Designing for a changing climate:
Towards zero-carbon - Design for resiliency

The retrofit challenge
PDP London is a 100 strong international practice.

We support R&D and the residential retrofit book has been instrumental in finding out:

- How to deliver retrofits in the uk – Design & details
- How these performed – 2 years POE
- Disseminating to the industry – Lessons learned
The Retrofit Challenge

- **38%** (678 TWh/yr) of the UK total CO2 emissions come from ‘buildings in use’

- 28% (501 TWh/yr) are directly linked to ‘residential buildings in use’

- One of the **oldest in Europe** with 55% of its dwellings dating from before 1960
Resilient Buildings

- Reduce CO2 emissions and address climate change urgency for the long term
- Generally reduce our reliance on fossil fuels
- Future-proof houses against fuel poverty
- Provide comfort for occupants

Cost to retrofit the UK:

£50,000 x 10,000,000 = £500,000,000,000

2008 UK bank rescue package = £500,000,000,000

A national health issue:
Fuel Poverty, 4.4m people

£1.4bn / year
NHS cost for treating conditions that arise from poor housing.

£26.9m/week!
How do we start?

Source of CO2 emissions in a standard Victorian House

80% CO2 reduction

Target
How to ‘Retrofit’?

Key principles

1- Insulation
2- Windows
3- Ventilation
4- Airtightness
5- Thermal bridges
How to ‘Retrofit’?
How to ‘Retrofit’?

1- Understand your building
2- Set your targets
3- Draw your details
4- Build and monitor quality
5- Measure performance

Vital statistics table

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Before</th>
<th>Target</th>
<th>Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary energy (kWh/m²/yr)</td>
<td>250</td>
<td>120</td>
<td>128</td>
</tr>
<tr>
<td>Space heating (kWh/m²/yr)</td>
<td>120</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Airtightness (m³/m²h @ 50 Pa)</td>
<td>–</td>
<td>0.6</td>
<td>0.34</td>
</tr>
<tr>
<td>Type of glazing</td>
<td>single</td>
<td>triple</td>
<td>triple</td>
</tr>
<tr>
<td>CO₂ emissions (kg CO₂/m²/yr)</td>
<td>70</td>
<td>17</td>
<td>20</td>
</tr>
</tbody>
</table>
1- Insulation

Internal

External
2- Windows

- Double glazed
- Triple glazed
- Single glazed
3- Ventilation & services
4- Airtightness
5- Thermal Bridges

- Metal ferrings holding the insulation
- 15mm Duraline plasterboard
- 150mm Insulation quilt
- Existing masonry external wall
- Continuous air tightness layer
- Thermally contained restraint rod resin anchored into external wall
- 18mm OSB board screw fixed to timber floor joists
- 203x102 PFC chased into partywall
- New timber floor joists notched into new beam. Sizes to be confirmed by Structural Engineer (225x50 tbc)
- 1No. layers of 15mm duraline
- 50mm Insulation quilt
- 15mm Duraline plasterboard
- Ventilated cavity
How do we know if it works?
Thermal imaging
How do we know if it works?
Becomes evident with POE / monitoring of the building in use
How do we know if it works?

70% reduction

Average pre

Average post
Conclusion:

What are the barriers to reducing CO2 emissions from existing buildings?

- VAT (20% for retrofit)
- Skills
- Funding
- Legislation
- The size of the challenge…

→ But… **It is possible** and more and more are built, and more knowledge is shared.
Thank You