Beginner's Guide To Retrofit

Host:

Presenters:

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Derived from a Carbon Co-op presentation:

To Come:

Poll 1: about you

‘**Retrofit in Context**’- Nicola

Q&A

Poll 2: your motivations

‘**Getting Started**’ - Margaret

Q&A

Finish 9pm

Poll 1:

- About you
- What age of retrofit home?

Retrofit in context

- Climate change
  - Decarbonising heating
- Comfort
- General upgrade

Domestic heating and cooking accounts for 60% of natural gas consumption in the UK (excluding powerstations) - or 35% of all gas use.

Open Eco Homes videos: openecohomes.org/video

Peter & Meg’s low-budget retrofit of two 1897 semis

Retrofit is possible...

Insulation
- Walls (inside or out)
- Floors
- Loft/attic

Air tightness and ventilation

Windows and doors

Heating systems
- Boiler upgrade or heat pump
- Radiators/underfloor heating

Solar panels/battery

Whole house approach takes into account shape and materials for best results without undesirable side effects.

Plan stages to fit your needs and opportunities and avoid wasted effort

Internal wall insulation

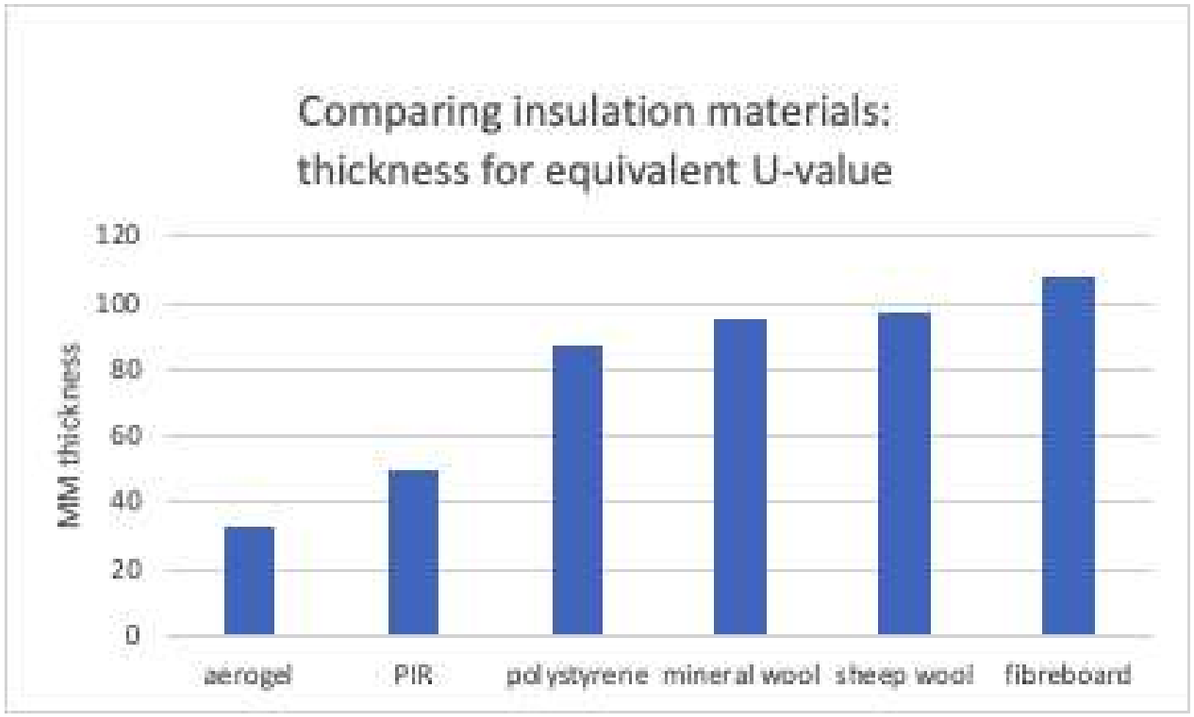
- Messy and disruptive
- Fiddly
  - Windows and doors
  - Radiators and electrical sockets
  - DIY possible
- Combine with redecoration work

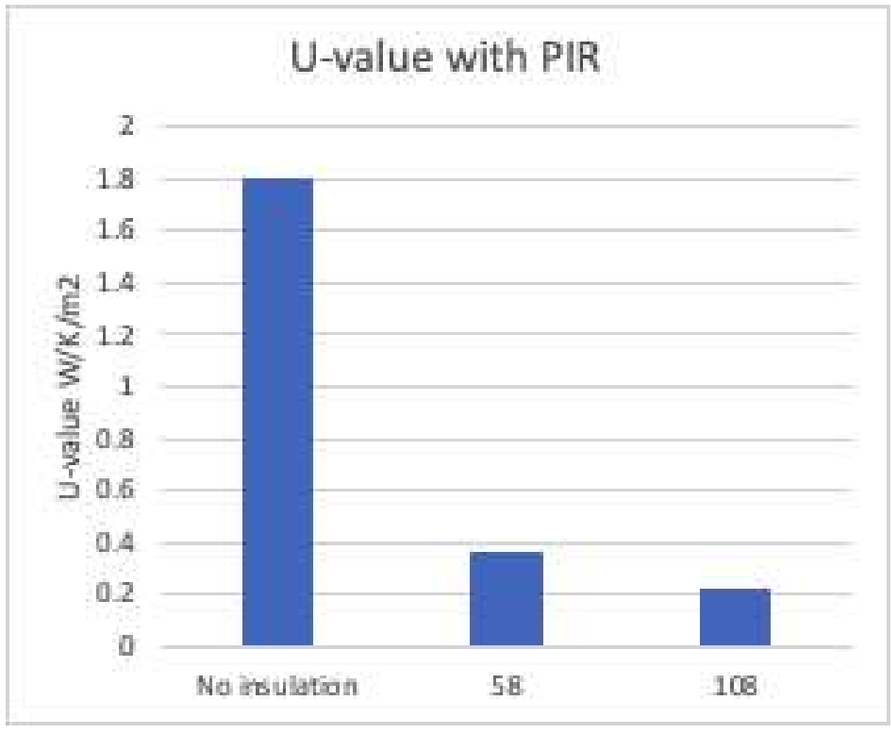
Insulation: how thick does it need to be?

Different materials have different properties: thermal resistance, vapour permeability, effect of liquid water.

Diminishing returns - but hard to add more later.

What is your ambition?





External Wall Insulation:
Fiddly downpipes and penetrations, extending roof overhangs
But you do not have to vacate rooms to do it

EWI results

You can do this even in a terrace, if you can get planning permission.

Can mix internal and external.

