



CLOSING THE GAP BETWEEN DESIGN AND AS-BUILT PERFORMANCE

NEW HOMES

INTERIM PROGRESS REPORT
EXECUTIVE SUMMARY

July 2013

Executive Summary

This interim progress report provides a summary of the work carried out to date within a collaborative industry project, led by the Zero Carbon Hub, to investigate and help close the gap between the design and as-built energy / carbon performance of new homes. This report presents initial findings and explains the next steps for the project.

Background

An earlier review by the Zero Carbon Hub in 2010, which investigated the energy / carbon modelling regime for new homes, included a detailed examination of the performance gap. That report contains a historical review of evidence from a limited number of sources and found that more evidence was needed to understand the scale of the performance gap and technical issues involved. Since that time more evidence has emerged, but in a piecemeal rather than coordinated manner.

In February 2011, as part of its recommendations to government on Carbon Compliance, a Zero Carbon Hub task group advised that future performance standards for zero carbon homes should be linked to 'as-built' performance (see 'The 2020 Ambition' below). Government has welcomed the opportunity to explore a collaborative approach to achieving this aim.

CLOSING THE PERFORMANCE GAP: THE 2020 AMBITION

From 2020, be able to demonstrate that at least 90% of all new homes meet or perform better than the designed energy / carbon performance

Introduction

The current work programme considers the complete house-building process, in its broadest sense, from conception through to completion on site. Performance of the completed home, beyond handover to the occupant, is outside the scope of this work, although the significance of building services controls is being considered.

The first phase of the project, concentrating on research and identification of issues, is well underway, with 140 industry experts across 90 companies presently involved as part of the project's Industry Executive Committee, Steering Group and Work Groups. The next phase will focus on the analysis of evidence found to date, and further evidence collection and assessment. This information will play a vital role in moving discussions from opinion to fact-based evidence. The Steering Group will then be able to more robustly prioritise issues to address and identify 'quick wins' within the project period to March 2014, whilst recognising that this journey is to 2020.

Emerging Themes and Issues

Understanding and addressing the performance gap is an industry-wide challenge. Creating a clear overview of the housing delivery process is considered an important task in order to provide a structure for considering the various potential issues.

There are multiple house building delivery routes within the industry, which makes mapping the process a complex task. Varying business model approaches are used by large, medium and small builders, in addition to differing contract types such as 'Design and Build' or 'Materials and Labour'. The potential routes to procure professional services, materials, and products, at varying development scales, add a further layer of complexity.

Considering the entire delivery process at a strategic level has resulted in the identification of a number of cross-cutting issues. Often bridging across professions and timescales these issues fall into four themes; Knowledge, Communication, Responsibility and Skills.

This Executive Summary provides a brief summary of the issues that might influence the performance gap, structured around headings related to the main phases of a development. Further information can be found in the main report.

Concept, Planning and Detailed Design

Decisions made at the very beginning of the development process can have a significant effect, both positive and negative, on the eventual energy and carbon performance of new homes. Local Authorities frequently set energy and carbon targets at the planning stage but there is currently inconsistency in how these are defined and what information is required to demonstrate they have been met.

There is a general lack of understanding across developers, designers and planners about the potential impact they can have on energy performance and buildability. For example, aesthetically driven features, such as dormers and bays, can create complexity for both the detailed design and construction stages.

There are multiple reasons for issues to arise. Information flow from early stage design to the later stages in the process may be limited or ignored, and lessons learnt during construction and the later design stages are not consistently fed back to create a virtuous circle of improvement. There is a lack of suitable energy performance analysis tools that enable designers to easily and routinely check the robustness of their design proposals.

The government's compliance tool, known as SAP (Standard Assessment Procedure), plays an increasing role as developments progress through the detailed design stage. A review of existing research indicates that the core building physics of SAP may be broadly sound but further work is required on the inputs and assumptions to ensure it is a robust tool for the future. Particular aspects of the model itself that need further work include ventilation, thermal mass, hot water and lighting. There is concern regarding the transparency of assumptions and the suitability of some of the inputs currently used if it is to become a more accurate predictor of 'as-built' performance (e.g. laboratory based thermal conductivities, building services component efficiencies). SAP as a whole has been identified by many of the Work Groups as a major area for further detailed investigation to establish its potentially significant role in contributing to the performance gap.

Energy literacy within the detailed design team can be limited, and often an external energy modeller (SAP Assessor) will be engaged for design and specification advice. A lack of ongoing communication between the design team and SAP Assessors can mean that the performance implications of design changes are not fully understood.

Procurement

The materials, components and systems used to create homes clearly have a significant role in their energy performance. Manufacturer performance declarations (e.g. thermal conductivity, heat recovery efficiency) are legally required to be in conformity with harmonised European test standards and further work is required to look at the impact of these on the performance gap. There are concerns regarding the appropriateness of such test data when related to 'as-built' performance. Products and materials are generally tested in isolation, as individual components, not as systems or fabric assemblies constructed on site.

