Domestic summer comfort; Closing the performance gap

Nick Grant
Mark Siddall

Passivhaus Trust

Mail Online News

Crazy eco rules that are turning modern homes into ovens: Experts warn drive for 'green' homes poses a potentially lethal ris

- Experts warn drive for 'green' homes creates a potentially lethal problem
- Eco houses cut help to carbon emissions and reduce winter heating bills
- But in summer can pose a health risk which worsens due to climate change
- It's feared heat-related deaths will triple to 7,000 a year by the 2050s

By TOM RAWSTORNE FOR THE DAILY MAIL | UPDATED: 08:22, 10 July 2015

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When Emma Taylor was offered a two-bedroom apartment in an award-winning block of flats, she couldn't wait to move in.

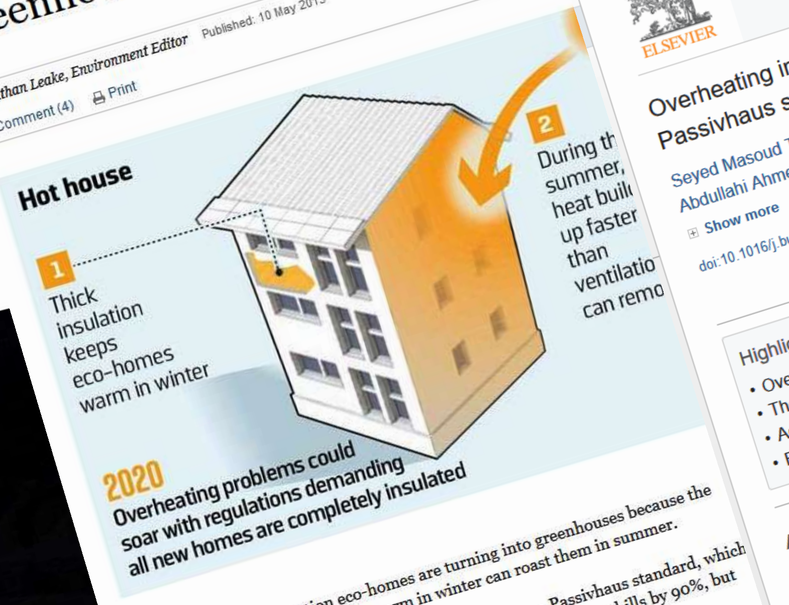
Newly built, she was informed the building had been constructed to such high eco-standards that it would cost just £1 a week to heat. Unfortunately, as she's discovered to her extreme discomfort, keeping warm is the least of her problems.

Because unlike most Britons, 23-year-old Emma has come to dread the summer months. Her ground-floor flat in Coventry is so well insulated that when the sun shines the temperature inside rockets — regularly over 25c, a point at which experts say health can suffer.

NEWS

Residents roast in eco-homes' greenhouse effect

Jonathan Leake, Environment Editor Published: 10 May 2015



BRITAIN'S first-generation eco-homes are turning into greenhouses because the insulation that keeps occupants warm in winter can roast them in summer.

The problem mainly affects homes built to the German Passivhaus standard, which levels for low energy consumption. Such homes can cut heating bills by 90%, but scientists say their heavy insulation can cause summer overheating.

One study, conducted over three summers at a housing association scheme in Cove

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Overheating investigation in UK social housing flats built to the Passivhaus standard

Seyed Masoud Tabatabaei Sameni, Mark Gaterell, Azadeh Montazami, Abdullahi Ahmed

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doi:10.1016/j.buildenv.2015.03.030

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Highlights

- Overheating risk is more related to occupant behaviour in Passivhaus (PH) flats.
- There is a significant risk of summer overheating based on PH benchmark.
- Adaptive model is better in representing the overheating risk in PH flats.
- Based on above model risk of overheating is higher for vulnerable occupants.

Abstract

Global environmental and energy concerns have led to a rapid growth in mandating the construction of more energy efficient dwellings in the UK. This is particularly true for the social housing sector which is partly founded by the government and it is expected to lead the way in this respect.

To address this issue energy efficiency standards such as Passivhaus are increasingly adopted by both private and social housing sectors in the UK. However, data describing actual thermal performance of dwellings built to such standards, particularly in dense social housing flats, are scarce.

This study considers the overheating risk during the cooling season in social housing flats built to the Passivhaus standard in the UK. It considers 25 flats over three cooling

Design for climate change?

Designing for current weather would be a leap forward!

