Innovate UK

Building Performance Evaluation: Overview of the Programme Portfolio

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Innovate UK, the new name for the Technology Strategy Board, has run a number of funding competitions to stimulate innovation towards achieving buildings with a much lower environmental impact while simultaneously improving the competitiveness of UK companies.

In 2010 Innovate UK launched the Building Performance Evaluation programme (BPE) to address the performance gap challenge in new buildings. The programme committed up to £8m to fund the costs of building performance evaluation studies on domestic and non-domestic buildings.

The Competition

Commencing in May 2010 funding has been allocated in tranches, at approximately four-month intervals, over two years. The funding covered the total cost of evaluating building performance and is intended to support the building supply chain deliver more efficient, better performing buildings. The programme has provided participating organisations the opportunity to up-skill and embed building performance evaluation practices to enable delivery of true low carbon buildings. There are a broad range of project teams, consisting of various entities including commercial and public sector clients, housing associations, contractors, developers and designers.

In total the programme has 101 completed studies in the BPE portfolio. The studies are delivering a significant body of work, providing insights on the performance of various design strategies, building fabric, target performances, construction methods and occupancy patterns, handover and operational practices. This work will be shared across the industry providing evidence based information, increasing industry understanding to support closing the loop between theory and practice, ensuring the delivery of zero carbon new buildings is more readily and widely achievable.

The projects provide good coverage of the UK, with 20% of the portfolio of projects representing Northern Ireland, Scotland and Wales as an indication. Predictably the portfolio is more weighted to London and the South, with 14% of the projects in London, 19% in the South East and 15% in the South West. This is comparable to data for new construction projects found in London, South East and South West from the Office for National Statistics for 2013 at 43% in total.
The programme comprises of two separate streams; one for domestic and one for non-domestic accounting for distinct variations for evaluating building performance. The number of projects is fairly evenly split between domestic and non-domestic, with 53 domestic projects and 48 non-domestic projects.

The buildings for the programme have focussed on new builds, but also include major refurbishment of older non-domestic buildings with a core objective to improve energy performance significantly. Three non-domestic projects matched the prerequisites to be considered as a major refurbishment project for the programme.
Domestic projects

Domestic projects are split into Phase 1 and Phase 2 studies. Phase 1 covers post completion and early occupation, with studies typically conducted within a 6 to 9 month window spanning practical completion and early occupation. Phase 2 covers in-use and post occupancy, with studies typically conducted over two years to enable energy monitoring over two heating seasons. From the 53 domestic projects there are 23 Phase 1 studies and 30 Phase 2 studies. Allocation of funding in tranches within the programme framework allowed Phase 2 studies to be submitted, following a Phase 1 project. From the initial 23 Phase 1 studies, 9 projects continued with a follow up Phase 2 study. Thus from the 53 domestic projects funded by the programme, there are 44 unique project sites.

Figure 3: Domestic project studies

The total number of dwellings assessed in the programme from the 53 domestic project sites is 350, which range from flats to detached homes. The number of assessed dwellings represents developments totalling 3,625 dwellings, equating to a 10% assessment of all developments for the programme. There is a broad range of development size within the domestic portfolio ranging from unique single builds up to 787 dwellings; Figure 4 indicates different sizes of developments are well represented.

Figure 4: Number of dwellings on project sites

Overall the portfolio of domestic buildings can be considered to be exemplary compared with industry averages. For the year 2013-14, the Code for Sustainable Homes statistics show for both design and construction stage the number of certificates issued is predominantly Code level 3, which aligns with the funding criteria for social housing. In comparison to Code level 3, Code level 4 certificates issued is less than one-third in number, and Code level 5 and 6 combined does not register. In contrast for the programme’s portfolio; Code level 4 and Code level 5 and 6 combined is over three times the amount of Code Level 3 projects.
The type of structure for the domestic buildings in the portfolio ranged from traditional masonry and timber through to Structural Insulated Panels (SIPs). The English Housing Survey (EHS) housing stock report (2011) shows post 1980 to 2011, 95% of construction is considered traditionally built with masonry or timber, leaving 5% non-traditional comprising of primarily of concrete and metal frame. Non-traditional materials account for 27% in the programme portfolio, which is largely due to flats with concrete and steel construction. The EHS report shows timber frame only accounting for 8% of the overall stock post 1980 to 2011, in contrast to 44% in the programme portfolio. The report acknowledges timber frame construction has been on the increase over the last 30 years, but any subsequent increase has not been captured. Additionally, the programme portfolio has a significant representation in Scotland, where timber frame is the primary form of construction.

