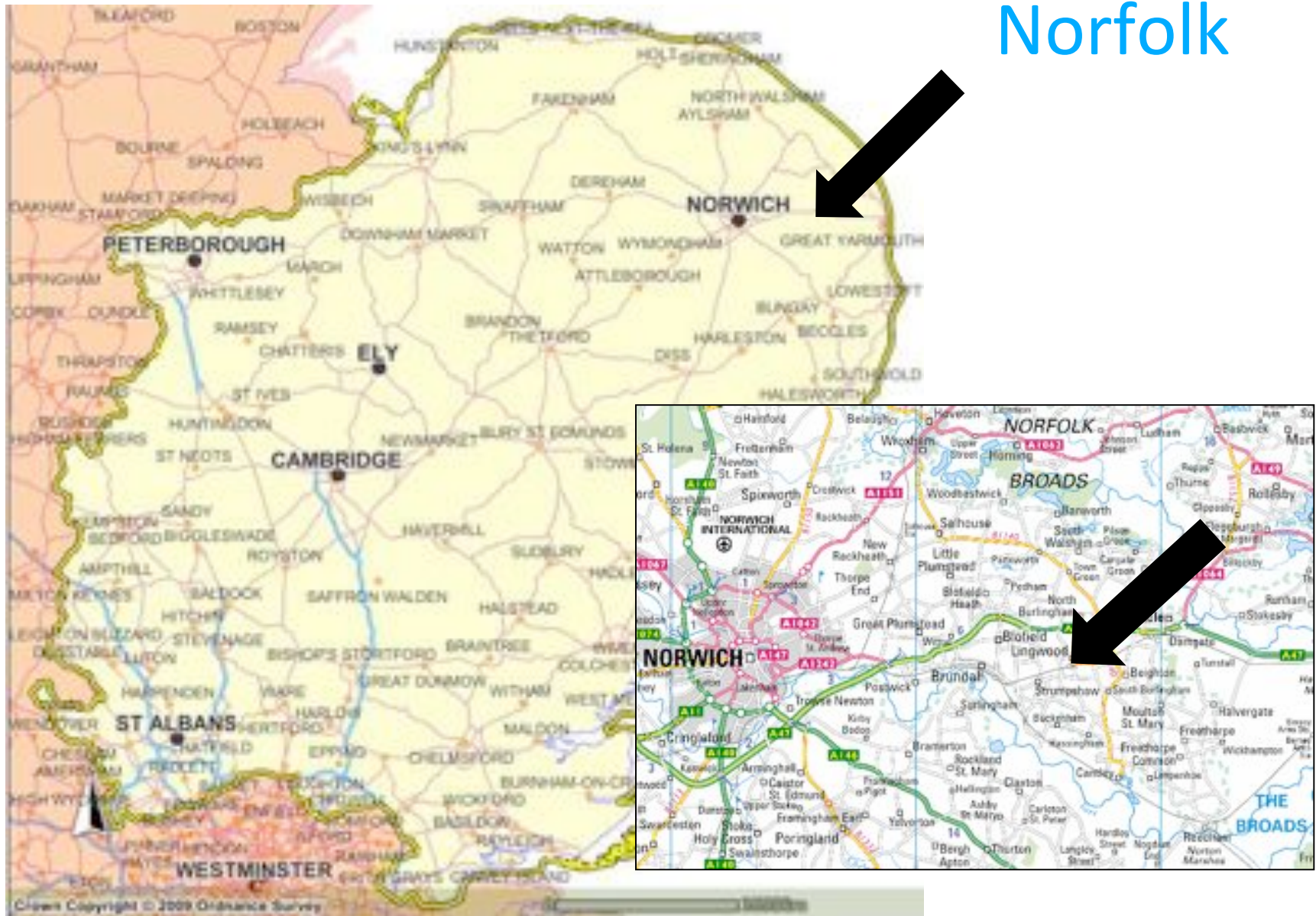


Affordable low energy housing

Dr Jane Powell



Lingwood, Norfolk



Housing objectives

- Social
 - Rural exception site
- Economic
 - affordable
- Environmental



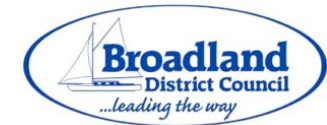
Barefoot & Gilles Architects, 2007

Research objectives

- Environmental cost of construction
 - Embodied carbon
 - Materials, energy, transport
- Energy in use
 - Monitoring
- Effects of household
 - Behaviour and attitude

Project Partners

- Broadland District Council:
 - Strategic Local Housing Authority
- Flagship Housing Group:
 - Housing Corporation Partner.
- Barefoot & Gilles:
 - Architects and development advisors
- Oxbury & Company:
 - Chartered Surveyors acting as project manager
- John Youngs Ltd:
 - Principle building contractor
- University of East Anglia:
 - Monitoring of project



barefoot & gilles



The site

- 15 units
- Timber frame
- Low energy
 - Thermal efficiency
 - Low energy lighting
 - Micro-generation
- Rainwater harvesting
- Dedicated recycling point
- Certified sustainable materials
- Ecohomes Excellent: Code Level 3



Off-site manufacture

- Timber frame
 - Modern methods of construction
- Minimises
 - Waste, skills, time
- Quality control

