatic radiator valve (TRVs) can reduce heating energy by 12% by improving control in individual rooms. Smart thermostatic radiator valves (TRVs) that can control single radiators are still prone to overshoot (i.e. allow the room temperature to rise to a higher temperature than set by the occupant) and to heat unoccupied rooms which suggests that greater savings are possible. To fully realise this potential more intelligence is required in smart heating controls to improve the energy performance of individual room controllers.

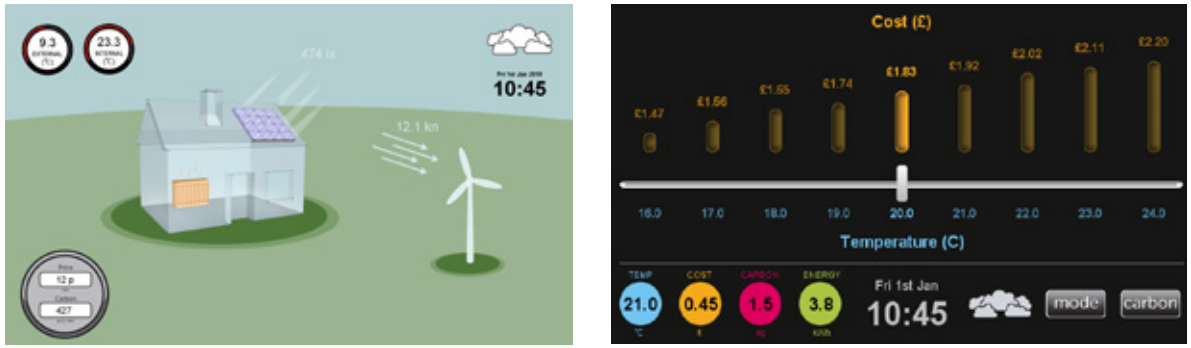
Technology development - Smart home technology is developing extremely fast. Most of the research to date has been based on bespoke research tools or products which are becoming outdated. More research is required to test the latest versions of smart heating controls in larger samples so that modelled energy savings can be tested in real world settings.

Data availability - It is essential that smart home developers enable there produces to store data about the settings occupants use and the temperatures that are measured by each sensor. This will ensure that large energy surveys can be carried out at low cost. These surveys will significantly increase the speed at which research activities lead to energy demand reduction in domestic dwellings.

Example: Intelligent Agents for Home Energy Management

The Intelligent Agents for Home Energy Management project developed a new home energy management system. The system aims to optimise energy use in homes. It learns the thermal properties of the home and provides real time feedback to occupants. It can also adapt to real-time energy cost and carbon intensity signals by changing timer settings to reduce costs while maintaining occupant comfort levels.

Simulations based on real world data showed that the system developed could save 15% of energy costs. The core thermal modelling algorithms were deployed within Joulo, which is a low-cost approach to providing home heating advice to households. Joulo Ltd. was spun out of the University of Southampton and acquired by Quby Ltd. in 2015.



Graphical interface of the smart home controller

http://www.teddinet.org/project.php?s=intelligent-agents

Information gathered from

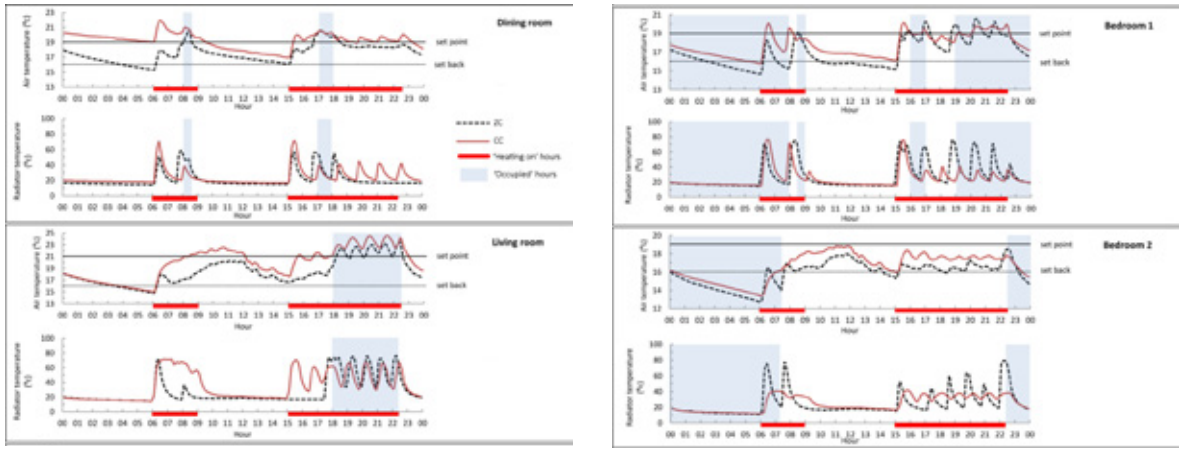
Rogers, A., Maleki, S., Ghosh, S. & Jennings, N.R. (2011) Adaptive Home Heating Control Through Gaussian Process Prediction and Mathematical Programming. In, Second International Workshop on Agent Technology for Energy Systems (ATES 2011), Taipei, Taiwan, 71-78.