Future is uncertain

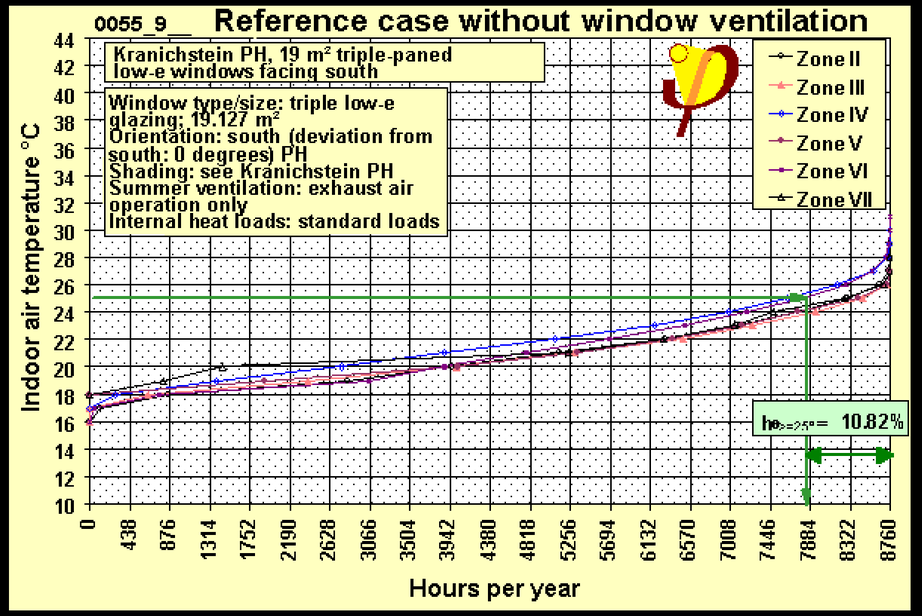
- How hot?
- How humid?
- How wet?

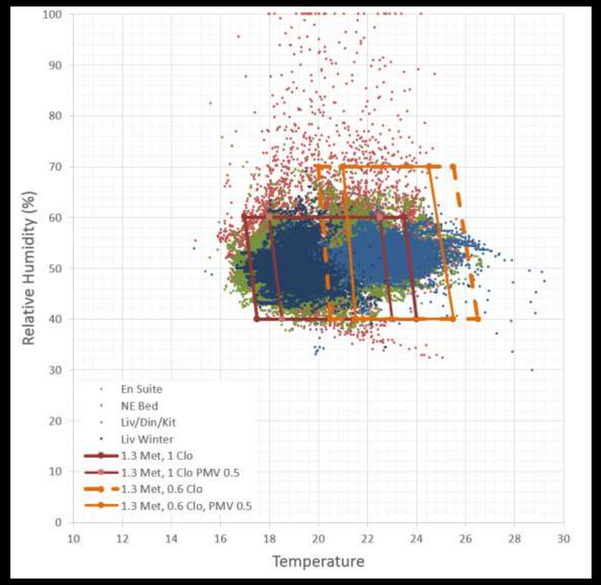
Can we assume night purge or cross vent will work?

Passivhaus

Total hours <10% <876 h/a <5% = best

Temperature swing <3K





BS EN 7730

Fanger

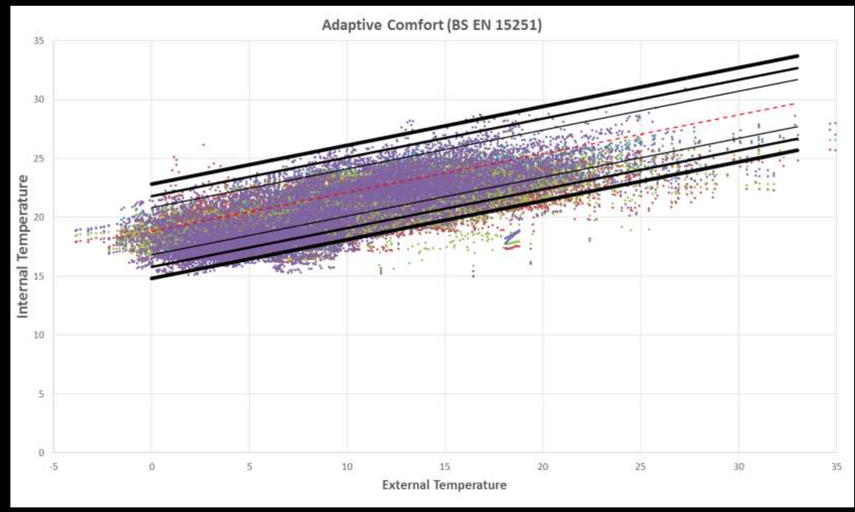
CIBSE Guide A

Occupied hours

26°C for 1% bedrooms

28°C for 1% living areas

Adaptive Comfort



Nicol

ASHRAE 55

BS EN 15251

Humphreys

PHPP assumptions

IHGs?

Night vent?

