Denby Dale **Passivhaus**:
monitoring & performance report

LEEDS METROPOLITAN UNIVERSITY
Leeds Sustainability Institute

CeBE

Two year occupancy performance data, collected and analysed by Leeds Metropolitan University, Centre for the Built Environment

Research methodology

- Observed the construction process.
- Undertook pressure tests on the dwelling prior to completion.
- Monitored the environmental conditions during occupancy.
- Interviewed householders and Green Building Store.

Temperature and relative humidity data

- Five locations in the dwelling
- One weather station to the rear of the dwelling
- 10 minute intervals, June 2010 – May 2012

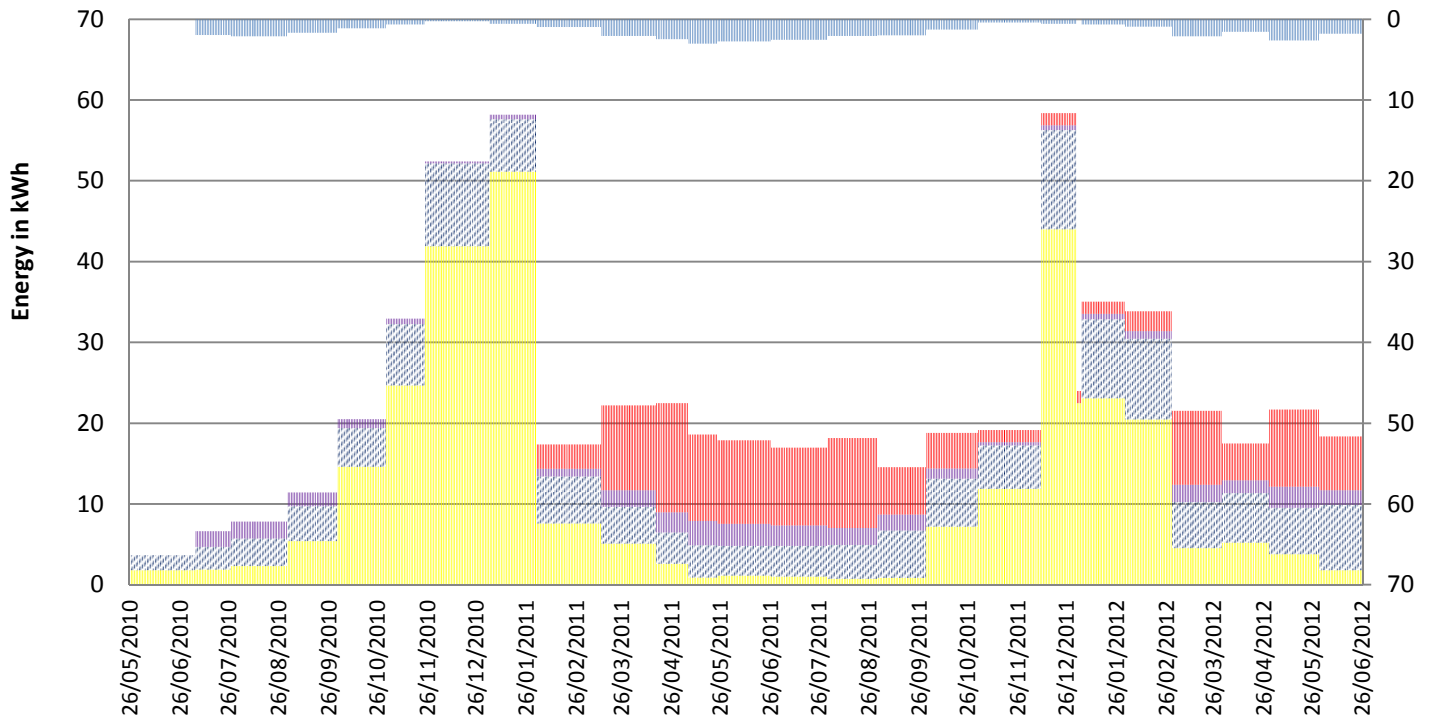
Carbon dioxide readings collected internally

- Two locations internally
- 10 minute intervals, June 2010 – May 2012

Meter readings: collected by the householder

- Gas and electric meters
- Solar hot water and photovoltaic system meters

Average Daily Energy Consumption/Generation



Source: Residents' meter readings.