Rogers, A., Ghosh, S., Wilcock, R. & Jennings, N. R. (2013) A Scalable Low-Cost Solution to Provide Personalised Home Heating Advice to Households [Best Paper Award BuildSys 2013]. In, 5th ACM Workshop On Embedded Systems For Energy-Efficient Buildings (BuildSys) 8pp. In, 5th ACM Workshop On Embedded Systems For Energy-Efficient Buildings (BuildSys) 8pp.

Contact: alex.rogers@cs.ox.ac.uk

Example: Defacto

The DEFACTO project is installing Smart Heating controls in 200 UK homes. Researchers aim to assess how the new controls change home energy use. A pilot study was conducted in two homes to test whether the improved zonal control offered through the Smart Controls saved energy. Researchers fitted one of the homes with Smart Heating controls which enabled the radiators in each room to be turned on and off at different times of the day. The other home was heated with using a conventional heating system. The homes were fitted with equipment to replicate occupants and were monitored during a winter period. Results suggested that energy savings of up to 12% may be feasible. The methods developed in the pilot study will be used to assess the impact of Smart Heating controls in a large sample of occupied homes.



Air and radiator temperature in different rooms measured in a test house with zonal control (ZC) and conventional control (CC)

Information gathered from

Beizaee, A., Allinson, D., Lomas, K.J., Foda, E. & Loveday, D.L. (2015) Measuring the potential of zonal space heating controls to reduce energy use in UK homes: the case of un-furbished 1930s dwellings. Energy and Buildings, 92, pp.29-44.

Contact: A.Beizaee@lboro.ac.uk

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

Example: REFIT

The REFIT study used a multidisciplinary approach to assess the success of installing Smart Home heating controls. 20 homes were recruited and energy use and room temperature data were collected at regular intervals. Researchers carried out Interviews to understand the expectations that occupants had of their Smart Home technologies. The homes were then upgraded with Smart Home heating controls. The researchers continued to monitor the homes and conducted additional interviews to ask occupant's how their attitudes changed.

Findings suggest the different people living in the same home have different motivations for engaging with Smart Home technologies. Some use it to save energy and others for convenience. Researchers observed that in most homes a single person is 'in charge' of the heating controls. When the new heating controls were installed this can disrupt current dynamics of control within the home, for example, in some homes the person in charge of heating changed. This may result in the occupants heating their homes in new ways. The work is continuing to understand the new behaviours and see if the Smart Heating controls save energy in real homes.

Other work has identified some ways to improve heating controls. Researchers suggest that energy is wasted because individual rooms are heated to higher temperatures than the occupant's settings as the controllers are not sensitive enough. Some homes were also heated when they were unoccupied. If the smart homes are to be successfully used in homes their design and operation needs to be more intuitive than the systems trialled.

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

Information gathered from

Hargreaves, T. et al. (2015) Smart homes, control and energy management: How do smart home technologies influence control over energy use and domestic life?. Proceedings from the European Council for an Energy Efficient Economy 2015, France. pp. 1021-1032.

Coleman, M., Kane, T., Dimitriou, V., Hassan, T.M., Firth, S.K. & Liao, J. (2015) Utilizing smart home data to support the reduction of energy demand from space heating – insights from a UK field study. IN: 8th International Conference on Energy Efficiency in Domestic Appliances and Lighting (EEDAL), Lucerne-Horw, Switzerland, 26-28 Aug.

Contact: t.kane@lboro.ac.uk

Smart home heating controls and sensors used in the REFIT project.