Passivhaus and Zero Carbon – Closing the Cost Gap

Jane Barnes, Aecom Roger Burton, nvirohaus

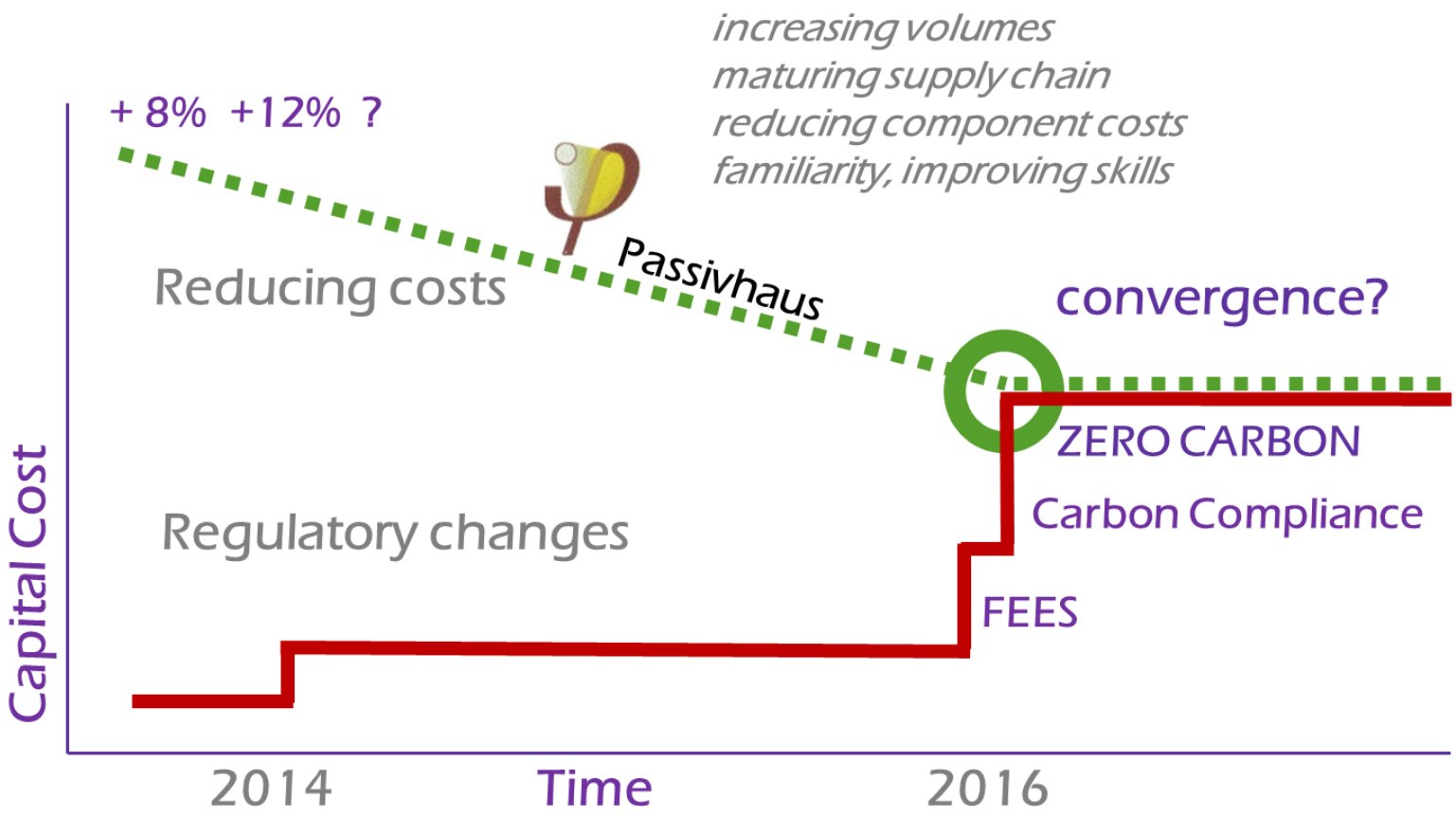
ukpassivhaus conference 2014

what are our ambitions?

- reduce the perceived barriers to increased uptake of Passivhaus
- share the benefits of quality construction, improved comfort, lower energy use and costs and reduced environmental impact
- meet future challenges

the issues?

- Zero Carbon Homes are on the near horizon and the new standard has been defined
- the cost of new homes will rise – how will this relate to Passivhaus?
- will the higher standard be achieved in reality?


increasing volumes
maturing supply chain
reducing component costs
familiarity, improving skills
+ 8% +12% ?
Reducing costs
Passivhaus
convergence?
ZERO CARBON
Carbon Compliance
FEES
Regulatory changes
Capital Cost
2014
Time
2016

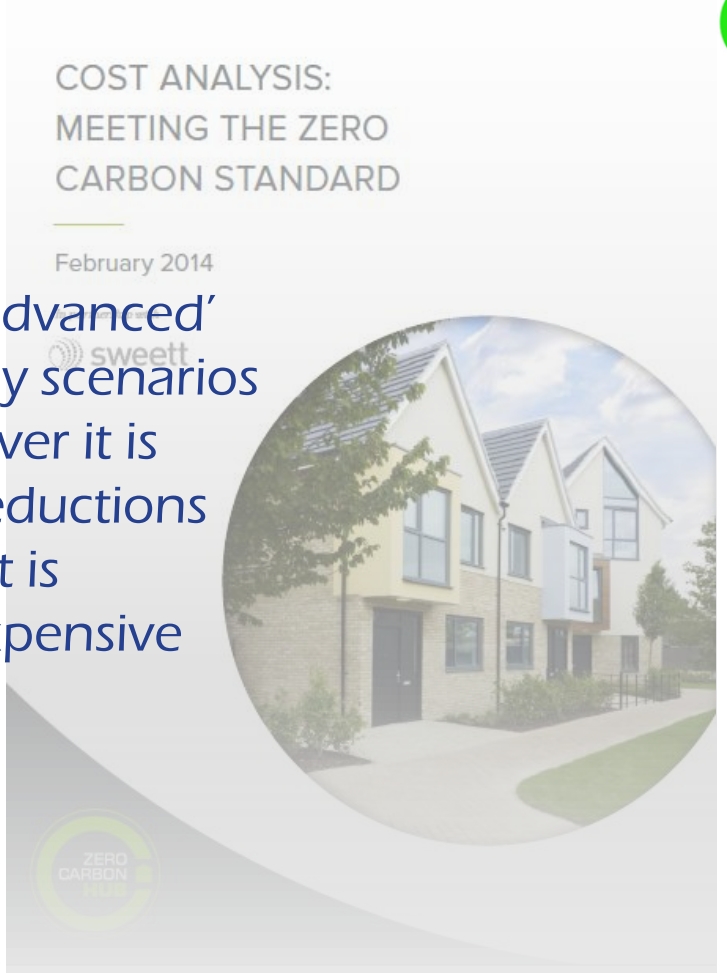
the study – in progress

- based on reality using existing house types
- compares both fabric efficiency standards and alternative modelling
- determines realistic standards for fabric efficiency
- examines requirements for Carbon Compliance
- undertakes comparative costs for achieving Zero Carbon

the background

'The cost premium associated with 'Advanced' (close to PassivHaus) energy efficiency scenarios is likely to reduce in the future, however it is unlikely that it will outstrip the cost reductions projected for solar PV and therefore it is assumed to continue to be a more expensive option in terms of capital costs'.