Images courtesy of Space4
www.space4.co.uk



Construction Methods:

- MCC frame:
- Precision engineered structural panels
- Integral high performance insulation
- Accurate, reliable ,fast
- Reduced resource consumption & waste

- External European larch cladding
- Sustainable from certified sources
- Airtight construction



Construction Methods

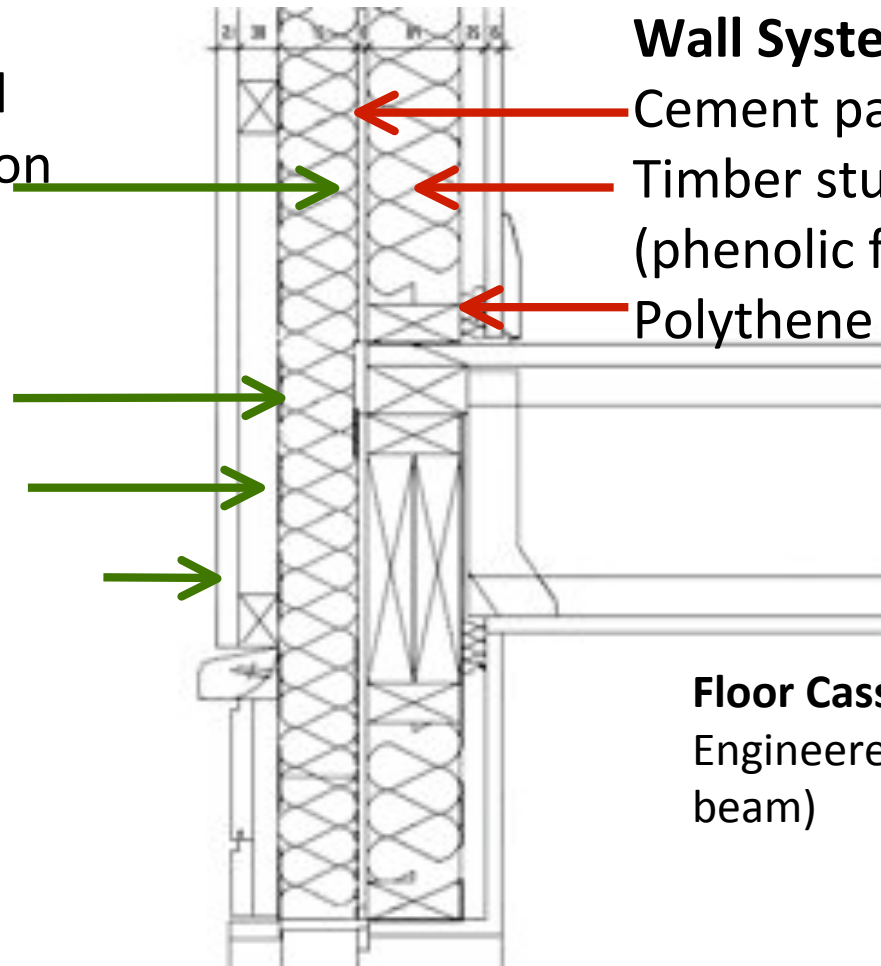
External Wall Detail:

Timber stud fixed to wall system & 75mm insulation

Breather membrane

Timber battens

Untreated Larch board



Wall System:

Cement particle board

Timber stud + insulation
(phenolic foam)

Polythene membrane

Floor Cassette:

Engineered Joists (I-beam)

The site



Control plots 1 - 2

- No renewable technologies
- High spec gas condensing combi boiler.
 - 'A' rated
 - 91% efficient
- 'Control' for comparison against other dwellings



Solar Plots 3 - 6

- High spec gas condensing combi boiler.
- Solar hot water system
 - Flat plate collector – 2m² & 4m²
 - 50 – 70% saving hot water energy (est)
- Photovoltaics
 - Grid connected (income?)
 - Polycrystalline silicone cells
 - 1.6 & 1.5 kWp

