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Heating Demand Reduction in Single Family Houses Community through Home Energy Management: Putting Users in Charge

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Abstract : Heating constitutes a major part of the overall energy consumption in Sweden. In 2013 heating and hot water accounted for about 55% of the total energy use in the housing sector. Historically, the end users have not been able to make a significant impact on their consumption on account of traditional control systems that do not facilitate interaction and control of the heating systems. However, in recent years internet connected home energy management systems have become increasingly available which allow users to visualize the indoor temperatures as well as control the heating system. However, the adoption of these systems is still in its nascent stages. This paper presents the outcome of a study carried out in a community of single-family houses in Stockholm. Heating in the area is provided through district heating, and the neighbourhood is connected through a local micro thermal grid, which is owned and operated by the local community. Heating in the houses is accomplished through a hydronic system equipped with radiators. The system installed offers the households to control the indoor temperature through a mobile application as well as through a physical thermostat. It was also possible to program the system to, for instance, lower the temperatures during night time and when the users were away. The users could also monitor the indoor temperatures through the application. It was additionally possible to create different zones in the house with their own individual programming. The historical heating data (in the form of billing data) was available for several previous years and has been used to perform quantitative analysis for the study after necessary normalization for weather variations. The experiment involved 30 households out of a community of 178 houses. The area was selected due to uniform construction profile in the area. It was observed that despite similar design and construction period there was a large variation in the heating energy consumption in the area which can for a large part be attributed to user behaviour. The paper also presents qualitative analysis done through survey questions as well as a focus group carried out with the participants. Overall, considerable energy savings were accomplished during the trial, however, there was a considerable variation between the participating households. The paper additionally presents recommendations to improve the impact of home energy management systems for heating in terms of improving user engagement and hence the energy impact.

Keywords : energy efficiency in buildings, energy behavior, heating control system, home energy management system
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