

#UKPHC21

Watts wrong with 15kWh/(m².a) Passive solar is dead, long live Passivhaus



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With Alan Clarke
[@ecomiminalnick](https://twitter.com/ecomiminalnick)

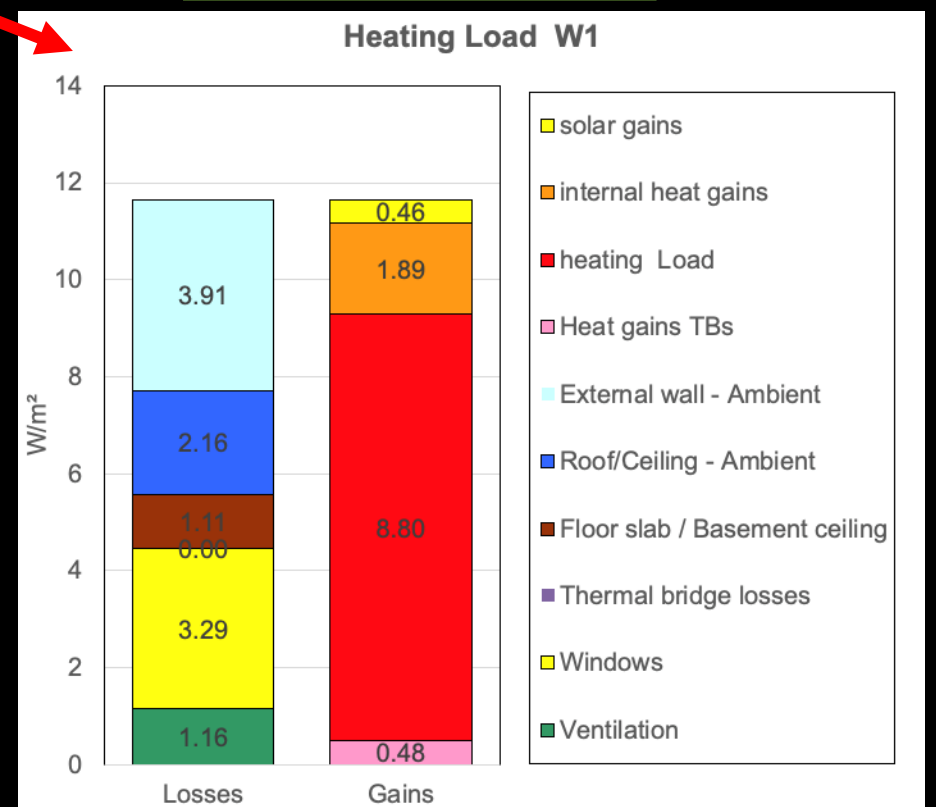
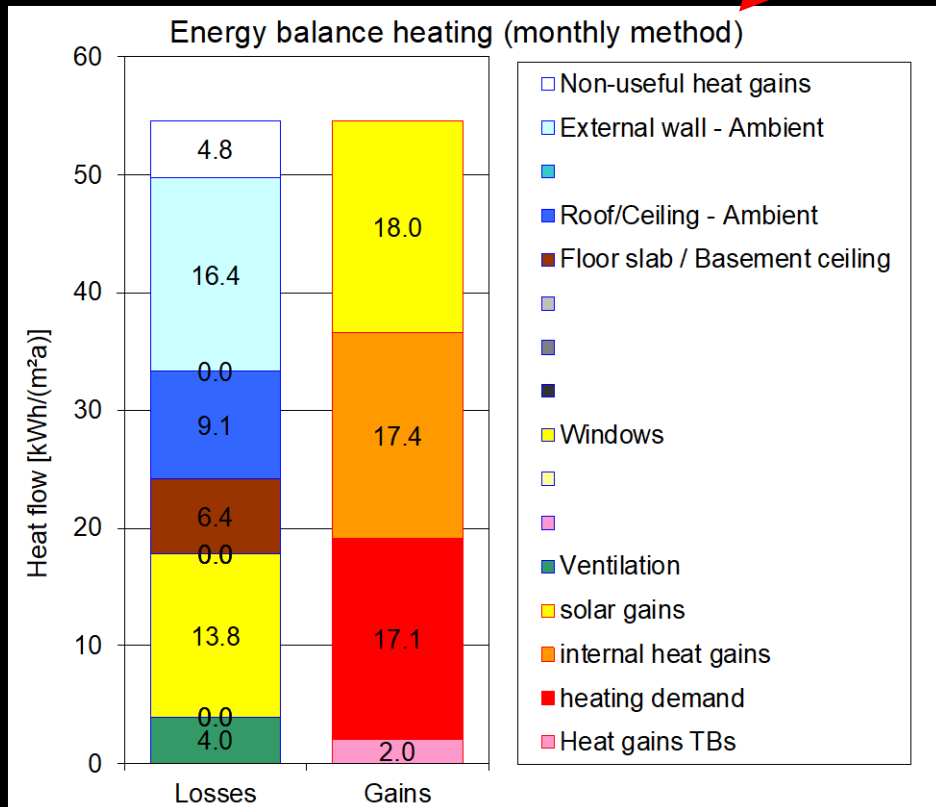


