

Exploring retrofit options on a 1930s home



Stuart Dyer
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@cswd

Exploring retrofit options on 1930s home

- ▶ Extending & retrofitting 1930s detached home
 - ▶ Currently cold & some damp issues
- ▶ Want to answer questions such as:
 - ▶ Where should I concentrate my effort - best return on expenditure?
 - ▶ What should I insulate (loft, walls, floors?)
 - ▶ What should I spend on windows vs other options?

Passive House Planning Package (PHPP)

- ▶ Great big spreadsheet developed & improved over 20+ years covering:
 - ▶ U-values of 'components' e.g. walls, loft, floors etc.
 - ▶ Heating
 - ▶ Ventilation
 - ▶ Windows
 - ▶ Shading...
- ▶ Models the house, predicts performance

The screenshot shows the PHPP software interface with the 'U-value of building assemblies' calculation for a rendered masonry wall. The software title bar indicates the file is '174.01 PHPP OPT3 BASE FILE 2018.10.08 PHribbonSpaceHeat rev2018.11.27 EnerPHit BASE LOCKED 240219.xlsm' and the user is 'Stuart Dyer'. The ribbon includes 'File', 'Home', 'Insert', 'Page Layout', 'Formulas', 'Data', 'Review', 'View', 'Help', and 'PDF Architect 6 Creator'. The active cell is L20, containing the formula '=EWI'. The main window displays the 'U-value of building assemblies' calculation for a 'rendered masonry wall' (Assembly no. 01ud). The calculation is for a 'Residence / Climate: Fairfield / TFA: 212 m² / Heating: 24.3 kWh/(m²a) / Freq. overheating: 7 % / PER: 72.5 kWh/(m²a)'. The secondary calculation is for 'Equivalent thermal conductivity of still air spaces'. The assembly description is 'rendered masonry wall' with interior insulation. The orientation is '2-Wall' and adjacent to '1-Outdoor air'. The heat transmission resistance is 0.13 m²K/W for the interior and 0.04 m²K/W for the exterior. The assembly is composed of three sections: plaster (0.250 W/(mK), 15 mm thickness), brick (0.560 W/(mK), 215 mm thickness), and render (0.150 W/(mK), 35 mm thickness). The total thickness is 38.1 cm. The U-value is 0.1500 W/(m²K). The software also shows a table for 'Area section' and 'Percentage of sec.' for each section. The bottom status bar shows 'WARM RESULTS 606' and various tabs like 'Costs', 'Verification', 'Variants', 'Climate', 'U-Values', 'Areas', 'Ground', 'Components', 'Windows', 'Shading', 'Ventilation', and 'Heating'.

Area section	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
plaster	0.250					15
brick	0.560					215
render	0.150					35
EWI	0.020					116.4

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			38.1 cm

Passive House Planning Package (PHPP)

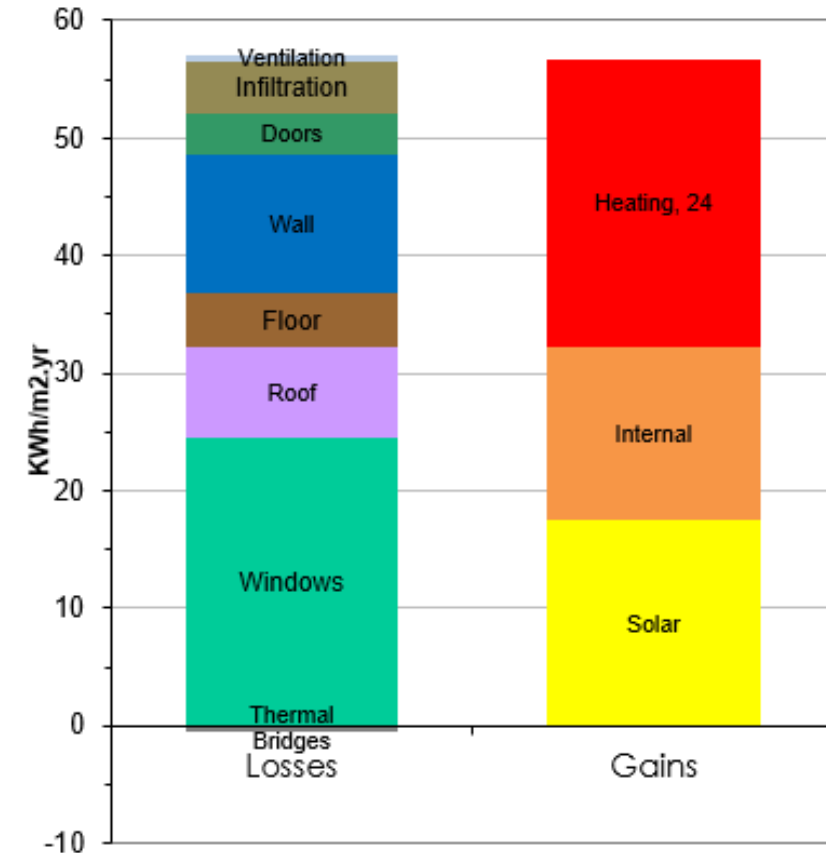
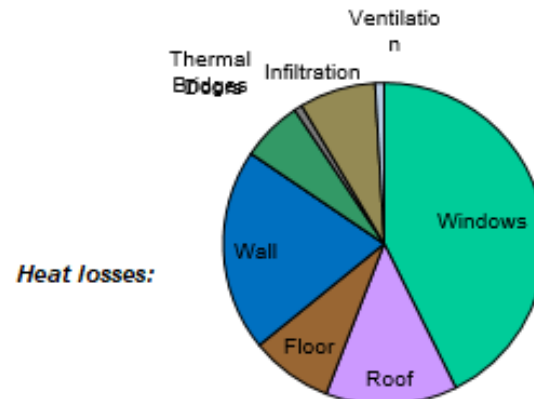
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WARM PHPP Results Sheet - Main Results

