Overview of Zero Plus case study in York (UK)

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Outline

1. Introduction to the UK case study
2. Summary of installed technologies
3. Pre-occupancy test results

Introduction to the UK case study

Derwenthorpe settlement

- LOCATION: York, UK
  Lat. 53.96, Long. -1.04

- CLIMATE: temperate

  Winter average temps:
  min. 1ºC | max. 5ºC

  Summer average temps:
  min. 11ºC | max. 18ºC

  HDD: 1975 | CDD: 298

Derwenthorpe settlement

At final completion 489 dwellings of various house types

Derwenthorpe settlement

3 dwellings:

- C4: 1x 3-bedroom, plus study detached property, with attached garage.
- B3R & B3L: 2x 2-bedroom semi-detached. Mirrored in plan sharing a party wall along the lounge.

Selected technologies

The following technologies contribute to the zero plus objectives for the UK case study

	Technologies					
Categories	Advanced Envelope	HVAC	BEMS	Energy Production Technologies	Thermal Energy Storage	Integrated Energy Resources Management
UK	N/A	N/A	**HIVE** BEMS installed (learning thermostat & energy management	**Typical PV system** installed across four dwellings to achieve settlement level aggregated generation	N/A	**Tesla Powerwall II batteries** installed in each dwelling to manage electricity demand from PV and off-peak reduced rate charging

Zero Plus performance targets and design phase results

Zero Plus target objectives	Zero Plus Type B3	Zero Plus Type C4
Target 1: Dwelling net-regulated energy ≤ 20kWh/m^2	9 kWh/m^2/yr	4 kWh/m^2/yr
Target 2: Energy production to be generated on average for settlement ≥ 50kWh/m^2	52.4 kWh/m^2/yr	
Target 3: Cost reduction for settlement ≥ 16% (compared with current costs)	17.4% reduction as compared to current costs	