Decarbonising your heating:
Air source heat pump
Hot water cylinder

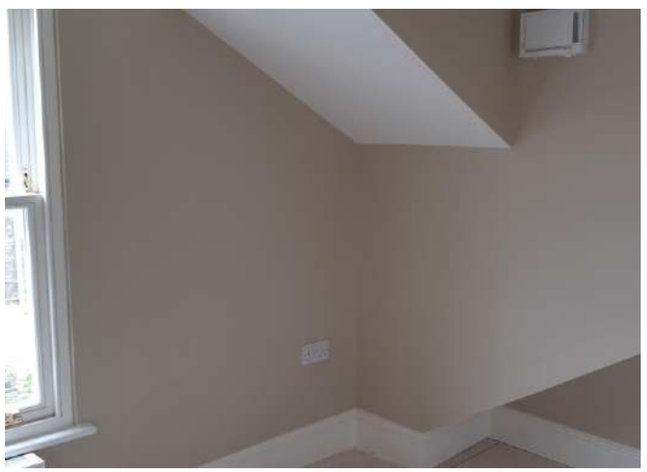
Ventilation

Draughts bad, ventilation good - control!

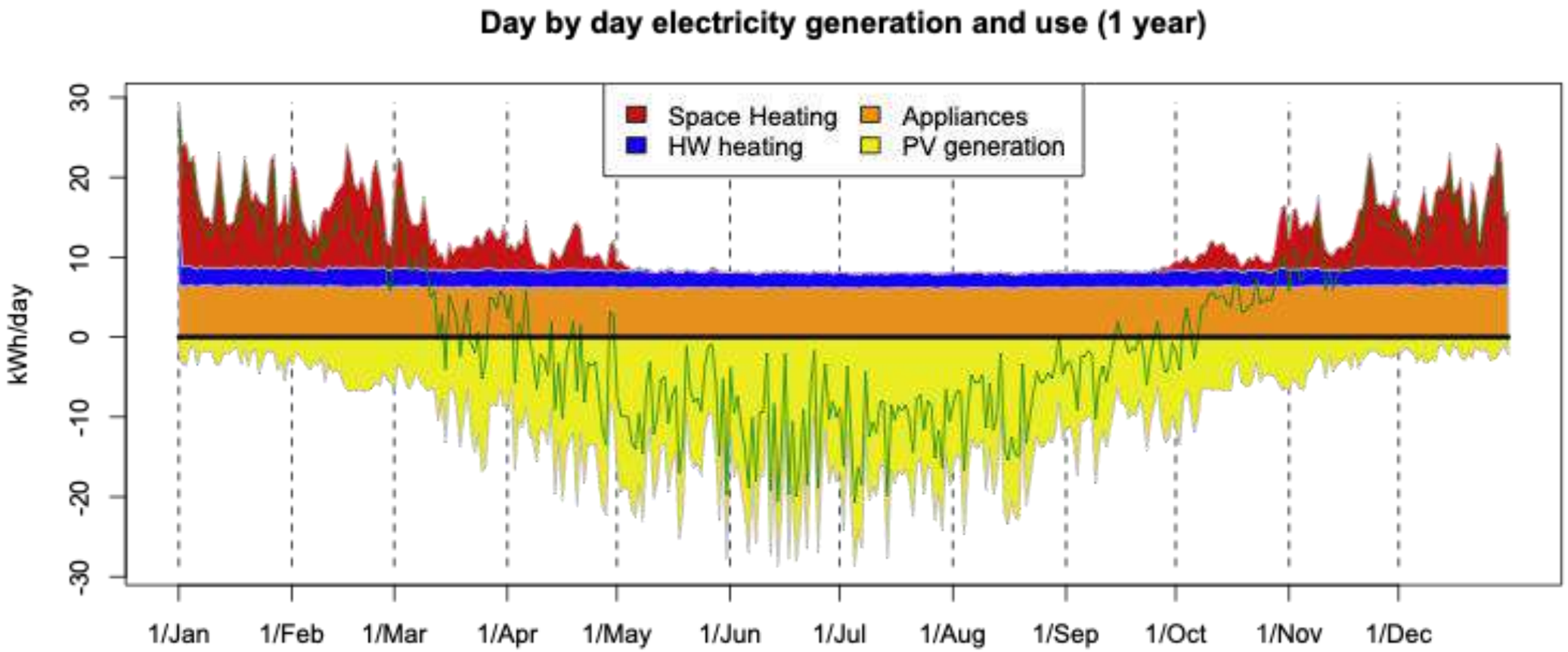
Avoid condensation and indoor air pollutants!

Choices:

- Wall units/Whole house
- Demand controlled/All the time
- Mechanical/passive
- With/without heat recovery
- Filters