Treated floor area: 212 m²

Monthly Method Heat Balance - kWh/(m².yr)

	Losses	Gains
Windows	24.5	
Roof	7.6	
Floor	4.8	
Wall	11.7	
	0.0	
Doors	3.5	
Thermal Brid	-0.5	
Infiltration	4.4	
Ventilation	0.5	
Solar		17.5
Internal		14.9
Heating		24.3
Totals	56.6	56.6

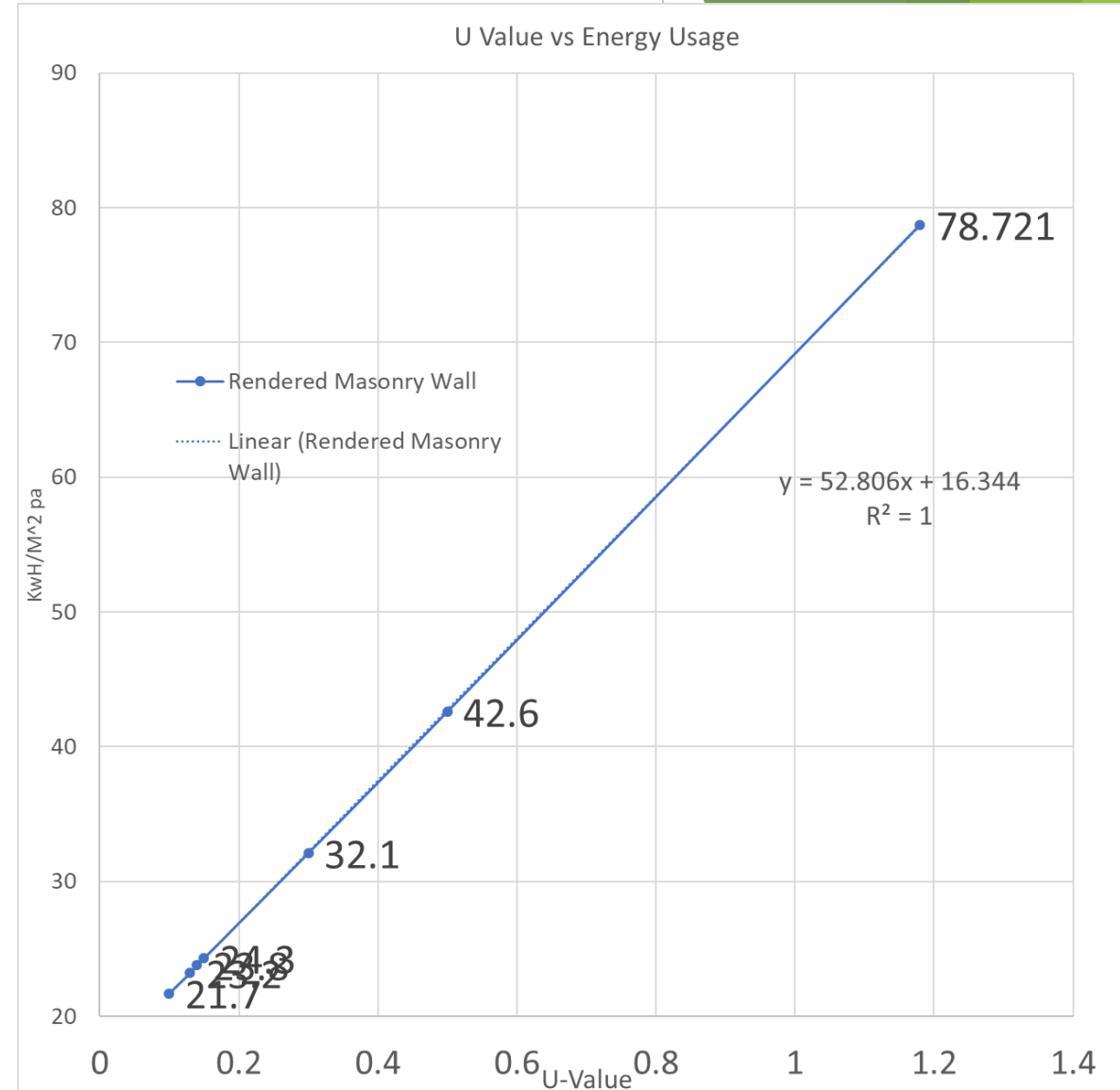


PHPP component EnerPHit values

1. EnerPHit requires certain criteria are met:
 1. Space heat demand $<25 \text{ kWh/m}^2\text{.a}$
 2. Airtightness normally 0.6 ach
