

Electric heat pumps – using energy storage to become a demand side management tool

Rationale:

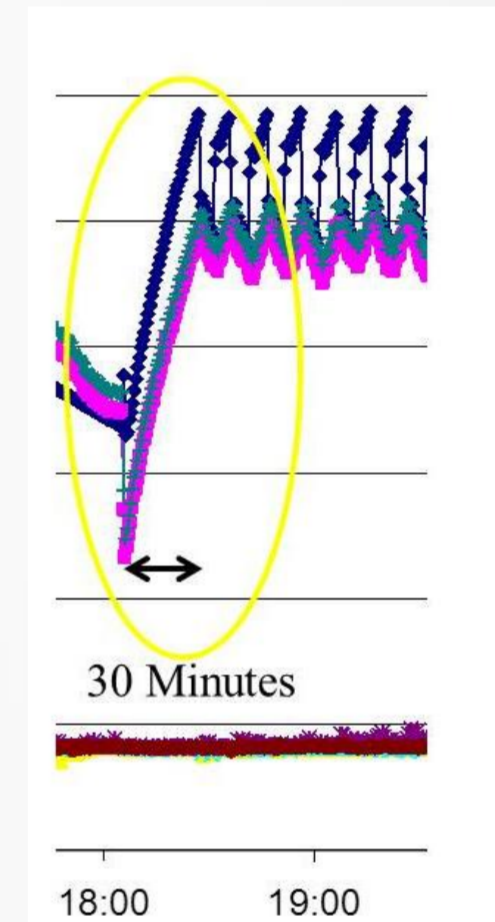
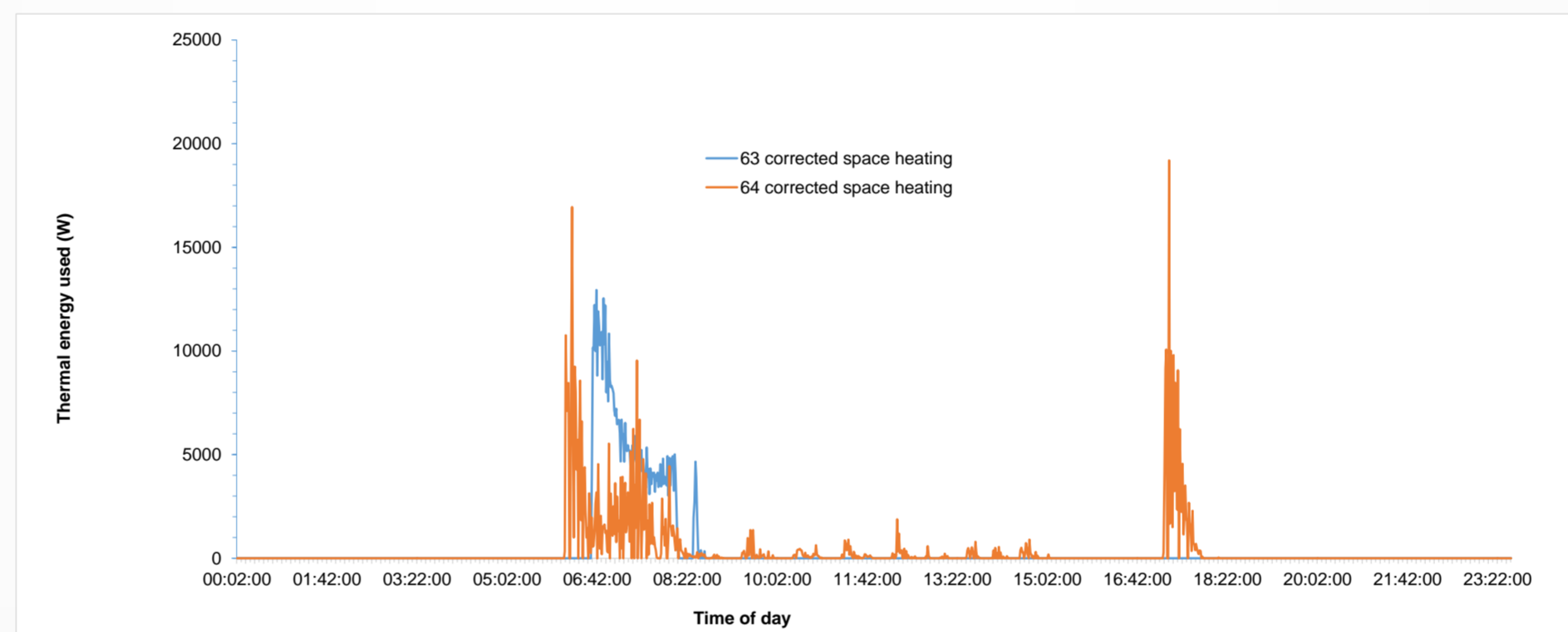
- 23% of UK energy demand and associated CO₂ emissions are as a result of domestic space heating and hot water supply
- Even with major improvements in building performance and behavioural change there will still be a major need for heat energy to provide comfort and sanitary hot water.
- Use of electrically driven heat pumps to:
 - Reduce carbon emissions through increased efficiency and use of renewably derived electricity
 - Provide a management tool for non-dispatchable renewable energy (e.g. wind) through efficient heat pump operation coupled to a compact thermal store