Focus has been on two areas: U-value calculation conventions (BR443) and current testing methodologies. A specially convened workshop has reviewed the existing U-value conventions and highlighted a range of areas requiring revision in the immediate future. The industry's ability to reliably and repeatedly test the 'as-built' performance of both fabric and services is an area of concern. Existing hotbox and heat flux tests are currently unable to replicate 'in-situ' issues (e.g. solar gain, moisture) and whole building co-heating tests face considerable limitations for widespread usage.

The main concerns regarding the influence of procurement on the performance gap relate to product substitution, the level of information contained in tender specifications and, as an overarching issue, the knowledge and skills of those making procurement decisions (be they the procurement team, site managers, contractors, or sub-contractors). Designers typically provide drawings and specification documents which include phrases such as 'or equivalent'. Without enough information as to the critical performance criteria, products chosen or substituted may not meet the original design intent, and these changes are unlikely to be fed back to the design team or SAP assessor to check any potential performance implications.

Construction, Commissioning and Completion

It is at the construction stage that design intent, materials, components and systems combine. It appears that culture and embedded behaviours are not always aligned to enable the delivery of 'as-built' performance. In some cases the design team will not provide sufficiently detailed drawings to explain how junctions should be assembled to achieve the air tightness and thermal performance envisaged. In others, such drawings will have been produced but may not be referred to by the construction teams. Information on unbuildable / uninstallable details may not be fed back to the design or concept team so lessons are not learnt.

Discussions have highlighted the potential for some materials and products to be inadvertently substituted on site, however the extent of this needs further investigation. Once packaging / labelling has been removed it can become very difficult to identify the correct specific product for installation (e.g. between different thicknesses / types of mineral wool insulation). In addition to this some manufacturers only provide limited, if any, installation or commissioning guidance for construction teams. This can result in improvised or 'ad-hoc' approaches being used on site without understanding the energy performance implications.

There are concerns regarding the level of both installation and commissioning skills for building services, especially mechanical ventilation and heat pumps as demonstrated by GHA research, Zero Carbon Hub's Ventilation and Indoor Air Quality reports and EST field trials.

Anecdotal evidence suggests a lack of ownership of verification across the delivery process and many incorrect assumptions and expectations of the part that various parties play in the verification process. For example, Building Control is often incorrectly perceived to be a Quality Control process, but this is not the case as responsibility for compliance remains with the builder. A risk-based approach to building control site inspections has become the norm, which tends to prioritise health and safety related issues. In addition, the specialist nature of regulatory requirements for thermal performance requires Building Control Surveyors to place reliance on the timely and accurate supply of information from specialist consultants and Competent Persons Schemes.

Verification by SAP Assessor Accreditation Bodies currently tends to focus on the calculation procedures themselves rather than a more intensive audit of the information

provided at the design and construction phase. This means the differences between the design intent and actual built specification are potentially missed, even though an 'as built' SAP assessment is required by Building Regulations.

Construction Joint Details

Following a specific government request a review is underway of the existing Accredited Construction Details, Enhanced Construction Details and associated thermal bridge calculation procedures. This is particularly pertinent with regards to any possible updates to Part L of the Building Regulations.

A multidisciplinary group has been considering issues including the strengths and weakness of existing details, potential for their revision, the need for any additional details and the ability to accommodate future innovations. In parallel, the future ownership and commercial viability of any such scheme has been investigated and it is the intention to pursue available options for this, including reviewing existing examples from Europe.

Findings to date include the conclusion that the current details need to be updated to reflect improved building fabric specifications, as well as buildability and robustness concerns, and to cover a number of common details currently not included within SAP Appendix K. The current lack of a Competent Person Scheme for thermal bridge modellers is also an area of concern. During their deliberations, the Work Groups considering design and construction both identified standard details as a potential aid to closing the performance gap. The commissioning of a new set of construction joint details is therefore thought to be a useful 'quick win' for the project and additional funding will be sought to achieve this.

Knowledge and Skills

Throughout the initial phases of this project every Work Group has identified that knowledge, skills and working practices within the industry are a serious concern and will have an influence on both the performance gap and the ability to close it. The Steering Group and Industry Executive Committee have supported the intention of the Zero Carbon Hub team in conjunction with HBF (Home Builders Federation) to seek substantial additional funding from CITB (the Construction Industry Training Board) to enable these aspects to be addressed.

Next Steps

The activities carried out so far have revealed the sheer number of issues which have a potential to impact the performance gap. The next phase of this project is the analysis of existing evidence and co-ordinated gathering of new data. It is also recognised that further work is required to identify the issues relating to building services and this will also take place during the next phase.

Evidence collection and analysis

It is recognised that in carrying out the initial identification of issues, the Work Groups relied quite heavily on their own experiences and expertise (which can mainly be classified as anecdotal evidence). Further evidence collection and analysis will be carried out over the summer, with the intention that in the autumn enough information will be available for the Steering Group to make decisions on the prioritisation of issues to be taken forward and tackled, including identification of 'quick wins'.