Add PV to make a net zero home

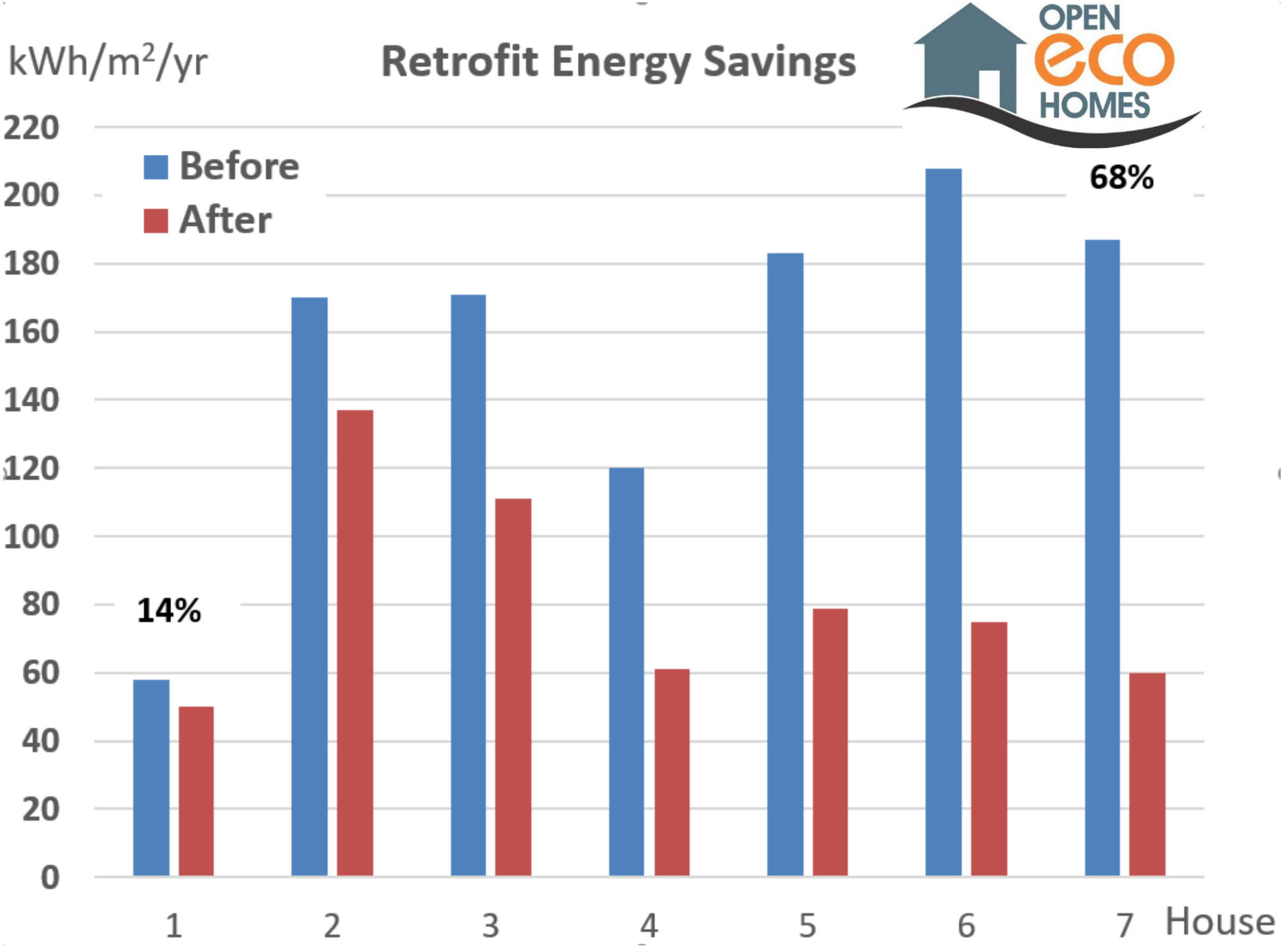


Adding Solar Panels, lots of insulation home and an efficient heat pump can achieve net zero over the year. Net zero day by day is much harder.

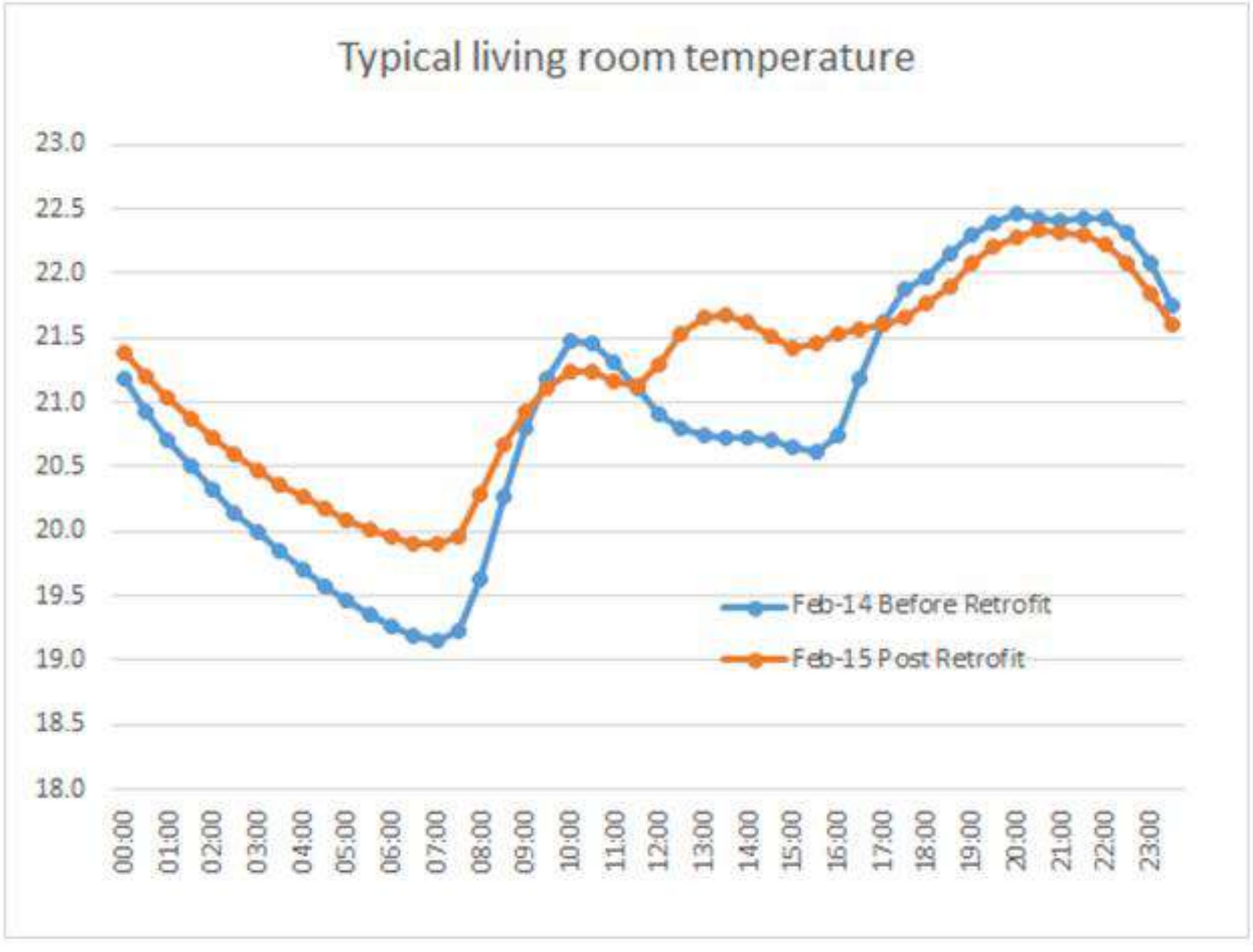
Modelled electricity use and PV generation by day over a year for a well insulated house with a 4.2 kWp array and heating from a heat pump with nominal SPF 4.0.

Over the year: 3800 kWh generated; 2290 kWh for lighting and appliances, 760 kWh for hot water heating and 1440 kWh space heating. Net use 590 kWh/year. The heat pump uses 2,200 kWh. An equivalent gas boiler would use 6,400 kWh gas.

Retrofit Energy Savings



The Results


Typical living room temperature
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
18.5
18.0
00:00
01:00
02:00
03:00
04:00
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18:00
19:00
20:00
21:00
22:00
23:00
Feb-14 Before Retrofit
Feb-15 Post Retrofit

What is most important for me?