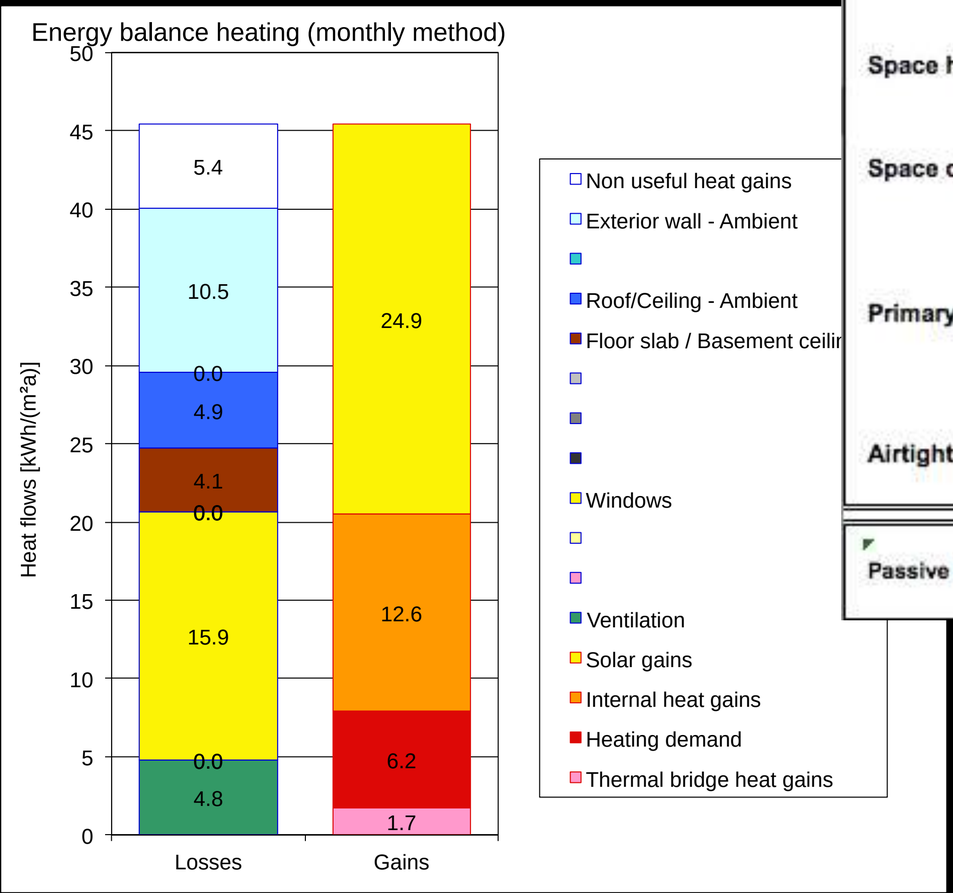
Thermal mass?

Solar gains?

Moveable shading?

Albert Einstein

We took the PHPP for a building that works, cranked up the South window area and fixed the overheating:



Specific building demands with reference to the treated floor area

				Requirements	Fulfilled?*
	Treated floor area	134.0	m²		
Space heating	Heating demand	**6.2**	**kWh/(m²a)**	15 kWh/(m²a)	**yes**
	Heating load	**9.4**	**W/m²**	10 W/m²	**yes**
Space cooling	Overall specif. space cooling demand		**kWh/(m²a)**	-	-
	Cooling load		**W/m²**	-	-
	Frequency of overheating (> 25 °C)	1.9	%	-	-
Primary energy	Heating, cooling, auxiliary electricity, dehumidification, DHW, lighting, electrical appliances	**97**	**kWh/(m²a)**	120 kWh/(m²a)	**yes**
	DHW, space heating and auxiliary electricity	43	kWh/(m²a)	-	-
	Specific primary energy reduction through solar electricity	60	kWh/(m²a)	-	-
Airtightness	Pressurization test result n_{50}	**0.6**	**1/h**	0.6 1/h	**yes**

* empty field: data missing; '-': no requirement

Passive House?	**yes**

1.9% ☺

Fill in the IHG sheet

Fill in DHW, electricity etc ...of course not used for heating calcs!

Year of construction:	2014		Interior temperature winter:	20.0	°C
No. of dwelling units:	1		Interior temperature summer:	25.0	°C
No. of occupants:	6.0		Internal heat sources winter:	2.5	W/m²
Spec. capacity:	132	Wh/K per m² TFA	Ditto summer:	5.0	W/m²

Specific building demands with reference to the treated floor area

	Treated floor area		134.0	m²
Space heating	Heating demand		**6.4**	**kWh/(m²a)**
	Heating load		**9.5**	**W/m²**
Space cooling	Overall specif. space cooling demand			**kWh/(m²a)**
	Cooling load			**W/m²**
	Frequency of overheating (> 25 °C)		9.4	%
Primary energy		Heating, cooling, auxiliary electricity, dehumidification, DHW, lighting, electrical appliances	**139**	**kWh/(m²a)**
	DHW, space heating and auxiliary electricity		57	kWh/(m²a)
	Specific primary energy reduction through solar electricity		60	kWh/(m²a)
Airtightness	Pressurization test result n_{50}		**0.6**	**1/h**