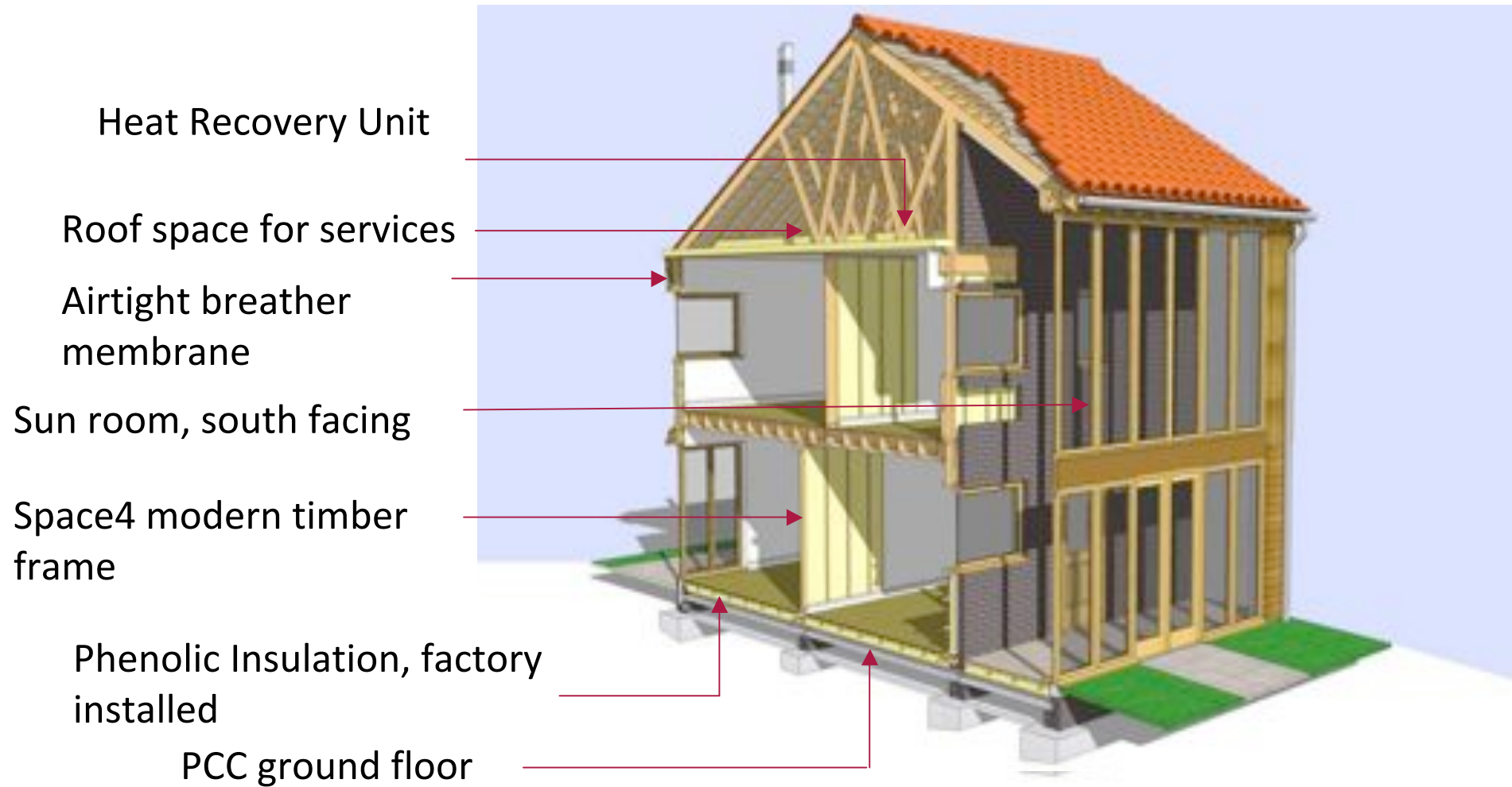


Sunspace Plots 7 - 10

- High spec gas condensing combi boiler.
- Thermal mass
 - Full height glazed sunspace to south
 - Single skin brick trombe wall
- Mechanical ventilation and heat recovery
 - Preheating of inflow fresh air
- Occupant regulated



Sunspace Plots 7 - 10



Ground Source Plots 11 - 15

- No gas
- Ground source heat pump
 - Space heating and hot water
 - Coefficient of performance
 - Manufacturers rating 3.8 – 4.2
 - Our estimate 1.75 – 2.4
- Under floor heating ground floor
- Radiators upstairs (unused)
 - Low energy
 - ‘Smart’ energy management
 - Low water volume