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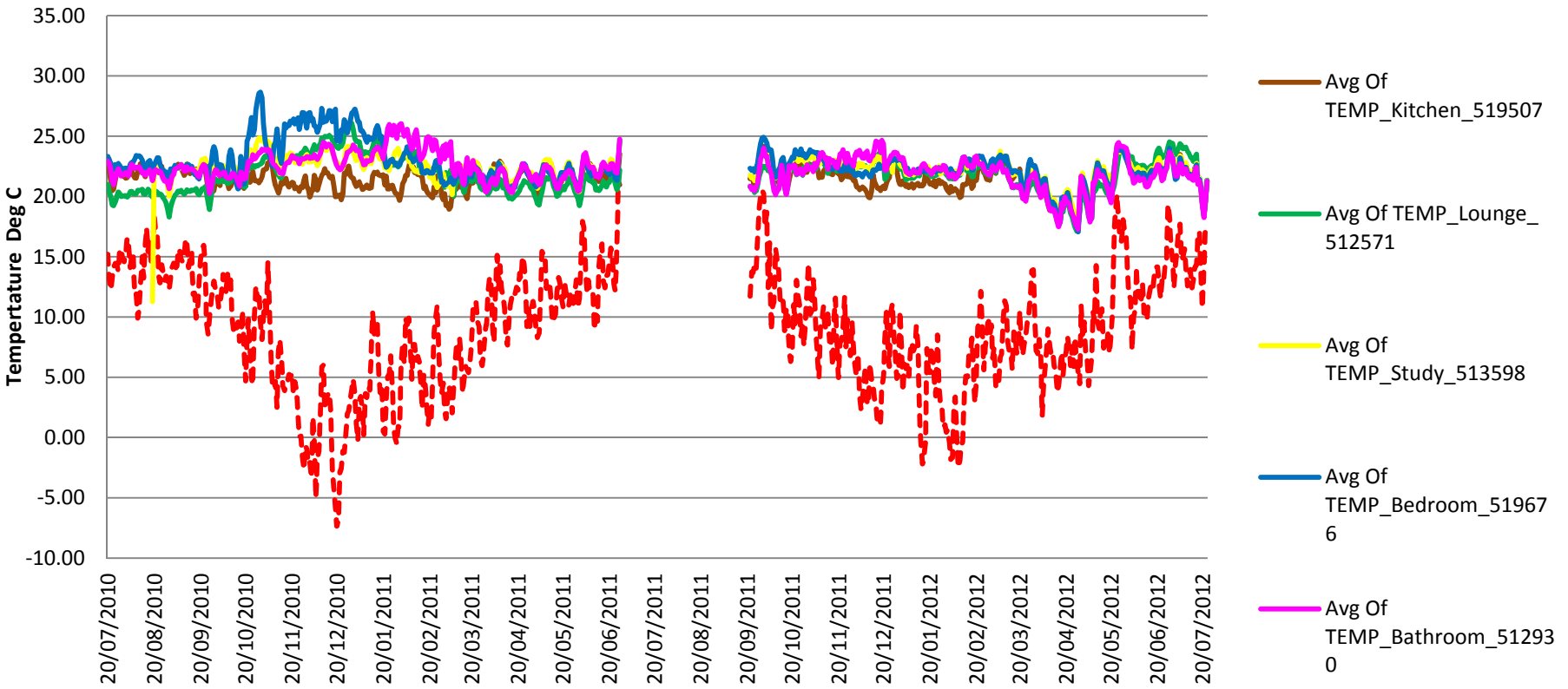