9.4% ☹

Night vent

Acceptable?
- security, noise, rain, insects, sleep disruption

Sensible assumptions

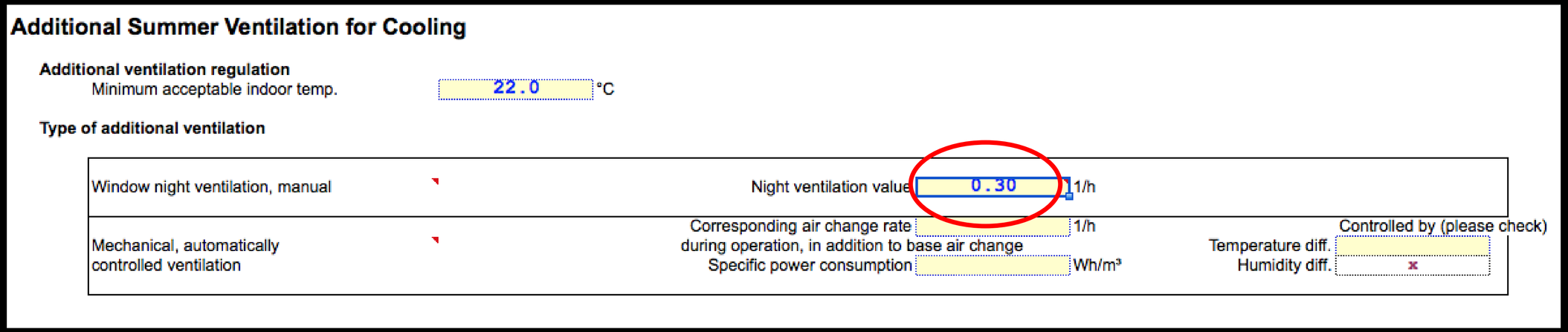
- Half the achievable night time ventilation and assuming internal doors are closed

Mechanical vent
- enough for cooling? Duct and fan sizing?

- Effectiveness of MVHR ‘summer bypass’ mode can be overstated in PHPP so set at 70%

See PHT Rules of Thumb Guide

Check the summer night vent



Additional Summer Ventilation for Cooling

Additional ventilation regulation
Minimum acceptable indoor temp. 22.0 °C

Type of additional ventilation

Window night ventilation, manual	Night ventilation value 0.30 1/h		
Mechanical, automatically controlled ventilation	Corresponding air change rate during operation, in addition to base air change 1/h Specific power consumption Wh/m³	Controlled by (please check) Temperature diff. Humidity diff. x	

6.3%

Note night vent is air changes per K!
Will internal doors be left open?

air changes per hour per K	% overheating hours	
0.3	6.3%	Total air changes? ☹
0.1	18%	Conservative assumption ☹
0	29%	Noisy road, windows shut ☹

Daytime window vent

Summer background ventilation to ensure adequate air quality

Air exchange via vent. system with supply air:	0.30	1/h	HRV/ERV in summer (check only one field)	
			None	
			automatic bypass, controlled by temperature difference	x
			automatic bypass, controlled by enthalpy difference	
			always	
Air exchange via extract air system		1/h	Specific power consumption (for extract air system)	0.20 Wh/m³
Window ventilation air exchange	0.50	1/h		

3.4% ☺

Realistic? Security, flies, hotter out than in?? . . .

Air exchange via vent. system with supply air:	0.30	1/h	HRV/ERV in summer (check only one field)	
			None	
			automatic bypass, controlled by temperature difference	x
			automatic bypass, controlled by enthalpy difference	
			always	
Air exchange via extract air system		1/h	Specific power consumption (for extract air system)	0.20 Wh/m³
Window ventilation air exchange	0.00	1/h		

14% ☹

Light and Tight vs. Mass and Glass

Top, La Vereda Compound is a condominium development in the historic district of Santa Fe, N.M. Designed by architects Mazria Odems Dzurec Inc., the buildings incorporate greenhouse spaces and passive heating and cooling strategies. Bottom, the Balcomb House in Santa Fe, featured in *Sunset* and *LIFE* magazines, has come to exemplify passive solar benefits.

Thermal mass

Modest benefit for domestic properties.

Still need to dump the absorbed heat.

Wh/K per m² TFA	% overheating hours	kWh/(m².a)
204 (max)	7.2%	5.9
132 (mixed)	7.5%	6.2
60 (light)	9.8%	7.2

Extra energy saving
(134m² x 1.3kWh/(m².a) = 174kWh/a

@ 11p/kWh = £19/a)