Non-domestic projects

Similar to the domestic stream, non-domestic projects are split into two categories of study. One is for buildings under construction but within 9 months of completion, and the other for those in operation for no more than three years post completion, aligned with the competition deadlines. From the 48 non-domestic projects there are 8
projects that were under construction and 40 in operation. Six projects studied multiple buildings, which provided a total of 55 study buildings for the non-domestic stream.

There is a wide range of non-domestic buildings for the programme, providing many lessons learned in various sectors. The study buildings include:

- Offices
- Retail
- Healthcare
- Libraries
- Industrial
- Hotels and other residential accommodation
- Schools
- Higher education
- Community centres
- Visitor centres

The leading sector represented is schools accounting for 29% of the portfolio, followed by offices with 27%. This parallels data from the Office for National Statistics for Q4 2012 and 2013, showing education with the highest value of new construction output in Great Britain, followed by offices.
Similar to the domestic stream, the non-domestic buildings for the programme can be considered to be exemplary compared with industry averages. Analysis of BREEAM\textsuperscript{2} design stage certificates issued in 2010 shows the majority of BREEAM ratings are Very Good\textsuperscript{3}, in comparison the Excellent rating is approximately 60% in relation to the Very Good rating. For the portfolio of buildings in the programme, this trend is reversed with the Excellent rating as the majority, and Very Good rating approximately 65% in relation to the Excellent rating. Additionally, representation of the Outstanding rating in the programme portfolio is over double the corresponding amount issued in 2010.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{ratings.png}
\caption{Ratings for BREEAM certificates issued in 2010 (left), compared to BPE programme portfolio (right)}
\end{figure}

The size of non-domestic buildings are categorised in Figure 10 by gross internal area; with small less than 1000m\textsuperscript{2}, large greater than 5000m\textsuperscript{2} and medium accounting for the remainder of the category. The trend across the portfolio of non-domestic buildings for the programme is an increasing number of buildings in relation to increasing size. The type of structure for the buildings in the portfolio is also represented in Figure 10. For large buildings only concrete and steel structure is available due to feasibility of other methods. In the medium size building category there is an even mix of structural types with the introduction of timber frames, and timber becomes the primary structural type in the small building size category. The final structural category labelled ‘Other’ accounts for buildings with a mix of structural types and unique structural techniques such as the use of rammed earth.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{structure.png}
\caption{Size and structure of non-domestic buildings}
\end{figure}
Summary

In review of the 101 projects supported in the programme, the portfolio provides a good representation of new builds in the construction industry when competition funding was allocated, although there is greater emphasis on buildings with higher design aspirations. The additional emphasis on more innovative buildings within the portfolio aligns with a core objective of Innovate UK’s Low Impact Building Innovation Platform; provision of funding to stimulate innovation towards achieving the challenging targets outlined by the UK Government for improving sustainability and limiting anthropogenic climate change. An understanding of the performance of the more innovative buildings and potential barriers are required to ensure delivery of zero carbon new buildings is more readily and widely achievable.

This building portfolio is providing a significant body of work for the Building Performance Evaluation competition, allowing invaluable insights on the discrepancy between predicted energy performance and what is measured. The breadth of building types, design strategies, construction methods and occupancy will offer overarching lessons for the industry, but also distil unique lessons for innovative approaches to building design. The output from the programme will be evidence based information, to support the industry tackle the key challenge of delivering buildings that actually perform as intended in building design.

Further outputs from the Building Performance Evaluation programme will be released from early 2015 via the Knowledge Transfer Network.

Innovate UK is the new name for the Technology Strategy Board – the UK’s innovation agency. Taking a new idea to market is a challenge. Innovate UK funds, supports and connects innovative businesses through a unique mix of people and programmes to accelerate sustainable economic growth. For further information visit www.innovateuk.org.

1 SAP refers to the Government’s ‘Standard Assessment Procedure’ for assessing the energy performance of dwellings.
2 BRE Environmental Assessment Method for assessing and certifying the sustainability of buildings.