ZERO CARBON HUB

Policy context, research & guidance

Ross Holleron, Projects Director
Introduction

Aims of this session:

- Review of current policy position
- European context
- Indication of future risks
- Examples of practical guidance
PURPOSE AND STRATEGIC OBJECTIVES

Facilitate the mainstream delivery of low and zero carbon homes working across borders

- Provide leadership & create confidence
- Reduce risk
- Disseminate information
Priorities for the ZCH in 2015 - 16

- Dissemination: 60%
- Risk research: 35%
- Policy development: 5%

(Part L.....?)

(Overheating, Ventilation & Performance Gap)

(technical & consumer)
Where are you?

- Government
- Industry

Low energy homes
Why Zero Carbon Homes?
2001-2010 was the warmest decade on record

2012 Hottest day ever in Scotland and wettest June in the UK

2013 Wettest winter ever recorded

2014 was the hottest year ever recorded

THE EFFECTS OF CLIMATE CHANGE

We are here (ish)
UK Government, European Policy & the Zero Carbon Agenda
The journey so far.....

2007
Building a greener future: policy statement

2008
UK GBC standard unattainable on many sites

2011
March 2011
New Government Regulated CO₂ only

2013
2013
AS consultation launched

2019/2020
EU Nearly Zero Energy Buildings

2016
All new homes to be zero carbon ??

PartL2010
No FEES
SAP2010
FEES

PartL2013
6% improvement FEE considered

Jul 2008
ZCH created
Housing Standards Review

○ Chapter 5 – Energy
  ○ A ‘building regulations only’ approach to delivering the Zero Carbon Homes standard from 2016
  ○ 63% agreed that this is the way forward
  ○ Similarly content with changes to the CSH (Energy)

○ Planning and Energy Act 2008

  Transitional period – LA ability to influence EE up to 2016?
Government Policy

Zero Carbon 2016
An interesting time for new build homes...

Open for each member state to define:
- nearly or very low
- very significant extent
- on-site or near-by
nZEB – Cost Optimal Review

- Reviewed every 3 years
- Next cycle is 2017

<table>
<thead>
<tr>
<th>Reference Home - Semi</th>
<th>Example specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall</td>
<td>0.18 W/m²K</td>
</tr>
<tr>
<td>Roof</td>
<td>0.13 W/m²K</td>
</tr>
<tr>
<td>Window</td>
<td>1.4 W/m²K</td>
</tr>
<tr>
<td>Floor</td>
<td>0.15 W/m²K</td>
</tr>
<tr>
<td>Heating System</td>
<td>Gas 90%, weather comp., zone control, interlock</td>
</tr>
<tr>
<td>Air tightness</td>
<td>6.1 m³/m²h</td>
</tr>
<tr>
<td>Thermal Bridging</td>
<td>0.09 W/m²K</td>
</tr>
<tr>
<td><strong>Primary Energy</strong></td>
<td><strong>117 kWh/m²/year</strong></td>
</tr>
</tbody>
</table>

Reference Building – May 2013 report
Some context for the challenge

**Part L 2013**

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening area</td>
<td>Same as actual up to 25% of floor area</td>
</tr>
<tr>
<td>Ext. walls (W/m²K)</td>
<td>0.18</td>
</tr>
<tr>
<td>Party walls (W/m²K)</td>
<td>0</td>
</tr>
<tr>
<td>Floor (W/m²K)</td>
<td>0.13</td>
</tr>
<tr>
<td>Roof (W/m²K)</td>
<td>0.13</td>
</tr>
<tr>
<td>Windows (W/m²K)</td>
<td>1.4 (g=0.63)</td>
</tr>
<tr>
<td>Air tightness (m³/hr.m²)</td>
<td>5.0</td>
</tr>
<tr>
<td>Thermal bridging (W/m²K)</td>
<td>Calculated using the lengths of junctions in the actual dwelling and the psi values provided in Appendix R</td>
</tr>
<tr>
<td>Ventilation type</td>
<td>Natural (with extract fans)</td>
</tr>
<tr>
<td>Gas boiler</td>
<td>89.5% (SEDBUK)</td>
</tr>
</tbody>
</table>

**The old days.....**

**END TERRACE MODEL SPECIFICATION**

- **Total Floor Area**: 76.32 m²
- **Number of stories**: 2
- **Floor U-value**: 0.13 W/m²K
- **External Wall U-value**: 0.18 W/m²K
- **Party wall U-value**: 0.00 W/m²K
- **Roof U-value**: 0.13 W/m²K
- **Windows U-value**: 1.4 W/m²K
- **Door U-value**: 1.0 W/m²K
- **Design air permeability**: 5.0 m³/h.m²
- **Condensing Gas Boiler**: 1998 or later
- **PV**: 1.6 kWp
- **PV orientation**: South East
- **Overshading**: <20%
- **y value**: 0.051 W/m²K