Light and Tight vs. Mass and Glass

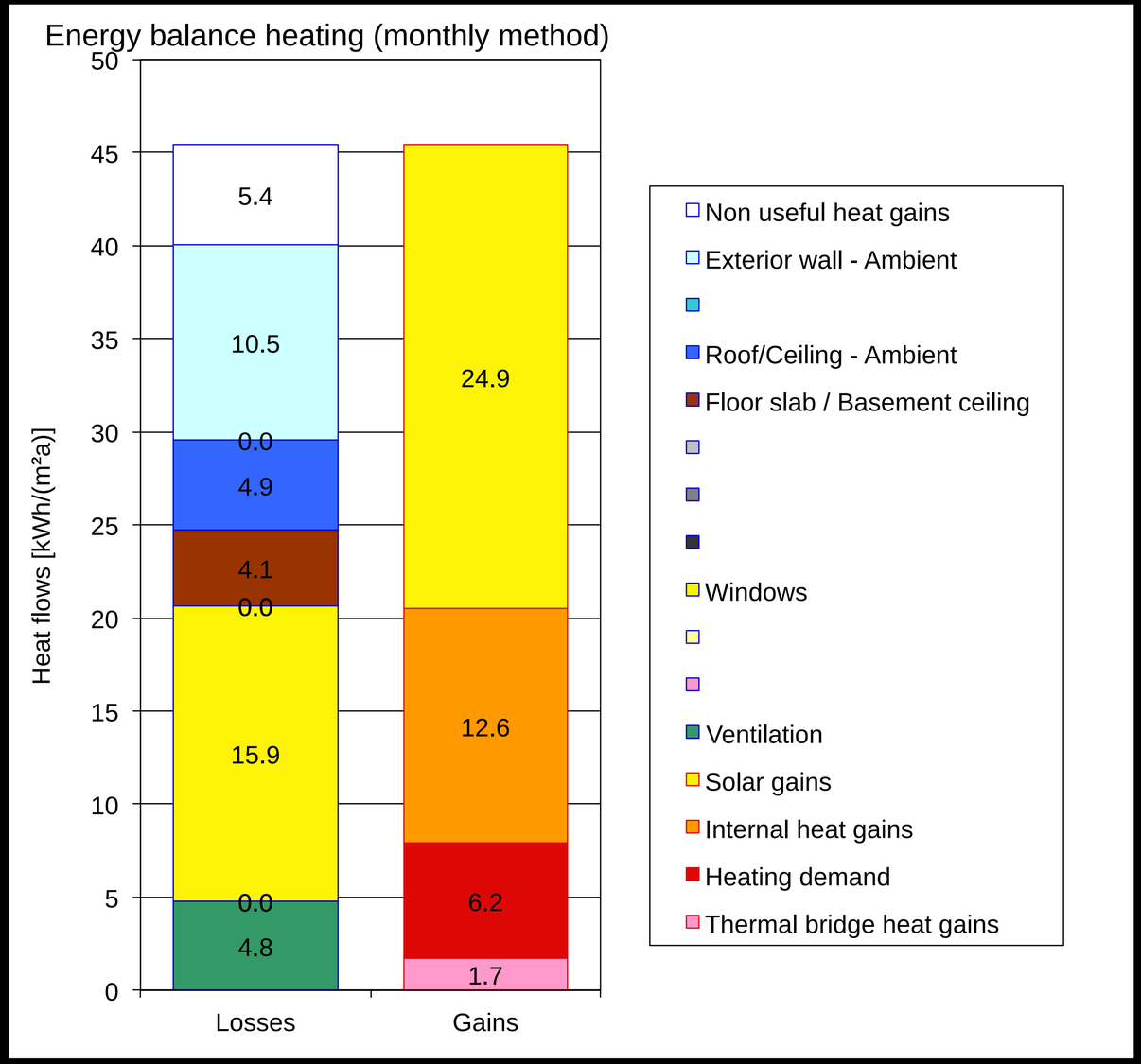
Solar gain

Solar gain

Difficult to control and largely out of synch with heating demand.

Glazing is expensive. c.a. £1/kWh for free solar heat

Generally avoid east and west facing glazing (some exceptions)



Moveable shading

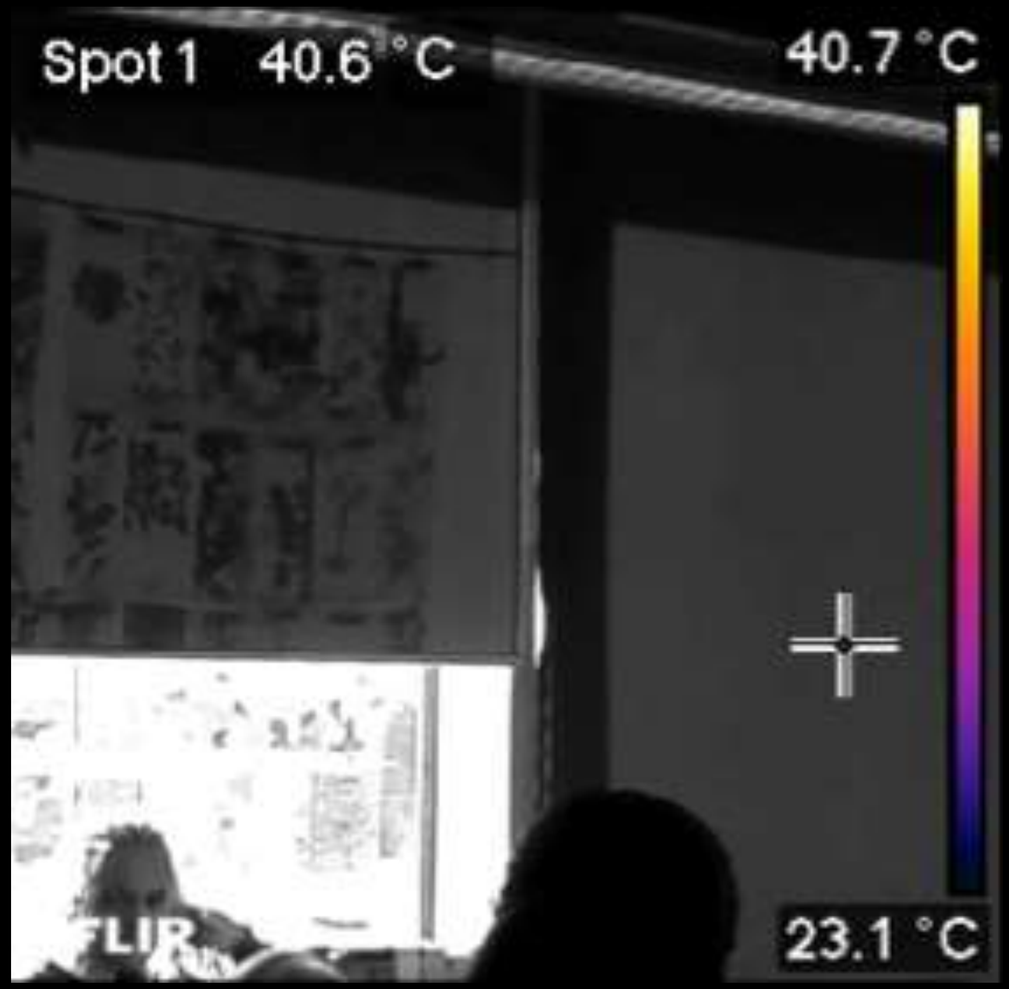
Will it stay in the budget?

