Meeting the 2011 zero carbon buildings target for Wales using the Passivhaus standard

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Cutting emissions from buildings is key in our drive to tackle climate change, as buildings account for about half of our emissions. I want all new buildings in Wales to be zero carbon from 2011. Laying down this goal now gives us a clear direction in which to step up the journey to zero emissions.

February 2007, Carwyn Jones, Leader of the House, Welsh Assembly
Social housing will be more energy efficient and environmentally friendly as a result of my procurement strategy which will create efficiency savings of up to 10% and encourage improved quality in design and greater use of non traditional methods of construction.

October 2008, Margaret Ritchie MLA, Social Development Minister, NI
Developing knowledge exchange mechanisms to support Welsh low-carbon housing

Research project funded by the Knowledge Exchange Fund of the Welsh Assembly Government
I. How can we build low carbon housing in Wales?
2. How can researchers disseminate the technical information needed to do this?
Zero carbon strategies
Reduce demand

• raise insulation levels

• lower the requirements

• better controls

• …
De-carbonise the supply
What is zero carbon?
What is zero carbon?
Reducing energy demand in new housing
Design heat loss for new housing

Reduction in typical house design heat loss (kW)

Design heat loss (kW)


Part L 2006
Zero carbon
Design heat loss for new housing

Reduction in typical house design heat loss (kW)

- Traditional construction systems and materials
- Part L 2006
- Zero carbon

Design heat loss (kW)
Low carbon housing standards
The Code for Sustainable Homes

Percentage allowed carbon emissions relative to Part L 2006

- Code Level 1: 10%
- Code Level 2: 18%
- Code Level 3: 25%
- Code Level 4: 44%
- Code Level 5: 100%
- Code Level 6:
The Code for Sustainable Homes

Passivhaus
The Passivhaus standard
Developed in Germany for a central European climate
Two main requirements:
Peak heating demand $< 10 \text{ W/m}^2$
Specific annual heat requirement
< 15 kWh/m² per annum
Does not require a conventional heating system
Heating requirement can be met by heating the air that is required for ventilation purposes.
UK common practice

\[ U < 1.8 - 2.2 \text{W/m}^2\text{K} \]

\[ U < 0.25 \text{W/m}^2\text{K} \]

Leakage 7 – 10m\(^3\)/hr/m\(^2\) @ 50Pa
Passivhaus (Central Europe)

- $U < 0.8 \text{W/m}^2\text{K}$
- $U < 0.15 \text{W/m}^2\text{K}$
- Leakage: $1 \text{m}^3/\text{hr/m}^2$ at 50Pa
Passivhaus characteristics

Heavily insulated

Tightly sealed

Makes use of solar gain during winter

Heated purely by post heating incoming air
Heat exchanger

Exhaust to outside

Incoming air from outside 0°C in winter

Mechanical Ventilation Heat Recovery

Supply to dwelling

Extract from dwelling +20°C

Heater +30°C

+15°C
Maximum heat input via air

\[ 1 \text{m}^3/\text{hr}/\text{m}^2 \times 30^\circ \text{C} \times 0.33 \text{Wh/m}^3/\text{K} = 10 \text{ W/m}^2 \]
Applying Passivhaus in Wales
Passivhaus (Wales)

\[ U < 1.1 \text{W/m}^2\text{K} \]

\[ U < 0.17 \text{W/m}^2\text{K} \]

Leakage 2m$^3$/hr/m$^2$ @ 50Pa

Mechanical Ventilation with Heat Recovery

20°C

1°C
Can we build to this standard in Wales?
Construction methods
Passivhaus construction methods

Based on figures from Austrian Passivhaus projects database
Component supply chain
Knowledge and skills
Consulting the industry in Wales
Construction companies in Wales by size of firm 2005-06

- Wales 2005
- Wales 2006

- 1
- 2-3
- 4-7
- 8-13
- 14-24
- 25-34
- 35-59
- 60-79
- 80-114
- 115+

- 3,199
- 2,762
- 1,576
- 580
- 349
- 102
- 92
- 25
- 18
- 24

4,000
3,000
2,000
1,000
0
Focus groups
Questionnaire survey

Developing knowledge exchange mechanisms to deliver zero carbon housing in Wales

The Welsh School of Architecture and the Building Research Establishment (BRE) Wales are carrying out research into the knowledge needed to design and build new housing in Wales that will meet the requirements for zero carbon emissions by 2011, as outlined by the Welsh Assembly Government last year. As part of this research we are asking people in the construction industry to spend a little time completing this short questionnaire. Completed questionnaires will be entered in a prize draw for two tickets for an international rugby match in Cardiff in the autumn.

1. Which one of the following best describes your role in the construction industry? (Tick one box only)
   - Architect
   - Planner
   - Surveyor
   - Building contractor
   - Component manufacturer
   - Other. Please specify:

2. How many people are employed in your organisation? (Tick one box only)
   - 1 (self-employed)
   - 2 – 10
   - 11 – 20
   - 21 – 50
   - 51 – 100
   - 101 – 250
   - More than 250

3. How long have you been involved with the construction industry? (Tick one box only)
   - Less than 5 years
   - 5 – 10 years
   - More than 10 years

4. How did you first learn about the goal to deliver zero carbon buildings in Wales by 2011? (Tick one box only)
   - On the radio
   - On television
   - In a newspaper
   - In a professional or trade magazine
   - From a colleague at work
   - From someone else you know through work
   - Other. Please specify:

5. Do you think the aspiration to create zero carbon buildings in Wales by 2011 is a worthwhile ambition? (Tick one box only)
   - Yes
   - No
   - Don’t know

6. Do you think the aspiration to create zero carbon buildings in Wales by 2011 is achievable? (Tick one box only)
   - Yes
   - No
   - Don’t know
Who responded?

Survey respondents (n=75)

- Architect: 21%
- Surveyor: 15%
- Bldg contractor: 7%
- Engineer: 13%
- Developer/client: 12%
- Env. Consultant: 11%
- Component manufacturer: 8%
- Housing association: 5%
- Project manager: 3%
- Local authority: 3%
- Others: 3%
- Others: 3%
2011: a worthwhile aspiration?

- Yes: 93%
- No: 4%
- Don’t know: 3%
2011: a realistic target?

- Yes: 18%
- No: 62%
- Don't know: 20%
Costs
The cost of the Code

Cumulative increase in capital cost

Level 1, Level 2, Level 3, Level 4, Level 5

Scenario 1: Initial energy efficiency followed by solar water heating
Scenario 2: Initial energy efficiency followed by small scale wind turbine
Scenario 3: Use of shared site wide infrastructure (CHP)
Scenario 4: Improved air tightness, mechanical ventilation and proprietary construction details
Examples
Some issues surrounding zero carbon housing
Lifestyle and behaviour
Now with zero carbon!
Existing buildings
Carbon targets and deadlines

• “Zero carbon” serves as an important ideal
• Targets/aspirations have stimulated debate, focused minds and prompted action
• BUT
• Is very difficult to achieve at same cost
• Could backfire if not met
Learning from the future
Well done?
Thank you