Some aspects of the energy-led retrofitting of solid wall dwellings

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Structure of presentation

- Relationship between airtightness and mechanical ventilation with heat recovery (MVHR)
- Effect of the order of installing retrofit measures
- Resilience to climate change

Used Dynamic Thermal Modelling on the E.On 2016 house
1. MVHR investigation

Why is it important?
- Air leakage is a waste of energy.
- MVHR recovers heat from extractor systems.
- Is promoted as a retrofit measure.

Research questions:
- What is the relationship between air-tightness and MVHR energy saving?
- How difficult is achieving air-tightness in retrofit?
- Can we use the results to model predicted performance?
MVHR workmanship problems
House sealing challenges
Modelled energy consumption with MVHR

5 achieved in E.On House after a lot of work!

Building Air Permeability (m³/m².h @ 50 Pa)
- Space Heating
- Auxiliary
### CO₂ emissions with MVHR

<table>
<thead>
<tr>
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<th>10</th>
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<tbody>
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<td>Natural Ventilation</td>
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<td>MVHR Minimum Building Standards</td>
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Building Air Permeability (m³/m².h @ 50 Pa)

- **Orange**: Space Heating
- **Purple**: Auxiliary

5 achieved in E.On House after a lot of work!
2. The order of installing retrofit measures

Why is it important?
- May spread costs over a manageable timescale.
- Ease of implementation varies.
- Risk of incurring additional costs.

Research questions:
- Does the sequence matter?
- Are measures equally effective whenever they are used?
- What are the effects on energy, CO₂ emissions and costs?
- Are there any implications for Green Deal?
### The sequences investigated

<table>
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<tr>
<th>Improvement Stage</th>
<th>1. Insulation driven</th>
<th>2. Affordability driven</th>
<th>3. Experienced installer driven</th>
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<td>Draught-proofing to stage 1</td>
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<td>2</td>
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<td>Double glazing</td>
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<td>External wall insulation</td>
<td>Ground floor insulation and initial draught-proofing</td>
<td>Reduced size boiler replacement</td>
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<td>External wall insulation</td>
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<td>6</td>
<td>Further draught-proofing &amp; installation of MVHR</td>
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<td>Ground floor insulation and CFL lights</td>
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<td>7</td>
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**Implications for Green Deal – double glazing**

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<td>Ground floor insulation and sealing</td>
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<td>Efficient condensing boiler replacement</td>
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| Energy reduction attributable to improved glazing | 8.81 MWh | 7.12 MWh | 6.36 MWh |
| Annual Cost Savings (@4p/kWh for gas) | £352 | £285 | £255 |
3. Climate change resilience

Why is it important?
- Retrofitting dwellings leads to concerns of overheating.
- Potential for householders to use cooling, increasing CO₂ emissions.

Research question:
- What is the effect of future climate on overheating risk and energy consumption?

Central estimate of increase in mean daily summer temp, 2050s (UKCP09)
Future overheating in the E.On house
As the climate warms:

- The E.On House uses less energy
- The internal temperatures rise
- The proportion of occupied hours at >25°C rises
- Bedroom temperatures are a potential problem with peaks up to 34°C
- Comfort depends on what is an acceptable risk of overheating
1. MVHR systems can save energy and CO$_2$ but must be properly installed and balanced, and the house made sufficiently airtight.

2. Performance of retrofit programmes depends on the order in which measures are installed and this has implications for Green Deal finance.

3. Climate change has the potential to cause overheating in retrofitted homes.


Thank You

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