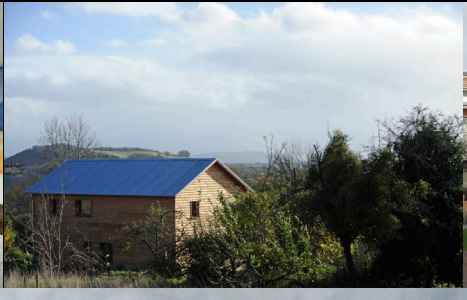
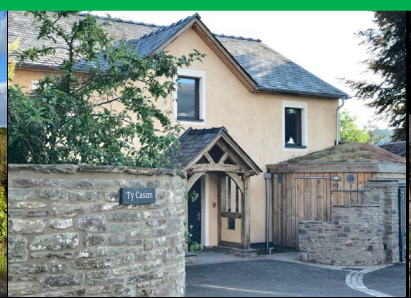
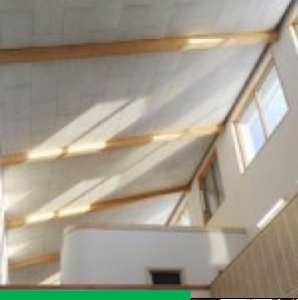
Heating demand or heating load

We can choose

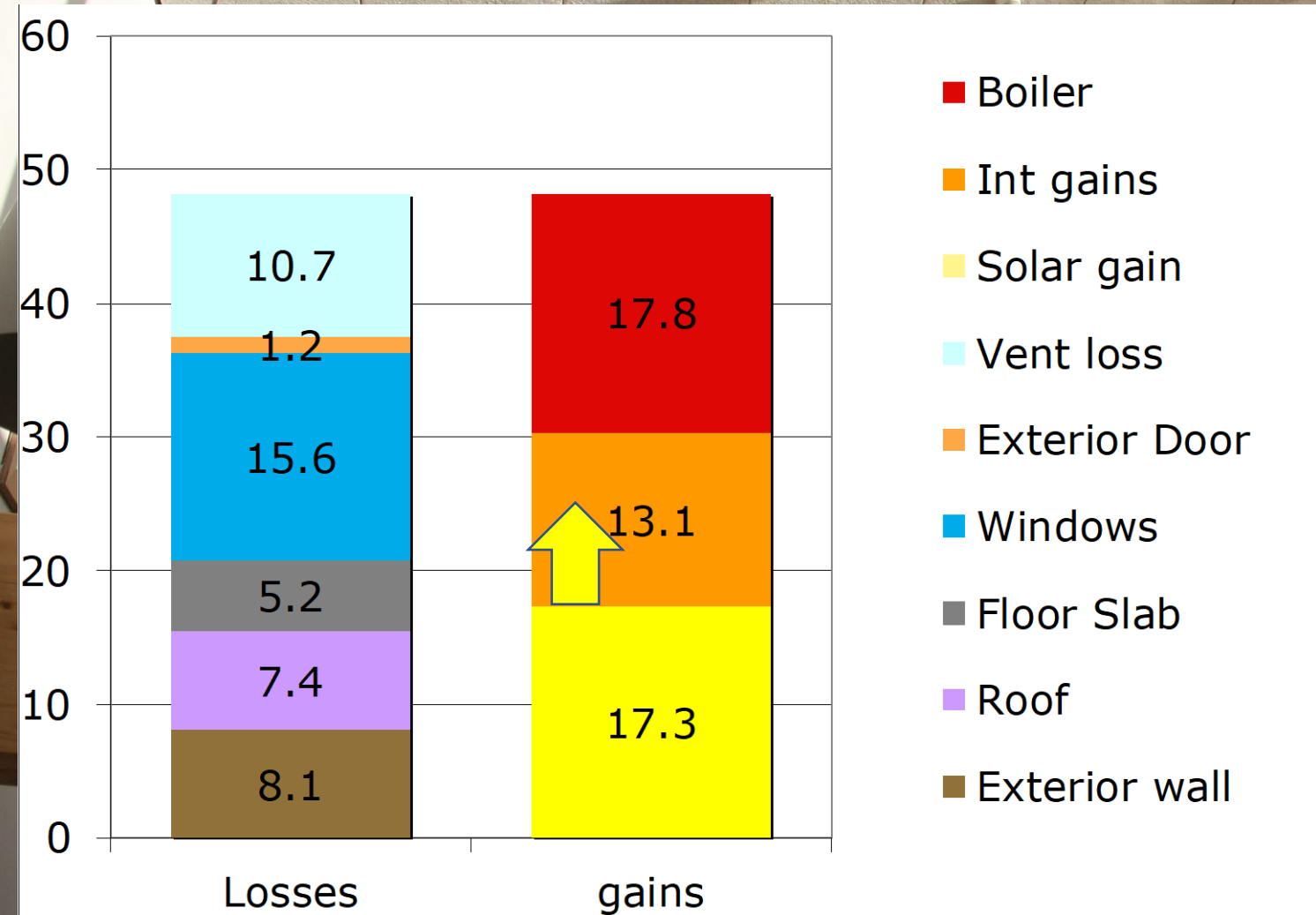


Space heating	Treated floor area m ²	170.5		<table border="1"> <thead> <tr> <th>Criteria</th> <th>Alternative criteria</th> </tr> </thead> <tbody> <tr> <td>15</td> <td>-</td> </tr> <tr> <td>-</td> <td>10</td> </tr> </tbody> </table>	Criteria	Alternative criteria	15	-	-	10	Fulfilled? ²
	Criteria	Alternative criteria									
	15	-									
-	10										
Heating demand kWh/(m ² a)	17.1	≤									