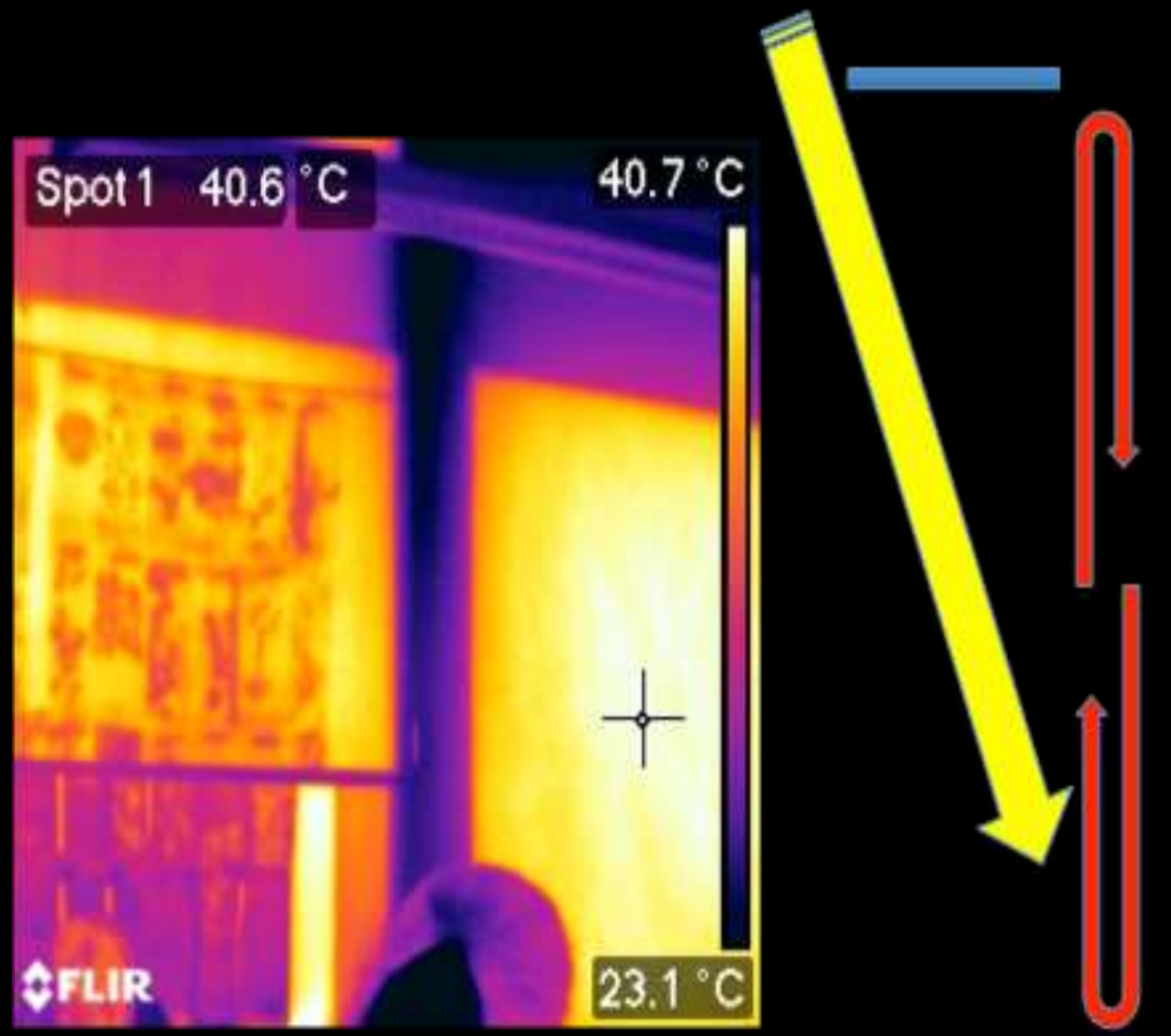
Will it be closed before going to work, it’s the UK not Spain!