 3. Proof moisture management issues have been adequately addressed
 2. If $25 \text{ kWh/m}^2\text{.a}$ is exceeded then they recommend U-values:
 - ▶ Walls EWI U values below $0.15 \text{ W/m}^2\text{K}$ ($>75\%$ of wall area)
 - ▶ Roofs / top floor ceiling - $U \leq 0.12$
 - ▶ Windows - installed whole windows $U \leq 0.85$ etc
- ▶ Use numbers in (2) as default U-values and explore effect of changes from there

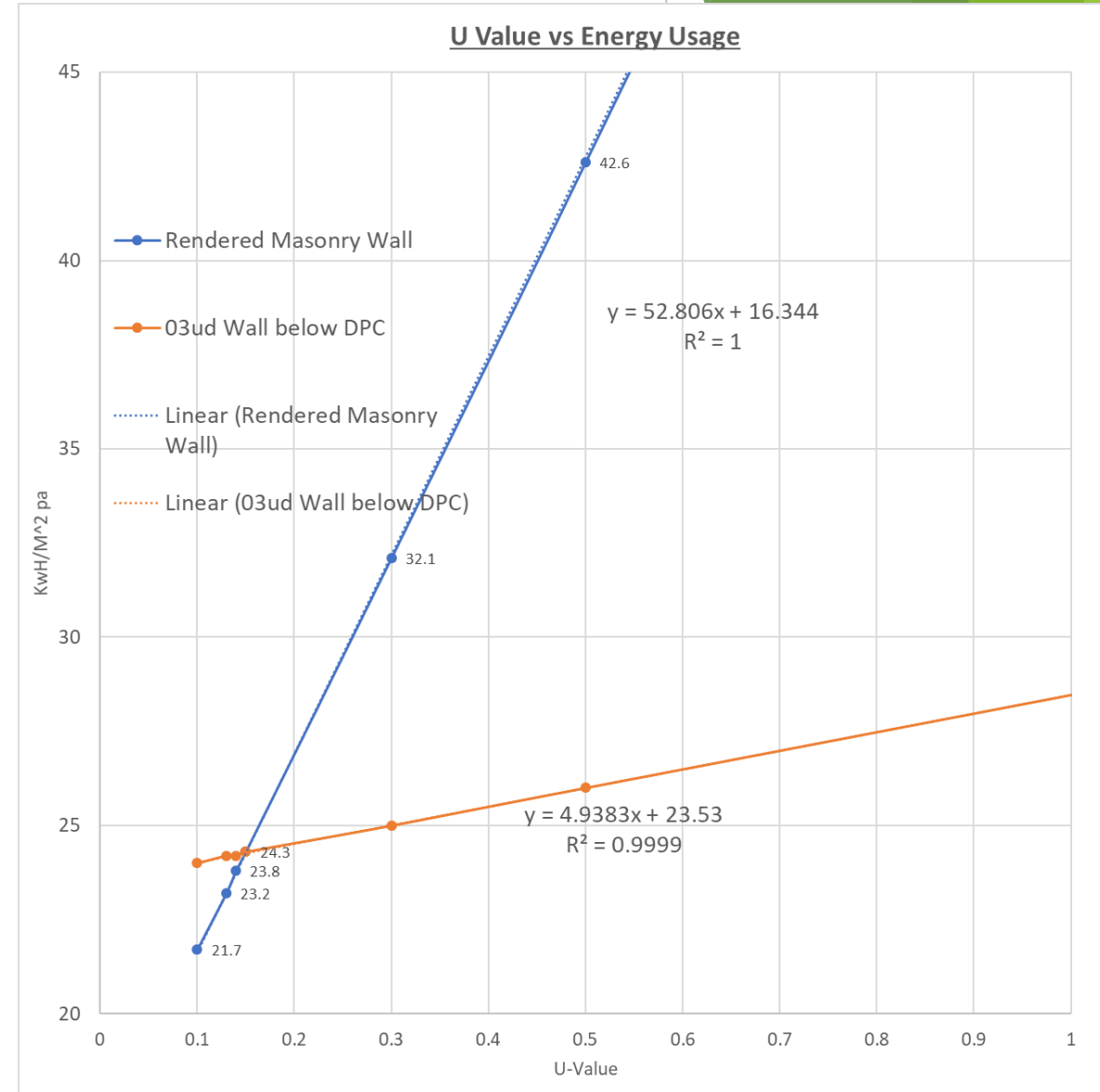
Vary each component individually around EnerPHit 'default' value