Ground Source Plots 11 - 15

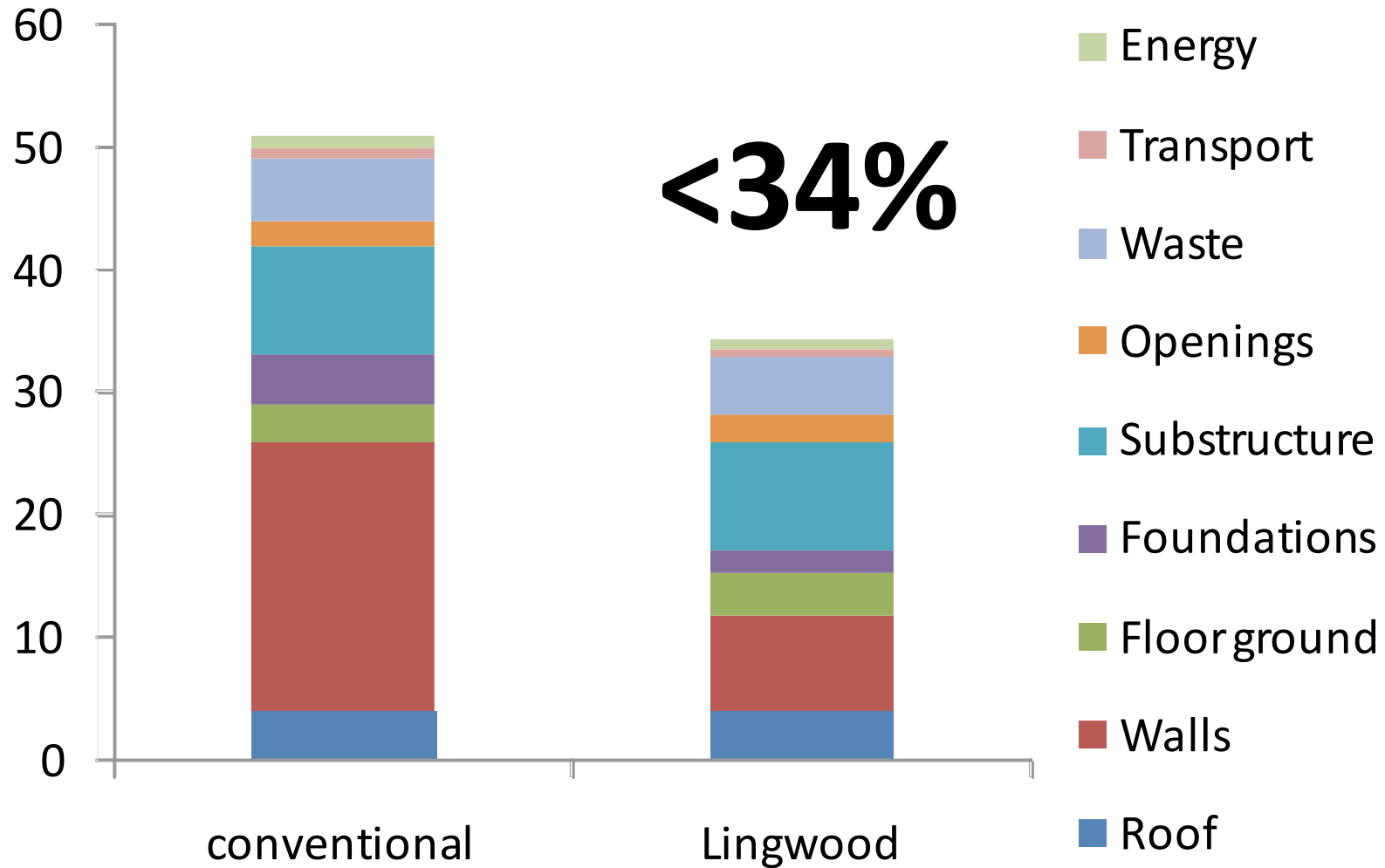


Ground Source Plots 11 - 15

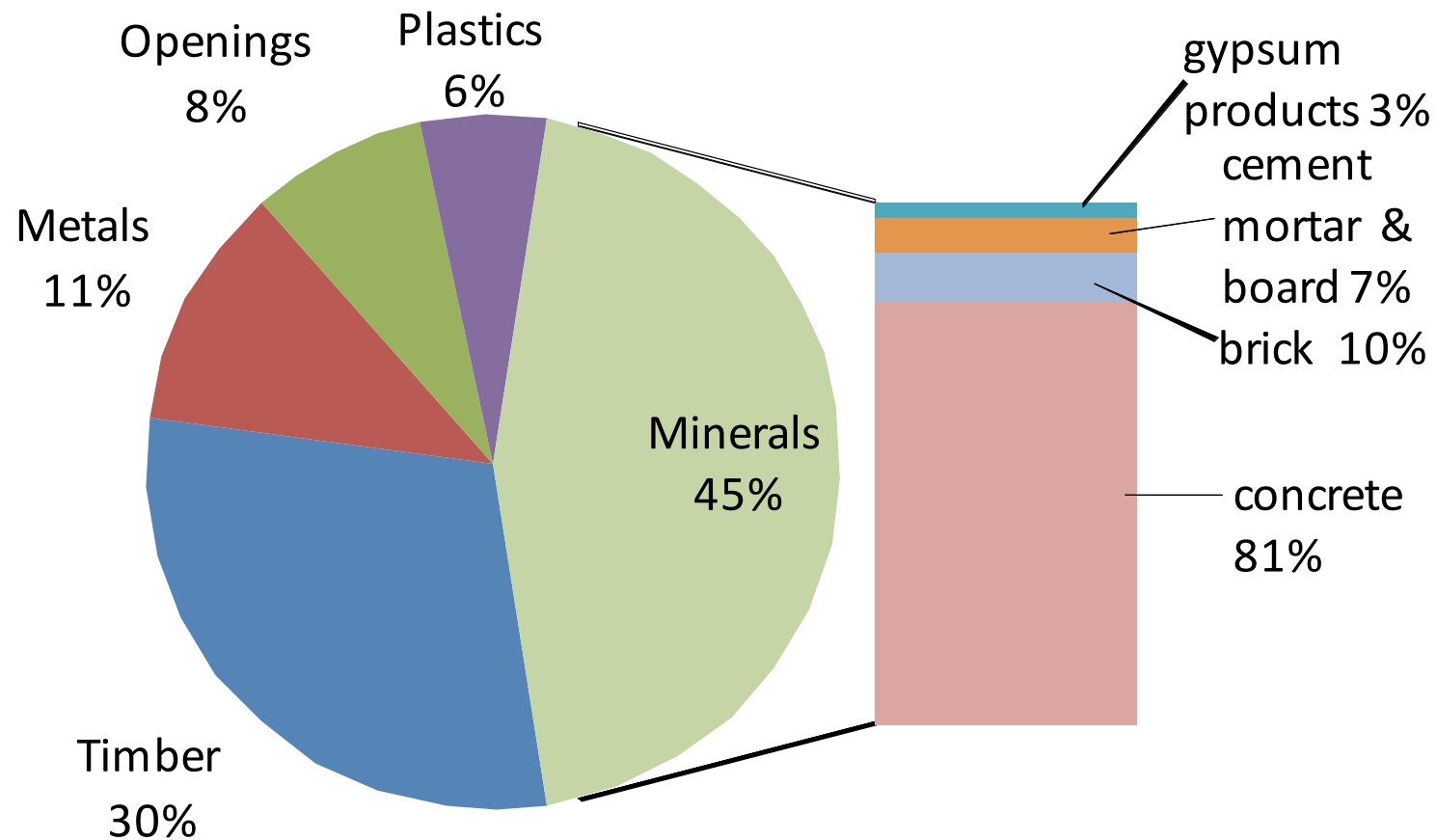
- Collector loops installed using hydraulic ram
 - No groundworks
 - No trenches or piles
- Ground source heat exchangers vertical
 - Minimal land required