ZCH Feb 2014



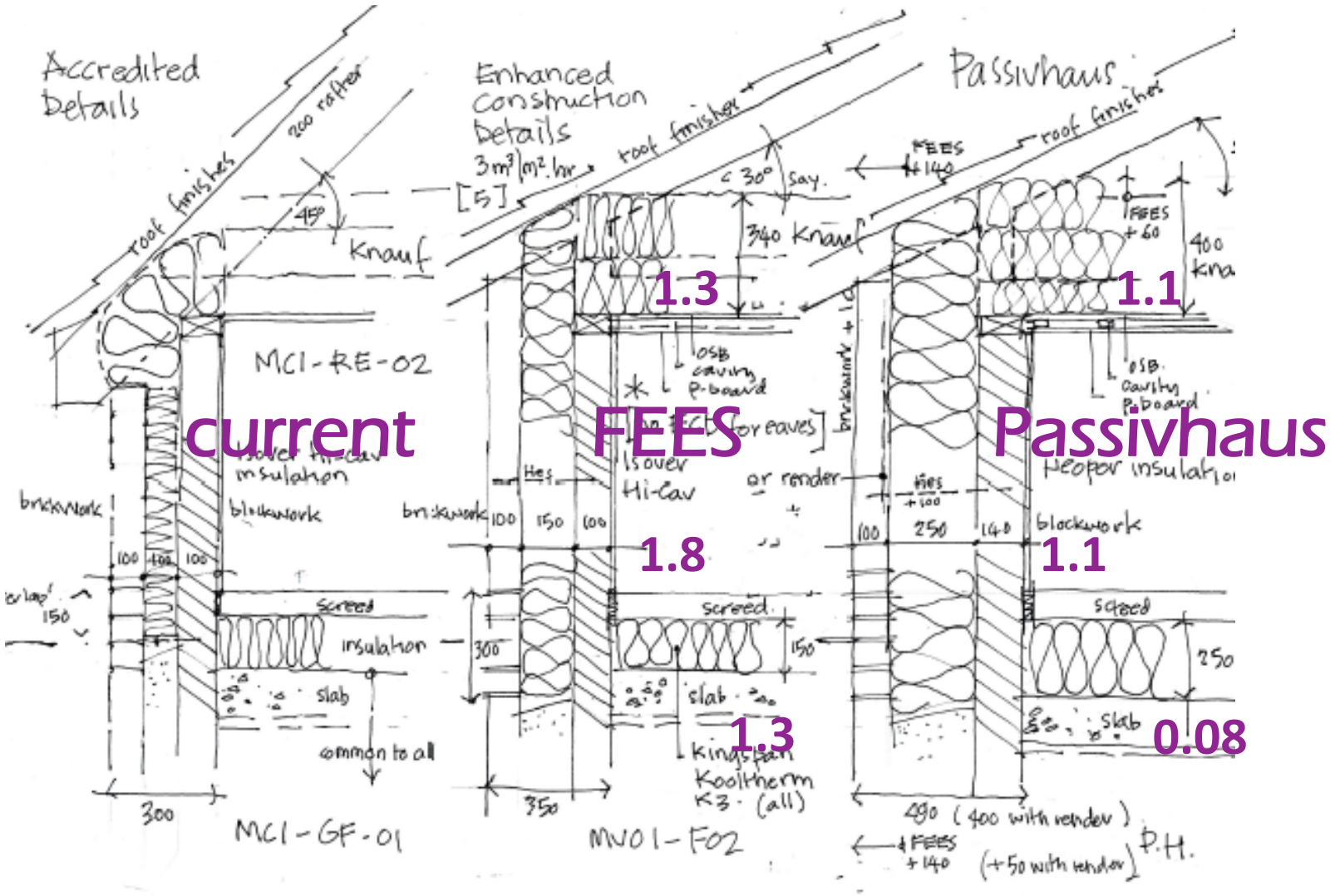
nvirohaus

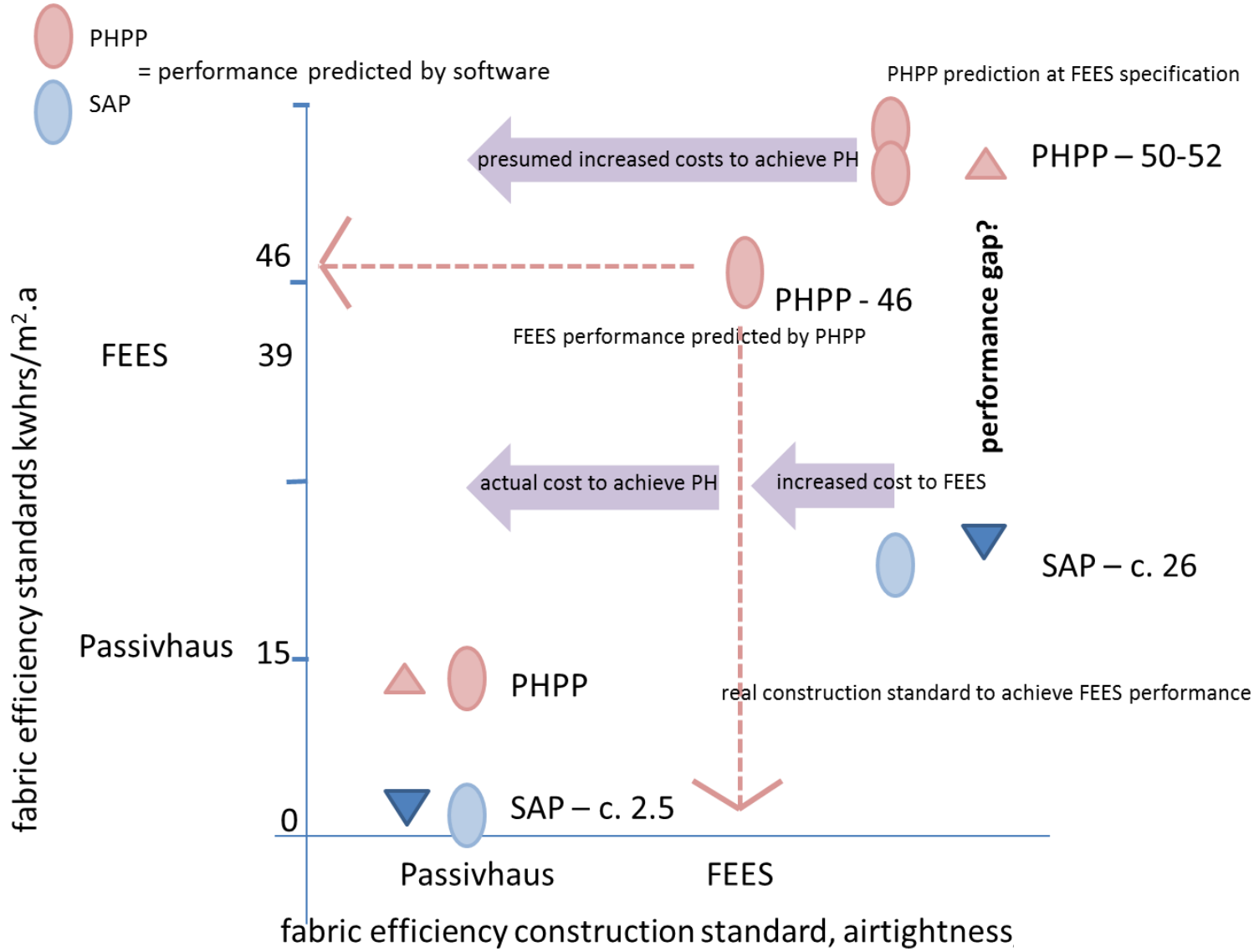
AECOM

ukpassivhaus conference2014

bre

- based on 2 bed and 3 bed end terraces at Wimbish
- re-modelled using PHPP 7.1 and Hemsby weather data
- modelled in both Passivhaus and the Fabric Energy Efficiency standards using both PHPP and SAP v. 9.92
- construction detailing developed for current, FEE and Passivhaus standards for comparison


Accredited Details
roof finishes
200 rafter
45°
Knauf
MCI-RE-02
insulation
brickwork
blockwork
100 100 100
screed
insulation
slab
common to all
300
MCI-GF-01
Enhanced construction Details
3m³/m².hr
[5]
roof finishes
c 30° say.
340 Knauf
1.3
OSB
cavity
P-board
* or eaves
or render
Hes
brickwork
100 150 100
1.8
Isover Hi-Cav
screed
150
slab
1.3
Kingspan Kooltherm K3 (all)
350
MV01-F02
Passivhaus
roof finishes
FEES +140
FEES +60
400 Kna
1.1
OSB
cavity
P-board
Neopor insulation
FEES +100
100 250 140
blockwork
1.1
screed
250
slab
0.08
490 (400 with render)
FEES +140
(+50 with render)
P.H.
current
FEES
Passivhaus



nvirohaus
nvh
AECOM
ukpassivhaus conference2014
bre

initial findings

- wide margins in modelling results for PHPP and SAP – is SAP appropriate for designing low carbon homes?
- The defined FEES do not deliver required performance when modelled in PHPP
- enhancements required – improved insulation, window specification, airtightness or ventilation systems

enhancement variants

Model Wimbish	Ceiling	Wall	Floor	Airchange rate ach	Glazing	PHPP Result
7 Passivhaus	400 Earthroll	250 Isopor	250 Kooltherm	0.6	triple	14.8
7 fees	340 Earthroll	150 Isopor	150 Kooltherm	5.26	double	52.9 X
7 fees 3 ach	340 Earthroll	150 Isopor	150 Kooltherm	**3.16**	double	46.1
7 fees insul	340 Earthroll	**250** Isopor	**200** Kooltherm	5.26	double	44
7 fees triple	**400** Earthroll	150 Isopor	**250** Kooltherm	5.26	**triple**	46.8
7 fees **mvhr**	340 Earthroll	150 Isopor	150 Kooltherm	5.26	double	46.2
10 Passivhaus	400 Earthroll	250 Isopor	250 Kooltherm	0.6		14.6
10 fees	340 Earthroll	150 Isopor	150 Kooltherm	5	double	50.6 X
10 fees 3 ach	340 Earthroll	150 Isopor	150 Kooltherm	**3**	double	43
10 fees insul	340 Earthroll	**200** Isopor	**200** Kooltherm	5	double	44.4
10 fees triple	340 Earthroll	150 Isopor	**250** Kooltherm	5	**triple**	47.1
10 fees **mvhr**	340 Earthroll	150 Isopor	150 Kooltherm	5	double	46.6