Heating load W/m ²	9.0	≤									
				yes							





Bushbury School 2010



12 31 Wh/(m²*month)	Heating Load		Cooling Load
	Weather 1	Weather 2	Radiation
	Radiation: W/m²		W/m²
3.9			
6			
11			
31	No Data		
11			
15			
-5.1			
12.7	12.1	12.1	15.5

Larch and Lime Houses Ebbw Vale

Justin Bere 2011



$<15 \text{ kWh}/(\text{m}^2.\text{a})$

$13 \text{ kWh}/(\text{m}^2.\text{a}), 11 \text{ W}/\text{m}^2$

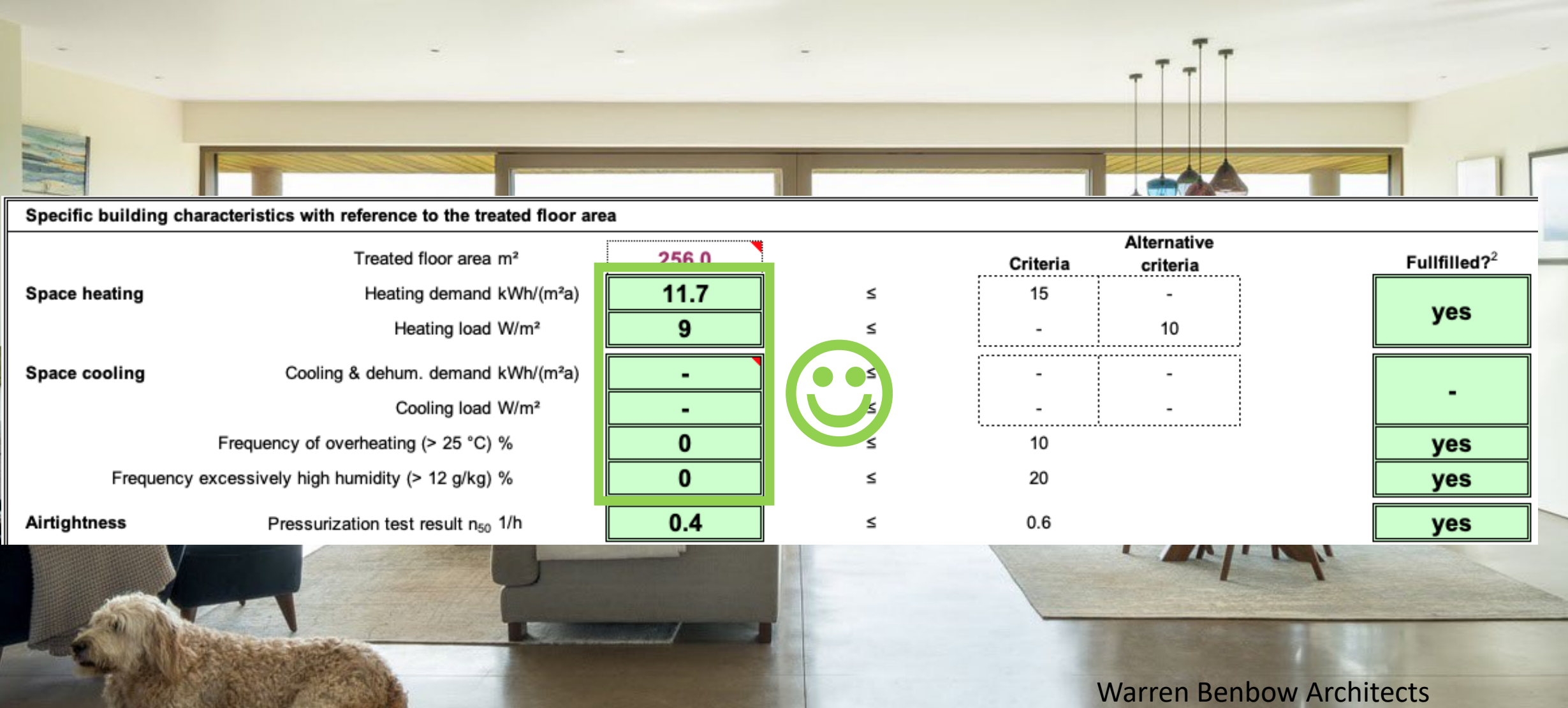
$<10 \text{ W}/\text{m}^2$

$17 \text{ kWh}/(\text{m}^2.\text{a}), 10 \text{ W}/\text{m}^2$

Heating demand or load, do we need to choose?