Results: Embodied carbon (tCO2)

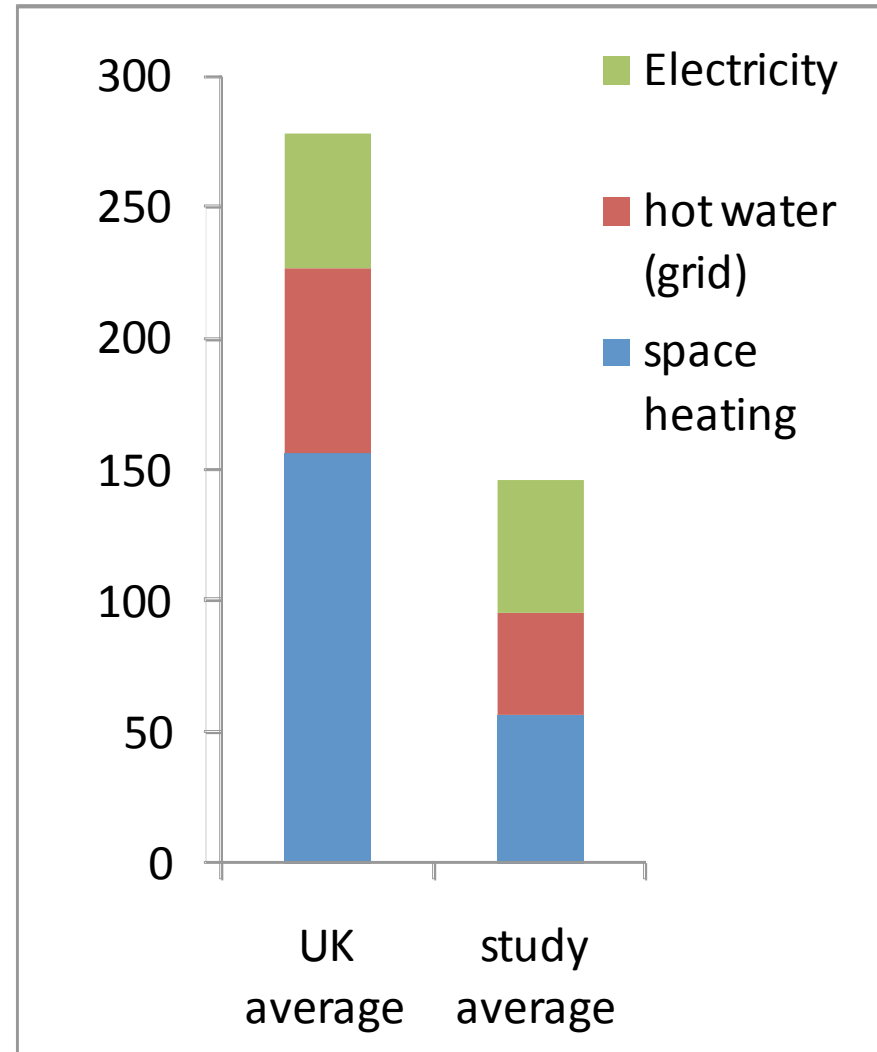


Proportion of embodied carbon in materials (excludes waste, transport and energy in construction)



