

# Residential Retrofit Measured comfort levels

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## Content:

1. Introduction – Retrofit for the Future and RIBA publication
2. Monitoring results – Property 1, 2, 3,4
3. Conclusion

- **Retrofit for the Future competition**  
Launched in 2009

- **100 projects have been completed**  
Data analysis report launched 2013  
[www.retrofitanalysis.org](http://www.retrofitanalysis.org)

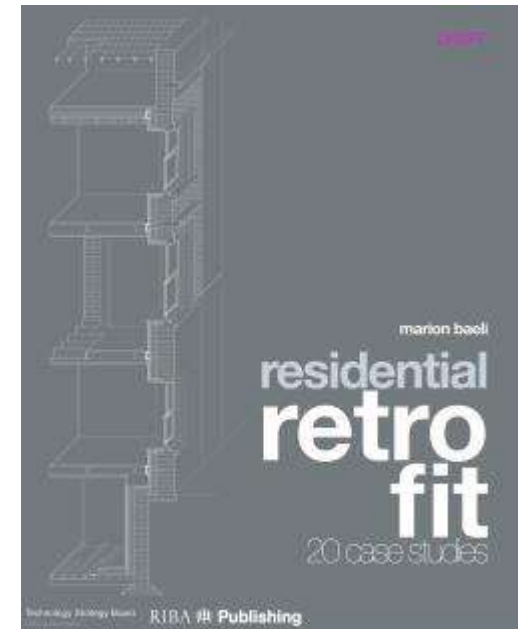
- **Book about 20x case studies**

commissioned by the RIBA Publishing written in collaboration with TSB

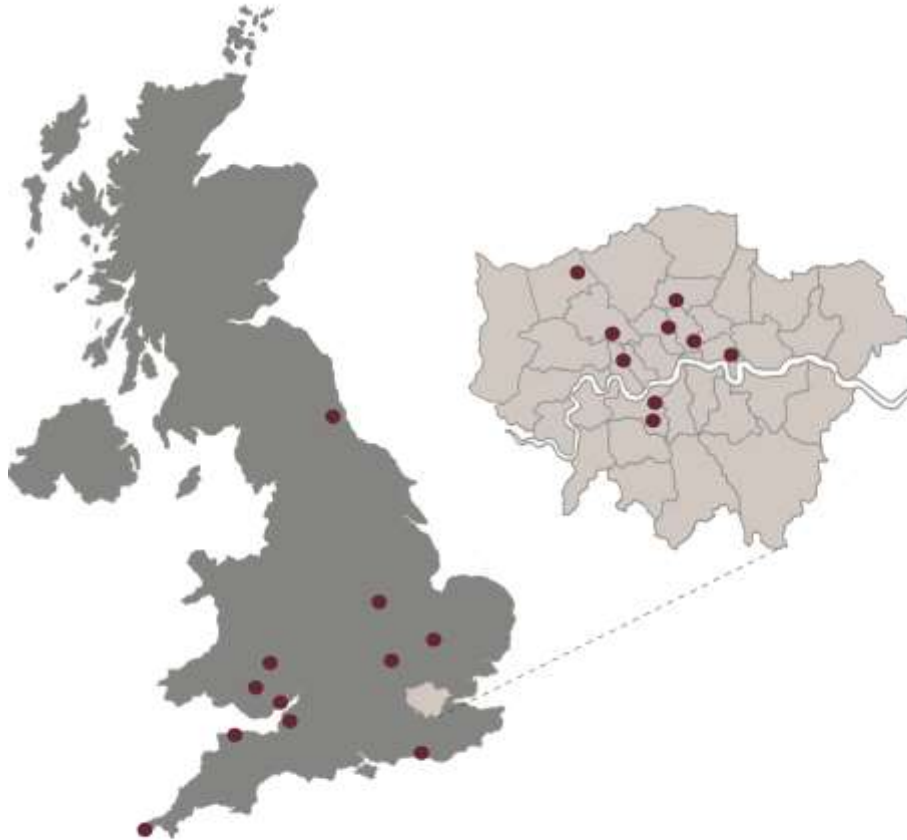
- Description of each strategy
- Details
- Costs (material and labour)
- Monitoring data

## Retrofit Revealed

The Retrofit for the Future projects – data analysis report



## Project locations



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## Type of monitored data

RftF Programme main targets:

- 80% reduction in CO<sub>2</sub> compared to 1990 emissions
- CO<sub>2</sub> emissions limited to 17 kg/m<sup>2</sup>.yr [20 kg/m<sup>2</sup>.yr for PHPP]
- Primary Energy limited to 115 kWh/m<sup>2</sup>.yr

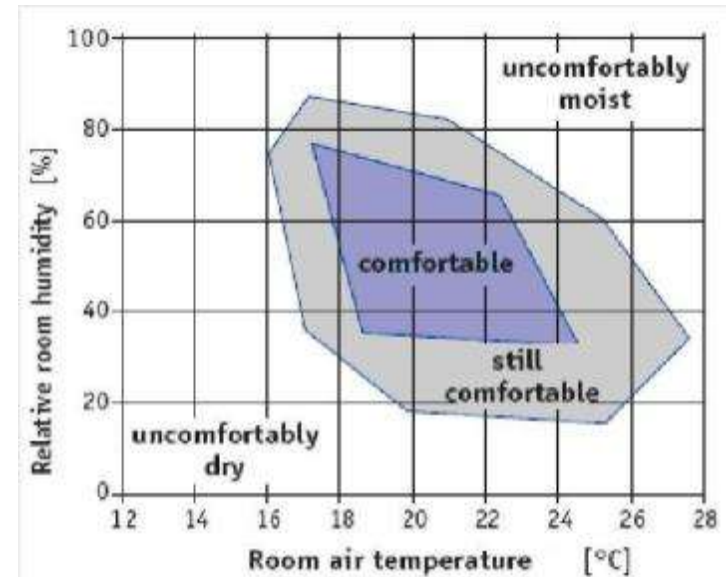
RftF Programme comfort monitoring:

