Abstract
With the inevitable transition of current electricity grids towards a Smart Grid architecture and the increasing deployment of embedded generation on a residential level, the practicalities of utilising well managed smart technologies within a household environment are quickly gaining greater attraction. Through the implementation of a Smart House Energy Management System (SHEMS), maximum benefits can be realised by residents, retailers and distributors alike through the reduction of overall power consumption, shifting of peak loads from peak times, more efficient utilisation of energy or any combination of these measures on a household level.

Project Objectives
• To develop a SHEMS using the Mixed-Integer Linear Programming (MILP) framework for the purpose of optimising the scheduling of household elements in order to achieve a pre-specified objective.
• To investigate the effects of varying the thermal insulation of a household on the power consumption of the household.

System Design
• The SHEMS was designed using the MILP framework, which is described in Figure 2 above. The objective employed by MILP is to maximise a function, while ensuring that certain constraints are satisfied.
• The household is defined by constraints and the overall objective is defined by the function to be optimised.
• Discrete elements, such as operational status, are easily modelled using integer variables.
• All data used by the system is viewed as deterministic for the purposes of this project.

Results
• The results vary depending on the specified objective. For the objective of load shifting, results are shown in Figure 3.
• The system output, given any objective, would be an operating schedule for the elements of household for which the system has control as well as the anticipated schedule of values for other variables.

Effect of Varying Thermal Insulation
• Both Figures 3 and 4 show the results for varied thermal insulation and indicate that the stiffness of internal temperature change acts as a form of energy storage.

Recommendations for Further Work
• Formulation of the problem as a stochastic one to account for the uncertain nature of the underlying process.
• Use scenario reduction techniques to reduce the computational burden.
• Further analysis of the effects of varying household thermal insulation, as well as other system variables.