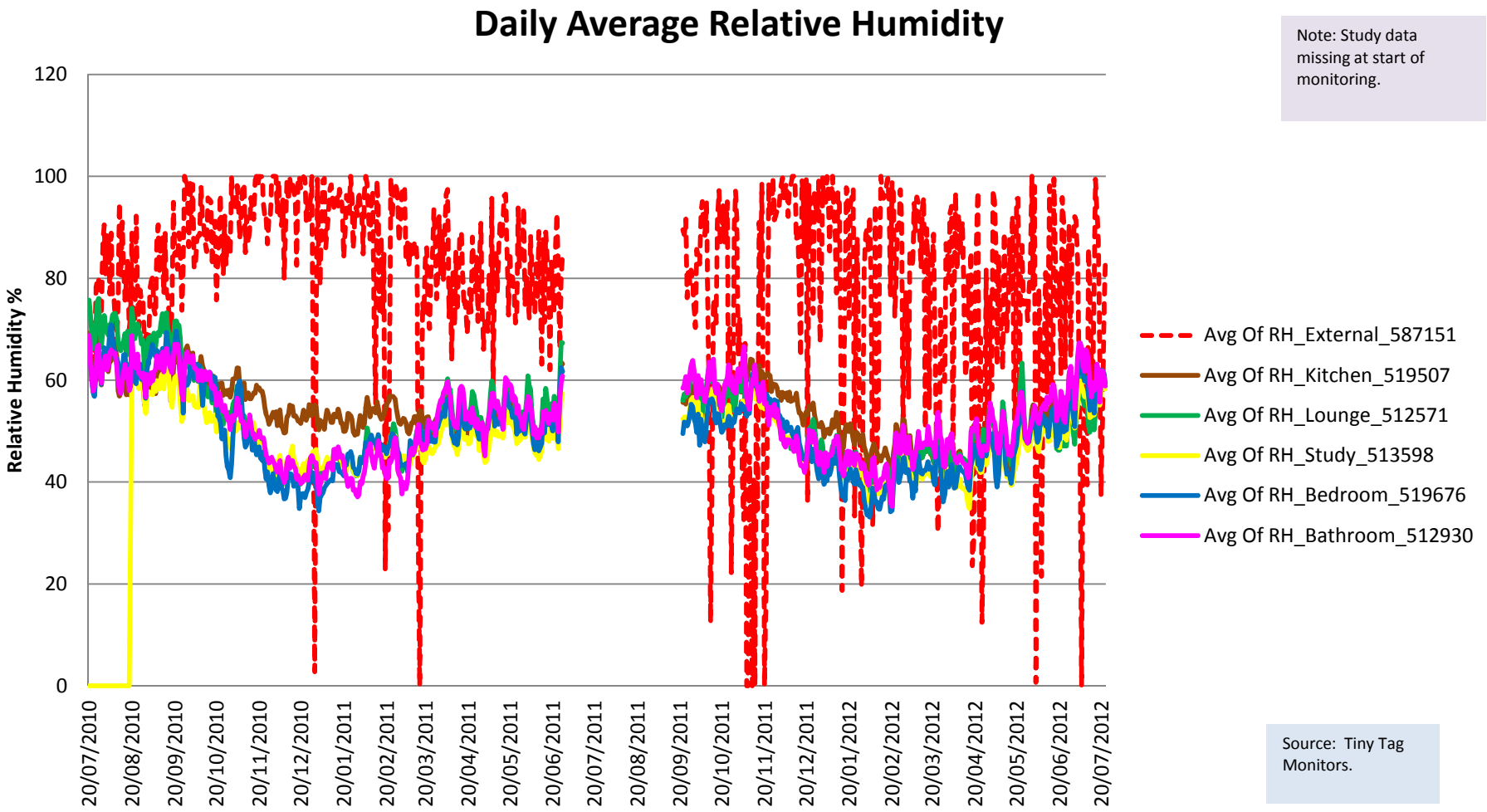
Note: Study data missing at start of monitoring.