**PREDICTED PERFORMANCE**

- **Fabric Energy Efficiency**: 46 kWh/m²/year
- **Carbon Compliance**: 11 kgCO₂/m²/year
- **Primary Energy**: 43.6 kWh/m²/year

**Circa 120 kWh/m²/yr**

**Circa 45 kWh/m²/yr**
Wider EU ambition for nZEBs (kWh/m²/yr)

<table>
<thead>
<tr>
<th>Member State</th>
<th>Full Definition in Place</th>
<th>Numerical Indicator</th>
<th>Share of Renewable Energy</th>
</tr>
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<tbody>
<tr>
<td>Austria</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Belgium - BXL</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Belgium - Walloon</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Belgium - Flemish</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Bulgaria</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Croatia</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Cyprus</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Czech Republic</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Denmark</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Estonia</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Finland</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>France</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Germany</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Greece</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Hungary</td>
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<td>Yes</td>
<td>Yes</td>
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<td>Ireland</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Italy</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Latvia</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Lithuania</td>
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<td>Yes</td>
<td>Yes</td>
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<td>Luxembourg</td>
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<td>Yes</td>
<td>Yes</td>
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<td>Malta</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Netherlands</td>
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<td>Yes</td>
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<td>Portugal</td>
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<td>Yes</td>
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<td>Poland</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Romania</td>
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<td>Yes</td>
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<td>Slovakia</td>
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<td>Spain</td>
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<td>Yes</td>
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<td>Sweden</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Denmark = 20
Belgium = 45
France = 40 - 65
Austria = 160
Germany = TBC......?
How well are we achieving low energy homes?
Build Costs
Additional Cost of Zero Carbon Homes

- **2015**: £5k?
- **Revised definition 2011**: £10k
- **Revised definition 2008/9**: £20k per home
- **Original definition**: £40k per home

**Reduction on 2006 Part L**:
- 2006 Part L: 25 kg CO₂ m²/year
- 2010 Part L: 20 kg CO₂ m²/year
- 2013 Part L: 14 kg CO₂ m²/year
- 2016 Part L: 10 kg CO₂ m²/year
- True Zero Carbon: ~150-200%

**Allowable Solutions**
- Code 3: 25%
- Code 4: 33%
- ‘Code 4½’: 70%
- Code 5: 100%
- Code 6: ~70%
<table>
<thead>
<tr>
<th>Type</th>
<th>Energy Spend (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-bed Detached house</td>
<td>£2,460</td>
</tr>
<tr>
<td>3-bed Semi-detached</td>
<td>£1,670</td>
</tr>
<tr>
<td>3-bed Mid-terrace house</td>
<td>£1,430</td>
</tr>
<tr>
<td>1-bed Ground Floor Flat</td>
<td>£940</td>
</tr>
</tbody>
</table>

Victorian with some modern day improvements.
The Performance Gap

Found cross-cutting themes:

- KNOWLEDGE & SKILLS
- RESPONSIBILITY
- COMMUNICATION
How is the u-value calculated?

Can’t assume same thickness across entire roof

500mm roof insulation specification on 18° roof pitch

Reduced space above joists makes installation of full insulation thickness impossible despite this being assumed in SAP calculation
Design Assumed:
- Wall ties
- Compressed edge seal
- Insulation

90% of sites visited:
- Window in wrong position
- U & G values wrong
Common themes on site
Site Posters - Fabric and Services

Fabric
1. Groundworks
2. Beam and Block Floor
3. Door Threshold
4. Cavity Wall – partial fill
5. Cavity wall – full fill
6. Floor Joists
7. Separating wall
8. Lintels
9. Windows
10. Bay windows
11. Projecting windows
12. Eaves
13. Roof
14. Dryline
15. Ventilation
16. Heating / hotwater
17. Finals
Unintended consequences
Ventilation – delivery improvements
Overheating – a few numbers

- 20%
- 1 in 3
- 9°C
- £100,000
- 2,000
- 7,000
- 100
Are Housing Providers looking out for risk factors?

Services design

Thermal mass / purge

Secure ventilation

Shading
Are the tools supporting proper checks?
How is delivery being checked?

Figure 32:
Types of process used to ensure that measures to mitigate the risk of overheating are implemented
(Total number of individual respondents = 72)

- No process in place
- General quality control
- Other
- Building control inspections
- A specific person responsible for ensuring overheating mitigation measures are properly implemented
- Quality control process specifically covers overheating
- I don't know
- Not applicable

NUMBER OF RESPONSES
Opportunities and risks

- **Performance gap** – moving to solutions
- **Ventilation** – encouraging best practice
- **Overheating** – understanding the issues
Practical guidance
The Fabric Energy Efficiency Standard

Building Fabric:
- U-values
- Thermal mass

Thermal Bridging

Air-permeability

Orientation, solar gains, Glazing proportion
DON’T PANIC!