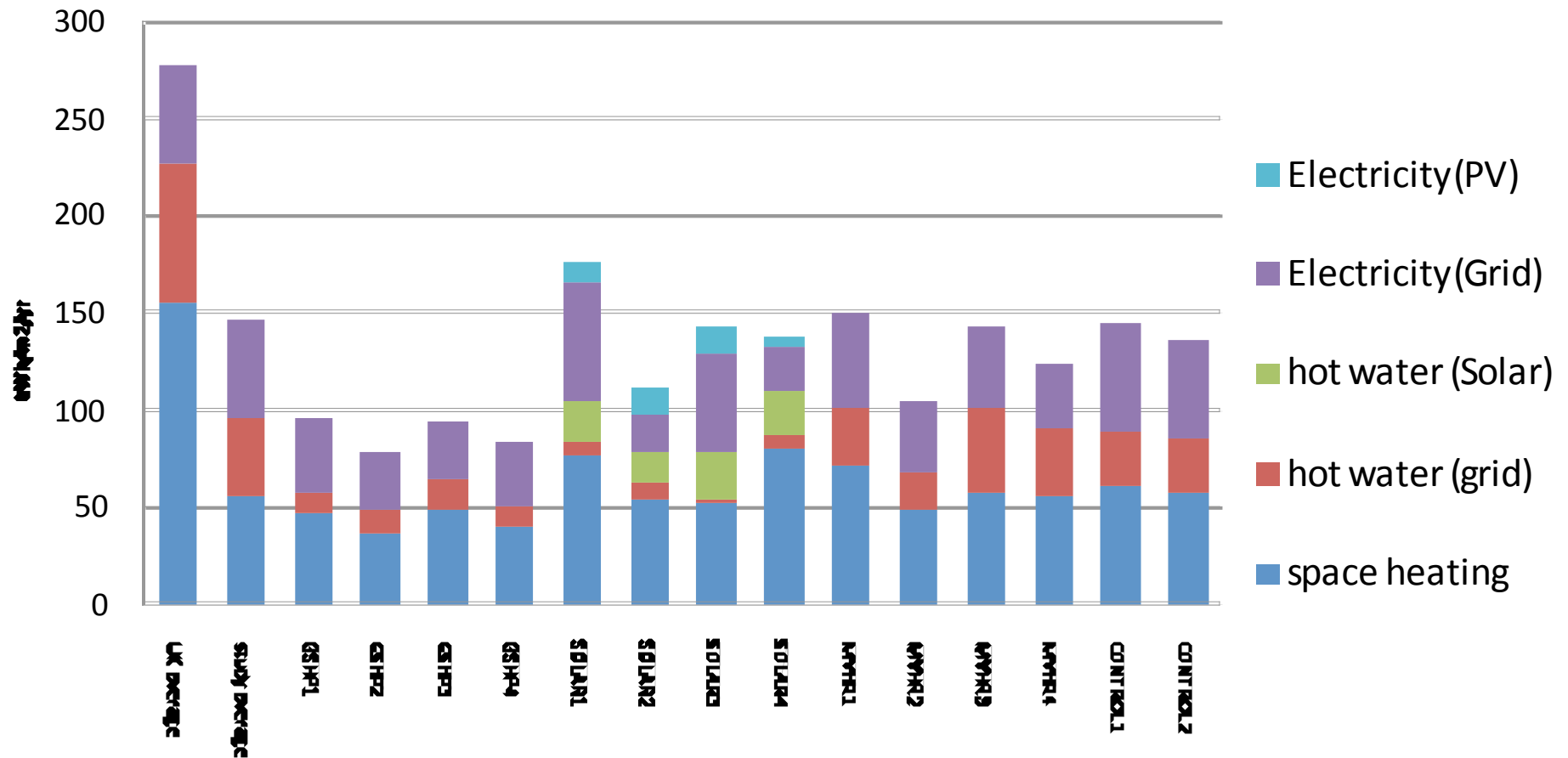
Results: energy usage

- Saving in space heating and hot water
- No difference in electricity usage
- No real difference in occupant behaviour observed
- Householders installed their own appliances



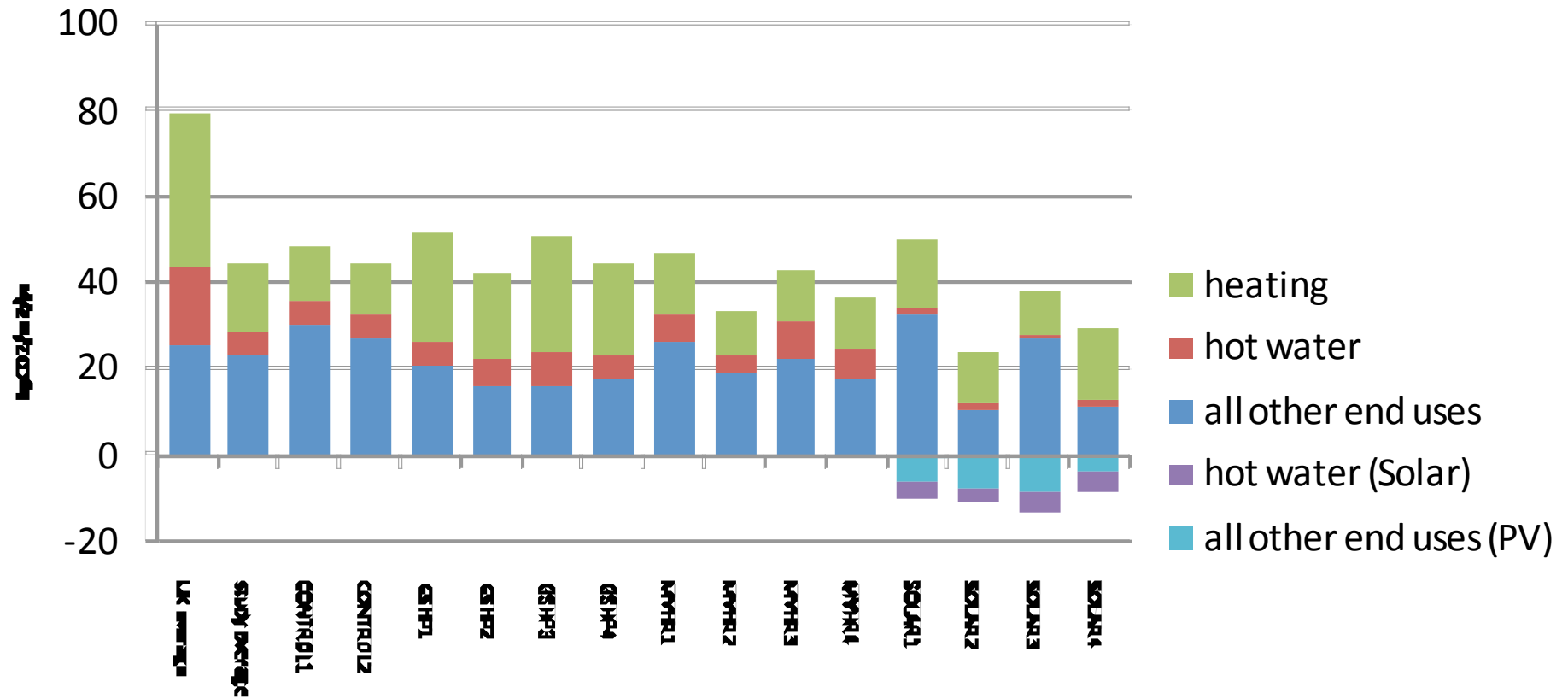
Total annual energy by end use.

