

Superhome No 83: 25 Palliser Road, HP8 4DL -

Introduction - our bungalow 'eco-retrofit'

History: 3 bedroom bungalow, built 1960s, extended 1980s, sun room extension + eco-retrofit, summer 2008 (except where stated)

Space: heated living space 126m². Houses 2 people (occasionally 3).

Starting point:

- old gas (65% efficient) non-condensing boiler for heating (radiators + foil + control valves) & hot water;
- 1950s cavity wall insulation, double glazing, reasonable loft insulation.

Carbon reduction: our 'baseline' starting point on CO₂ for heat, power, water - was 7.4 tCO₂/year, or 59kgCO₂/m²/year; our finish point was 1.4 tCO₂/year (0.5, counting Good Energy power as zero carbon), or 11 (4) kgCO₂/m²/year.

Summary and lessons learnt

- There are 'low hanging fruit' actions relevant to all properties: loft & cavity wall insulation, low energy light bulbs, probably double glazing, maybe floor insulation..
- After that the best choice of actions depends on your objectives: less CO₂, get off fossil fuels, less running cost, more comfort?
- And, for the *renewables heating/insulation choices particularly*: it depends on your property details, your starting point, and your £ to invest
- The *sequence and total target* of investment matters - do it in order of best 'bang for the buck'. This tells you the right point to *switch* from investing in *insulation* – using less energy – to *renewables* – non fossil fuel, low carbon energy
- Take other factors into account too - disruption, maintenance, cleaning, do you want 'fit and forget' or not.
- It's fun doing it (mostly!) and very satisfying when you've done it ... and has not made the house 'hard to run'.

Details – bungalow eco-retrofit 2008 [and 2003, 2005]

Biomass (wood pellet) boiler: all heating, via radiators + hot water. Runs at 10 kw; ~3-3.5t/yr pellets. Runs 7 months of year. 3t hopper in shed, deliveries 2 x per yr.

Low Energy bulbs & fittings, throughout;
Result: annual saving 730 kWh electricity.

Solar Thermal (east & west), 12 + 12 evacuated tubes. (2005). Does all HW for 5 summer months. Yields ~ 1000kwh/yr



Rain water harvesting: 110m² roof area; 3,300 litre tank. Yields ~ 12,000 litre/yr

Passive solar sun room, 5m x 4.5m. Washing, drying, plants, gardening; some heat input into house ventilation system.

Solar PV: 2.4 kW peak, 20 panels, 2 DC>AC inverters (2003). Yields ~ 2000 kwh/yr

Extra insulation, – extra in loft, roof, dormers, garage - house walls, front door. Plus **Sealed ventilation** – to 8.6 m³/m²-hr, draughts sealing, MVHR ventilation system. Saved ~15% of heat energy; good comfort, no condensation

Utility use, costs and CO₂ - 1/10/12 - 1/10/13, but at 2013 prices +comparison [bottom of table] with 2007-8 pre-retrofit

