Behavioural options in buildings – a socio-technical perspective

Robert Lowe & Lai Fong Chiu

UCL-Energy Institute

Innovation in relation to building energy demand in IAMs

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SUMMARY

- insights from energy epidemiology
- cautionary tales
- insights from case studies of deep retrofit
- closing remarks

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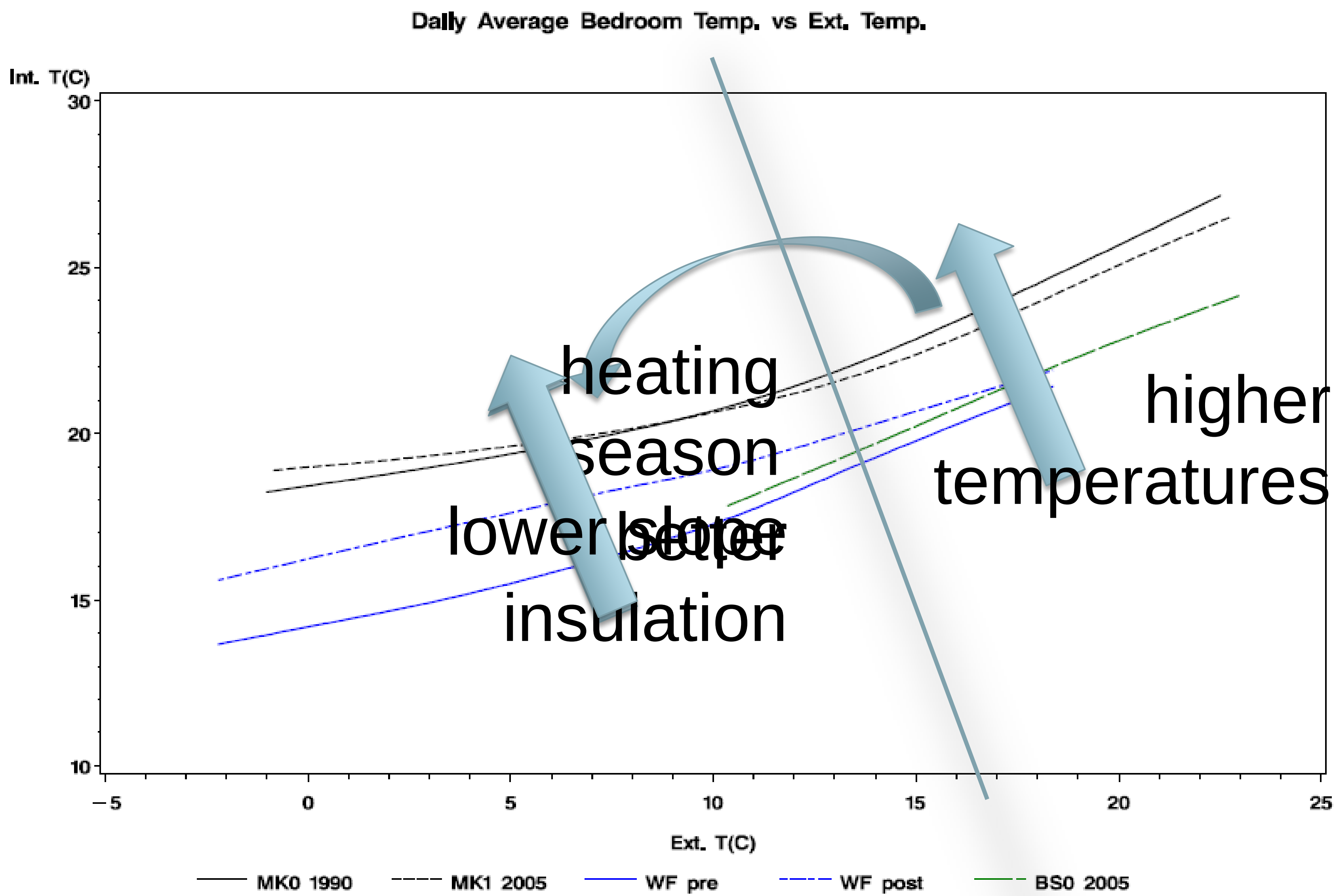

