Demand Response Algorithms for Home Area Networks (HAN)

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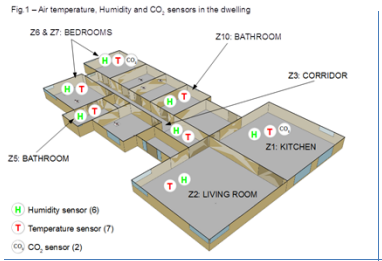
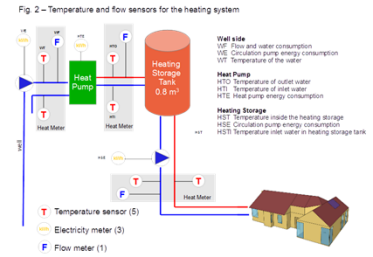
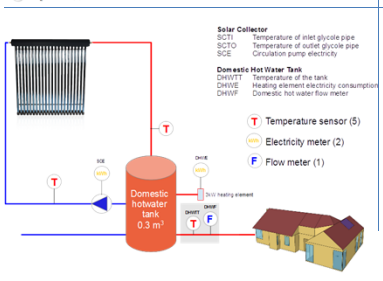
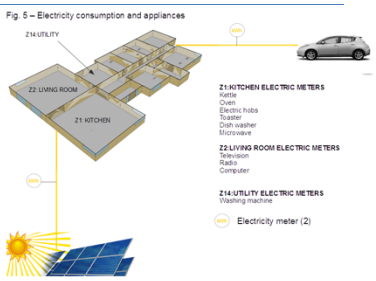
Context and Motivation









Research Question

Can demand response algorithms be effectively used in domestic energy management systems?

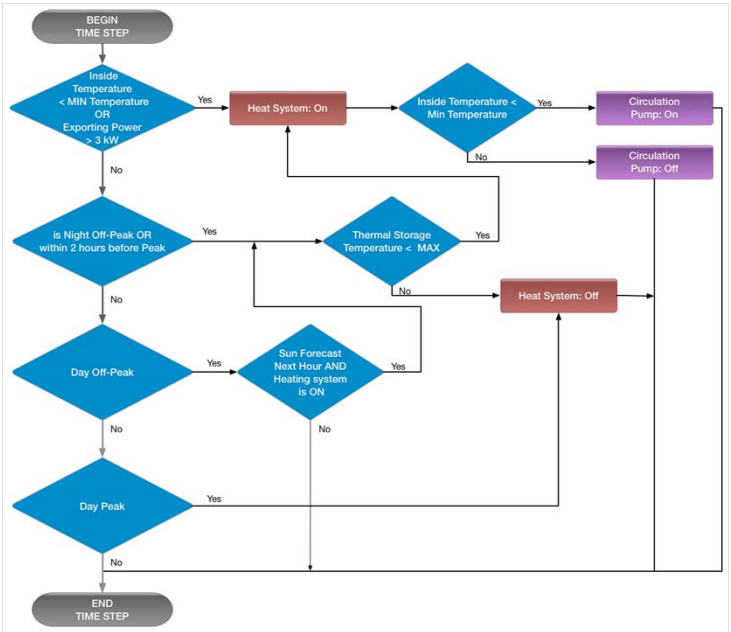
Objectives

Evaluate the flexibility of demand response strategies in all-electric residential building using building simulation analysis

Develop demand response algorithms capable of being implemented on Home Area Network systems

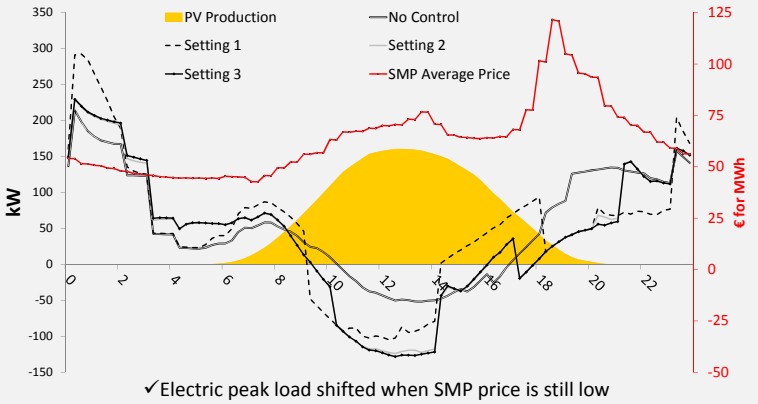
Test and optimise demand response algorithms on a low energy all-electric test residential dwelling

Algorithm Flow Chart



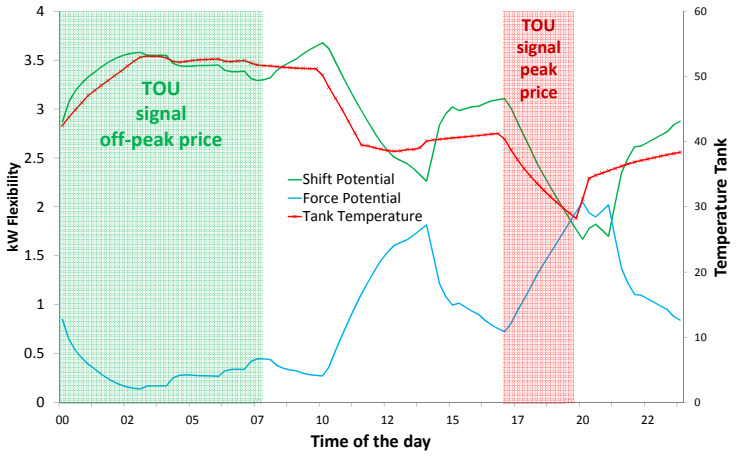
Simulation Results

	Setting 1	Setting 2	Setting 3
Schedule weekdays	Single	Divided for room category	Divided for room category
Schedule weekend	Single	Single	Single
TES - MIN & MAX settings point	40°C – 55°C	40°C – 55°C	35°C – 55°C
Use of PV for increase the TES charge	when the kW of PV available > 3 KW	when the kW of PV available > 3 KW	when PV available > 2 kW
Hours before peak price to begin charge the TES	2	2	2



✓Electric peak load shifted when SMP price is still low
✓Change of the typical electricity demand pattern

Can Thermal Storage Provide Flexibility to the Grid?



$$S_{t+1} = \frac{(4.2 * Z * (T_t - 40))}{3600 * C} + P_{t+1} \qquad F_{t+1} = \frac{(4.2 * Z * (55 - T_t))}{3600 * C}$$

where the specific heating capacity of water is 4.2 $kJ/kg\ K$ and Z is the volume of the thermal storage, T_t is the temperature of the TES at time t and C is the heat pump average COP. At time $t+1$ the heating system can shift S_{t+1} kW to the next hour. At the same time the potential load forcing flexibility in kWh is calculated.

Future Work

- Detailed calibration of the model
- Develop a Rest API for access and control the building
- Evaluate and optimise demand response algorithms in the test bed house
- Assess performance (i.e., energy use, energy cost, thermal comfort, occupant response, system flexibility, etc.).

Acknowledgement

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