Source:
Tiny Tag Monitors.


Daily Average Relative Humidity
Relative Humidity %
120
100
80
60
40
20
0
20/07/2010
20/08/2010
20/09/2010
20/10/2010
20/11/2010
20/12/2010
20/01/2011
20/02/2011
20/03/2011
20/04/2011
20/05/2011
20/06/2011
20/07/2011
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20/11/2011
20/12/2011
20/01/2012
20/02/2012
20/03/2012
20/04/2012
20/05/2012
20/06/2012
20/07/2012
Avg Of RH_External_587151
Avg Of RH_Kitchen_519507
Avg Of RH_Lounge_512571
Avg Of RH_Study_513598
Avg Of RH_Bedroom_519676
Avg Of RH_Bathroom_512930
Note: Study data missing at start of monitoring.
Source: Tiny Tag Monitors.

Occupant learning

Process of learning to 'drive the house' in first year:

- Preventing overheating with external blinds
- Awareness of impact of large thermal mass
- Night-time purging during the summer cool the thermal mass and bring in fresh air.
- Developing understanding use of MVHR 'summer bypass'
- Learning how to deal with/ prevent low humidity using wet towel/ winter MVHR flow rates.
- Awareness of energy saving:

  "It's the culture; it makes you think about it"

  "…You become mindful of turning lights off"

Energy consumption

	Gas kWh	Electricity imported kWh	Electricity generated kWh	Solar thermal kWh	Total kWh
May 2010-2011	5095.2	1851.9	918.4	938.0	8803.5
May 2011-2012	3471.2	2319.6	1226.0	2260.0	9276.8
Predicted primary energy demand					9082

Estimated space heating kWh/m^2/year

- Total gas consumption 3471.2 kWh
- Annual gas usage – cooking: 800–1500kWh
- Annual gas usage – water heating: 500-1000kWh
- Space heating need: 9 -20.7 kWh/m^2/year

Based on monitoring data for year 2 (2011-2012).

Estimates for water heating & cooking determined from summer consumption: Ruth Sutton, Leeds Metropolitan University.

Known factors

- Over-capacity heating system led to problems in year 1 leading to overheating, short cycling of the boiler and decreased boiler efficiency. In December 2011, a weather compensator was fitted to control boiler modulation.
- Electricity consumption occurring outside of the thermal envelope: an electric heater and power tools were used in the garage for long periods throughout winter months, for occupants' business. In December 2010/ January 2011, heating was used in the garage to defrost the MVHR condensate pipe during a particularly cold spell.
- Occupant preferences have meant that mean temperatures in the house have stayed above 21 degrees C.

Lessons

Heating design

- Prioritising the fabric of the building meant not enough focus on the heating system
- Heating design needs to be integrated at an earlier stage – not ad hoc
- Beware late design changes – (eg renewables added at late stage)

Supply chain

- Needs to be improved availability & supply of suitable low cost gas heating units

Occupant handover/participation

- Project benefitted from engaged occupants who worked to optimise/ fine-tune the performance of the house.
- Even so, occupants underwent a period of learning to 'drive the house'
- Informal handover/ inadequate suppliers manuals meant that occupants had to learn to drive it without a manual

Conclusions

- The Denby Dale Passivhaus is performing well and energy consumption is close to that predicted in PHPP (Passive House Planning Package).
- Occupants need a reasonable level of understanding of their building to optimise comfort & performance. Formal handovers with clear instructions (especially for MVHR) are essential.
- Need for careful specification and design of heating (& ventilation) systems for Passivhaus dwellings at early stage for optimal performance

Geoff & Kate Tunstall:

"We are very happy with our home and wouldn't want to ever live in a non-Passivhaus now. You can sum Passivhaus up in three words: cost-effective, comfortable and sustainable. There isn't anything about the house that we'd change. The whole thing has been a victory for common sense."

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Leeds Metropolitan University, Centre for the Built Environment: www.leedsmet.ac.uk/as/cebe

More information on the Denby Dale Passivhaus project is at: www.denbydalepassivhaus.co.uk