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CAUTIONARY TALES

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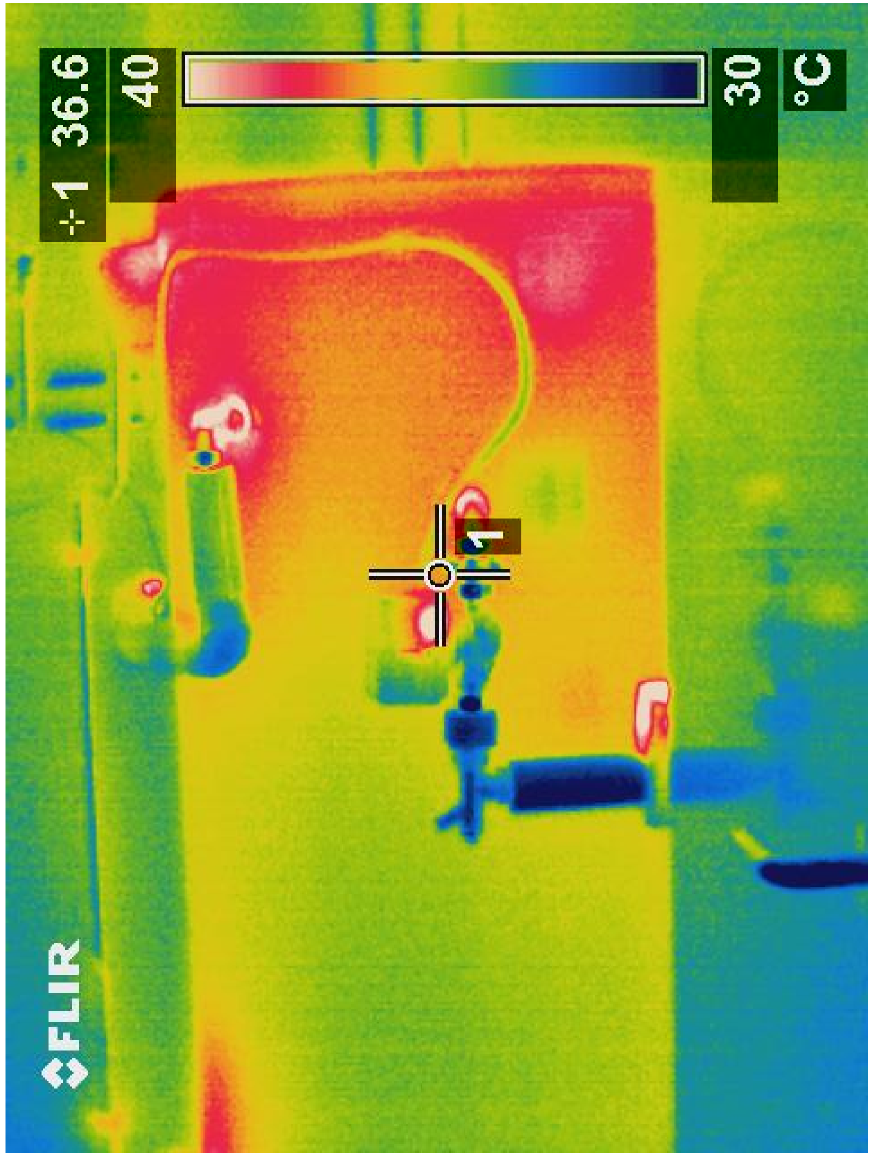
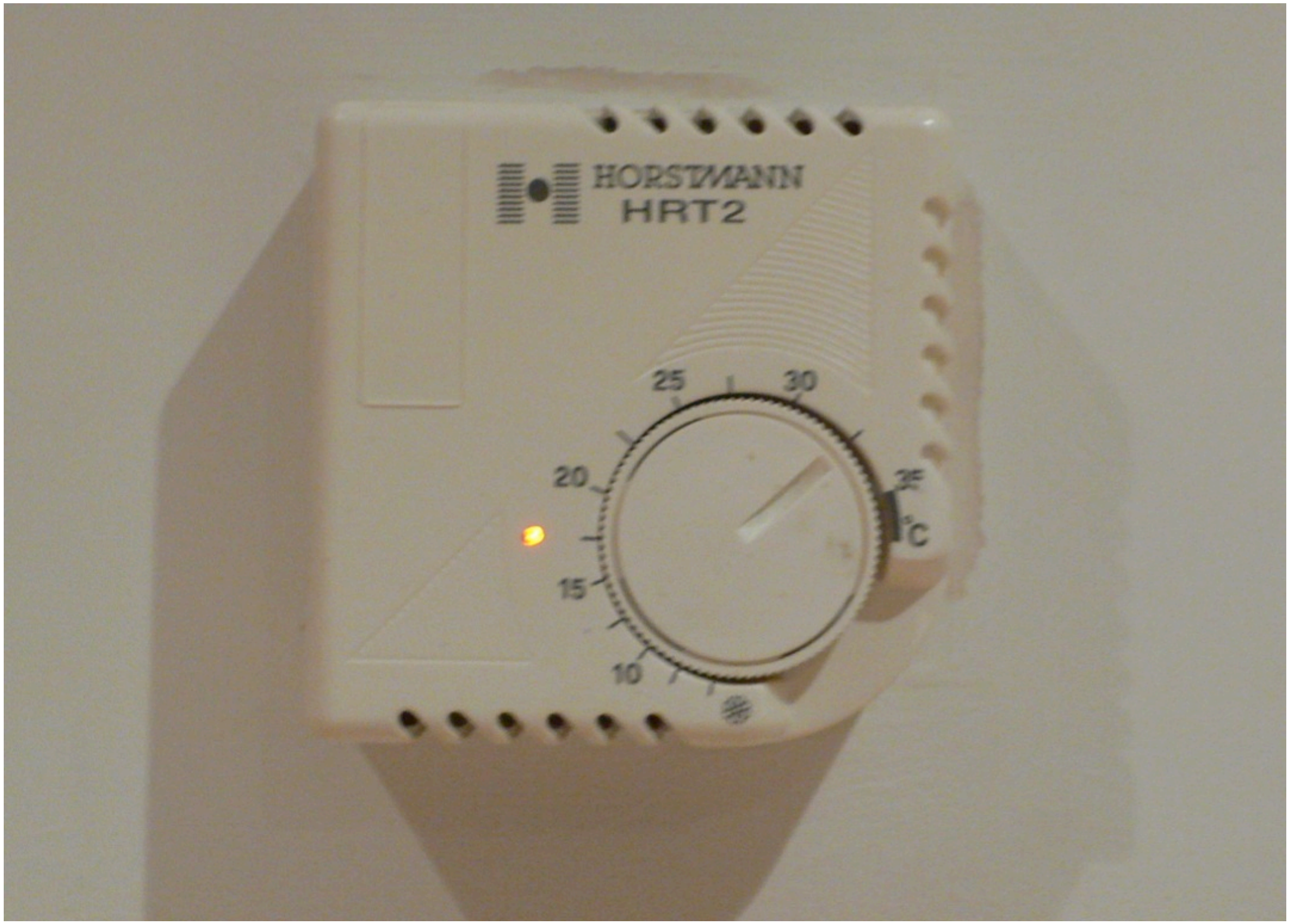