Will it still be working in 5 years?

So minimise user operated summer shading – last resort to fix a design problem

Don’t forget radiant discomfort





Approach

Drive IHGs down

- DHW distribution and storage

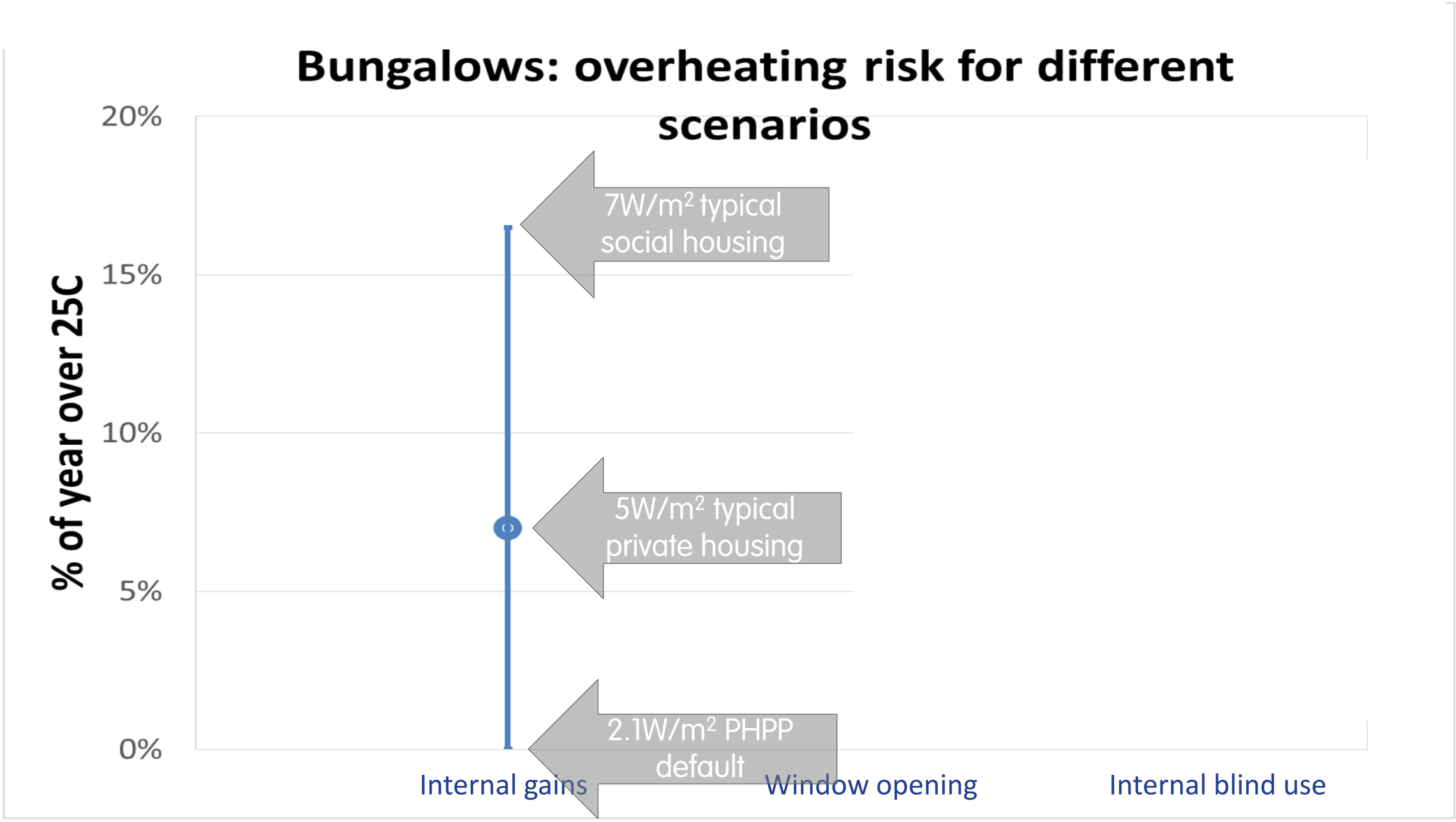
- Induction hobs

- Most efficient white goods

- Clothes drying in house

- Passive cooling as first choice but only if simple!

Lessons Learnt: Can we use PHPP to get more accurate results?