- ▶ Pick 1st component, vary U-value
- ▶ **Rendered Masonry Wall**: Test at U-value of :
 - ▶ 0.239, 0.15, 0.12, 0.11, 0.1
 - ▶ Bold & underlined number = default EnerPHit value
- ▶ Take readings of kWh/m² pa & Overheating at different U-values
- ▶ Plot on graph & get equation



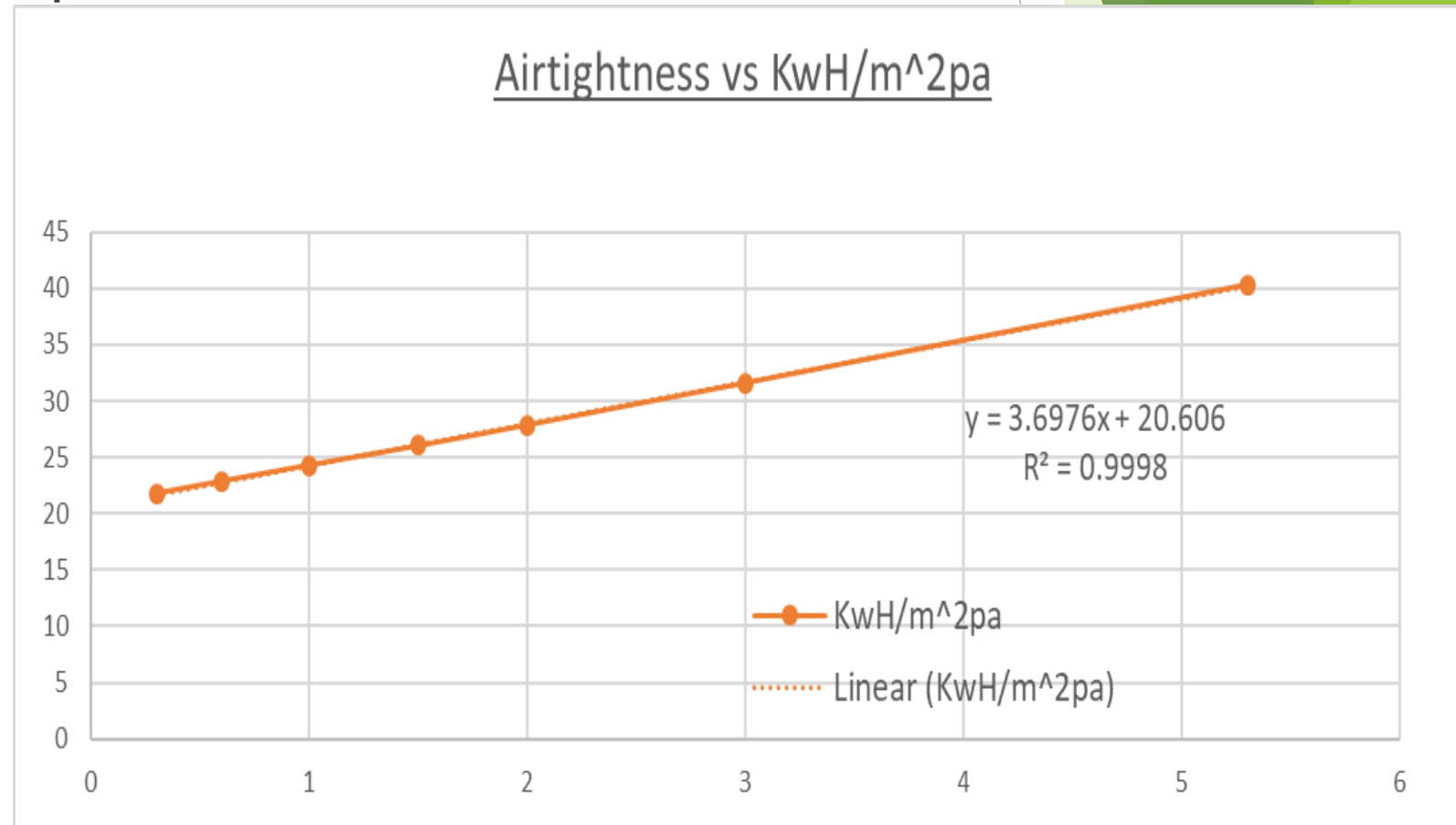
Vary each component individually around EnerPHit