All **fees** with extract ventilation unless MVHR

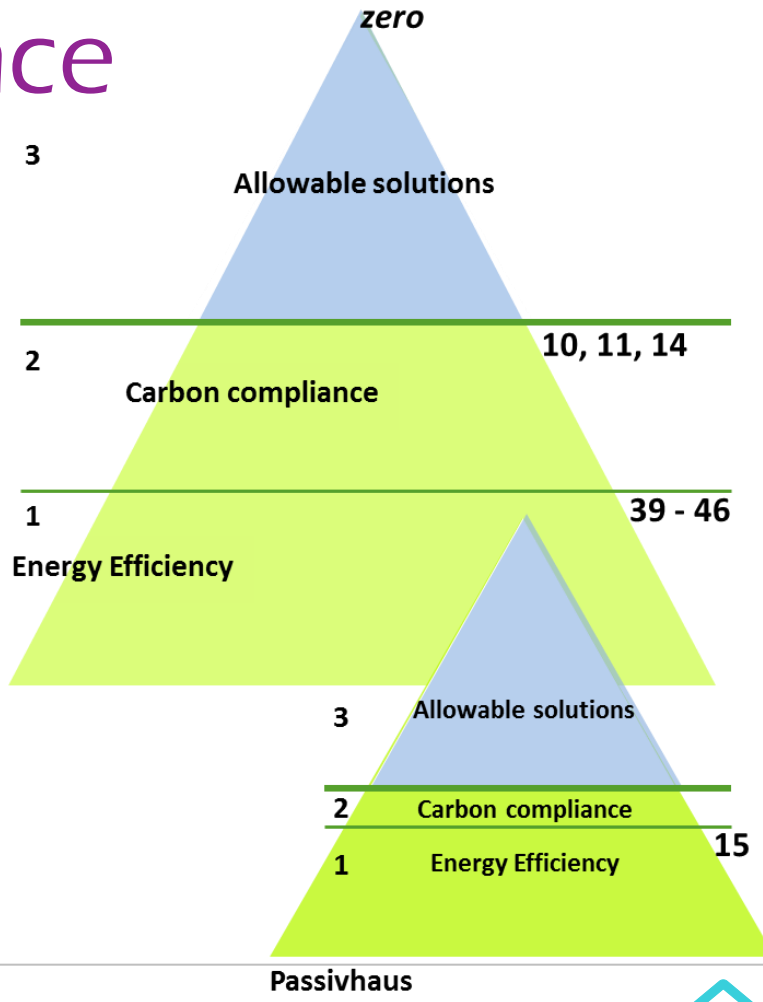
end terrace target 46 kwhrs/m^2.a

engineering services

- the Zero Carbon standard can continue to be based on ‘conventional’ systems for heating and hot water provision
- the higher infiltration and simple extract ventilation of FEES cannot offer the many benefits of MVHR – and must come with a health warning
- Passivhaus cannot eliminate the DHW demand albeit heating demand is minimal
- We need simple, compact systems to deliver enhanced environmental standards whilst minimising the premium

