Half-hourly Active Building Energy Demand Model

ACTIVE BUILDING CENTRE RESEARCH PROGRAMME

Aim

Estimate half-hourly energy demands hourly from groups of Active Buildings at an early design stage.

Existing methods

- Dynamic thermal simulation
- Quasi-static models
- Rules of thumb

Problems

- Occupant behaviour is very variable
- Results not always half-hourly
- Can require inputs that are not known at early stage

Our approach

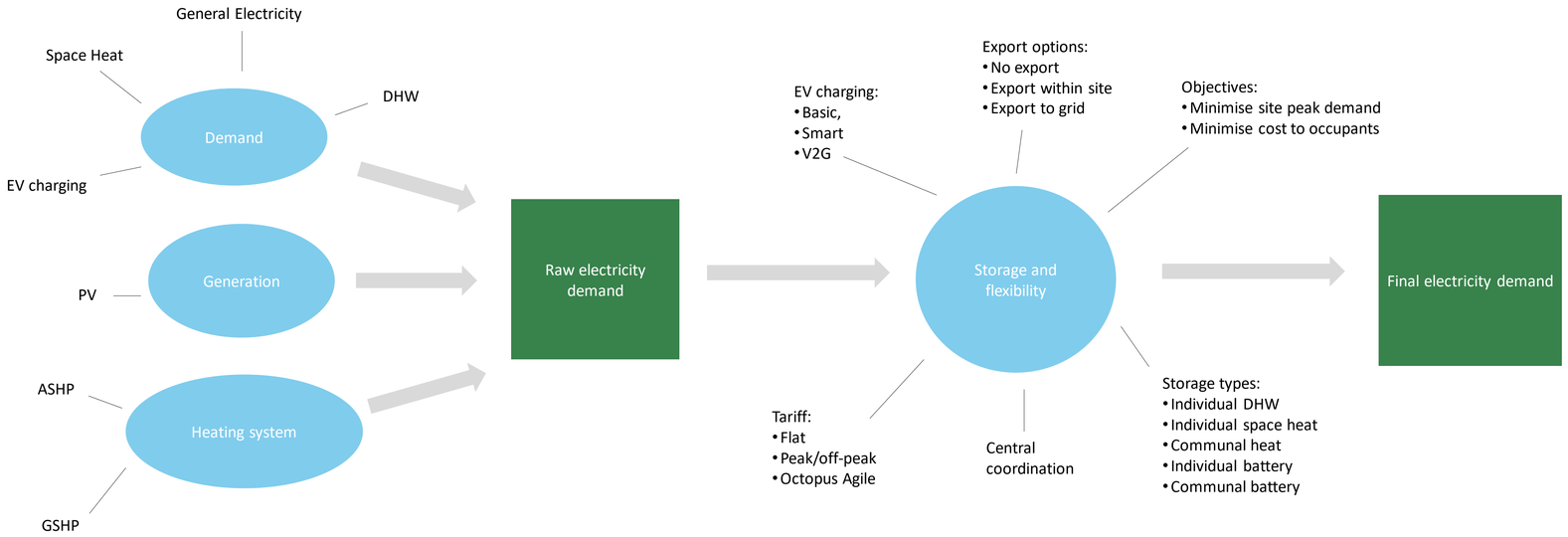
Model based on selections of suitable monitored data. Multiple runs to represent variation due to occupants.

Wider context

Increasing proportion of electricity coming from intermittent renewables, making it challenging to match supply and demand nationally.

Electrification of transport and domestic heating, potentially overloading electricity distribution networks.

Active buildings can help with both of these challenges, but we need credible estimates of demands, taking real occupants into account.



Example model results

Half-hourly electricity demands were calculated for the five homes described in Table 1. Ten runs of the model were carried out, with a different automatic random selection of profiles each time. The median and 95th percentile are given for annual electricity bill per dwelling and for site peak demand. Results are given for raw electricity demand (Table 3 and Figure 1), and final electricity demand, for the objective of minimising peak demand (Table 3 and Figure 2) and minimising cost (Table 3). The storage options used are shown in Table 2.

Table 1: Dwelling properties

Number of homes	5
Floor area	90 m²
Design annual space heat demand	45 kWh/m²
PV area per dwelling	20 m²
Number of EV charge points	5

Table 2: Storage properties

Tariff	Octopus Agile 2019
Central Coordination	Yes
Export to grid	Yes
EV charging	Smart
DHW store capacity	2 kWh
DHW store max power	1 kW
Space heat store capacity	4 kWh
Space heat store max power	2 kW

Table 3: Example results

Scenario	Variable	Median	95th Percentile
Raw electricity demand	Site peak demand (kW) Annual bill per dwelling (£)	30 1570	35 1840
Final electricity demand, minimise peak	Site peak demand (kW) Annual bill per dwelling (£)	18 1480	24 1770
Final electricity demand, minimise cost	Site peak demand (kW) Annual bill per dwelling (£)	38 900	43 1150

Figure 1:
Raw site electricity demand on 2nd January for one run of model

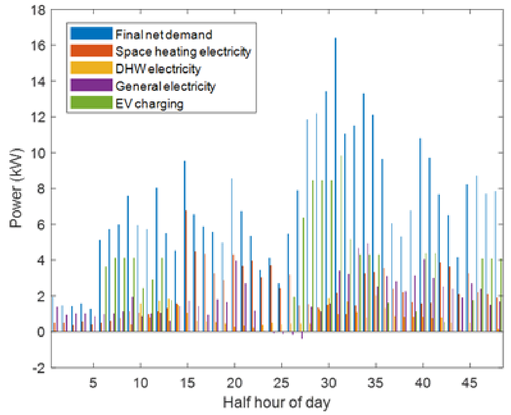
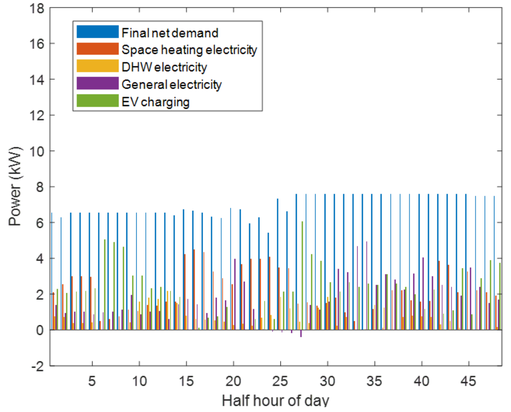


Figure 2:
Final site electricity demand on 2nd January for one run of model. Objective is to minimise peak.



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