	Bills	Carbon	Comfort	Air quality
Insulation	X	x	X	
Windows		x	X	
Heat pump		X		
Boiler	X	x		
Air tightness	X	x	X	
Ventilation			X	X
Solar panels		X		

Q&A

Poll 2: What are your priorities?
Top three motivations

Establishing a **Baseline** and **Rates:**

- **Energy use,**
- **Floor area**
- **Costs.**

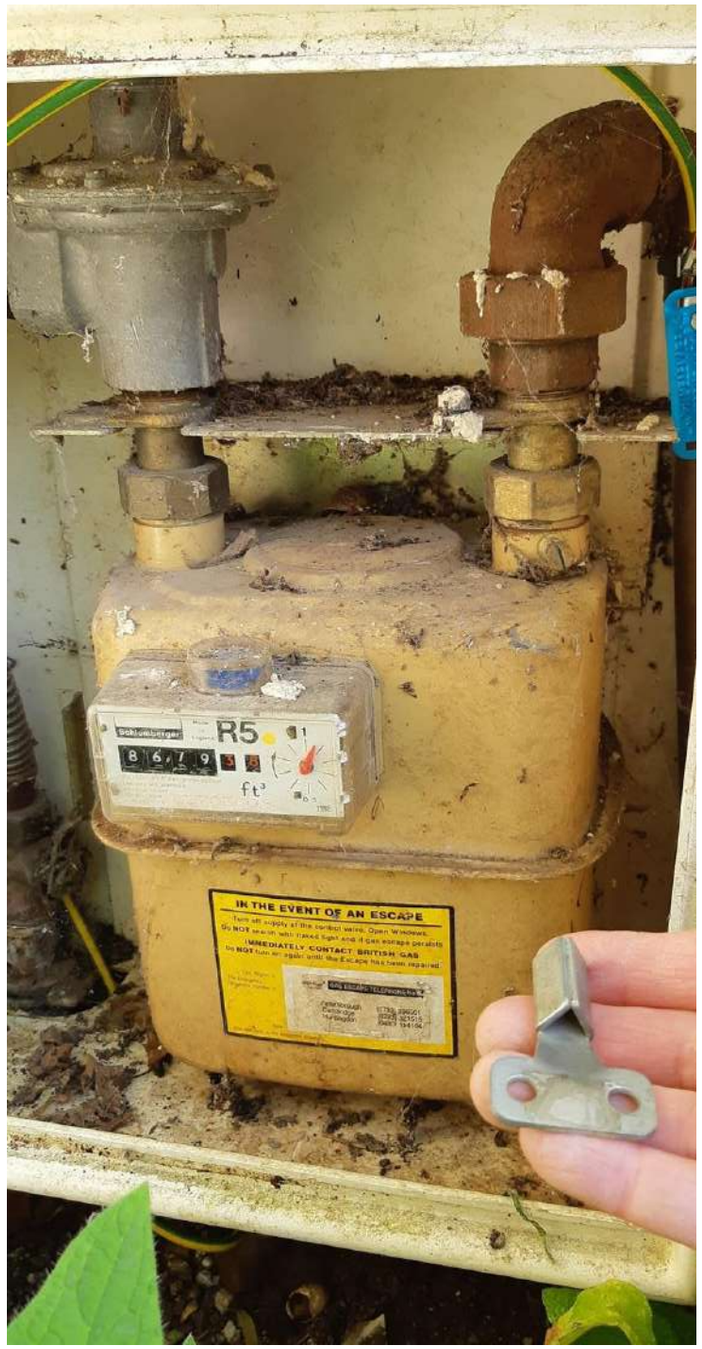
1. How much **ENERGY** do you use now?

•To compare we use a rate:

kWh per **Square Meter of Floor area** per **Year**

Your Energy Usage

1. How much **ENERGY** do you use now?



4 **I'd like more detail**

About your tariff

This information will help you to compare your current tariff with others available.

Your gas tariff

Tariff name	Standard
Payment method	Monthly Variable Direct Debit
Tariff ends on	No end date
Exit fee (if you cancel this tariff before end date)	Not applicable
Annual usage (based on your estimated use in the last 12 months)	17881.24 kWh

To help you find a better deal, you'll need your energy data. Just scan this QR code to download it to your smart phone or tablet. If you don't have a QR code reader, you can download one from the App Store or Google Play.

What you paid – thank you

Total payments £32.67

Your gas use in detail

Meter number: 0270360

2 Sep 2019 - estimated meter reading	8150
30 Sep 2019 - estimated meter reading	8167
Estimated units used over 29 days	17
(Unit calorific value for this period 39.2)	
Gas units converted into kWh	535.72
Cost of gas (535.72 kWh x 3.882p)	£20.80
Standing charge 2 Sep 19 - 30 Sep 19 29 days at 25.257p per day	£7.32
1 Oct 2019 - estimated meter reading at price change	8167
1 Oct 2019 - estimated meter reading at price change	8168
Estimated units used over 1 days	1
(Unit calorific value for this period 39.2)	
Gas units converted into kWh	31.51
Cost of gas (31.51 kWh x 3.448p)	£1.09
Standing charge 1 Oct 19 - 1 Oct 19 1 days at 25.257p per day	£0.25
Total gas used	£29.46
VAT at 5.00 %	£1.47
Total gas including VAT	£30.93
Total	£30.93

Your estimated meter readings.

Gas 8168

How we calculate your gas cost?

Gas is a natural product. One unit does not always produce exactly the same amount of energy. In order to price energy from gas consistently, we convert your units used into kiloWatt hours of energy, using the following formula:

a. imperial units used	See detail 100's Ft³
b. x metric conversion	2.83
c. x calorific value	See detail
d. x volume correction	1.0226400
e. ÷ kWh conversion	3.6
f. = kWh	See detail

How does this compare with last year?