CAUTIONARY TALES



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CAUTIONARY TALES

- in the 1970s and early 1980s building physicists viewed a conservatory as a passive solar device, and
- estimated that the presence of a conservatory would reduce space heat demand by 1000-2000 kWh/a
- UCL undertook a postal survey of conservatory owners in 1991…
- and a second survey in 2004

Chu & Oreszczyn (1991) The Energy Duality of Conservatories: should conservatories be exempt from the Building Regulations? *Building Technical File*, 32, 9-13.

Pathan et al. Trends in Conservatory use: A comparison between the 1991

CAUTIONARY TALES

- 67% heat their conservatories with gas central heating (22% in 1991)
- 90% used all year round (72% in 1991)
- 37% have no door between their dwelling and conservatory (5% in 1991)
- 56% now report heating their conservatory 7 or more hours per day in winter (32% in 1991)
- the use of AC has doubled to 6%
- our estimate is that the fitting of a conservatory roughly doubles the space heat requirement

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INSIGHTS FROM DEEP RETROFIT

- the FLASH project studied 10 dwellings in detail, taken from TSB's Retrofit for the Future Project that ran from 2009 to 2011 - http://www.lowenergybuildings.org.uk/leb/2013/07/retrofit-for-the-future/
- TSB's stated objective for the project was an 80% reduction in CO_2 emissions
- in practice, reductions were about 50%, though this can only be estimated in the absence of energy use data from before retrofit for most of the dwellings

INSIGHTS FROM DEEP RETROFIT

Hear the hum? That's the heat pump. [. . .] But I don't understand why is it doing it now? Because it is supposed to be pumping hot air from the bathroom and the kitchen which aren't being used and that's still pumping. Why? And most of the time it's like that. I hardly [. . .] I only ever use the shower once a day and heat in the kitchen once a day [so where is the extra heat]?' [. . .]

INSIGHTS FROM DEEP RETROFIT

the way we were sold it [how we would save energy], was we will be able to if it were too hot down here [in the living room] that we could send the heat upstairs. So that excess heat from when you are cooking in the kitchen would go to heat upstairs [the MVHR] and through filters they would take out the cooking smell upstairs. Well, which I can't see [. . .] how's it gonna function? So I don't think that is connected up to do that anyway [. . .] Yeah, I don't know where it is. Because to me, it only blows air. So obviously, you got to send it upstairs you got to have an intake as well to draw it out to send it upstairs [. . .] which you know, the little time it was working and blowing out cold air, you know [. . .] it's not working.

INSIGHTS FROM DEEP RETROFIT

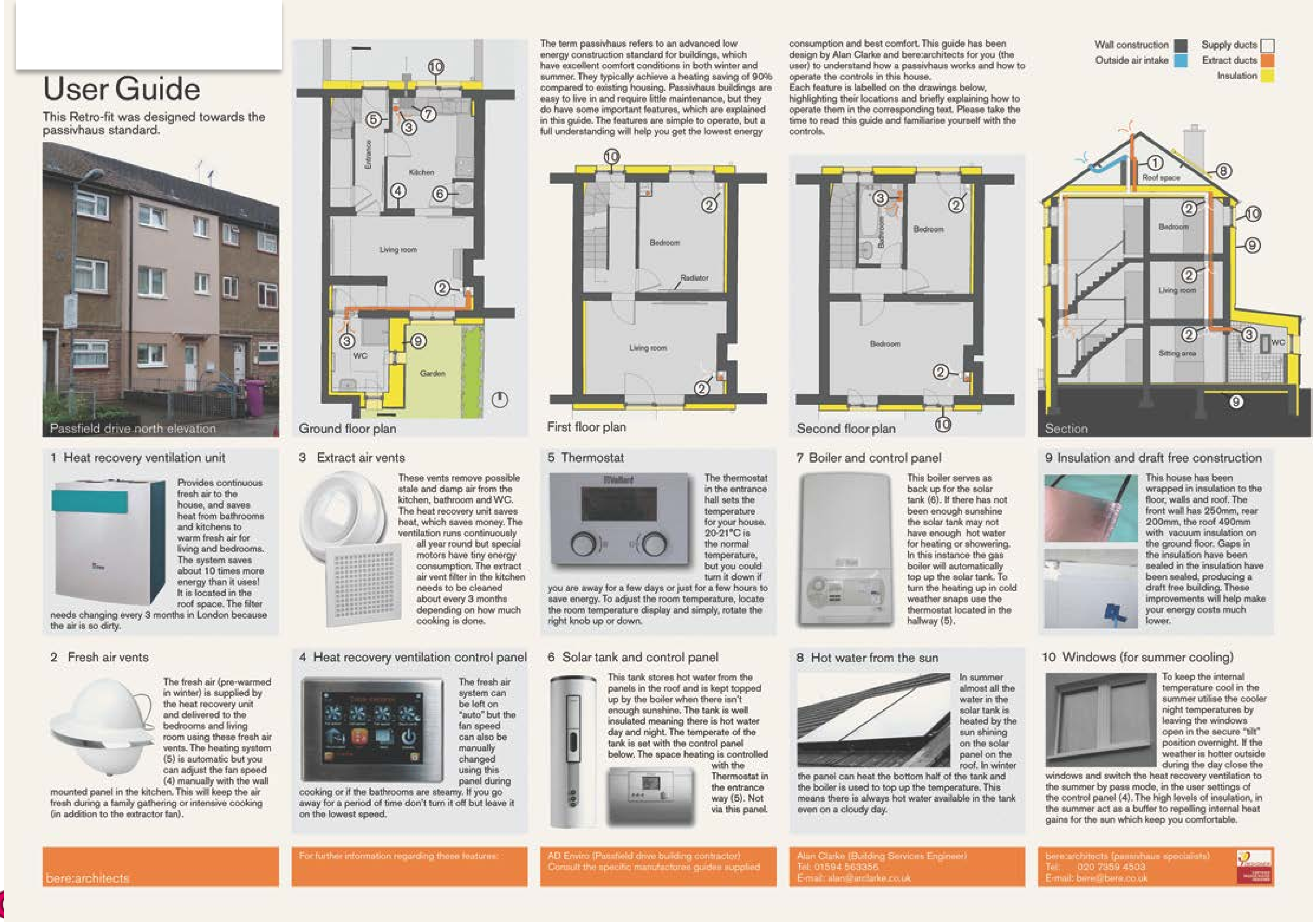
Without any central heating for almost a year, B1 appeared to have resorted to using her tumble dryer to keep the house warm and consequently was not in a position to save any energy and money. When asked whether the retrofit had influenced her energy saving behaviour, she said:

> No, not really, ’cause I’m using the tumble dryer a lot. The tumble dryer takes most of the money up, ’cause I’m using it 24 hours sometimes. It can go on all night.

INSIGHTS FROM DEEP RETROFIT

‘In the winter, we never had to open the windows [to ventilate]. First of all, the temperature. It’s always warm. During winter we didn’t have to turn on the central heating much. It was like five or six times during the whole winter, we switched on the central heating and it was only for ten to twenty minutes. The temperature from the cooker used to warm up the house. That’s one of the amazing things! It’s a huge difference. And the other thing is the air – the freshness of the air. My dad used to get hay fever every season. You know, this season he didn’t get hay fever [neither did] my brother’s eczema.’

Case D



User Guide

This Retro-fit was designed towards the passivhaus standard.

Passfield drive north elevation

Ground floor plan

First floor plan

Second floor plan

Section

Wall construction
Outside air intake
Supply ducts
Extract ducts
Insulation

The term passivhaus refers to an advanced low energy construction standard for buildings, which have excellent comfort conditions in both winter and summer. They typically achieve a heating saving of 90% compared to existing housing. Passivhaus buildings are easy to live in and require little maintenance, but they do have some important features, which are explained in this guide. The features are simple to operate, but a full understanding will help you get the lowest energy consumption and best comfort. This guide has been design by Alan Clarke and bere:architects for you (the user) to understand how a passivhaus works and how to operate the controls in this house.
Each feature is labelled on the drawings below, highlighting their locations and briefly explaining how to operate them in the corresponding text. Please take the time to read this guide and familiarise yourself with the controls.

1 Heat recovery ventilation unit

Provides continuous fresh air to the house, and saves heat from bathrooms and kitchens to warm fresh air for living and bedrooms. The system saves about 10 times more energy than it uses! It is located in the roof space. The filter needs changing every 3 months in London because the air is so dirty.

2 Fresh air vents

The fresh air (pre-warmed in winter) is supplied by the heat recovery unit and delivered to the bedrooms and living room using these fresh air vents. The heating system (5) is automatic but you can adjust the fan speed (4) manually with the wall mounted panel in the kitchen. This will keep the air fresh during a family gathering or intensive cooking (in addition to the extractor fan).

3 Extract air vents

These vents remove possible stale and damp air from the kitchen, bathroom and WC. The heat recovery unit saves heat, which saves money. The ventilation runs continuously all year round but special motors have tiny energy consumption. The extract air vent filter in the kitchen needs to be cleaned about every 3 months depending on how much cooking is done.

4 Heat recovery ventilation control panel

The fresh air system can be left on "auto" but the fan speed can also be manually changed using this panel during cooking or if the bathrooms are steamy. If you go away for a period of time don't turn it off but leave it on the lowest speed.