Utility:	Heat & HW; Wood Pellets (Tonnes)	HW: Solar Thermal (kWh)	Mains electricity (kWh)	Solar PV electricity (kWh)	Gas (hob) (kWh)	Mains Water (cu. m)	Rain Water (cu. m)	TOTAL cost/year		Comments
								Electricity Heat, HW	Plus Water	
Annual Quantities, from 1/10/12 - 1/10/13										
Used per year:	3.75 [18,000kwh]	473 [more?]	1991	1952	200	54.7	8	NA	NA	Total electricity: 3943 kwh Total Heat/HW: 18673 kwh
Annual Costs (at 2013 rates - £)										
'Day' cost:	0	0	55	0	78	85	0	NA	NA	Daily standing charges
Quantity rate:	205/tonne	Free!	14p/kWh	Free!	3.959p/kWh	1.7£/m ³	Free!*	NA	NA	*RWH pump is in 'electricity'
Quantity cost: £	769	0	279		8	93	0	1056	1149	
Total Cost inc 5% VAT	807 (inc. VAT)	0	351 (inc VAT)	0	90 (incVAT)	178	0	1248	1426	Not counting subsidies
Less Subsidies:		139[HotROC]		222 [FIT]				361	361	Govt. FIT & HotROC
Utility 'Net' cost:	807	-139	351	-222	90	178	25	887	1065	For Total of 22,616 kwh
+Home maintenance	80	25	0	25	0	0	25	130	155	Work done in the house
Utility Net cost + Maint	887	-114	351	-197	90	178	25	1017	1220	Actual av. total cost/year
Annual CO₂ emissions (kg) [** This is if it was average mains electricity. (this is actual with Good Energy's 100% renewables = 0) Saves 0,89 T CO₂)										
Kg CO ₂ : [emission factor]	450 [0.025kg/kwh]	0	887** (0) [0.445kg/kwh]	0	37 [0.184 kg/kwh]	37 [0.684 kg/m ³]	0*	1.374 T/yr (0.487)	1.411 (0.524)	If av. mains electricity (actual: GE renewables)
NUMBERS after ECO-RETROFITTING, and SAVINGS MADE (Excl. water): 'Before' = 2007-8 use; 'After' is 2012-3 use; both at 2013 prices.										
Per year:	NET ENERGY COST			TOTAL ENERGY USE			TOTAL CO ₂ EMISSIONS			Notes: * The 3 bedroom bungalow has 126m ² of heated space [plus 20m ² of unheated 'sun room' - not counted in this calc.], and houses 2 people. () = CO ₂ if counting actual use of Good Energy renewable power supply**.
	Total £	£/m ²⁺	£/ person	kWh	kWh/m ²⁺	kWh/ person	Tonnes CO ₂	kgCO ₂ /m ²⁺	TonnesCO ₂ / person	
Before:	1968	15.6	934	27240	216	108	7.4	59	3.70	
After:	1017	8.1	519	22616	181	91	1.37 (0.49)	10.9 (3.9)	0.69 (0.25)	
Saving (& %):	912	= 45%		4624	= 17%		6.03 (7.51)	= 82% (93%)		

Comparison of actions – other factors beyond CO₂, kWh and £ costs

Action:	Solar PV electricity	Solar Thermal H Water	Wood Pellet Boiler	Low Energy Lights	Rainwater harvesting	Insulate (beyond the basic)	MVHR, air sealing
Installation disruption?	Low - nearly all external	Medium - internal plumbing	High - internal installation and plumbing	V. Low - all DIY	Medium - dig hole, some plumbing	High, work inside likely	High, ducts to install, raise carpets
Extra electrical on-costs likely?	No	Small pump	Small fan, pump, igniter	No	Small pump	No	Small fan, but 24/7 running
'Fit & forget' - controls?	Yes: no controls	Quite: auto-control	Quite: choose auto or manual filling	Yes - no controls	Quite - auto controls	Yes	Quite -
Yearly maintenance, repairs?	Clean panels. Inverters may need work in ~ 5 yrs?	Clean tubes. Controls & pumps need 5 yr check?	Annual check and clean, ash disposal. May need 2 yr check?	None - very long life	Clean filters Controls & pump need 5 yr check?	None	Clean heat exchanger and filter
Free from fuel supply & cost?	Yes	Yes	No, but pellets costs rise less than gas, oil	Yes	Yes	Reduces it	Reduces it
Adds comfort?	NA	NA	NA	NA	NA	Yes - warmth	Yes - free of condensation

In hindsight - what would we do differently, if we had known..

Insulation and MVHR:

- The thermograph photo actually showed that the main roof was not bad; but windows were poor: *so still do dormers, but then look at triple glazing windows, floor insulation, not the sloping roof?*
- The MVHR has been worth it for comfort ; and helps us close down the Wood Pellet Boiler [WPB] heating for maybe 1 - 2 months longer – *but we now don't run it 24/7 in summer, opening windows and turning it off. Latest regulations require less air changes per hr, and newer versions can also have [even] more efficient fans. Make the lowest possible noise and energy use a big specification demand.*

Renewable energy generation:

- If going 'wood-burning' think very hard about auto or manual – if auto, *what space and road access for bulk hopper and filling?*
- Heating alternatives (remember we started with a hot water radiator system - this constrains the options): *look at air source heat pump (we had no space for ground source), maybe with a new condensing gas boiler for coldest month. Also, consider Sterling engine CHP.*
- Low Energy Lights are great - would now go all LEDs. So is Solar PV. *But might not have done solar thermal, if we had installed renewable heat (like the WPB) first. However, having the solar thermal stops us having to run the wood pellet boiler in-inefficiently, just for hot water, during 5 summer months*

Judy and Charles Ainger. March 2013/December 2014