- Temperature
- Relative Humidity
- CO<sub>2</sub> concentration
- (Occupant interviews)

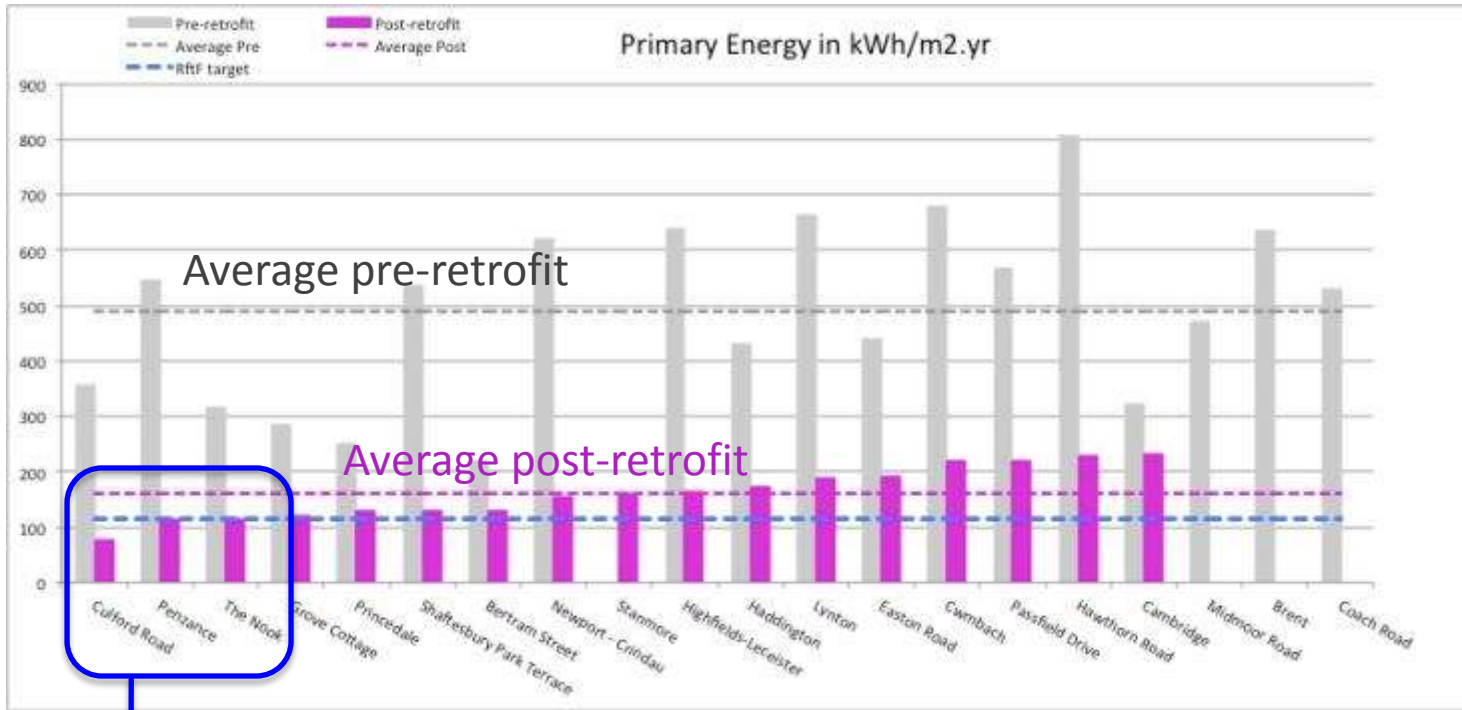
- Temperature:  
~21°C

- Relative Humidity  
40 – 60%

- CO2 concentration  
1000 – 1500ppm



## Primary Energy Results



70%  
reduction



3 projects out of 20 met the target for Primary Energy of 115 kWh/m<sup>2</sup>.yr

## Property 1 (Princedale Road)

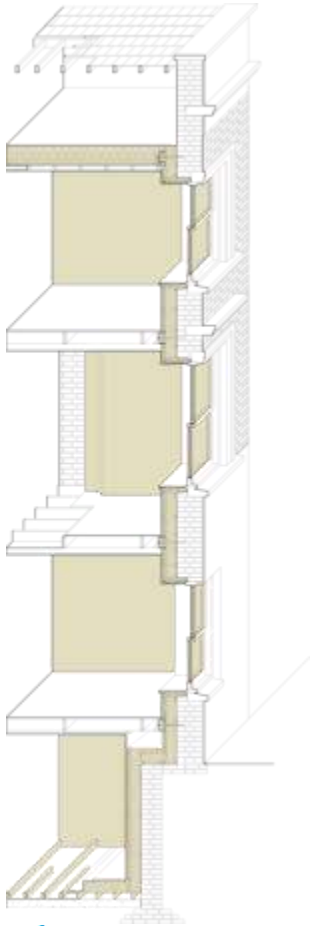
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Internal insulation



## Property 1 (Princedale Road)



### Fabric:

- Continuous internal insulation
- Triple glazing
- No cold bridges (joist ends detached)