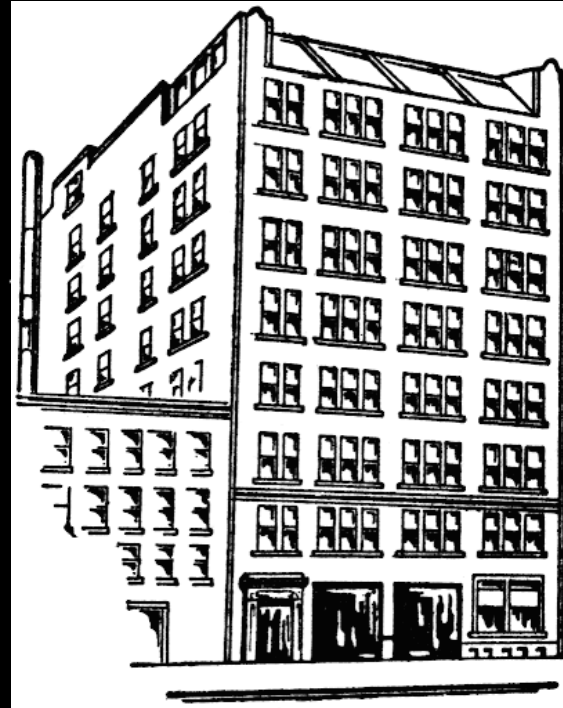
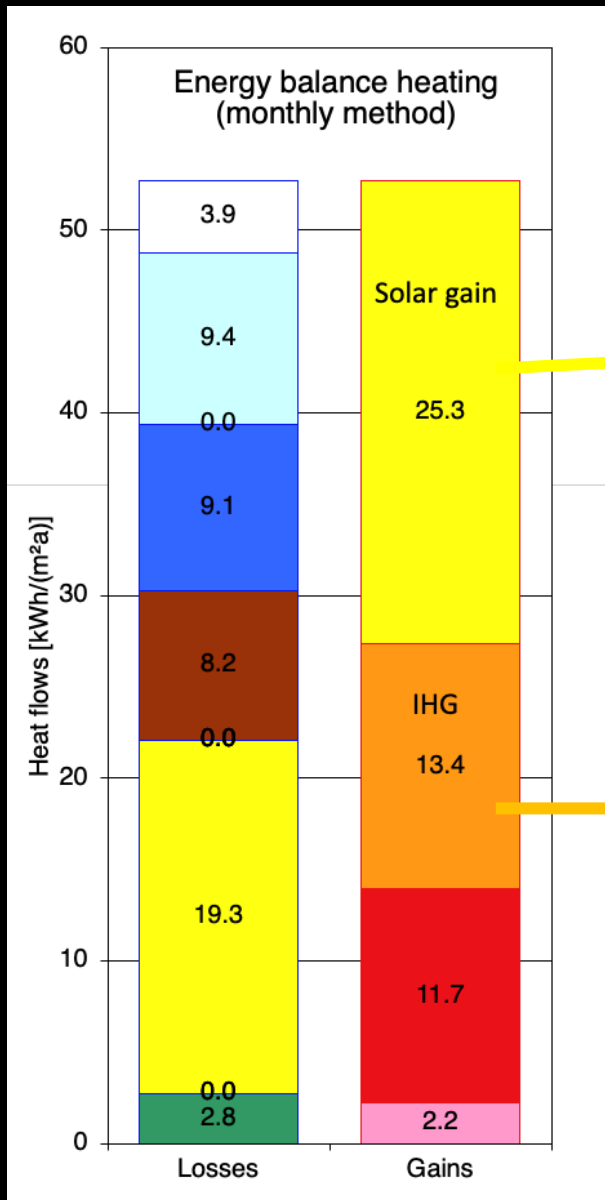
Classic passive-solar Passivhaus



Specific building characteristics with reference to the treated floor area										
	Treated floor area m ²	256.0								
Space heating	Heating demand kWh/(m ² a)	11.7	≤	<table border="1"> <thead> <tr> <th>Criteria</th> <th>Alternative criteria</th> </tr> </thead> <tbody> <tr> <td>15</td> <td>-</td> </tr> <tr> <td>-</td> <td>10</td> </tr> </tbody> </table>	Criteria	Alternative criteria	15	-	-	10
	Criteria	Alternative criteria								
15	-									
-	10									
	Heating load W/m ²	9	≤							
Space cooling	Cooling & dehum. demand kWh/(m ² a)	-	≤							
	Cooling load W/m ²	-	≤							
	Frequency of overheating (> 25 °C) %	0	≤	10						
	Frequency excessively high humidity (> 12 g/kg) %	0	≤	20						
Airtightness	Pressurization test result n ₅₀ 1/h	0.4	≤	0.6						



Energy balance, gains dominate



Passive solar (b. 1940, d. 1979) Hot in summer, cold in winter



Saskatchewan Conservation House (1977)

Airtight, super-insulated, HRV, glazed for daylight not solar gains.