910.82 kWh

2 Sep 2018 - 1 Oct 2018

567.23 kWh

2 Sep 2019 - 1 Oct 2019

Gas Bill

Log utility bills on a spreadsheet - kWh

59 Oxford Road - Gas and Electricity usage																							
Area:		**Sq Ft**	**Sq m**	**Total Sq m**		**Sq Ft**	**Sq m**																
1927 original house		930	86.39																				
1988 extensions		341	31.7																				
				118.09																			
1988 garage						470	43.7																
Renovations (Bathrm Showrm Hall)						108	10																
2004 kitchen extension			4.8																				
2004 loft			48.5																				
Renovations (Utility, Showrm, Kitchen)																							
				171.39																			
Gas usage kWh																							
date	annual kWh	annual £	EPC	kWh/m2/yr	Gas kWh/da	£/day		**Electricity usage kWh**			**Solar photovoltaic generation**			**Total ener**	**Cost**		**Tot incl PV**
														usage kWh			
Oct-07	16582	£ 532.00		96.75	45.43	£ 1.46											
Oct-08	18957	£ 772.00		110.61	51.94	£ 2.11											
Oct-09	17092	£ 496.00		121.63	46.83	£ 1.36		3754	£ 652.00					20846	£ 1,148.00		
Nov-10	15687	£ 594.76		112.45	42.98	£ 1.63		3585	£ 567.00					19272	£ 1,161.76		
Oct-11	15934	£ 537.00		114.76	43.65	£ 1.47		3734	£ 605.00					#REF!	£ 1,142.00		
Oct-12	12795	£ 743.96		97.86	34.96	£ 2.03		3978	£ 690.00		2577	£ 1,194.84	£ 1,000.00	16773	£ 436.70		1419
Nov-13	17996	£ 941.54		129.21	49.30	£ 2.58		4150	£ 657.00		2550	£ 1,228.98	£ 1,000.00	22146	£ 96.12		1959
Nov-14	12216	£ 668.10	167kWh/	93.16	33.47	£ 1.83		3751	£ 599.00		2771	£ 1,368.97	£ 1,000.00	15967	£ 108.66		1319
Nov-15	17789	£ 878.63		122.55	48.74	£ 2.41		3214	£ 573.80		2712	£ 1,365.25	£ 1,000.00	21003	£ 87.18		1829
Nov-16	17874	£ 778.09		114.82	48.97	£ 2.13		1805	£ 297.95		2631	£ 1,399.04	£ 1,000.00	19679	-£ 323.00		1704
Nov-17	17040	£ 746.22		109.28	46.68	£ 2.04		1690	£ 373.54		2498	£ 1,245.79	£ 1,000.00	18730	-£ 126.03		1623
Nov-18	19022	£ 865.95		123.21	52.11	£ 2.37		2095	£ 382.31		2677	£ 1,445.00	£ 1,000.00	21117	-£ 196.74		1844
Nov-19	18144	£ 753.97		118.74	49.71	£ 2.07		2206	£ 558.40		2704	£ 1,506.00	£1,000.00	20350	-£ 193.63		1764

8:50 PM

Area: Establishing a **Baseline** and **Rates**

2. What are the rooms and sizes in your house

= **SQ METER AREA**?

Energy Performance Certificate

SAP

59, Oxford Road, CAMBRIDGE, CB4 3PH

Dwelling type:	Detached house	**Reference number:**	7508-2082-7244-2614-4920
Date of assessment:	30 April 2014	**Type of assessment:**	RdSAP, existing dwelling
Date of certificate:	03 May 2014	**Total floor area:**	179 m²

Use this document to:

- Compare current ratings of properties to see which properties are more energy efficient
- Find out how you can save energy and money by installing improvement measures

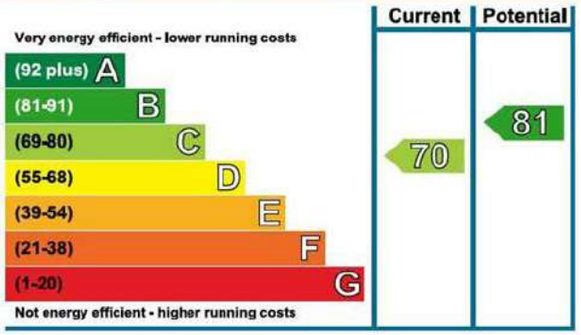
Estimated energy costs of dwelling for 3 years:	**£ 4,692**
Over 3 years you could save	**£ 1,380**

Estimated energy costs of this home

	Current costs	Potential costs	Potential future savings
Lighting	£ 432 over 3 years	£ 267 over 3 years	You could save £ 1,380 over 3 years
Heating	£ 3,864 over 3 years	£ 2,793 over 3 years	
Hot Water	£ 396 over 3 years	£ 252 over 3 years	
Totals	£ 4,692	£ 3,312	

These figures show how much the average household would spend in this property for heating, lighting and hot water. This excludes energy use for running appliances like TVs, computers and cookers, and any electricity generated by microgeneration.

Energy Efficiency Rating



The graph shows the current energy efficiency of your home.

The higher the rating the lower your fuel bills are likely to be.

The potential rating shows the effect of undertaking the recommendations on page 3.

The average energy efficiency rating for a dwelling in England and Wales is band D (rating 60).

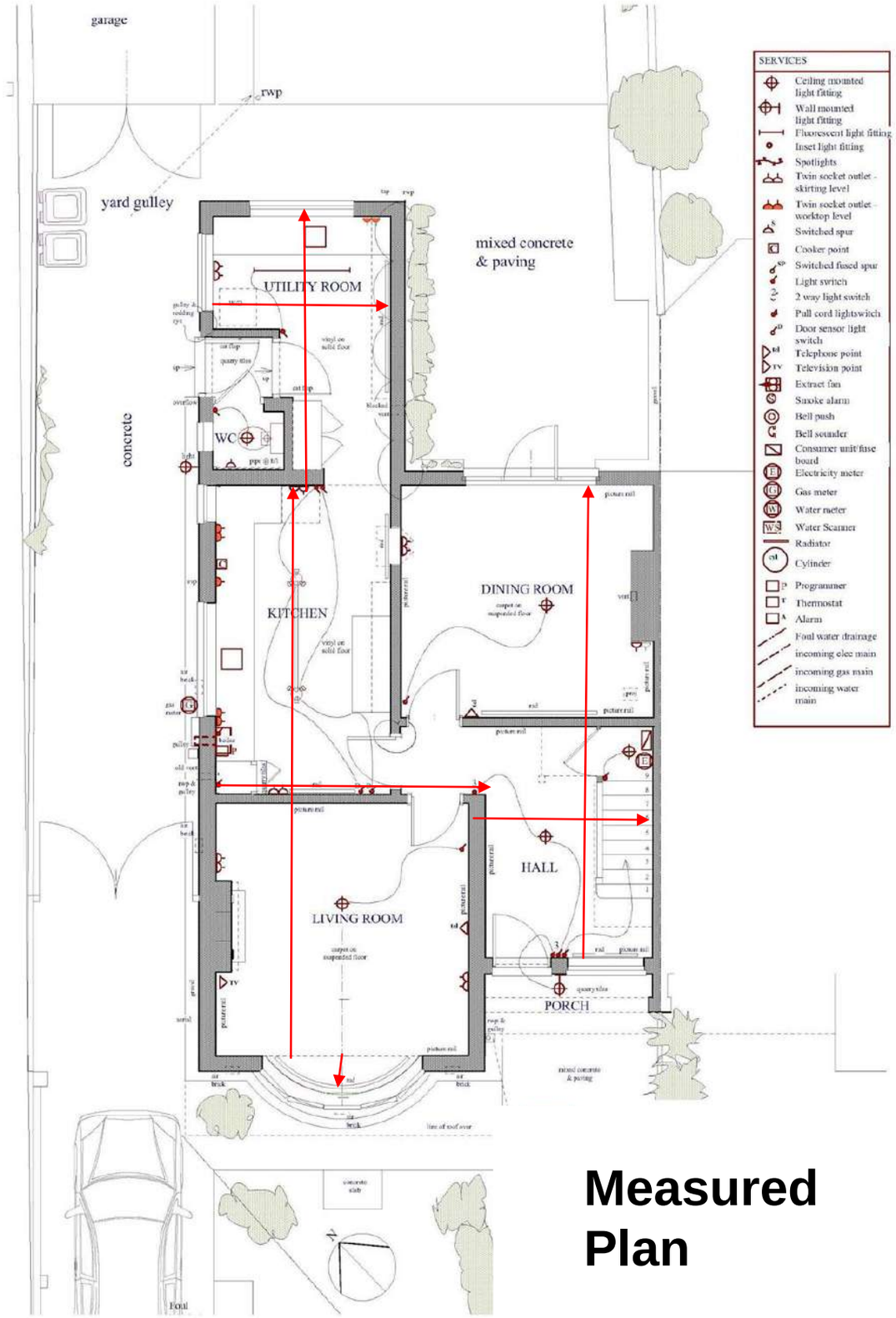
Top actions you can take to save money and make your home more efficient