### Services:

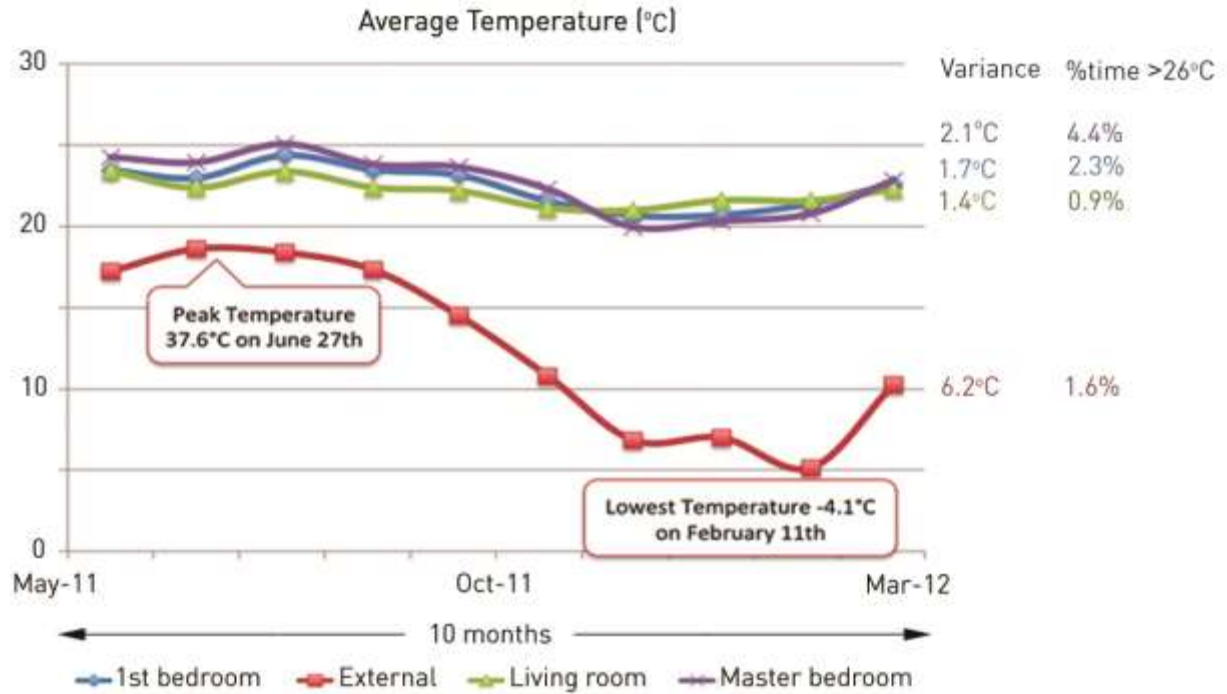
- MVHR (Genvex Combi)
- Solar thermal
- Below ground heat exchanger

- **Airtightness 0.34**

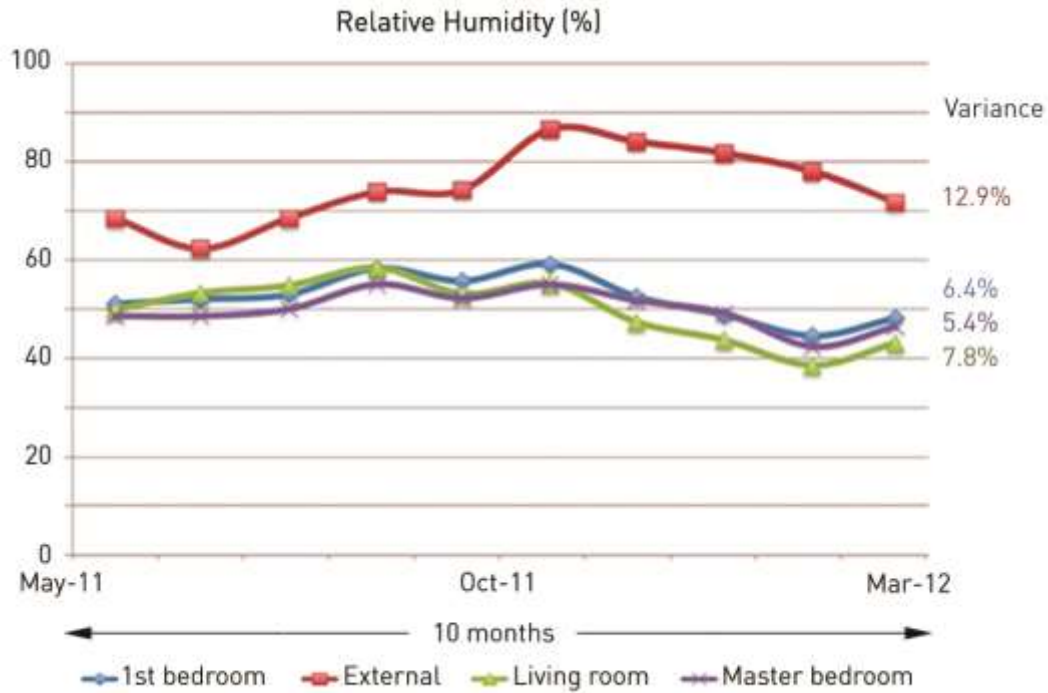
### Vital statistics table

Characteristic	Before	Target	Measured
Primary energy (kWh/m <sup>2</sup> /year)	250	100	128
Space heating (kWh/m <sup>2</sup> /year)	128	5	10
Airtightness (m <sup>3</sup> /h @ 0.5 Pa)	—	0.6	0.34
Type of glazing	single	triple	triple
CO <sub>2</sub> emissions (kg CO <sub>2</sub> /m <sup>2</sup> /year)	76	7	20

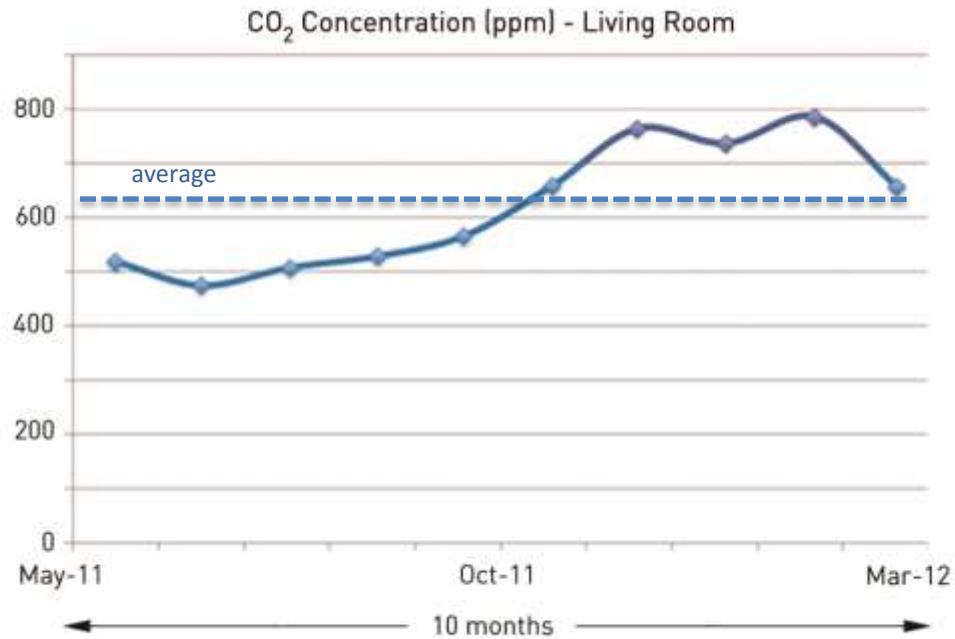
## Property 1 (Princedale Road)