Passivhaus is not passive-solar but old habits die hard



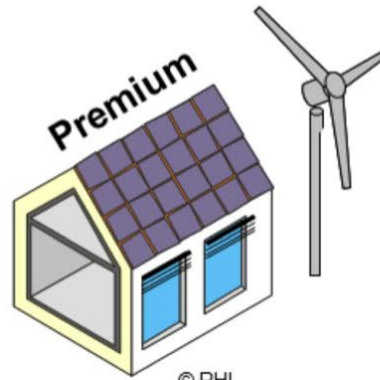
PASSIVE HOUSE CLASSES



120

Renewable energy generation

[kWh_{PER}/(m²_{projected}*a)]



30



60



45



Total PER-demand

[kWh_{PER}/(m²_{TFA}*a)]

60

Bigger windows, thicker insulation?

- Not cost effective
- More embodied carbon
- Summer discomfort
- Orientation crucial

West facing plot challenge

South gable
faces
neighbour



Dempsey
Decourcy
Architects

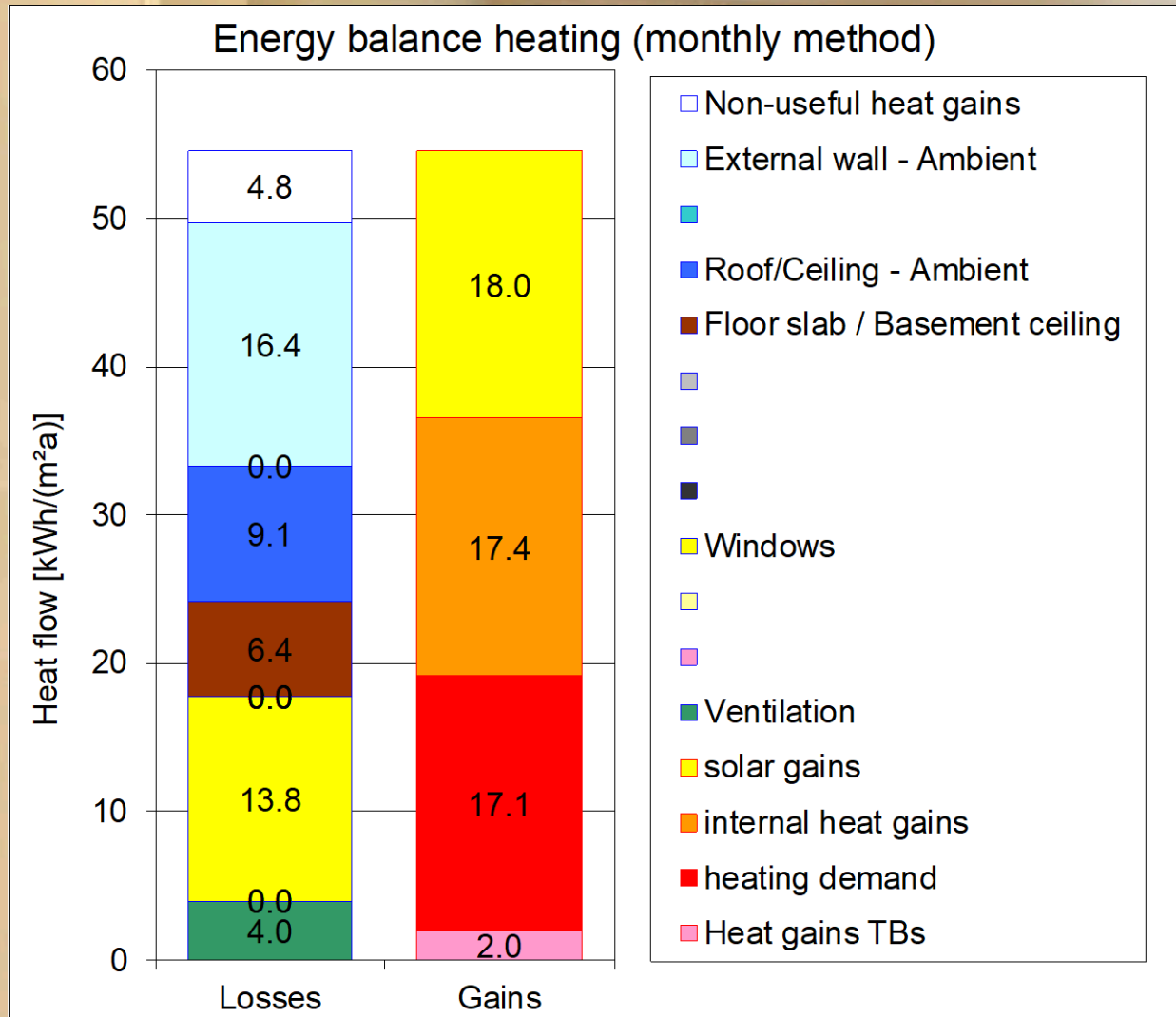
Kitchen/dining looking west and east

Forced us to optimise the glazing for daylight and summer comfort



Struggled to hit 15 kWh/(m².a)

$n_{50} < 0.1$, negative thermal bridges etc



How to get from 17 to 15 kWh/(m².a)?