Installed technologies

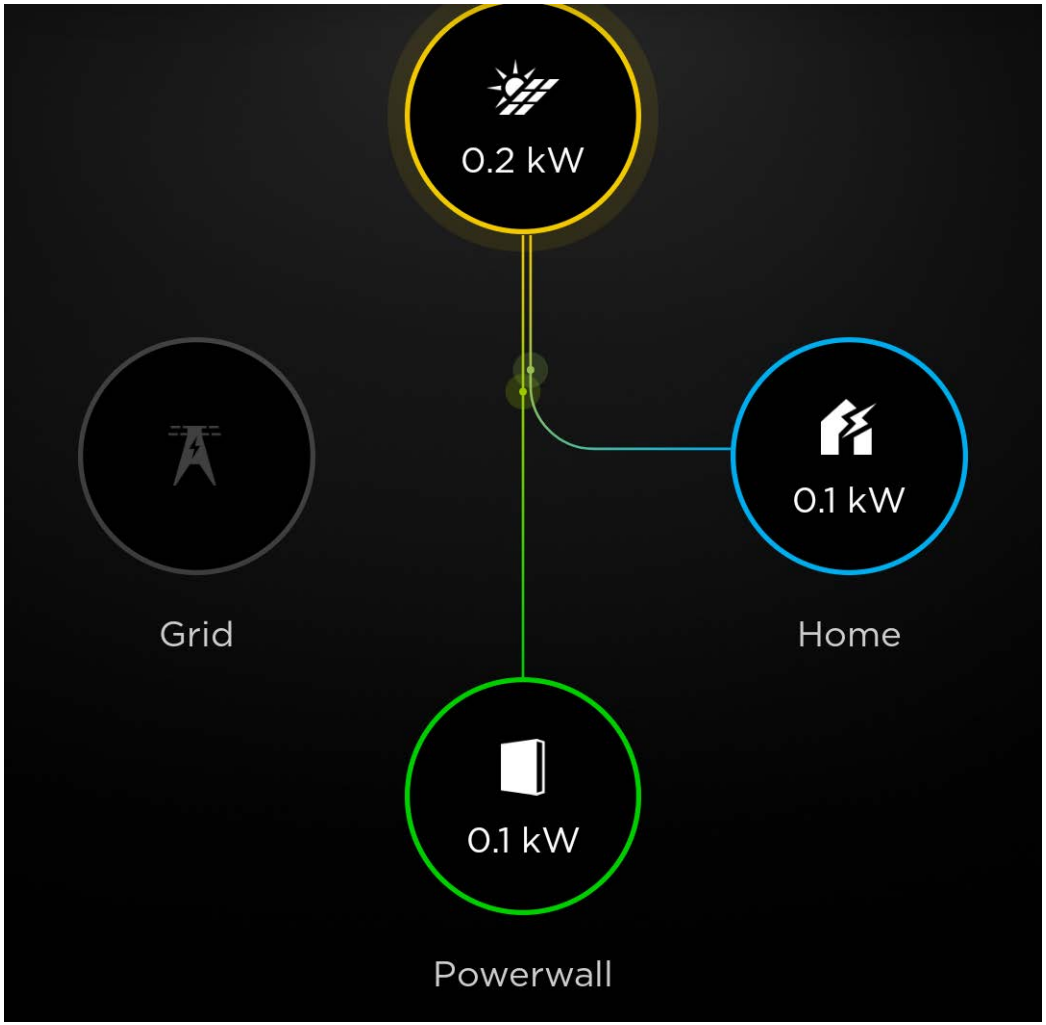
Solar Photovoltaics

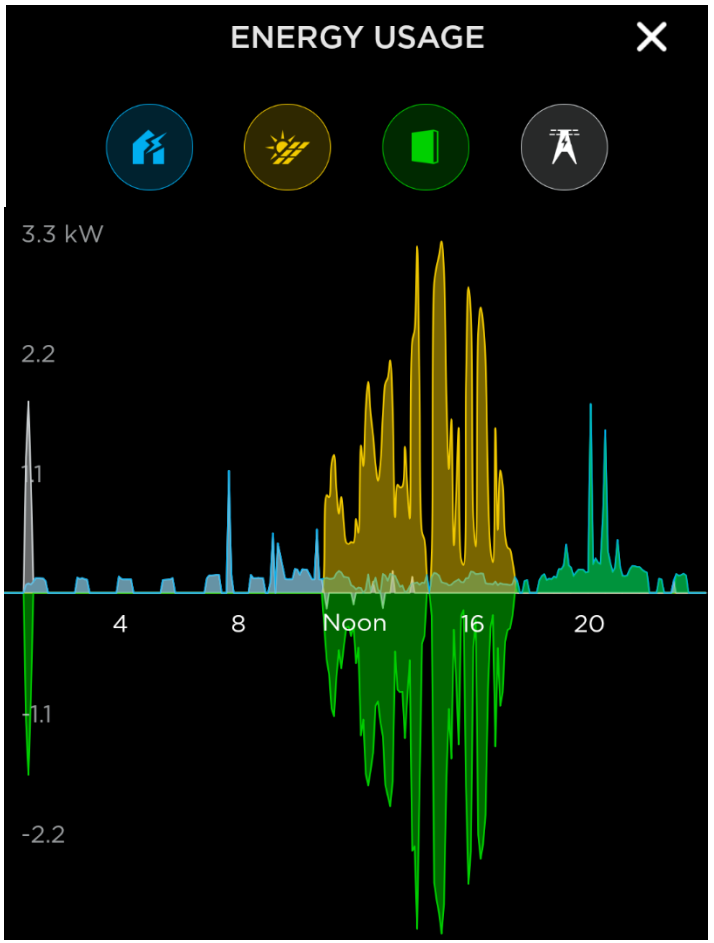
Energy storage (Tesla Powerwall)

Tesla Powerwall 2 Battery
Outside house

Tesla Gateway (communication)
Inside house

Tesla data access





HIVE energy management system

HIVE Learning Thermostat

HIVE Energy Management technologies pre install:

- Motion sensor
- Active plug
- Active light
- Window & door sensor

HIVE energy management system

HIVE motion sensor

HIVE active plug

HIVE energy management system

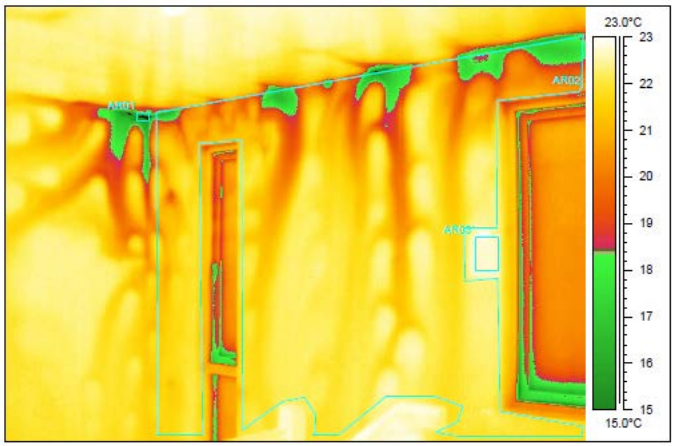
Door sensor

Window sensor

Pre-occupancy test results

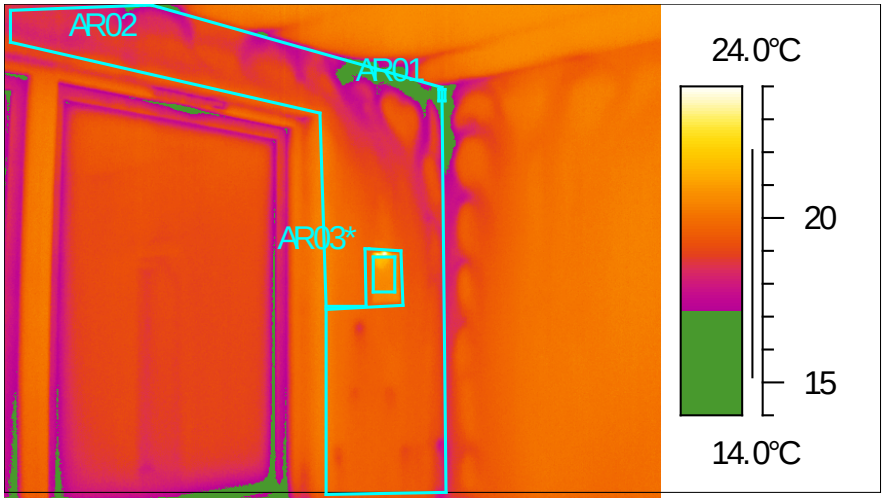
Air tightness testing results

- All the properties had better air permeability results when they were first tested and no longer meet the design target.
  - Plot C4 had deteriorated most significantly, and it was noted that there were holes in the kitchen wall where waste pipes had been fitted and the gaps around the pipes were not well sealed.
  - Other areas that had deteriorated were holes cut in the first floor, presumably to trace pipes or cables in the void and not properly filled and cracks at the edges of the stairs and under skirtings.



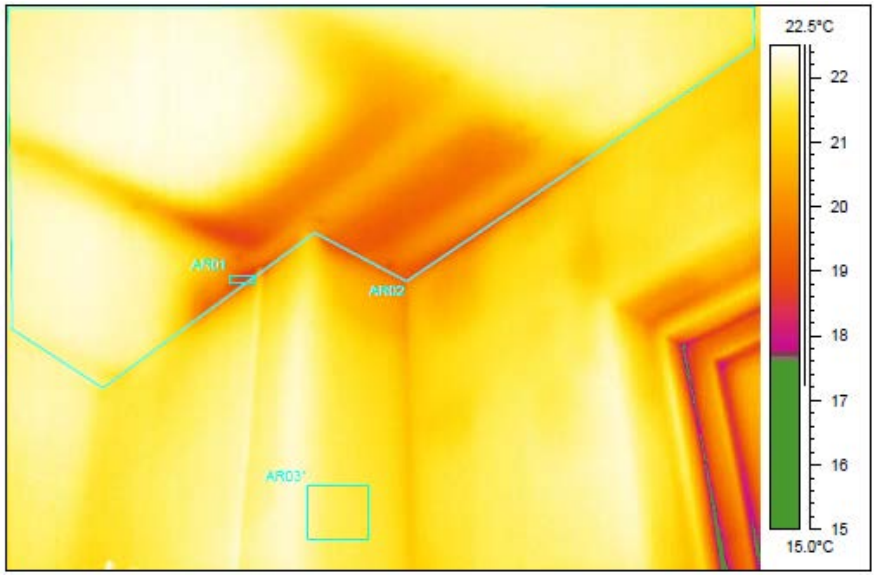
Thermography survey findings: B3L

- A majority of images had thermal indexes that were equal to or less than the 0.75 threshold thermal index.
  - Areas that fall below this threshold have a greater likelihood of condensation forming on its surface.
- The preliminary thermal survey without depressurisation revealed some areas where thermal bypass is apparent.
  - internal studwork wall is affected by cold air penetrating behind the plasterboard.



Thermography survey findings: C4

- A little over half of the images had thermal indexes that were equal to or less than the 0.75 threshold thermal index.
- Similar signs of air leakage that was observed in B3. Mainly seen at the junctions between the ceiling and wall and the doors.
  - First floor bathroom - areas of missing or displaced insulation causing thermal bypass



Pre-occupancy test results conclusion

- Overall most elements of solid wall construction in the dwellings appeared well insulated
  - brick and block walls appeared to function as designed other than in the areas where air could penetrate.
- Many areas within all properties showed signs of:
  - air leakage around the skirting boards on both floors
  - air movement at the junction between walls and ceilings
  - air leakage around each of the all exterior doors along the base
- *It Is advised that a suitably trained individual locates and inspects these areas to ensure that adequate sealing is present, this may help to improve thermal comfort and energy performance in their respective areas.*