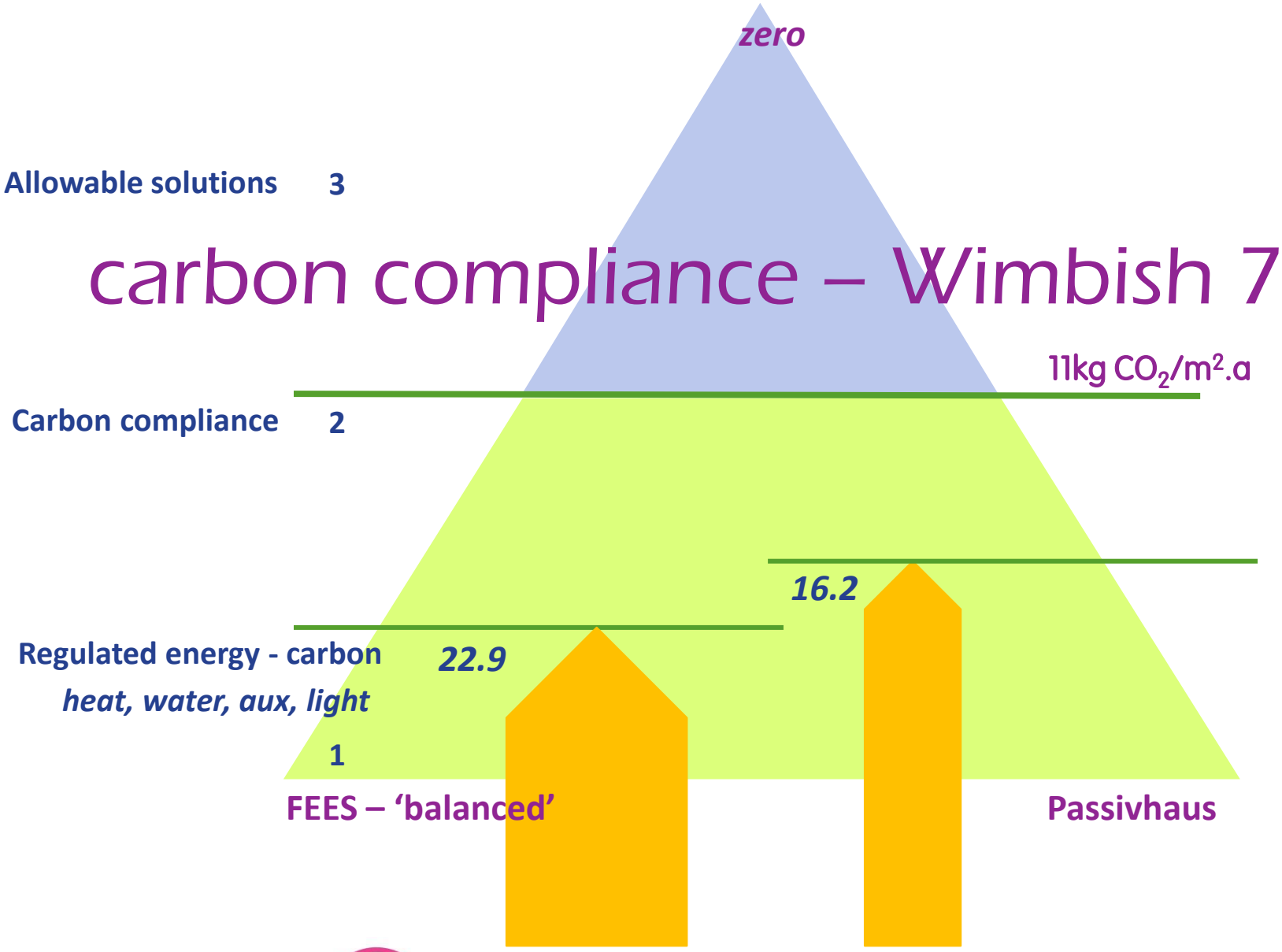
carbon compliance

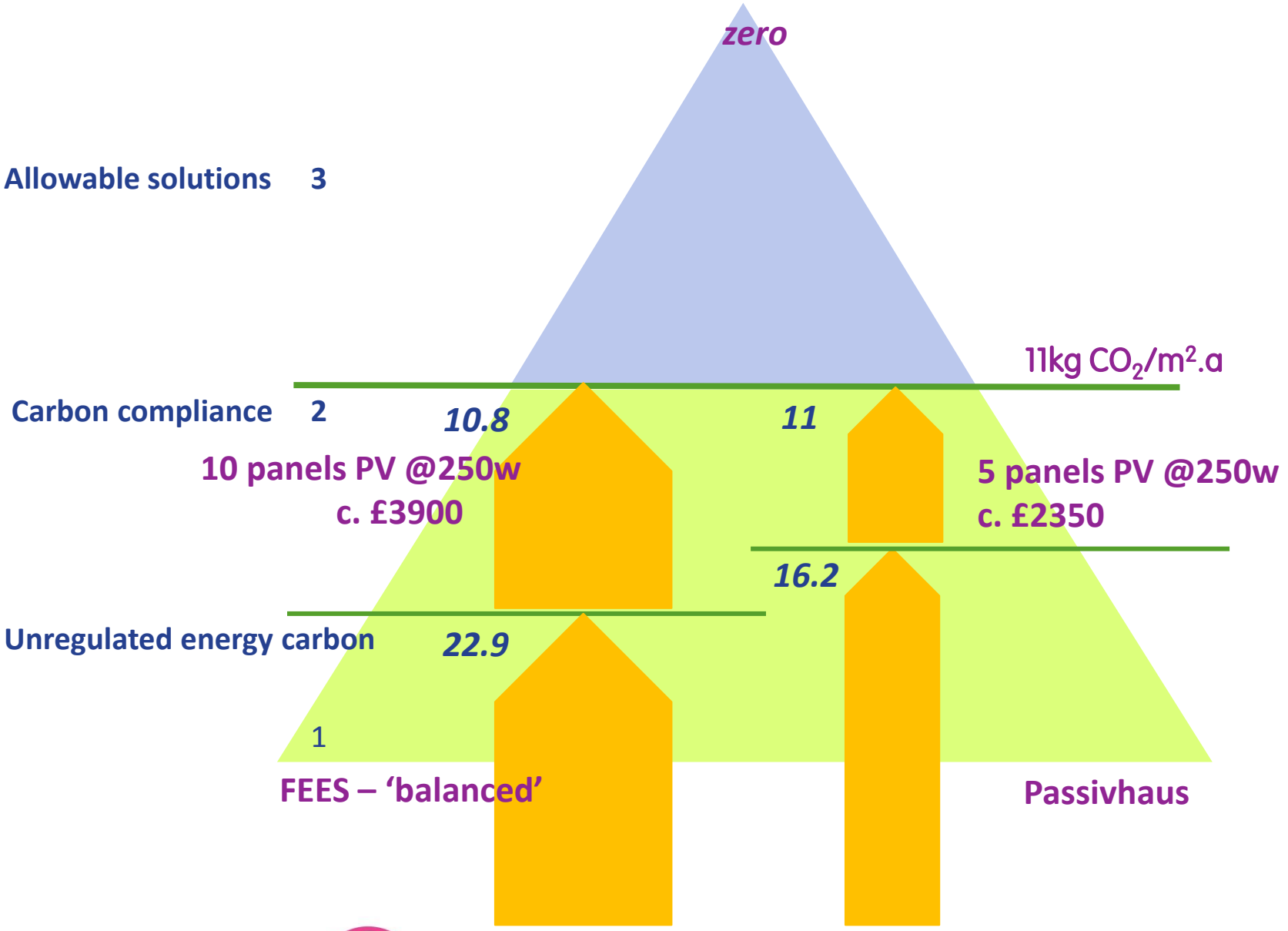
- principles established by the Zero Carbon Hub
- higher fabric efficiency