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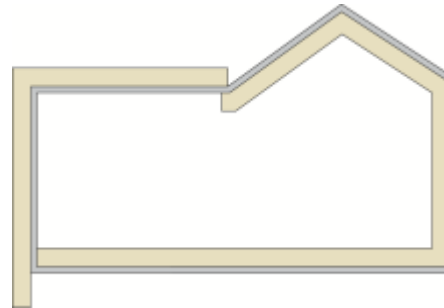


## Property 1 (Princedale Road)



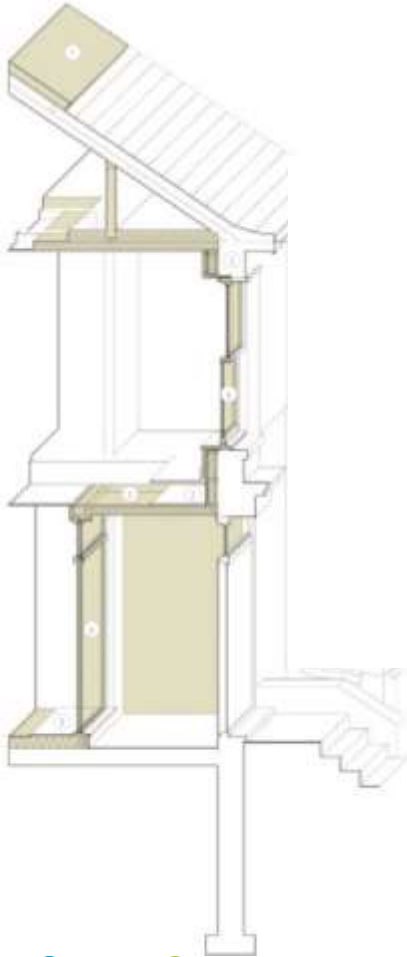
## Property 2 (The Nook)

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Internal & external insulation

## Property 2 (The Nook)



### Fabric:

- IWI & EWI
- Triple & Double glazing
- Some cold bridges (joist ends)

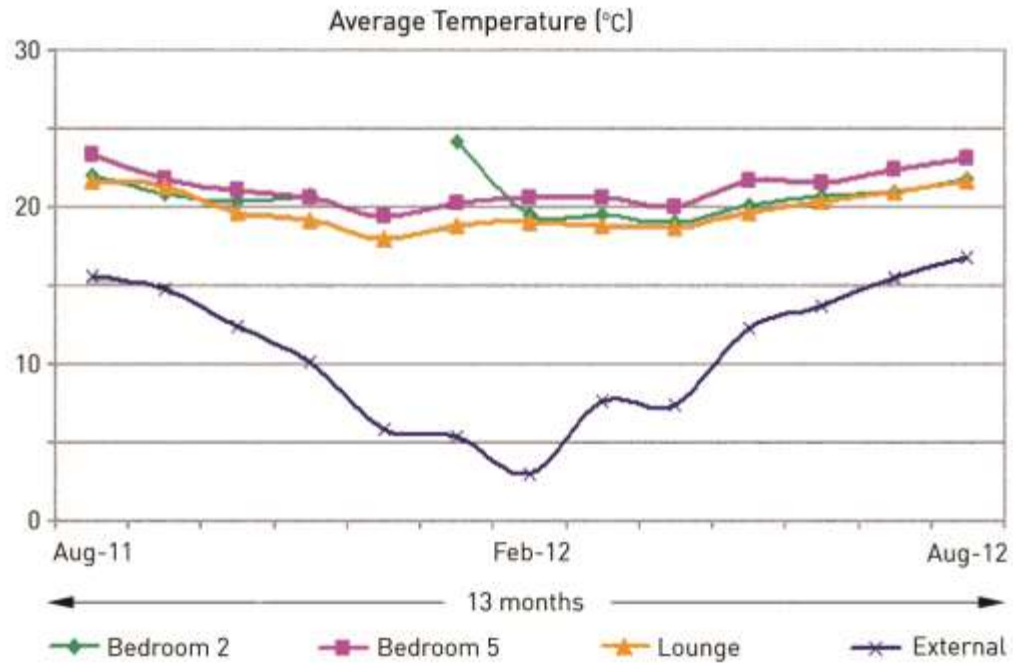
### Services:

- MVHR (Paul)
- Gas boiler
- Solar thermal
- **Airtightness: 3**

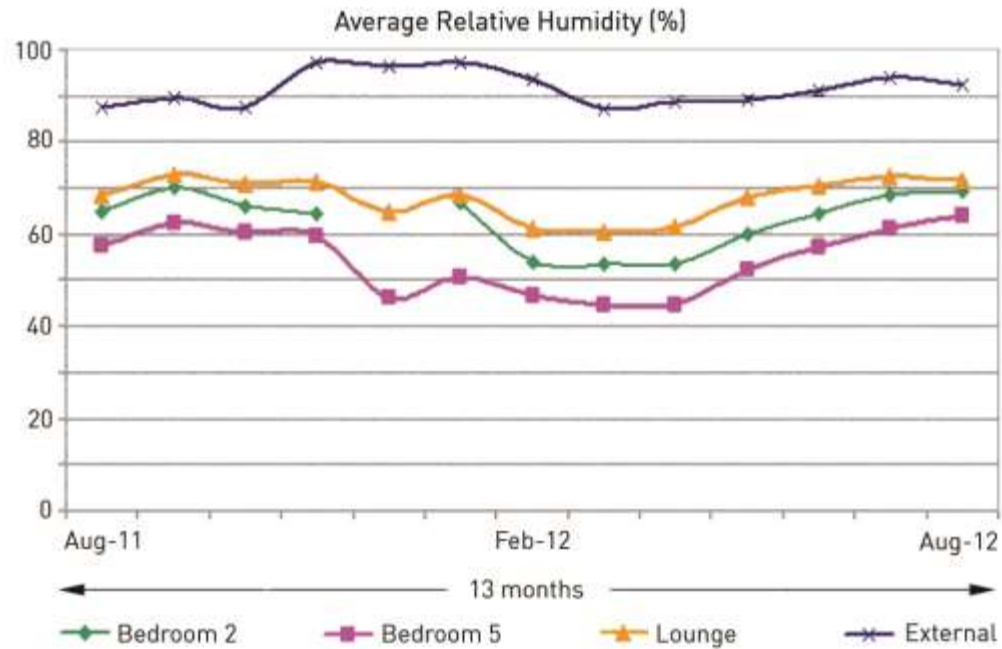
### Vital statistics table

Characteristic	Before	Target	Measured
Primary energy kWh/m <sup>2</sup> /year	36	14	13
Space heating kWh/m <sup>2</sup> /year	—	33	—
Airtightness m <sup>3</sup> /h @ 50 Pa	—	—	3
Type of glazing	single	double/ triple	double/ triple
CO <sub>2</sub> emissions (kg CO <sub>2</sub> /m <sup>2</sup> /year)	107	23	21

## Property 2 (The Nook)

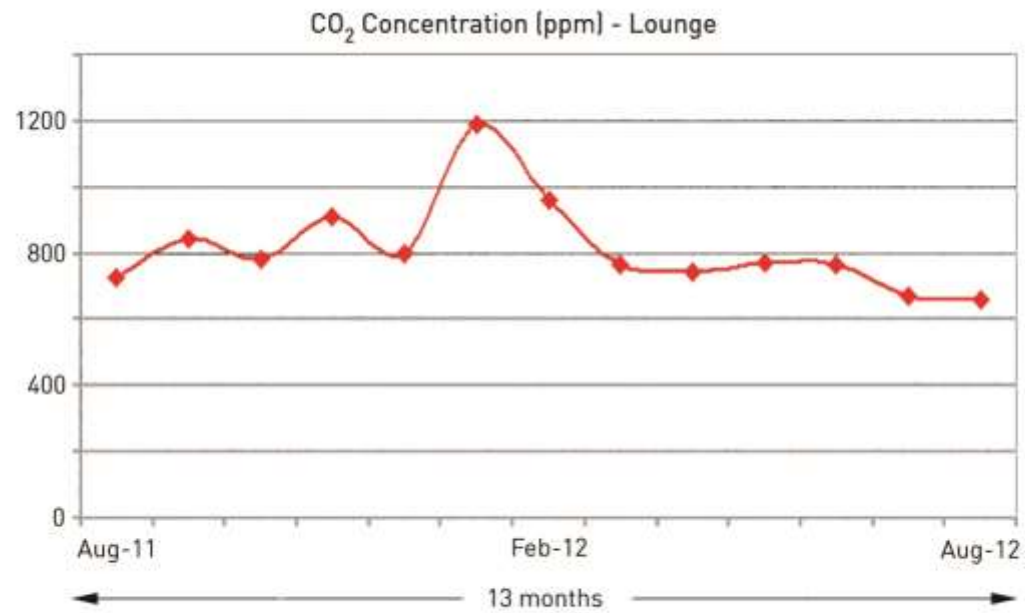


## Property 2 (The Nook)



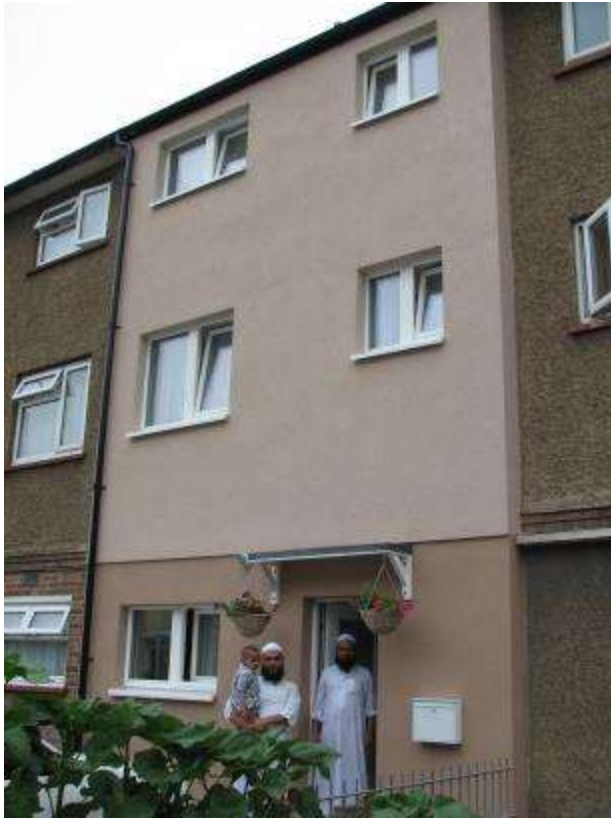


## Property 2 (The Nook)



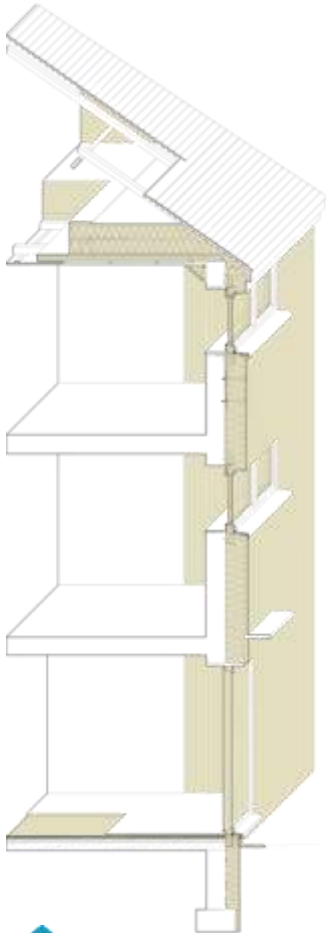
## Property 3 (Passfield Drive)