Why a Heat Pump and Demand Side Management?

An electric heat pump uses high grade energy to extract heat from the environment (the outside air, the ground, a river etc.) and to *upgrade* it to a temperature that can be used for heating and hot water. The Coefficient of Performance of a heat pump, equivalent to the efficiency of a boiler, is the useful heat output / high grade input and is always greater than one. A condensing boiler might have a maximum efficiency of 0.9 (90%).

Demand Side Management: using energy storage to match energy supply to energy demand

- **Heat Pump Performance** - Ensuring maximum Coefficient of Performance is compatible with Energy Storage
- **Energy Storage** - Phase change or Chemical materials to minimise storage size



Ulster's Terrace Street test houses with two families, their energy use and response time of an air source heat pump

Previous Research at Ulster



Advanced Heat Pumps developed under EPSRC "Calebre"

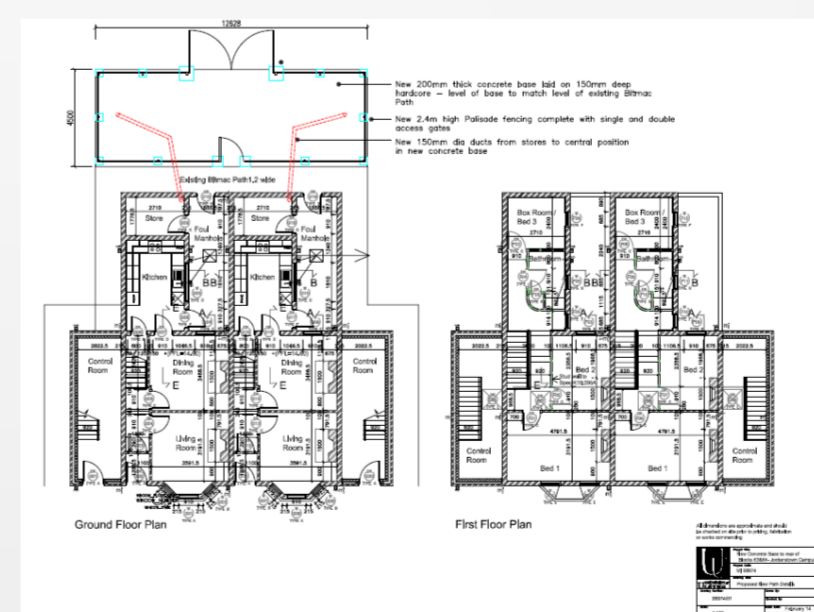


Economised vapour injection and rotary compressor & expander units under development and test



Current research (i-STUTE)

Demand Side Management Test Stand integrated to rear of Terrace Street



- **Terrace Street**
- 1900's solid wall houses
- Phase 1 – Integration of optimised heat pump and energy storage

- **Challenges**
- Optimised heat pump uses weather compensation
- Air source heat pump heating time may be too slow to benefit from 30 minute pricing intervals
- What temperature should heat be stored at?
- Heat Pump requires a feed forward prediction to supply heat at required temperature later in the day
- Storage temperature needs to be variable
- **Solutions**
- Multiple tanks, blends of PCMs etc are possibilities