of Passivhaus reduces energy demand and reduces need for renewable technologies



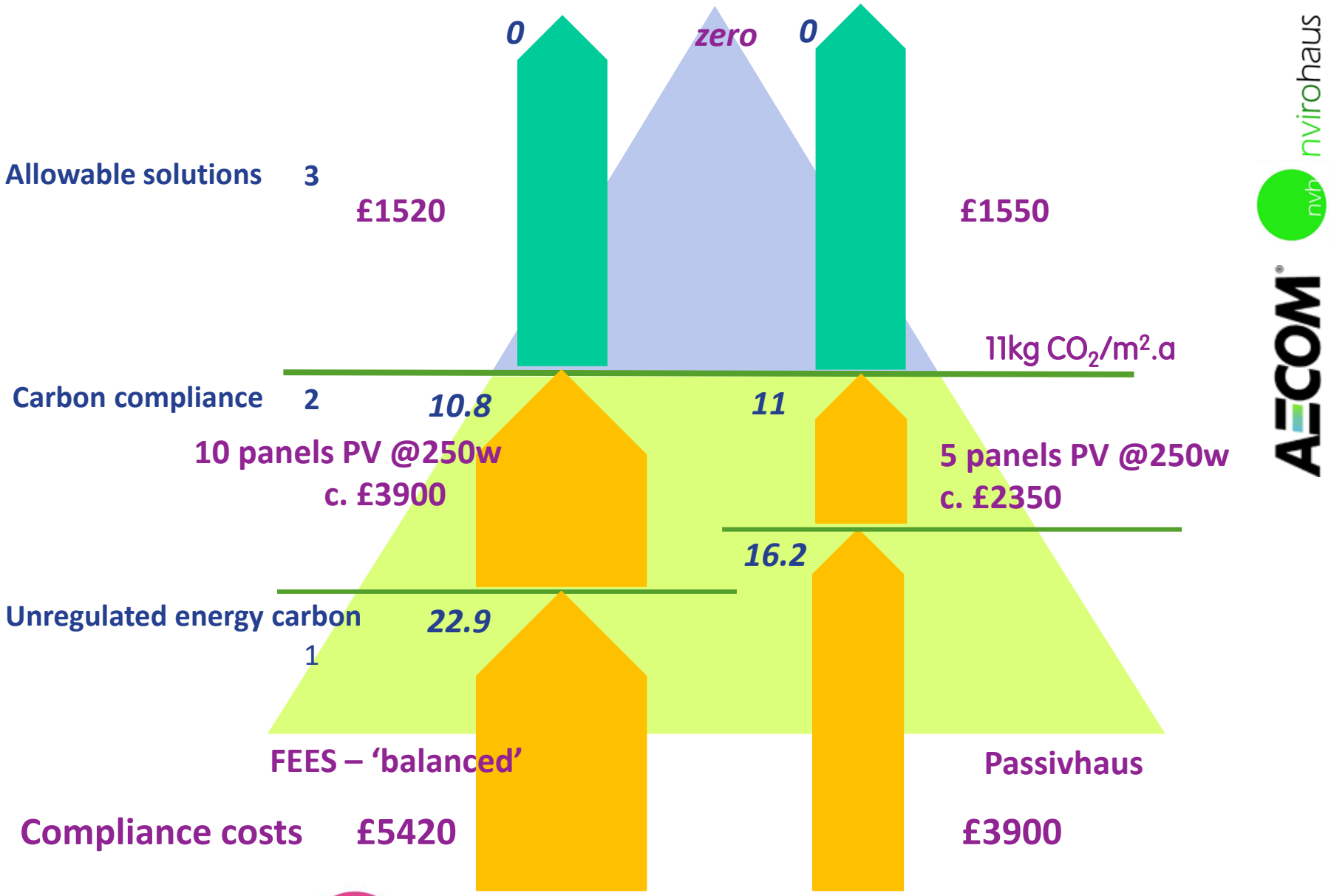
nvirohaus
nvh
AECOM
ukpassivhaus conference2014
bre