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External wall insulation

## Property 3 (Passfield Drive)



### Fabric:

- EWI
- Triple glazing
- Minimal cold bridges (floor/wall)

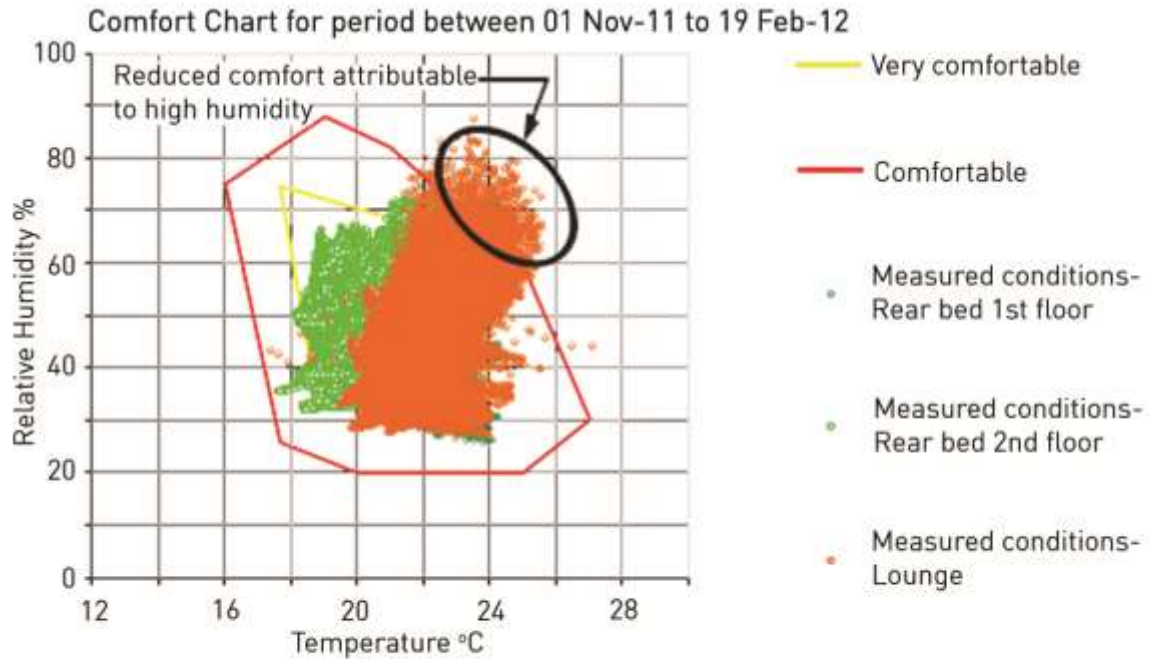
### Services:

- MVHR (Paul)
- Gas boiler
- Solar thermal
- **Airtightness: 1.4**

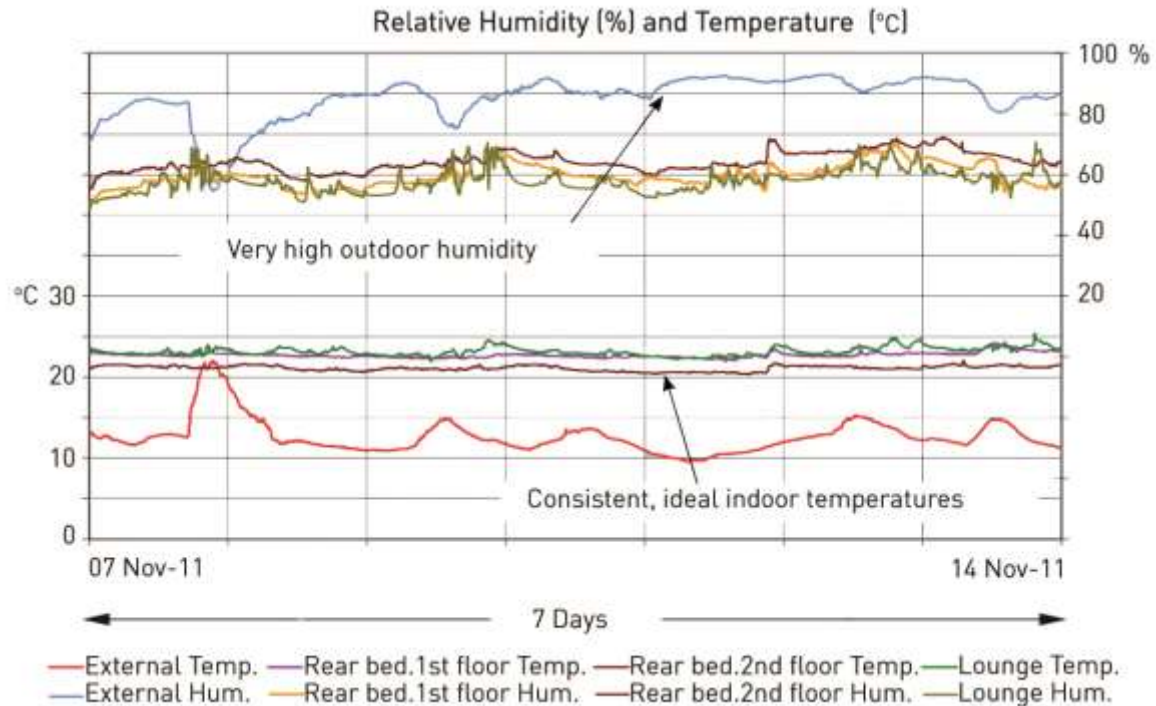
### Vital statistics table

Characteristics	Belire	Target	Measured
Primary energy (kWh/m <sup>2</sup> /year)	506	119.2	219
Space heating (kWh/m <sup>2</sup> /year)	203	25	—
Airtightness (m <sup>3</sup> /m <sup>2</sup> h @ 50 Pa)	5.5	1	1.4
Type of glazing	double	triple	triple
CO <sub>2</sub> emissions (kg CO <sub>2</sub> /m <sup>2</sup> /year)	100.5	25.2	—