Applying the lessons

Predictions and Assumptions

IHGs 2.1W/m^2

Ventilation Summer Bypass (0.37 ach/hr)

Night vent None

Shading Fixed (230mm deep reveals)

Mass 108 Wh/K per m^2 TFA

Temp swing0.9 K

Overheating 0%

Measured Results

Minimum Temperature

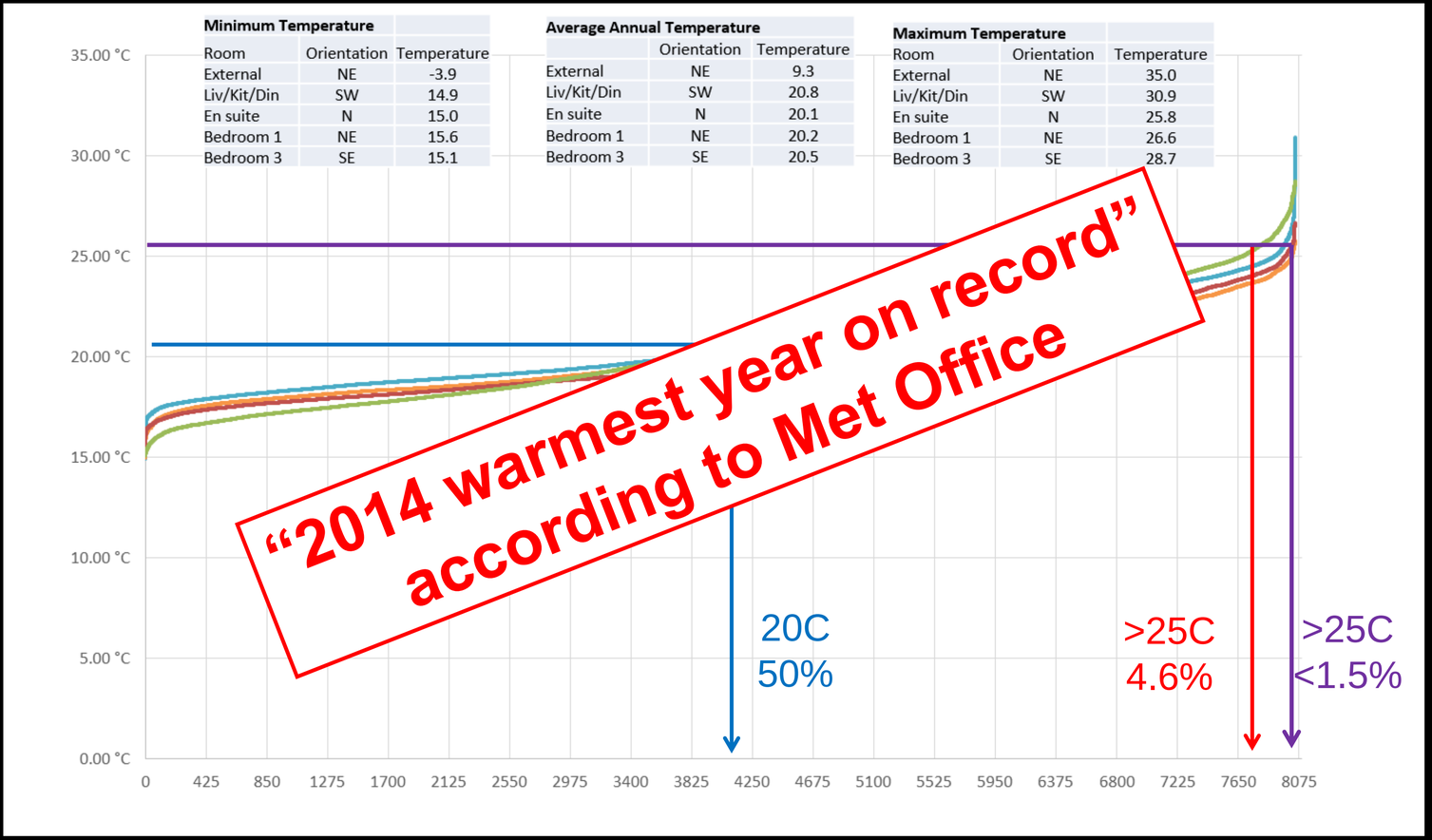
Room	Orientation	Temperature
External	NE	-3.9
Liv/Kit/Din	SW	14.9
En suite	N	15.0
Bedroom 1	NE	15.6
Bedroom 3	SE	15.1

Average Annual Temperature

	Orientation	Temperature
External	NE	9.3
Liv/Kit/Din	SW	20.8
En suite	N	20.1
Bedroom 1	NE	20.2
Bedroom 3	SE	20.5

Maximum Temperature

Room	Orientation	Temperature
External	NE	35.0
Liv/Kit/Din	SW	30.9
En suite	N	25.8
Bedroom 1	NE	26.6
Bedroom 3	SE	28.7



Garway Passivhaus by Dempsey Decourcy Architects

“*In the hot spell this summer the builders all wanted to work inside because it was so cool!*”

Photos Juraj Mikurcik


Photo Juraj Mikurcik

Conclusions

- Use conservative design assumptions (occupancy, IGH, night vent rates, thermal mass, pipe insuation etc)
- Ruthlessly reduce IHGs (DHW losses, efficient goods, lighting etc)
- Favour reduced heat loss over increased solar gain
- Consider future cooling strategy, cooling load vs % overheating hours?