- ▶ Repeat for other components:
- ▶ 03ud Wall below DPC: Test at U-value of :
 - ▶ 1.553, 0.5, 0.3, 0.15, 0.14, 0.13, 0.1
- ▶ Take readings of kWh/m² pa & Overheating
- ▶ Plot on graph & get equation
- ▶ Tells us:
 - ▶ Each Unit change in U-Value for Wall saves 53 kWh/m²pa
 - ▶ Each Unit change in U-value for Wall below DPC saves only 5kWh/m²pa
 - ▶ The variation is linear



Can also analyse Airtightness

- ▶ Each unit change in Air tightness = 3.7 kWh/m²pa
- ▶ Obviously not directly comparable with unit change in U-value!



Vary each component individually around EnerPHit

- ▶ Repeat for all components
- ▶ Savings:

Component	Saving per Unit Change in U-value
01ud Rendered Masonry Wall	52.8
04ud Clay Tile Pitched Roof	45.8
05ud Suspended Floor	16.9
10ud New Roof	11.1
03ud Wall below DPC	4.94
Air Tightness	3.70*

* = Saving per Unit Change in ACH (not U-value)

Can also use this for prediction

Component	U-value	Effect	Total	
01ud Rendered Masonry Wall	0.15	52.81	7.92	
03ud Wall below DPC	0.15	4.94	0.74	
04ud Clay Tile Pitched Roof	0.12	45.77	5.49	
05ud Suspended Floor	0.15	16.90	2.53	
10ud New Roof	0.12	11.10	1.33	
Air Tightness	1	3.70	3.70	
			<u>21.72</u>	Sub-total
			2.6	Adjust
			<u>24.3</u>	Predicted kWh/m ² pa

What effect would these changes have on energy usage?

Component	U-value (Existing/ as designed)	U-value (EnerPHit)	Savings (kwh/M2pa)	
01ud Rend Masonry Wall	1.18	0.15	54.4	
03ud Wall below DPC	1.553	0.15	6.9	
04ud Clay Tile Pitched Roof	0.239	0.12	5.4	
05ud Suspended Floor	0.244	0.15	1.6	
10ud New Roof	0.219	0.12	1.1	
Air Tightness	5.3	1	15.9*	
			<u>85.4</u>	Total

* = Saving per Unit Change in Air Changes per Hour (not U-value)

Results & next steps

▶ Results:

- ▶ I have worked out the relative importance of each set of options
- ▶ Focus on walls & loft
- ▶ Don't insulate under the Damp Proof Course - lots of effort, little return

▶ What's next?

- ▶ Check practicality of insulation depths (is roof overhang enough?)
- ▶ Try to align with costs? Work out change per £ ?
- ▶ E.g. have window quotes - is it worth spending more on windows or insulation?
- ▶ Work out which materials to use (performance vs cost vs sustainability etc)

The End

The background features abstract, overlapping geometric shapes in various shades of green, ranging from light lime to dark forest green. These shapes are primarily located on the right side of the frame, creating a modern, layered effect against the white background.