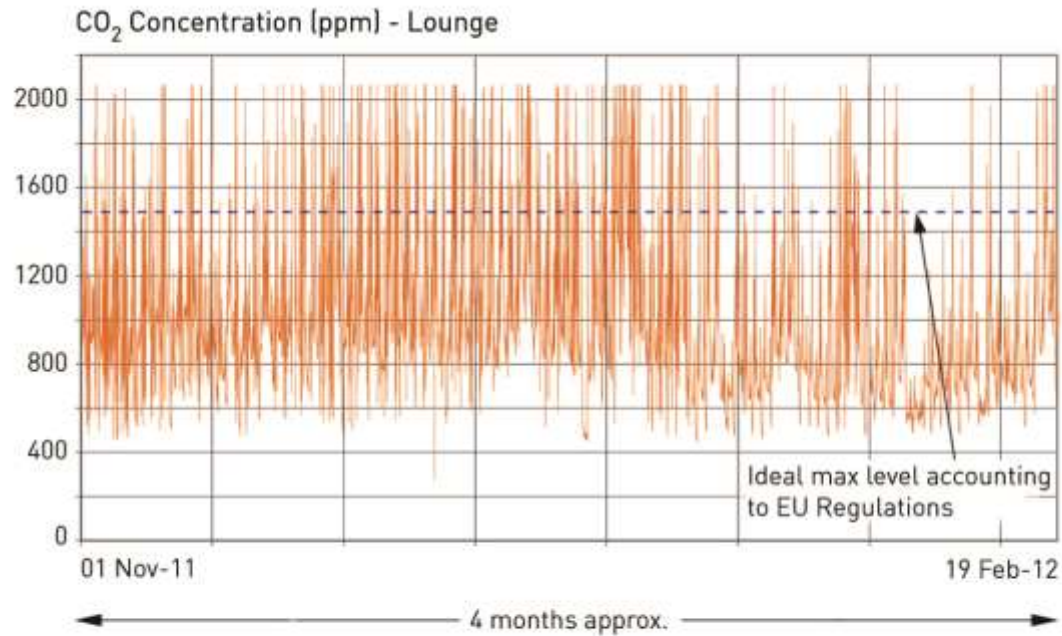
## Property 3 (Passfield Drive)



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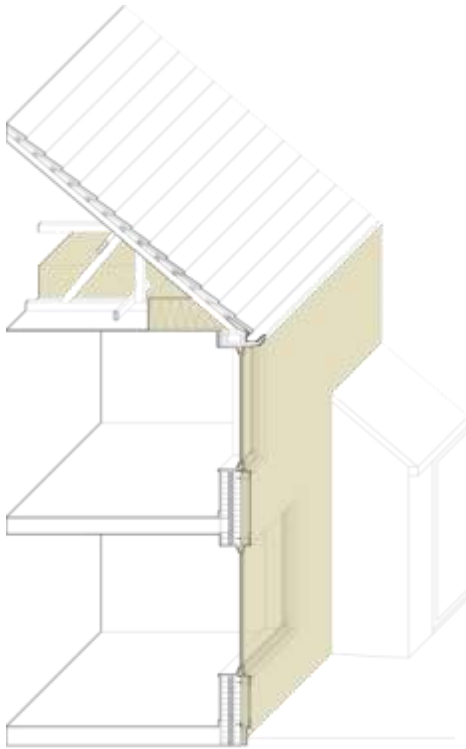
## Property 4 - Penzance

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External wall insulation

## Property 4 - Penzance



### Fabric:

- EWI
- Triple glazing
- Minimal cold bridges (ground/wall)

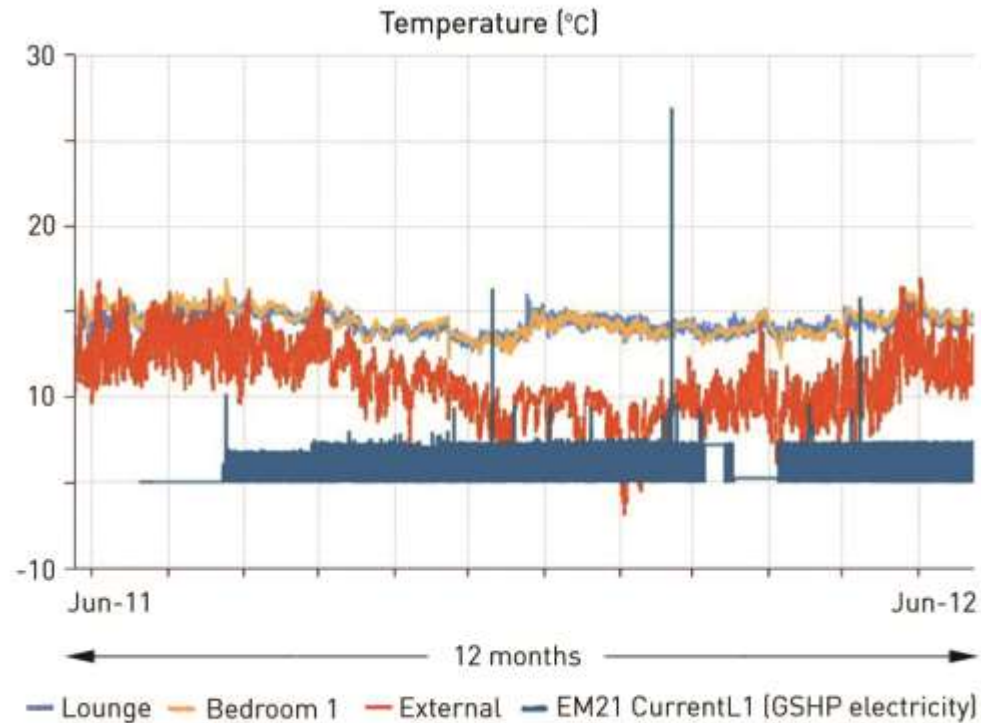
### Services:

- MVHR
- Ground source heat pump (Calorex 3.5 kW) & pressurised cylinder
- 'Heat pod' extension
- Photovoltaic panels
- **Airtightness: 5.25**

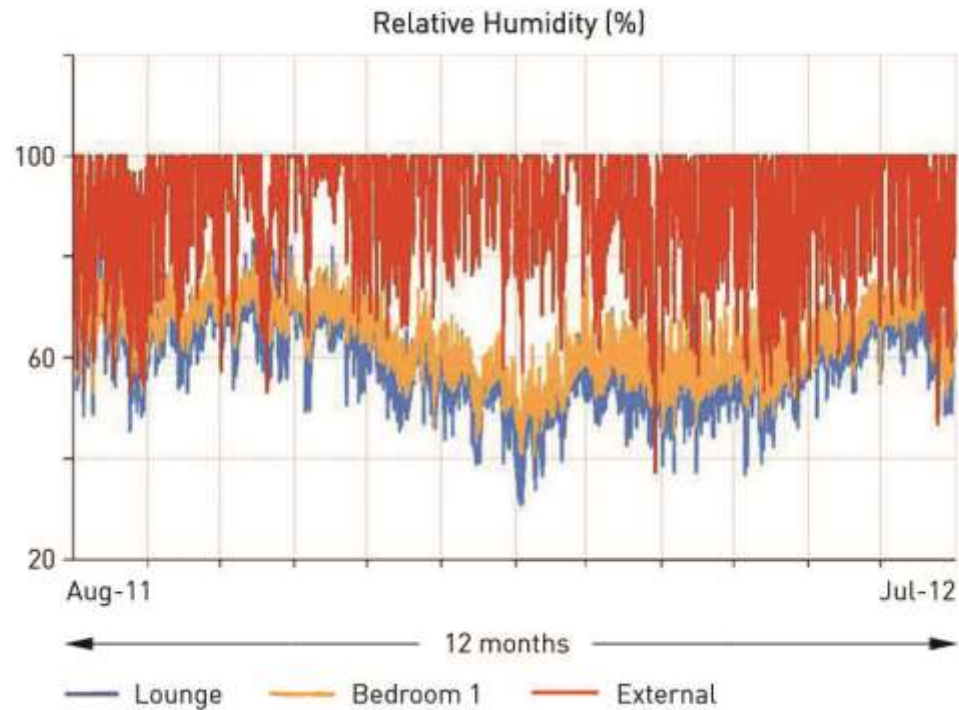
Vital statistics table			
Characteristic	Delivered	Target	Measured
Primary energy kWh/m <sup>2</sup> /year	544	110	112
Space heating kWh/m <sup>2</sup> /year	102	64.0	39
Airtightness (permeability @ 50 Pa)	5.27	3	5.25
Type of glazing	double	triple	triple
CO <sub>2</sub> emissions kg CO <sub>2</sub> /m <sup>2</sup> /year	148	17	16.97



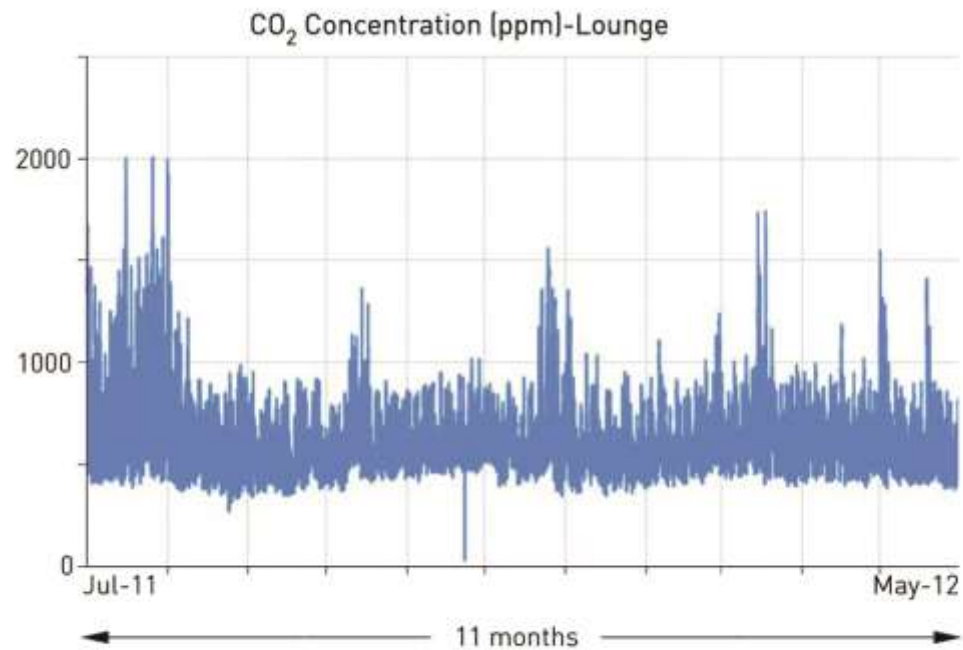
## Property 4 - Penzance



## Property 4 - Penzance



## Property 4 - Penzance



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## Conclusion

- More research needs to be undertaken on costs, procurement, training, methodology
- Urgency of retrofitting the UK Housing Stock
- Retrofit for the Future programme – A platform for engaging the industry into retrofits
- The 20x case studies are a source of information and inspiration for others

Thank you.



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