Recommended measures	Indicative cost	Typical savings over 3 years	Available with Green Deal
1 Internal or external wall insulation	£4,000 - £14,000	£ 880	✓
2 Floor insulation	£800 - £1,200	£ 230	✓
3 Low energy lighting for all fixed outlets	£110	£ 142	

See page 3 for a full list of recommendations for this property.

To find out more about the recommended measures and other actions you could take today to save money, visit **www.direct.gov.uk/savingenergy** or call **0300 123 1234** (standard national rate). The Green Deal may allow you to make your home warmer and cheaper to run at no up-front cost.

kWh per m2 per year



Measured Plan

Your Energy Usage: Air tightness Test

Air Leakage Test Report

In Compliance with European Norm EN13829 – European Union

Cambridge Architectural Research

Building Address:	59 Oxford Road Cambridge, CB4 3PH
Performed for:	Prof David Reynolds &Mrs Margaret Reynolds
Performed by:	Peter Pope
Test date:	2015-06-18
Associated Test file:	EN13829-EU 2015-10-10 1115

Test Result: - Permeability @ 50Pa = 12.2 $m^3/h/m^2$

Living Room: The floor in the entranceway leaks air through the cracks, this could be sealed with silicone caulk. The flap for the letterbox also does not seal very effectively.

Front Bedroom: Air enters through a crack around the outside edge of the window, goes into the sash boxes and then comes into the room around the pulley.

Figure 2

Figure 3

Costs: Establishing a Budget

What is a reasonable **BUDGET** for your proposed work?

1. Do you have a budget figure in mind?

- **is your budget fixed?**
- **do you need a financial return? Eg room in house for lodger**
- **where's the money coming from?**

2. How many m2 of your house do you want to retrofit? budget £/m2 for these?

Any extensions? Could the work be phased?

Here are some examples of phasing:

- **wet rooms first, bathroom and kitchen, and then living/bedrooms**
- **inside then outside (EWI)**
- **extension or loft conversion first, then the remainder of the house.**

3. How are you going to procure the work?

- **how will you cope with disruption?**
- **one big job or parcels of work? (scope/risk)**
- **DIY or get the builders/ professionals in?**

4. Can you get specific quotes for some of the works, eg supply and install

- **Air Source Heat Pump**
- **Solar PV (photovoltaic) panels**
- **new windows**
- **External Wall Insulation**

Deciding on **Retrofit Measures**

1. **INSULATION** of fabric – inside or out?

- **Roof/loft**
- **Walls**
- **Windows and doors**
- **Floor**

2. **AIR-TIGHTNESS** of envelope (walls floor roof)? (+ **VENTILATION** ↓)

3. **SERVICES**

- **HEATING**
- **VENTILATION**
- **HEAT SOURCES**

4. **RENEWABLES -** eg Solar Photovoltaic

5. **EFFICIENT LIGHTING & APPLIANCES**

Government is establishing standards for retrofit, PAS 2035, including a new role:

RETROFIT COORDINATOR

Retrofit Coordinator - useful checklist

Intended Outcomes?

Examples:

- lower **energy** use, cost - tackling fuel poverty, OR emissions

- improving internal **comfort**, indoor air quality, OR reducing overheating

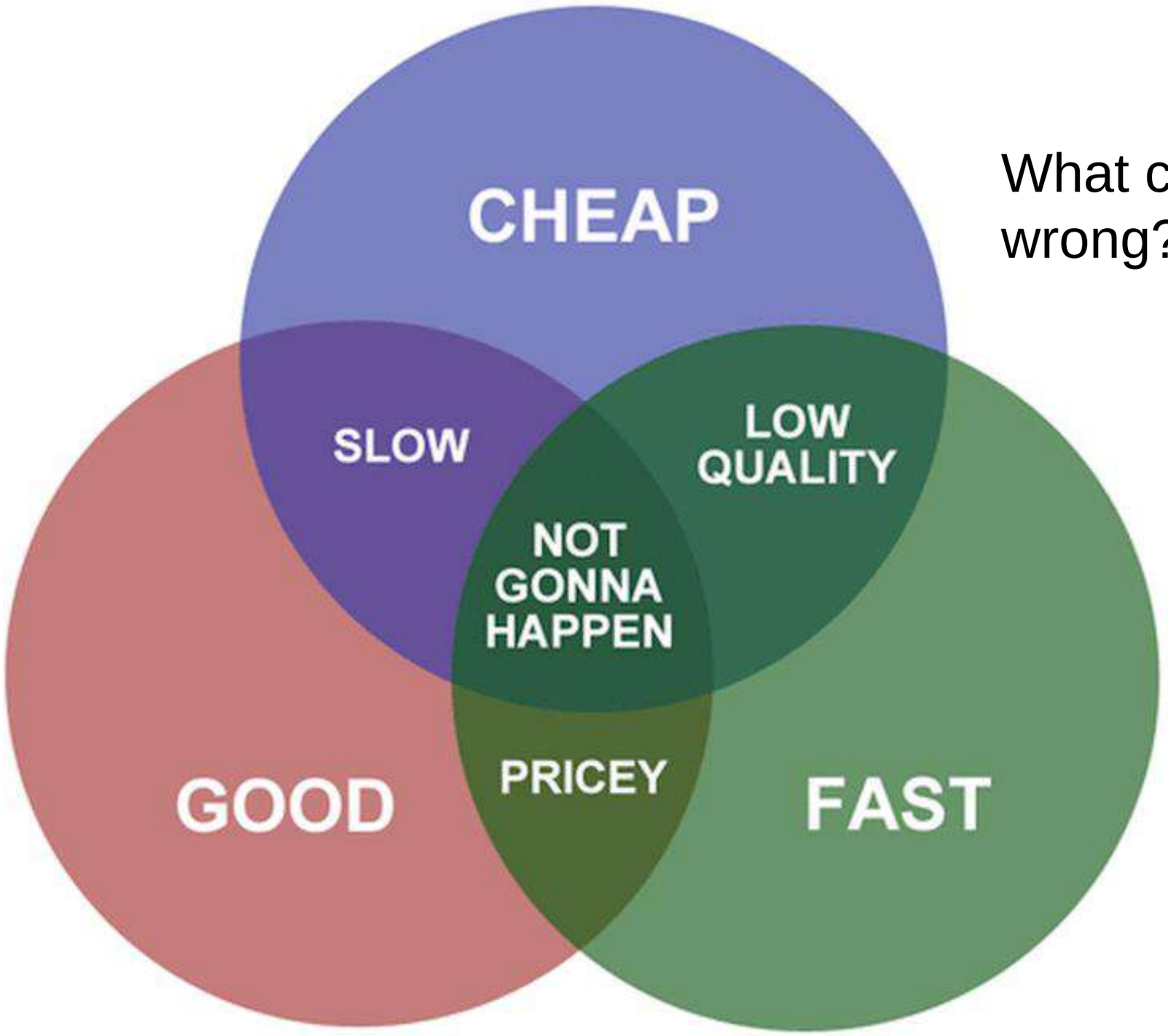
- **remedial**: elimination of condensation, damp and mould OR repair of gutters, flashings OR air leakage