Due to the cross industry nature of the performance gap there are a number of potentially valid evidence types which are being considered. These include:

- State of the industry (statistical analysis)
- Compliance processes (surveys)
- Field trials
- Academic studies
- "Secret" knowledge (unpublished)
- Anecdotal

A review of the evidence identified to date shows in many cases a willingness to share 'secret' knowledge from within house builders. Some manufacturers are also willing to share similar information about product and system performance. The Zero Carbon Hub team has been in discussions with the Technology Strategy Board to explore how this project can gain access to data from the Buildings Performance Evaluation programme and wider EMBED (Energy Monitoring and Building Evaluation Database) datasets prior to their wider publication, which does not quite tally with the timescales of this project.

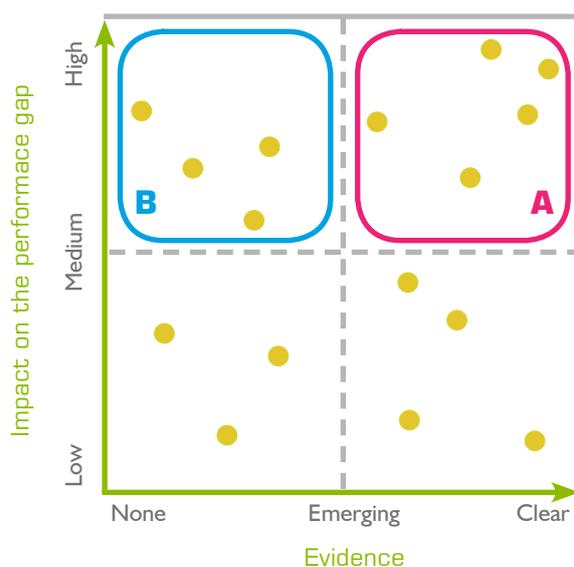
Following an All Member workshop, focussing on cross-cutting issues, a number of additional evidence-gathering exercises are being investigated. For example the Zero Carbon Hub team is in discussions with HBF regarding their offer of making homes available on a number of their members' sites for anonymous testing / trialling and evidence-basing. A coordinated analysis of SAP calculations has also been proposed.

Prioritisation of Issues

The Work Groups have been keen to turn to solutions, but prior to moving to this phase of the project a process of prioritising the issues that impact the performance gap will be carried out. Only activities relating to those issues considered to have a significant impact will be taken forward within the timescale of this funded project.

A matrix has been developed to help prioritise the importance of identified issues. This compares the potential impact each issue has on the performance gap against the sufficiency and clarity of evidence collected for that specific issue (see illustration). Once the placing of the issues has been ratified by the Steering Group, it will be clear which form part of the ongoing work plan for this project and which can be disregarded as they are of relatively low significance or are best tackled at a later date.

Those issues where there is both clear evidence and a high impact will be taken forward by the project, to develop solutions and recommendations (Area A). Those where a medium-high impact is suspected, but clear evidence is not available (Area B), will be investigated by further evidence gathering and analysis to see whether the issues are substantiated (and hence move horizontally to the right of the matrix) or if they turn out to be low impact or unsubstantiated issues (and hence move towards the bottom right of the matrix).



Establishing a baseline

It is recognised that in order to measure progress on topic areas there must be a defined method to clarify whether there is an actual impact on closing the performance gap. This might take the form of establishing 'where we are now' and identifying how much progress has been made over a defined period. Where the initial baseline is impossible to establish, the method of demonstrating a reduction in the performance gap 'by proxy' will be developed.

Defining solutions

The intention is to focus effort around the activities dictated by the issues which fall in the 'clear evidence, high impact' and 'low evidence, potentially high impact' quadrants of the matrix.

These 'activity groups' will set their own programme of work, assisted by the Zero Carbon Hub team, to tackle the prioritised issues and additional evidence gathering. Issues that are identified as 'quick wins' will be progressed with a view that by the end of the funding period of this project there will be activities completed or detailed work plans in progress to deliver the specific solutions identified. Cross-cutting issues such as those surrounding the SAP compliance tool may need additional consideration in relation to defining workable solutions.

A thorough analysis of the potential cost impacts of the Work Group proposals and final Steering Group recommendations will be prepared using a combination of qualitative and quantitative techniques. Impacts will be identified using a structured assessment framework, with the significance of each impact determined using available evidence or other relevant information. The Industry Executive Committee will also aid this analysis and act as the 'commercial oversight' for proposals coming forward.

Areas requiring government support

The project work to date has already identified that government departments may need to be consulted with in order to address potential issues that may inhibit the closing of the performance gap if action is not taken. Areas requiring government support include:

- A serious review of the SAP assessment tool, including inputs.
- The update of construction joint details.
- Supporting industry's ambition to improve knowledge and skills.
- Supporting the development of new test methods.

It is also recognised that there may be particular legislative barriers to certain solutions. For example, harmonised European Standards may be a barrier to 'in-situ' product performance declarations. This may require specific recommendations on revisions to the rules or their application in certain parts of the industry.

A final report to government will be delivered at the end of the project period in March 2014. This will include a more detailed analysis of the issues affecting the performance gap and recommendations for a future programme of work to 2020.