5 Thermostat

The thermostat in the entrance hall sets the temperature for your house. 20-21°C is the normal temperature, but you could turn it down if you are away for a few days or just for a few hours to save energy. To adjust the room temperature, locate the room temperature display and simply, rotate the right knob up or down.

6 Solar tank and control panel

This tank stores hot water from the panels in the roof and is kept topped up by the boiler when there isn't enough sunshine. The tank is well insulated meaning there is hot water day and night. The temperate of the tank is set with the control panel below. The space heating is controlled with the Thermostat in the entrance way (5). Not via this panel.

7 Boiler and control panel

This boiler serves as back up for the solar tank (6). If there has not been enough sunshine the solar tank may not have enough hot water for heating or showering. In this instance the gas boiler will automatically top up the solar tank. To turn the heating up in cold weather snaps use the thermostat located in the hallway (5).

8 Hot water from the sun

In summer almost all the water in the solar tank is heated by the sun shining on the solar panel on the roof. In winter the panel can heat the bottom half of the tank and the boiler is used to top up the temperature. This means there is always hot water available in the tank even on a cloudy day.

9 Insulation and draft free construction

This house has been wrapped in insulation to the floor, walls and roof. The front wall has 250mm, rear 200mm, the roof 490mm with vacuum insulation on the ground floor. Gaps in the insulation have been sealed in the insulation have been sealed, producing a draft free building. These improvements will help make your energy costs much lower.

10 Windows (for summer cooling)

To keep the internal temperature cool in the summer utilise the cooler night temperatures by leaving the windows open in the secure "tilt" position overnight. If the weather is hotter outside during the day close the windows and switch the heat recovery ventilation to the summer by pass mode, in the user settings of the control panel (4). The high levels of insulation, in the summer act as a buffer to repelling internal heat gains for the sun which keep you comfortable.

bere:architects

For further information regarding these features:

AD Enviro (Passfield drive building contractor)
Consult the specific manufactures guides supplied

Alan Clarke (Building Services Engineer)
Tel: 01594 563356
E-mail: alan@arclarke.co.uk

bere:architects (passivhaus specialists)
Tel: 020 7359 4503
E-mail: bere@bere.co.uk

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INSIGHTS FROM DEEP RETROFIT

I like it the way it is now, it’s just grand unless you open the window of course [. . .] it’s just lovely, you know what I mean? You can walk around with no clothes and just socks [laughs] you can walk around in a nightie actually and feel no cold [. . .]

SUMMING UP

- the introduction of any new technology has the capacity to set off a process of interactive adaptation
- adaptation is most likely to be effective in the context of effective and transparent technologies, with clear, non-chaotic, and intuitive interfaces
- in some cases, interactive adaptation can turn a modest potential for reduction into a significant increase in energy demand
- the constraints and enablements* afforded by new technologies are best understood from a socio-technical perspective

* Schatzki, T. Where the action is (On large social phenomena such as sociotechnical regimes), Working Paper, November, 2011. p. 10).

SUMMING UP

- behavioural responses are mediated by technology
- behaviour and behaviour change are therefore issues for building occupants **and** for the supply chains that design, build, install, commission, maintain energy efficiency technologies in new and existing buildings
- the next 30-40 years will see transformations in technology that have the capacity to fundamentally change behavioural responses
- e.g. widespread adoption of DH with large scale storage would decouple heating from the electricity grid, shifting the locus of intervention from dwelling occupants to utilities

SUMMING UP

- technologies can interact in complex ways
- in the UK, most boiler replacements are combi-boilers
- combi-boilers eliminate heat storage in dwellings thus eliminating a range of options for DSM through control of water heating, and
- make it more difficult to retrofit technologies such as solar heating and heat pumps

SUMMING UP

- how much choice do people have about the temperatures they live at?
- how easy is it for people to understand the systems in their homes well enough to exercise that choice?
- how might comprehensibility and the range of choice be improved?

SUMMING UP

- don't stop what you are doing - we need integrated assessment models
- but be aware that the behavioural response assumptions that you build into your models are at best rough approximations…
- and that they may be qualitatively as well as quantitatively incorrect

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