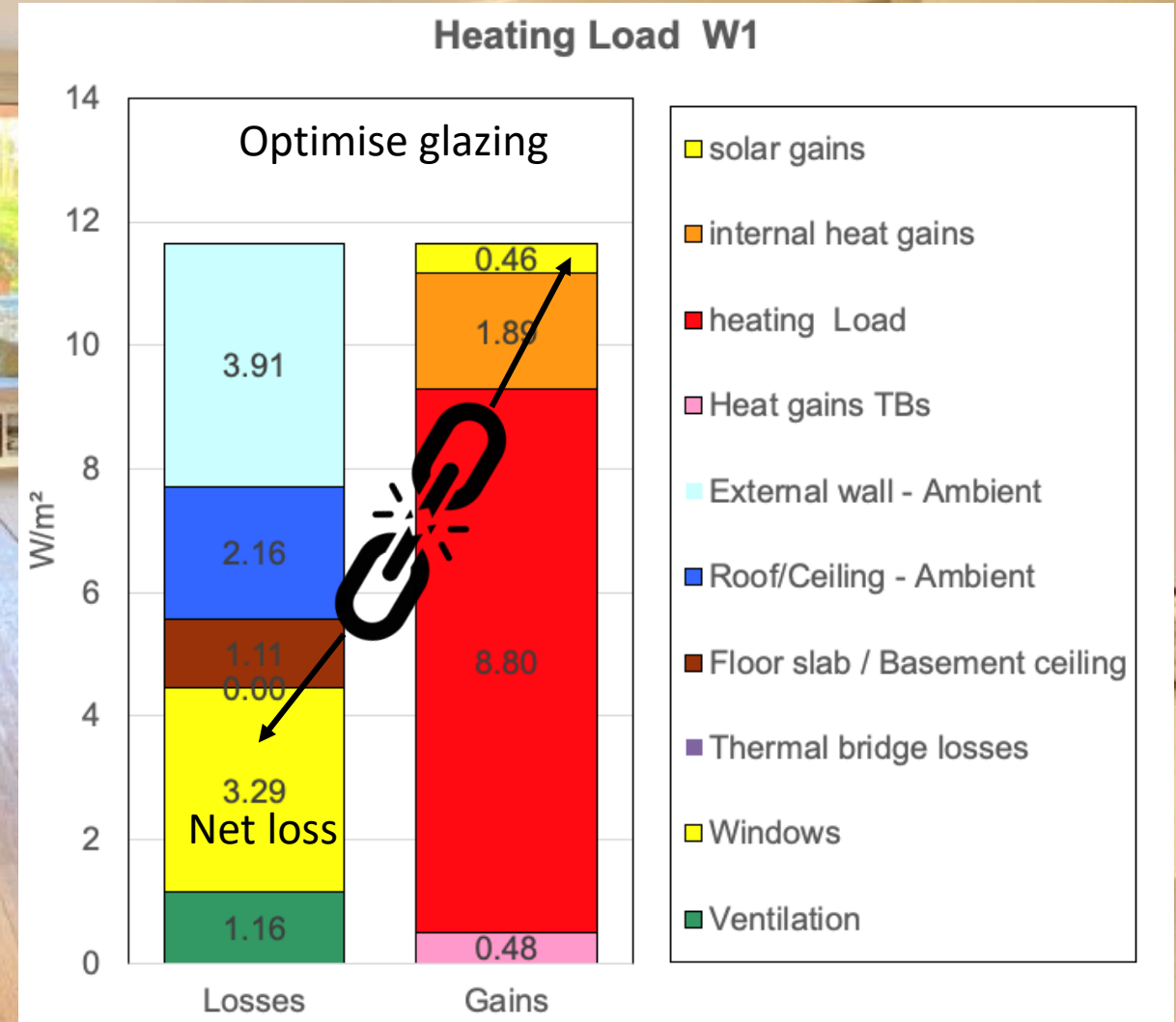
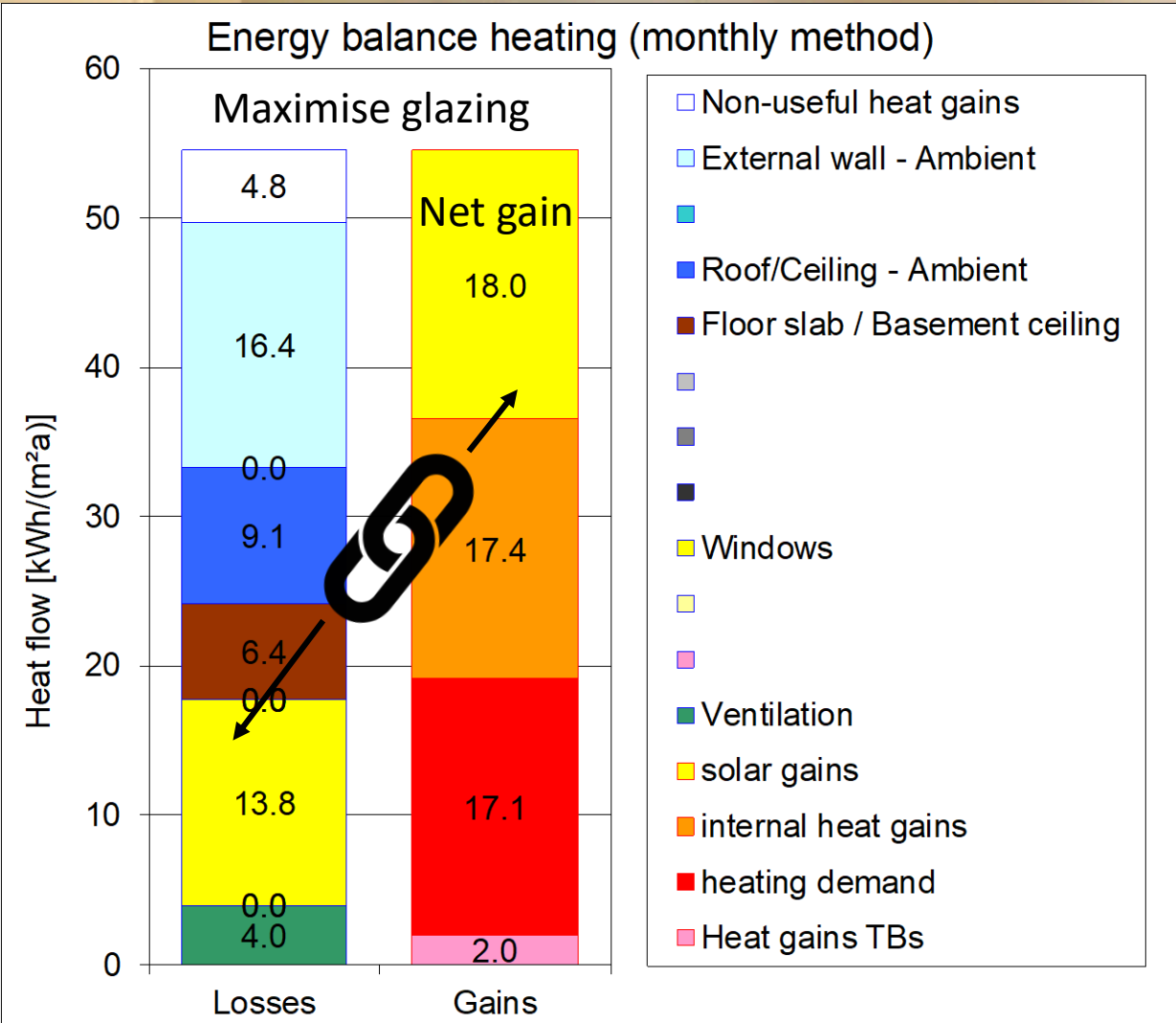
Already optimised design using our standard construction