Concrete

Brick and Block
Part L 2013 has a % relaxation built into the calculation procedure.
Part L 2013 – Where to start?

- Guidance available for masonry and timber frame
- Provides practical ‘recipes’ to fine tune
- Select the route to best suit your experience / supply chain
1.3 Detached house

<table>
<thead>
<tr>
<th>Elements</th>
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<tbody>
<tr>
<td>External wall</td>
<td>0.15 W/m²K</td>
</tr>
<tr>
<td>Roof</td>
<td>0.13 W/m²K</td>
</tr>
<tr>
<td>Ground floor</td>
<td>0.14 W/m²K</td>
</tr>
<tr>
<td>Windows</td>
<td>0.8 W/m²K</td>
</tr>
<tr>
<td>Doors</td>
<td>1.2 W/m²K</td>
</tr>
<tr>
<td>Air permeability</td>
<td>6 m³/h.m²@50Pa</td>
</tr>
<tr>
<td>Thermal bridging</td>
<td>0.15 W/m²K</td>
</tr>
<tr>
<td>Renewables</td>
<td></td>
</tr>
<tr>
<td>e.g. Solar thermal</td>
<td>2.0 m² flat plate solar panels</td>
</tr>
<tr>
<td>or PV</td>
<td>0.6 kWp (4.8 m²)</td>
</tr>
</tbody>
</table>

**Thermal bridging: key junctions to consider**

- Ground floor perimeter (34%)
- Lintel (26%)
- Gable (11%)
- Jamb (10%)
- Eaves (7%)
- All other junctions (12%)

Impact of each junction (%)

- Ground floor perimeter: 34%
- Lintel: 26%
- Gable: 11%
- Jamb: 10%
- Eaves: 7%
- All other junctions: 12%
Common themes on site
Site Posters - Fabric and Services

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**WINDOW INSTALLATION** 9.0

**PROBLEM TO AVOID**

WINDOS INSTALLED FORWARD OF DESIGN POSITION

- COLDSPOT

INSIDE

WINDOW POSITIONED TOO CLOSE TO EXTERNAL FACE

NO OVERLAP OF WINDOW AND CAVITY

**WHAT TO DO?**

- Close the cavity with tightly packed insulation (1)
- Insulation to window reveal (2)
- Window fitted to provide non-standard large air (3)
- Overlap frames with cavity as much as possible - minimum 30mm
- Check trickle vent sizes as design
- Less than 10mm tolerance around window frame and structural opening

**GOOD PRACTICE**

A large overlap with cavity will improve thermal performance

For improved airtightness, use air barrier tapes between the window door and structure

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**EAVES** 12.0

**PROBLEM TO AVOID**

NO INSULATION AT EAVES

- SQUASHED INSULATION
- INSULATION MISSING
- NO SPACE FOR INSULATION
- REDUCED SPACE ABOVE JOISTS MAKES INSTALLATION OF FULL INSULATION IMPOSSIBLE

**WHAT TO DO?**

- Install rigid insulation to top of the wall plate (1)
- Truss design to accommodate space for insulation of eaves (2)
- Lay mineral wool insulation into eaves (3)
- Cut insulation around eaves linoleum

**OPTION 1**

**OPTION 2**

1. 160MM

**GOOD PRACTICE**

Install insulation before eaves are inaccessible

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**GROUND WORKER**

**BRICKLAYER**

**CARPENTER**

**PLUMBER**

**ELECTRICIAN**

**PLASTERER**

**WINDOW FITTER**

**ROOFER**

**DECORATOR**
**Dryline/Plaster**

**Problem to Avoid:** Air-leakage

- Air gap

**What to Do?**
- Foam fill all penetrations/gaps before drylining
- Stopper ceiling boards and over door openings to minimise future cracking
- Mark continuous ribbon of adhesive to be applied around all openings, along the top and bottom end of internal and external corners of walls, and over service chasers

**Good Practice:** Use a purge coat or plaster on block work to improve airtightness

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**Ventilation**

**Problem to Avoid:** Poorly specified and installed ductwork

- Flexi duct too long
- Ductwork not connected

**What to Do?**
- Install rigid ductwork for extract fans, and minimise use of flex ductwork
- Install audible commissioning fans to port F domestic ventilation compliance guide
- Commissioning sheets to be provided to site manager
- Check noise of fan is not excessive
- Check ducts to outside are fully insulated
- Clearly label the ventilation control

**Good Practice:** Specialist or manufacturer to commission fans
A quick review of your thinking …

- Can you understand the ‘Builders’ Book’ style of guidance?
- How important is thermal bridging to you?
- In what way will today’s event influence your next project?
As you start to build quicker consider…

- Does your ambition out weigh your talent?

- How do you avoid the ‘gym membership’ syndrome?
Thank you

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