carbon compliance – Wimbish 7





nvirohaus
nvh
AECOM
ukpassivhaus conference2014
bre



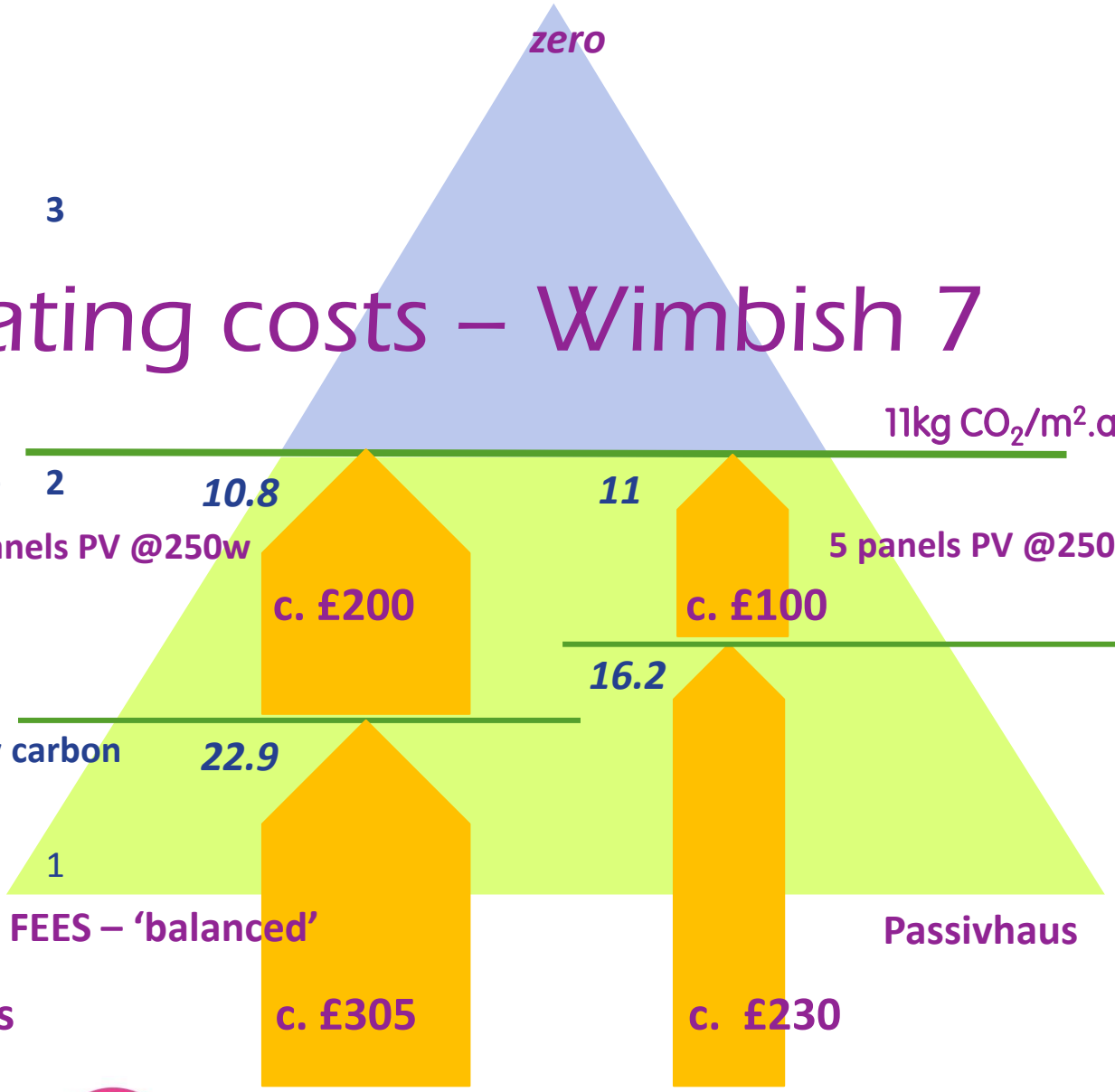
nvirohaus

AECOM

ukpassivhaus conference 2014

bre

operating costs – Wimbish 7



preliminary conclusions

- reliable predictions of performance may narrow the specification and cost gap
- Passivhaus will require less renewables to achieve Carbon Compliance and further reduce the ‘cost premium’
- operating costs may be neutral but…
- any ultimate cost differential trades better comfort and quality assured construction for a technological solution

cost comparison using live data

- Code for Sustainable Homes still being widely used across affordable housing sector
- translation into FEES and Carbon Compliance Standards
- how do the costs compare to Passivhaus standards? - using completed project examples.

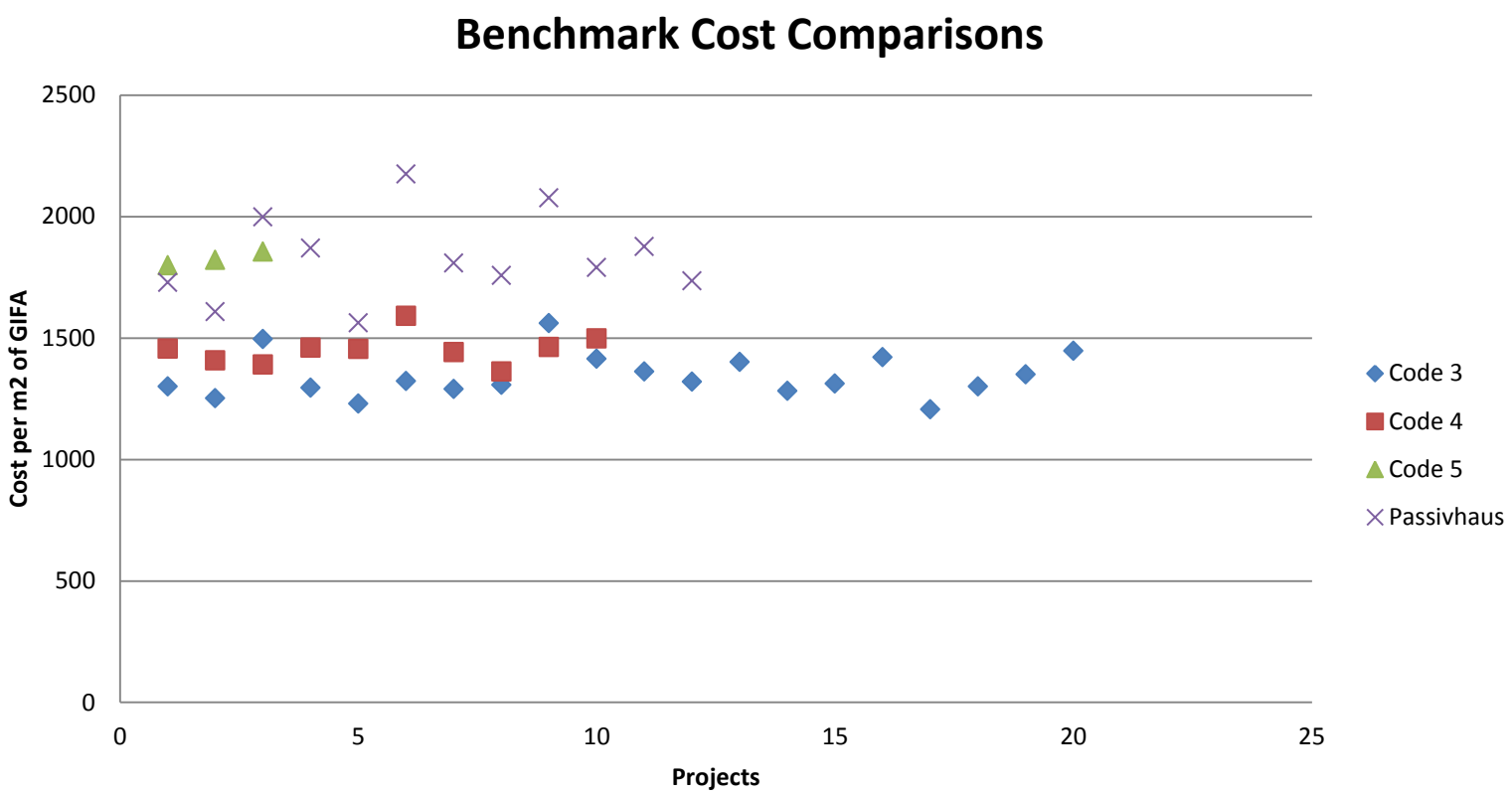
CFSH: translation to FEES and Carbon Compliance

