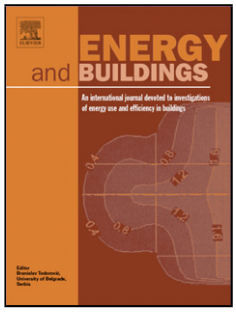

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The effect of time-of-use tariffs on the demand response flexibility of an all-electric smart-grid-ready dwelling

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Abstract

The paper is concerned with the development and evaluation of control algorithms for the implementation of demand response strategies in a smart-grid enabled all-electric residential building. The dwelling is equipped with a 12 kW heat pump, a 0.8m^3 water storage tank, a 6 kW photovoltaic (PV) array, solar thermal collectors for domestic hot water heating and an electric vehicle. The building, located in Ireland, is fully instrumented. An EnergyPlus building simulation model of the dwelling was developed and calibrated using monitored data from the building. The developed model is used to assess the effectiveness of demand response strategies using different time-of-use electricity tariffs in conjunction with zone thermal control. A reduction in generation cost (-22.5%), electricity end-use expenditure (-4.9%) and carbon emission (-7.6%), were estimated when DR measures were implemented and compared with a baseline system. Furthermore, when the zone control features were enabled, the efficiency of the control improved significantly giving, an overall annual economic saving of 16.5% for the residential energy cost. The analysis also identified an annual reduction of consumer electricity consumption of up to 15.9%, lower carbon emissions of 27% and facilitated greater utilisation of electricity generated

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