Includes solar contribution.

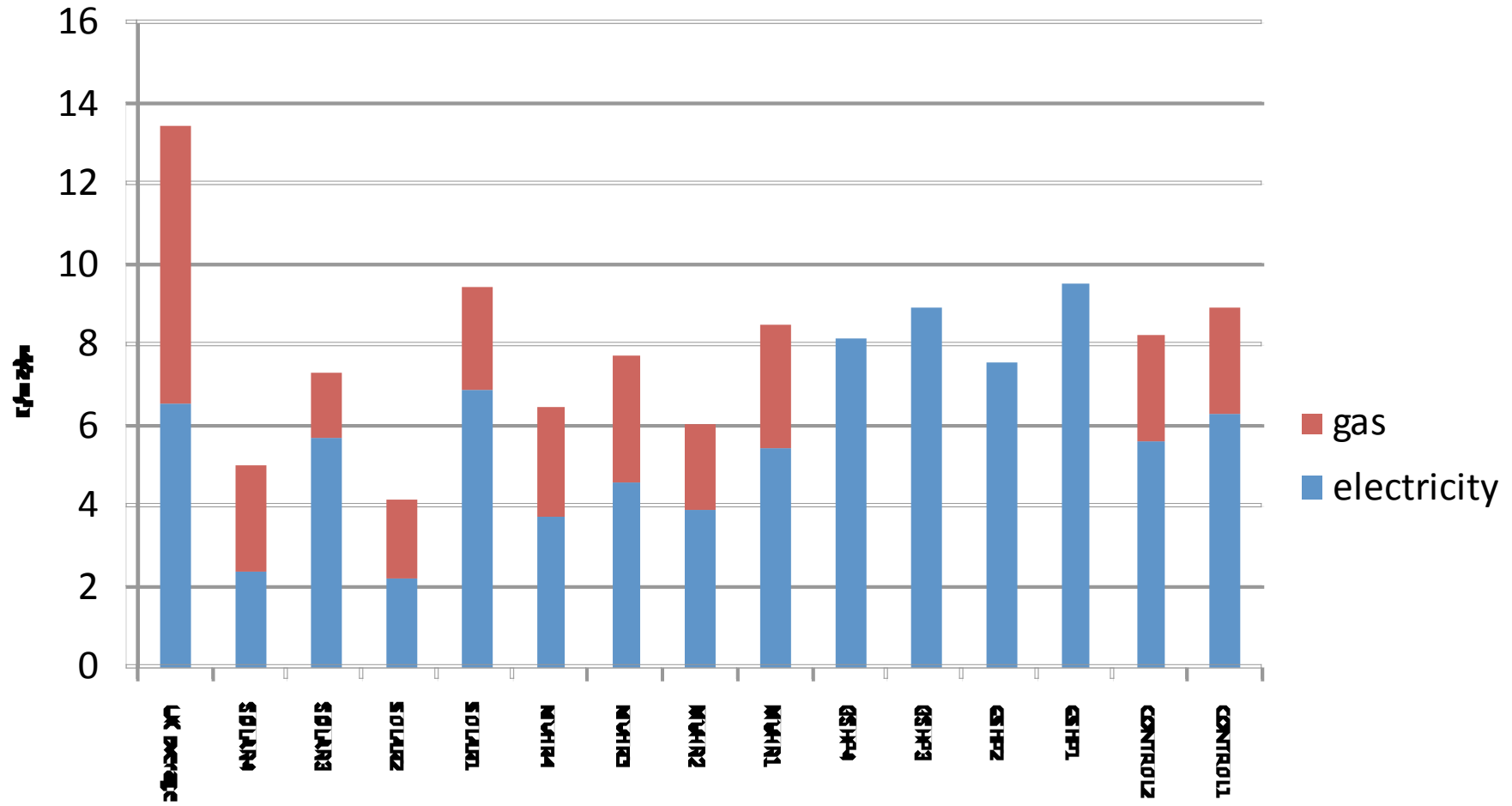


Total annual carbon emissions by end use

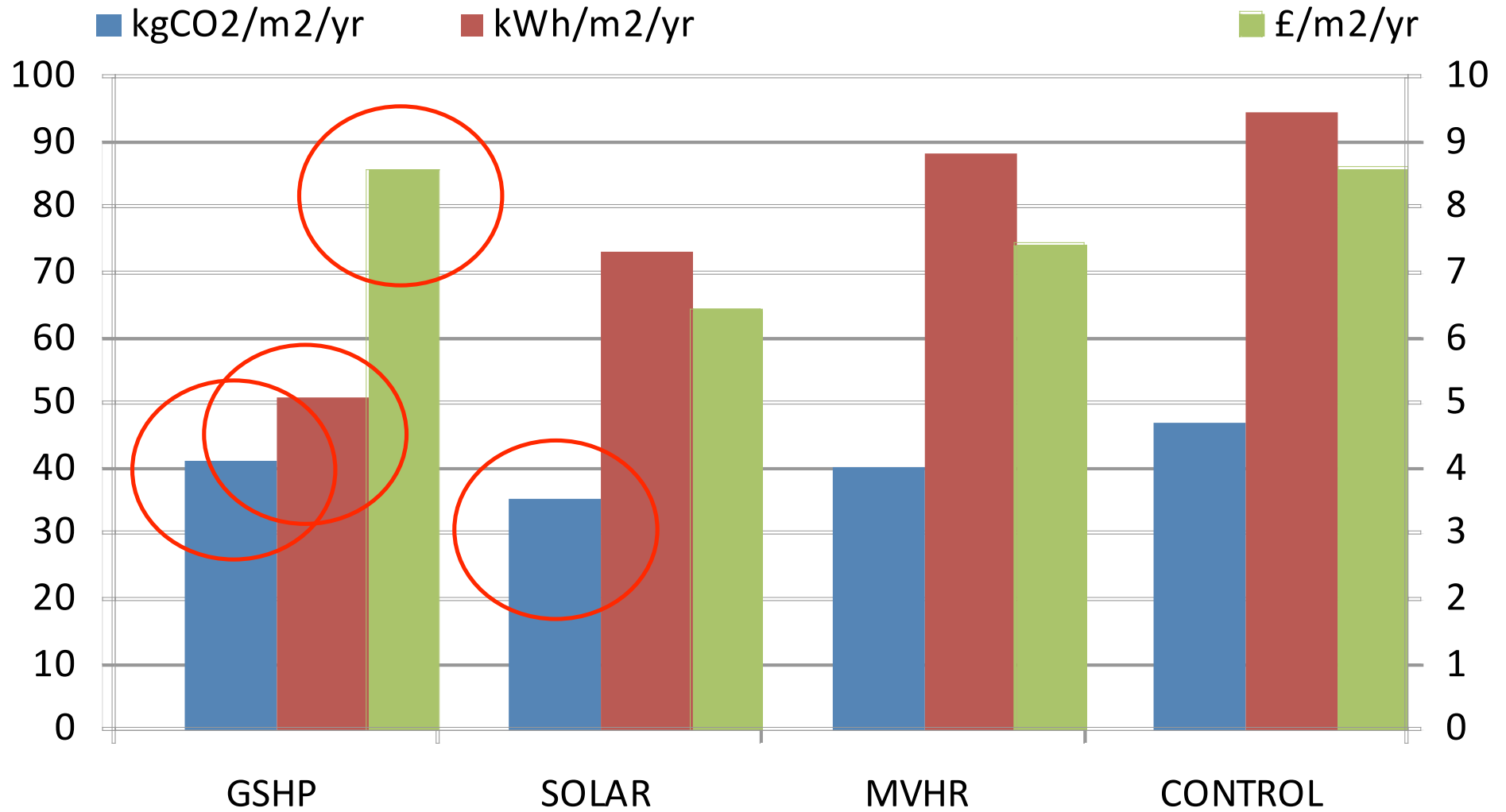
Solar contribution shown as offset



Running cost



Comparison of results



Household behaviour

When asked about the solar hot water systems:

“Once the heating is off we haven’t used the gas. The solar is enough for washing up, baths and showers. Which is great.”

“ If I know there’s no hot water in the morning I’ll wait until later when the solars heated up enough. We just go with the flow now.”

Household behaviour

When asked about what difference having PV has made:

“Now I will do my washing during the day. I’ve got a timer on my machine so what I do is set it if I’m going out in the morning. And occasionally, I’ll even do the ironing during daylight”

Misuse of technologies

- GSHP – under floor heating & carpets
- MVHR households disabled ventilation system
- Sunspace used for:
 - Cloakroom
 - Laundry drying space
 - Home gym
 - Home office
 - Utility room
 - Smoking room
 - Children's play area
 - Dogs room
 - Indoor garden

Household behaviour

“I think it’s pure luxury... It’s like when it was snowy I was walking around in shorts and tee shirt in here because it was so warm and nice. It was lovely.”

Lessons learnt

- Lack of knowledge in support staff
 - Training essential
- Lack of accessible information to householders on using new technologies
 - Improvements in information packs
- Inappropriate metering arrangements
 - Dual meters not single for all electric homes
 - Net metering arrangements for PV

Questions?

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