Standard	Carbon compliance level
UK Building Regs	Part L 2013
CFSH Level 4	c. FEES standard
CFSH Level 5	FEES + Carbon Compliance Standard
N/A	Passivhaus

project data

- analysis of 45 projects – combination of Building Regs compliant, Code 4, Code 5 and Passivhaus certified (excl. Code).
- average cost per m² of GIFA. Uplift from Building Regulations equivalent.
- focus on M&E systems and External wall fabric.

overall cost comparison



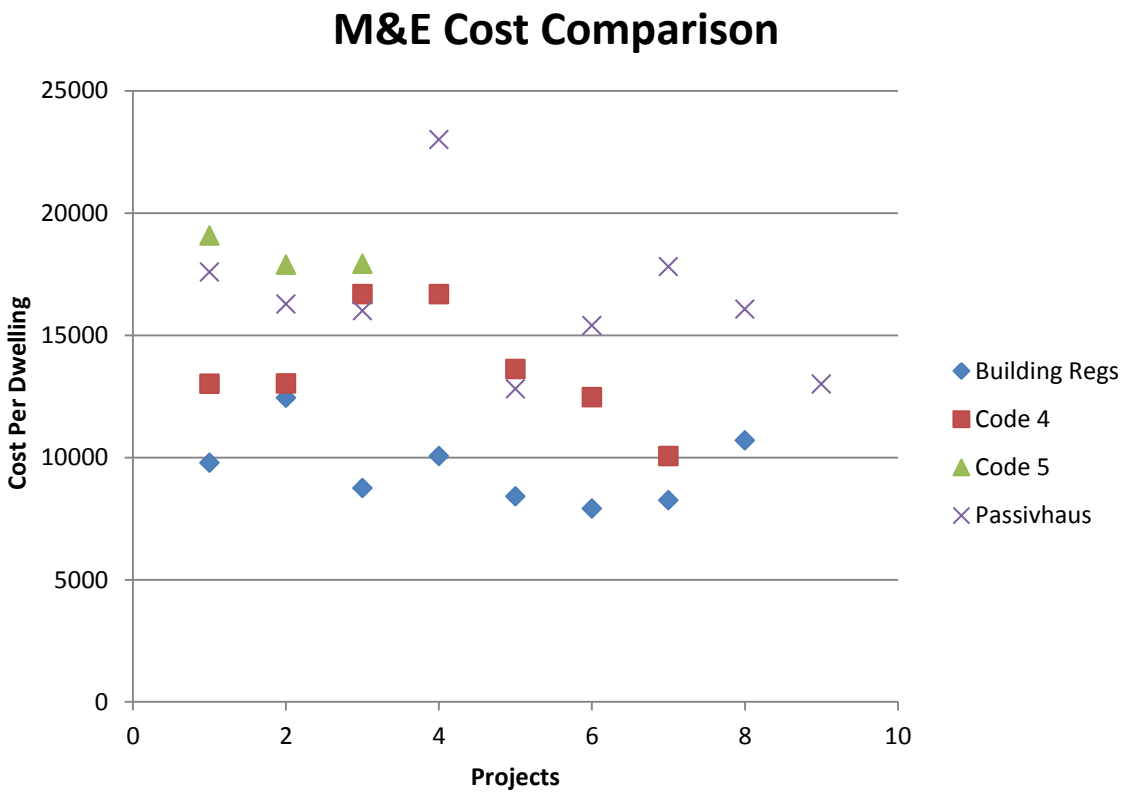
nvirohaus
nvh
AECOM
ukpassivhaus conference2014
bre

headline figures

Standard	Average (£/m2)	Uplift from base
B Regs	£1,343	Base standard
Code 4 / FEES	£1,452	+8%
Code 5 / CC	£1,824	+26%
Passivhaus	£1,831	+26%