Option	As built	SHD kWh/(m ² .a)	Heat Load W/m ²	>25°C (no window vent)	Notes
As built		17.1	8.8	5%	200m altitude
0.62 g glass	0.54	17.1	9.0	7.5	Glass area is 13% of TFA
400mm floor ins'	200	15.4	8.4	7.6	High cost and embodied carbon
400mm wall studs	300	15.0	8.1	6.1	High cost, redesign, larger footprint
400mm roof	300	15.4	8.3	5.7	Higher cost, raised ridge height

- All measures are high cost, extra embodied energy, hotter in summer.
- Heating costs £150/year so might save about £18/y 😞

Compare with heat load balance

Losses similar, gains very different



What if we can face the same building south?

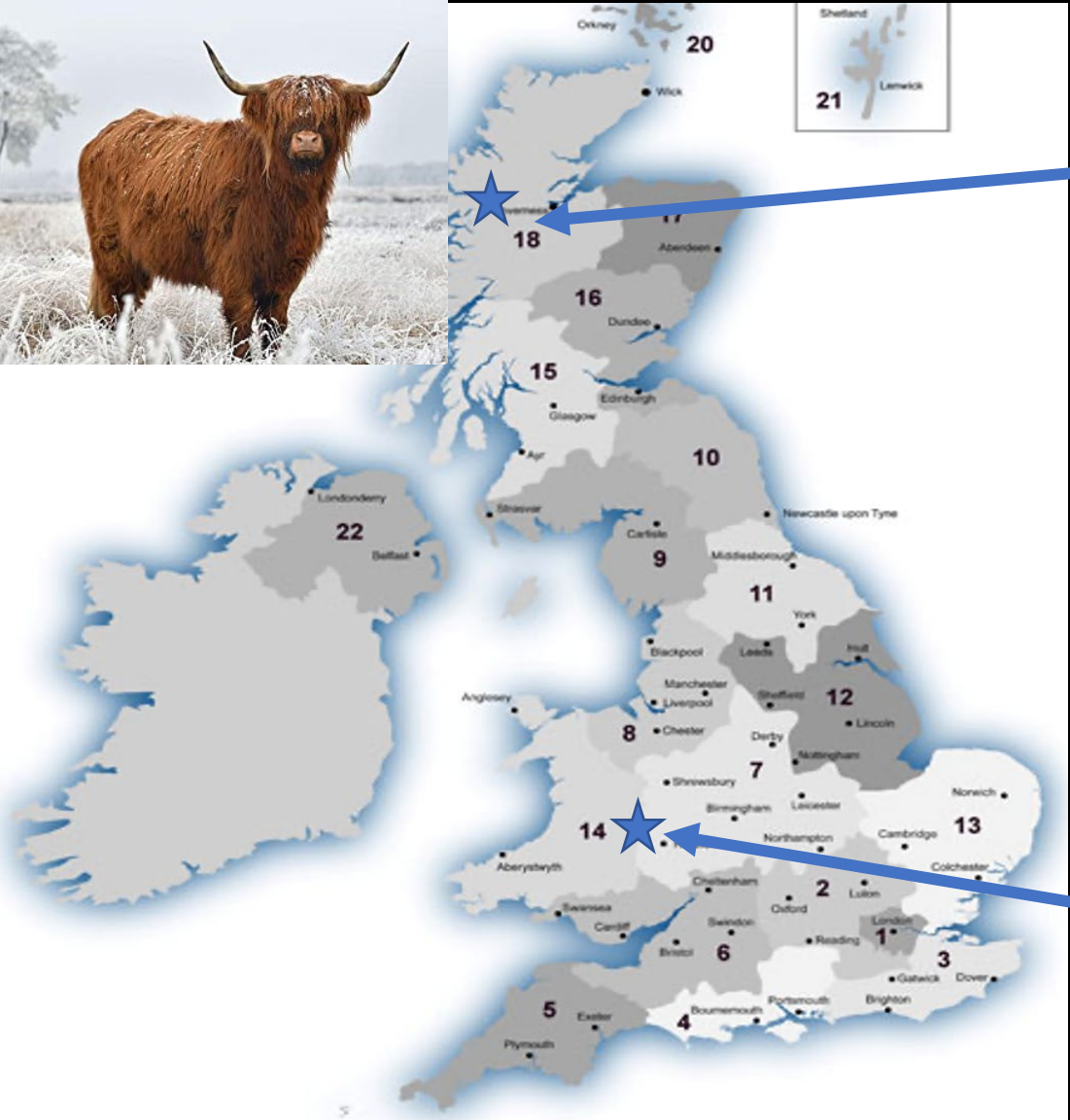
- Summer comfort even better
- Save £18/year on heating!

Space heating	Heating demand kWh/(m ² a)	15.0
	Heating load W/m ²	8.5
Space cooling	Cooling & dehum. demand kWh/(m ² a)	-
	Cooling load W/m ²	-
	Frequency of overheating (> 25 °C) %	2

(The occupants are really happy with the east-west orientation!)

What if we move it to Scotland?

Same house, still facing west @ 200m altitude, can meet PH!



Space heating	Heating demand kWh/(m ² a)	20.9
	Heating load W/m ²	10.5
Space cooling	Cooling & dehum. demand kWh/(m ² a)	-
	Cooling load W/m ²	-
	Frequency of overheating (> 25 °C) %	0



+ £60/year for heating for a 170m² house

(compared to 15 kWh/(m².a))

Space heating	Heating demand kWh/(m ² a)	17.1
	Heating load W/m ²	8.8
Space cooling	Cooling & dehum. demand kWh/(m ² a)	-
	Cooling load W/m ²	-
	Frequency of overheating (> 25 °C) %	5

Some advantages of designing for peak load

- Less sensitive to solar gain;
 - shading, orientation, location, climate data accuracy, weather, fenestration etc
- Doesn't encourage too much glass!
- Good airtightness and ventilation is rewarded (very economic)

Lower cost, better comfort, confidence in design pre planning

Recommendations:

- Design for daylight and views not solar gain.
- Standardise solutions, tried and tested not bespoke.
- 10 W/m² pre-dates Passivhaus and seems a good target
(but we don't advise heating with air 😊 or 100W lightbulbs)

Power or energy?

Thanks for listening



UK **passivhaus** conference 2021



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PASSIVHAUS

THANK YOU

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