- energy efficiency measures integrated with **other works**, eg extension, loft conversion, OR general upgrading of property

PAS 2035 , 6. Requirements for retrofit coordination and risk management, p.13-15

How are you going to procure the work?

balancing time, cost, quality



What can go wrong?

Beware: Quality!

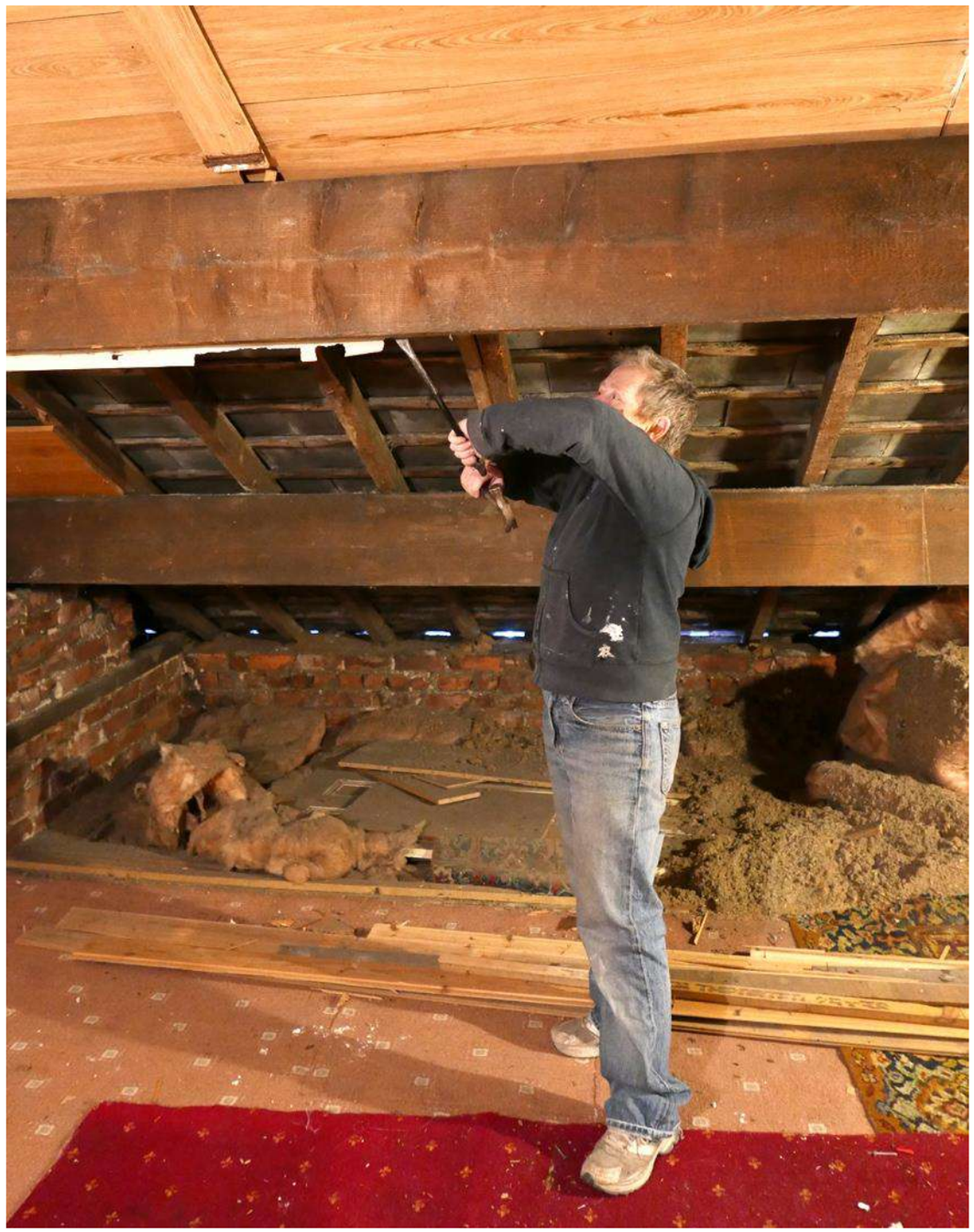
How are you going to procure the work? - Trades?

Whole house plan?

Retrofit Coordinator?