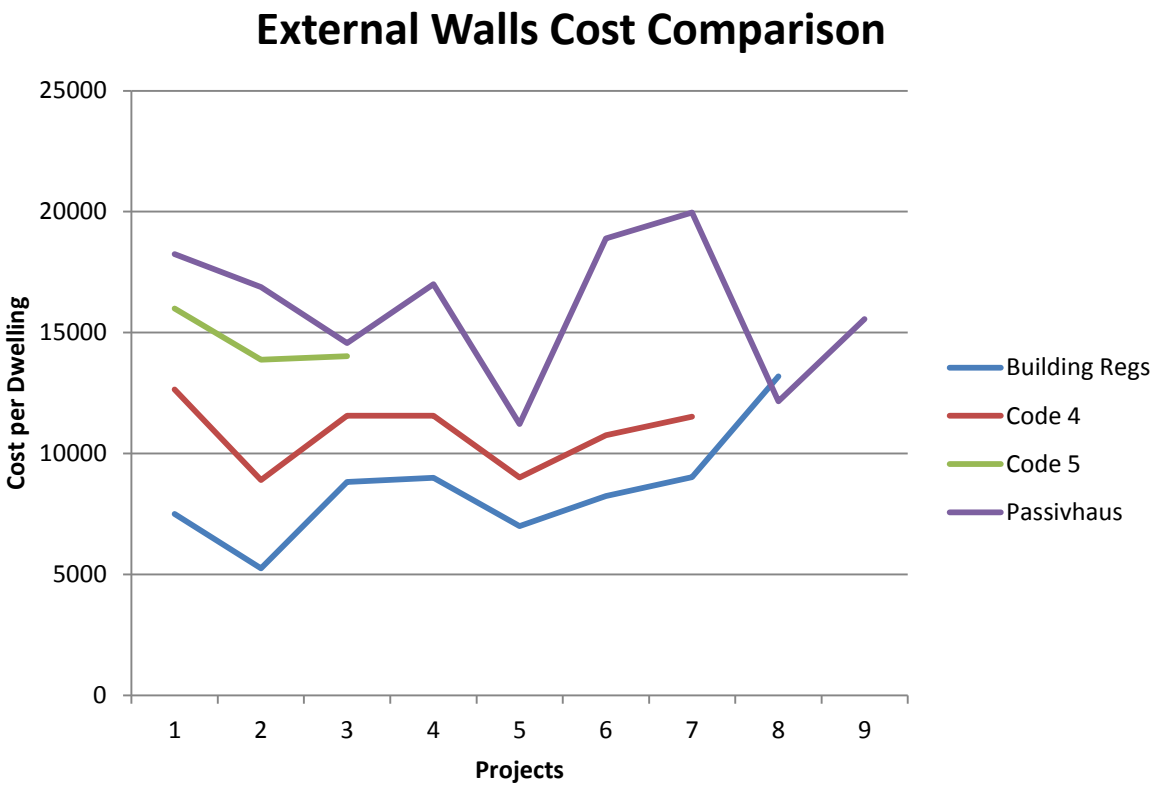
- Passivhaus and Code 5 / Carbon Compliance standards attracting similar uplift costs.
- possible that additional M&E systems associated with Carbon Compliance offset e/o costs for Passivhaus fabric standards.

focus: M&E systems



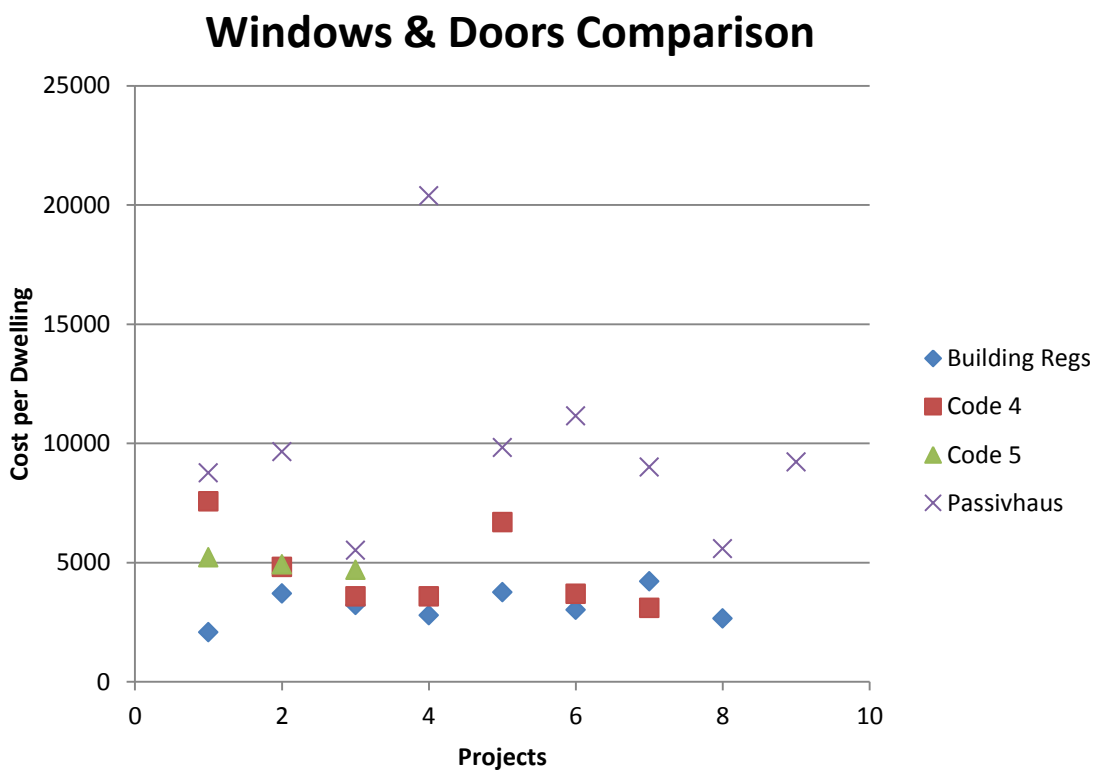
- Code 5 M&E costs are highest on average: 50% uplift from Building Regulations. Average extra cost of £9,000 per dwelling.
- Passivhaus M&E uplift of 42% over Building Regulations: average extra cost of £7,000 per dwelling.
- Similar costs for Code 4 and Passivhaus M&E elements on some schemes.

focus: external walls



- Average external walls costs highest for Passivhaus: 47% cost uplift from Building Regs. £7,500 per dwelling.
- Code 5 / Carbon compliance: 42% uplift – not significantly more than Passivhaus. £6,000 per dwelling.
- Code 4 / FEES: 20% uplift, average of £2,300 per dwelling.

focus: external windows & doors



- Average costs highest in Passivhaus. 60% increase from Building Regs - £5,000 per dwelling avg. But historic data, product limitations.
- Code 5 / Carbon compliance: 35% uplift / £2,000 per dwelling.
- Code 4 / FEES: 25% / £1,500 per dwelling.

cost comparison conclusions

- uplift to FEES can be achieved relatively affordably with an 8% uplift in total costs over Building Regulations standards.
- Carbon Compliance and Passivhaus attract similar cost uplifts. Difference is carbon compliance uplifts are higher for M&E systems which are likely to attract higher lifecycle costs than fabric and ……

cost comparison conclusions

- higher external windows and doors costs associated with Passivhaus could be due to some historic data being used where product limitations may have driven costs up.
- learning curve on M&E systems for Passivhaus, again ‘historic data’ effect.
- no patterns currently emerging in terms of ‘most cost effective’ construction method

so finally

- the Passivhaus v Regulation cost gap is likely to close as the Zero Carbon standard is introduced
- Passivhaus delivers other benefits which can't be allocated a monetary value - quality assured construction, comfort and improved health benefits
- our cost study will continue to seek the most cost effective route to achieving Zero Carbon without losing these benefits

Passivhaus and Zero Carbon – Closing the Cost Gap

Thank you