Innovate UK

Building Performance Evaluation Programme: Findings from non-domestic projects

At a glance

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The UK Government has set challenging targets to cut greenhouse gas emissions 80% by 2050. As around 45% of emissions come from buildings, achieving this will only be possible if we revolutionise energy performance. This summary of the 'Building Performance Evaluation Programme: Findings from non-domestic projects' outlines the challenges – and what stakeholders can do to overcome them.

Energy use

- The range of energy use per square metre across the projects was very wide – from 28 to 367 kWh/m^2 for electricity, and from 0 to 316 kWh/m^2 for fuel.*

- The average electricity use across the buildings was 103 kWh/m^2, while the mean for fuel was 92 kWh/m^2. Electricity and fuel use are important. We can only assess a building as performing well if it achieves low electricity and fuel use – while keeping occupants comfortable.

- Standout success stories from an energy perspective are Staunton-on-Wye Primary School (electricity and fuel both below 30 kWh/m^2), Mildmay Community Centre (electricity use of 47 kWh/m^2 and no fuel), and Angermering Community Centre (electricity use of 49 kWh/m^2 and again no fuel).

- Energy Performance Certificates (EPCs) do not reliably predict actual energy use in buildings – and there is very little correlation between EPCs and Display Energy Certificates, which record actual energy use.

Carbon emissions

- Average total carbon emissions were 3.8 times higher than the average design estimate – and only 1 of the 49 buildings had actual carbon emissions that matched the design estimate.**

- Average total carbon emissions were 75.2 kgCO_2 per square metre per year – or an average equivalent to the annual emissions of 90 homes for each of these buildings.

Airtightness

- The average tested airtightness across non-domestic buildings was 6.1 m3/m2.h – significantly better than the minimum requirement in Building Regulations.

Roots of success

- There was no single, simple recipe for a successful building with low energy use and carbon emissions.

- Many buildings with natural ventilation achieved low-carbon emissions, whereas buildings with poor control of space and water heating and/or lighting often had high emissions.

- Biomass boilers seem to polarise: they are often temperamental and there can be problems sourcing and delivering fuel. However, they can provide much lower emissions when they work.

- Controls are a problem. There is a tendency to make controls for mechanical and electrical services too complicated. This alienates occupants and can mean the building defaults to high energy use.

- Building Management Systems (BMSs) are another big challenge. Many buildings had systems their occupants could not use. Sometimes, they conflicted with other system controls, leading to confusion and wasteful energy use.

Recommendations

Designers

Put simplicity first – especially when it comes to controls.

Contractors

Do not substitute systems and controls for lower-cost alternatives if they are harder to use – and potentially unmanageable.

Designers

Mark the air barrier clearly on all drawings, and appoint an airtightness champion onsite if you wish to achieve top results.

Contractors

Ensure all operatives understand the importance of airtightness, and how to avoid puncturing an air barrier.

Contractors

Allow extra time in the programme for innovative systems. Installation often takes longer than expected, and full commissioning before handover is essential.

Clients and contractors

Ensure individual installers have previously and successfully installed the systems you are using in similar contexts.

Designers or contractors

For Passive House projects, find contractors experienced in meeting Passive House standards.

Designers

To reduce energy use, use natural ventilation and/or mixed mode (with natural ventilation and supplementary mechanical ventilation for specific areas or at specific times of the year).

Designers and contractors

Do not assume that a BMS will provide the control occupants need. Ensure that the BMS is properly commissioned before handover. Also be very careful to avoid conflicts between a BMS and integrated controls in building services equipment.

Clients

Do not rely on a BMS giving the control you need over building services – you may need specialist help for this, which can be expensive.

Key

* Total energy use per year, comprising electricity, gas or oil, biomass and any use of renewable energy from photovoltaics or known solar water heating.

** The design estimate, taken from SAP, which is used for the energy part of Building Regulations compliance, only includes 'regulated' energy (heating, hot water, ventilation and lighting). Whereas total carbon emissions include unregulated energy (plug-in appliances and lamps).

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