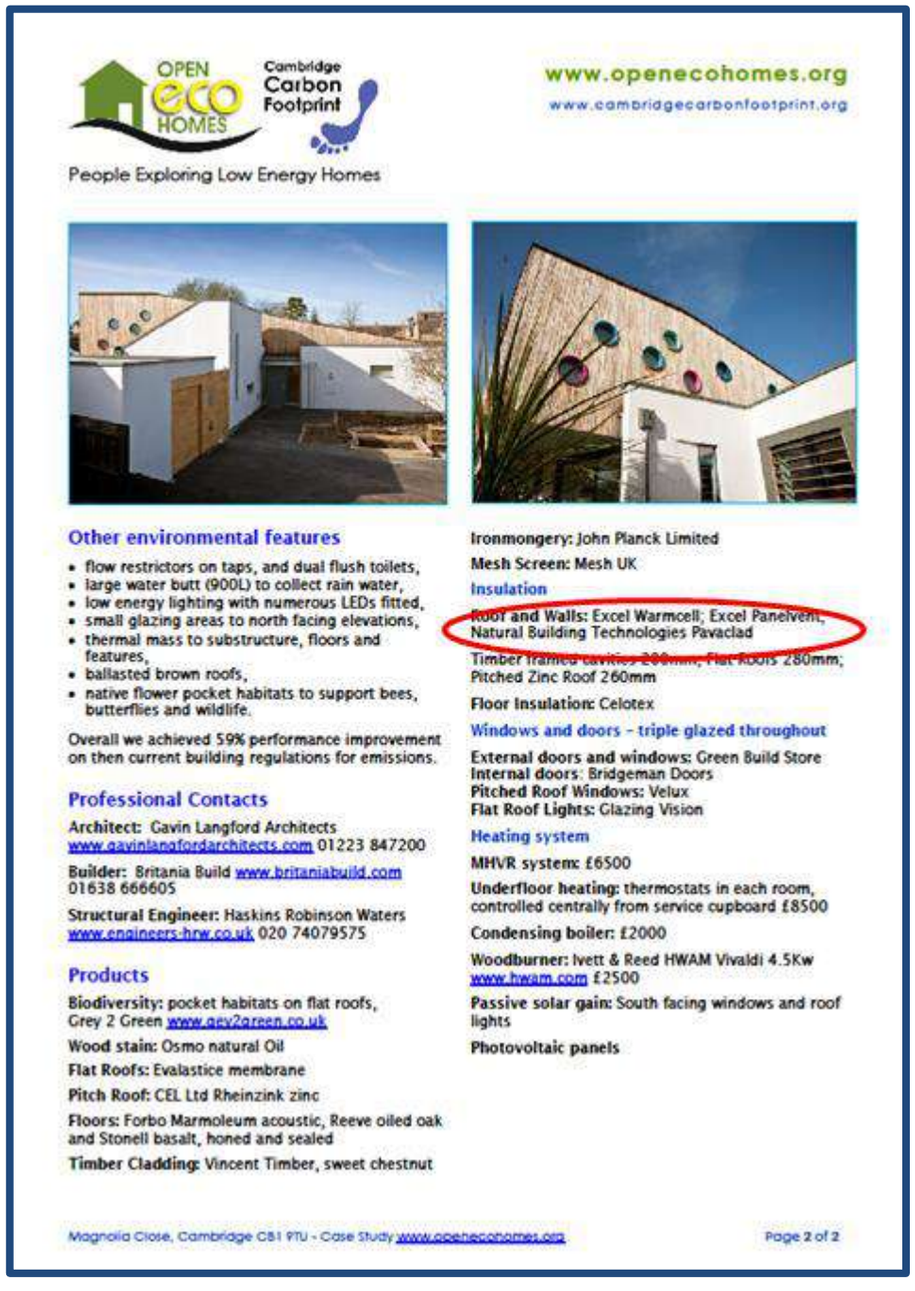
DIY, mainstream or specialist contractors?

RetrofitWorks specialist network?



Contractors

- Qualities of a good builder?
- Which builders do you usually use?
- Would you recommend them?



OPEN ECO HOMES
Cambridge Carbon Footprint
People Exploring Low Energy Homes

www.openecohomes.org
www.cambridgecarbonfootprint.org

Other environmental features

- flow restrictors on taps, and dual flush toilets,
- large water butt (900L) to collect rain water,
- low energy lighting with numerous LEDs fitted,
- small glazing areas to north facing elevations,
- thermal mass to substructure, floors and features,
- ballasted brown roofs,
- native flower pocket habitats to support bees, butterflies and wildlife.

Overall we achieved 59% performance improvement on then current building regulations for emissions.

Professional Contacts

Architect: Gavin Langford Architects www.gavinlangfordarchitects.com 01223 847200

Builder: Britania Build www.britaniabuild.com 01638 666605

Structural Engineer: Haskins Robinson Waters www.engineers-hrw.co.uk 020 74079575

Products

Biodiversity: pocket habitats on flat roofs, Grey 2 Green www.grey2green.co.uk

Wood stain: Osmo natural Oil

Flat Roofs: Evalastice membrane

Pitch Roof: CEL Ltd Rheinzink zinc

Floors: Forbo Marmoleum acoustic, Reeve oiled oak and Stonell basalt, honed and sealed

Timber Cladding: Vincent Timber, sweet chestnut

Ironmongery: John Planck Limited

Mesh Screen: Mesh UK

Insulation

Roof and Walls: Excel Warmcell; Excel Panelvent, Natural Building Technologies Pavaclad

Timber framed cavities 200mm; Flat roofs 280mm; Pitched Zinc Roof 260mm

Floor Insulation: Celotex

Windows and doors - triple glazed throughout

External doors and windows: Green Build Store
Internal doors: Bridgeman Doors
Pitched Roof Windows: Velux
Flat Roof Lights: Glazing Vision

Heating system

MHVR system: £6500

Underfloor heating: thermostats in each room, controlled centrally from service cupboard £8500

Condensing boiler: £2000

Woodburner: Ivett & Reed HWAM Vivaldi 4.5Kw www.hwam.com £2500

Passive solar gain: South facing windows and roof lights

Photovoltaic panels

Magnolia Close, Cambridge CB1 9TU - Case Study www.openecohomes.org Page 2 of 2

Good Questions
to ask householders
or to explore in OEH Archive:

What was their brief?
- retrofit priorities?
- combined projects/ added value?
- retrofit values and philosophy?

What was their budget?
- was it fixed?
- was payback important?
- did they have grants?

How did they procure the work?
- where did they get advice?
- how did they manage time/cost/quality?
- one big job or parcels of work?
- DIY or builders/ professionals?
- how did they cope with disruption?

What do they wish they had done differently?

Resources:

openecohomes.org/eco-homes-archive Case Studies

cambridgecarbonfootprint.org/home-energy-resources Resources

cse.org.uk/advice/advice-and-support Centre for Sustainable Energy

transitioncambridge.org/faqs

Energy Advice greenbuildingstore.co.uk/services/training-cpds/free-cpds

is a project of

Donations welcome: cambridgecarbonfootprint.org/donate

Please write feedback in Chat one thing each:

- that's been good
- that needs improving
- a suggestion

If you'd like a discussion session another time on tonight's topics, please write '**discuss**' in Chat.

Thank you,
Nicola Terry, Margaret Reynolds, Tom Bragg