From an E to a B - A Victorian House Refurbishment

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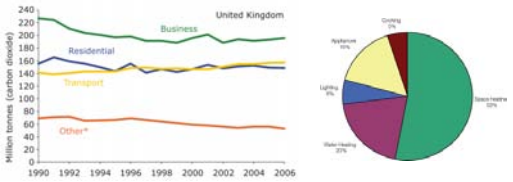
Background

- Housing is responsible for ~ 27% of CO_2 eq. emissions



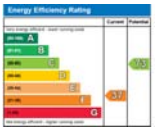
Background

The 40% house report (www.40percent.org.uk);

- Residential emission reduction by 60% by 2050
- 2/3 of housing stock of 2050 is already built!
- Therefore renovation of existing housing stock to a high standard
- Average space heating target of 9000kWh for homes built before 1996 (down from 14600kWh)
- Average space heating target of 6800kWh overall
- No of solid walled (problem!) houses 7 million

Energy Performance Certificates

- Derived from SAP (Standard Assessment Procedure)
- Average UK performance is a D
- House performance was an E
- House now achieves a B



The House Pre-refurbishment

- Built 1865-1870, 3 storeys high
- Solid wall construction – Brick with cement render
- Double glazing – Poor quality
- Poorly fitting or missing doors
- Condensing boiler
- Poorly insulated hot water tank
- 75mm thick loft insulation
- Draughty

Hierarchy of Works

- Reduce energy consumption
- Alternative energy sources
- Use low environmental impact products where possible
- Increase comfort
- Do everything in one go (Room in the roof)

Typical Space Heat Losses

•Walls
Roof
Windows and doors
Floor

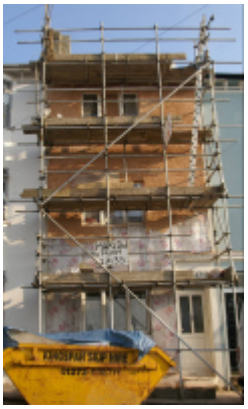
Walls – External Insulation

- External insulation chosen so as not to reduce internal space, thermal mass and reduce thermal bridging
- Minimum thickness to reduce likelihood of planning rejection
- No issues of damp from outside
- Unknown damp proof course
- Brick not bungaroosh / bungarouch(e)

Walls

Front; (U value <0.26)
- 80mm thick Celotex
- Stainless steel mesh
- Haired lime render
- Lime and tallow wash

Rear: (U value <0.26);
- 100mm thick Celotex
- Stainless steel mesh
- Cement render
- Masonry paint



Windows

- Wooden tilt-and-turn double glazing with average U value of 1.5
- New front and rear wooden doors
- Trickle vents fitted to all windows

Ground Floor

- Existing concrete floor
- Cork underlay
- Composite cork and wood fibre board laminate flooring

Alternative Energy Sources

Solar water heating;
- Oversized system for longer heating season (30 vacuum tubes, 250litre tank)
- Unvented system

Wood burning stove
- 5kW output
- Smokeless Zone compliant

Room in the roof

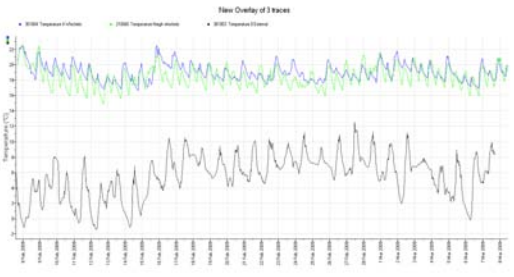
Sloping roof;
- 150mm Celotex
- Gypsum plaster board
- Gypsum plaster

Flat roof;
- 150mm Sheep wool
- Heraklith board
- Lime plaster

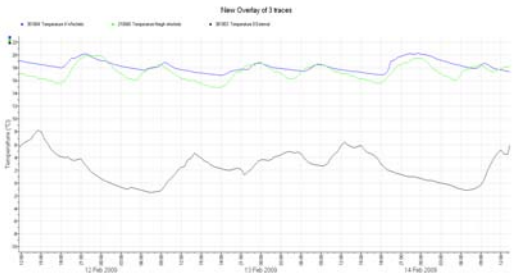
Floor;
- 200mm Warmcel,
- FSC pine floor boards

Baa!

Energy Comparison – February



Energy Comparison - 2 Days



Energy Comparison - Figures

Gas use during trial period;

- Refurbished house 4.5 m3 gas/day (49 kWh/d)
- Unrefurbished house 9.5 m3 gas/day (104 kWh/d)
- Wood stove equivalent to 1m3 gas/day (11 kWh/d)
- Gas reduction 57% per house, 68% per person
- Space heating reduction 47%, 61% per person
- Total annual gas usage 8800 kWh/PA (>50% less)
- Est. annual gas use for space heating 7000 kWh
- Hot water heated by solar only since

Additional Features

- 2 Low water use toilets (2.5/4.5 and 4.5l)
- Flat roofs built to take green roofs
- AAA rated appliances where possible
- Insulation between other floors (75mm+ warmcel)
- New fire doors throughout
- Environmentally friendly paints and oils

Payback

Financial;

- £30000+ cost of environmental improvements
- Energy prices and interest rates fluctuating
- Saving £300 / annum on gas at present day cost
- Some resale value
- How do you price comfort!

Carbon; (very approximate!!)

- Solar thermal - <1 year
- Insulation 2-3 years

Thermal Comfort – Before

Summer;

- Cool throughout the house

Winter;

- Heating struggled to maintain temperature
- Damp on some walls from condensation
- House cooled rapidly
- Cold external walls - reduced usable internal space

Thermal Comfort - After

Winter;

- Comfortable temperature throughout the house
- Minimum temperature 16 degrees C
- All floor space usable
- Damp patches eradicated
- Not draughty

Summer;

- Expected to be cool on the ground floor
- Shading of upper floors to prevent overheating

A work in Progress

- Curtains and blinds to be properly fitted
- Small greenhouse for buffer space / solar drying
- Lagging of pipes under floors
- More accurate control of heating system
- Perhaps 20% more to be saved on space heating

Conclusion

- Space and water heating reduction >50%
- Further reduction >60% next year?
- The aspiration of the 40% house report can be met today for “problem” houses
- Financial payback is misleading
- Carbon payback is rapid 2-3 years
- Every house is different!
- Socioeconomic impact - Local jobs, fuel poverty
- Just do it!

Acknowledgements

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