The Chartered Institute of Building

submission to

The Energy Efficiency Partnership for Homes (EEPH)

on the Call for Evidence on

Costs and Benefits of Energy Efficiency Measures

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Costs and Benefits of Energy Efficiency Measures

Introduction

The Chartered Institute of Building (CIOB) represents, for the public benefit, the most diverse set of construction management professionals in the construction industry.

Our Mission:

To contribute to the creation of a modern, progressive, and responsible construction industry; able to meet the economic, environmental and social challenges faced in the 21st century**.**

Our 7 Guiding Principles:

- Creating extraordinary people through professional learning and continuous personal development.
- Promoting the built environment as central to the quality of life for everyone everywhere.
- Achieving a sustainable future, worldwide.
- Advocating exemplary ethical practice and behaviour, integrity and transparency.
- Pursuing excellence in management practice, and technological innovation rooted in evidence based science.
- Being socially responsible and working responsibly.
- Enabling our members to find an emotional resonance with the Institute; their success is our success.

We have over 47,000 members around the world and are considered to be the international voice of the building professional, representing an unequalled body of knowledge concerning the management of the total building process. Chartered Member status is recognised internationally as the mark of a true, skilled professional in the construction industry and CIOB members have a common commitment to achieving and maintaining the highest possible standards within the built environment.

The CIOB is a member of the Society for the Environment and is able to award the Chartered Environmentalist (CEnv) qualification. We currently have over 300 CEnv members and this number is steadily growing.

The CIOB puts sustainability at the heart of its business. We consider carbon dioxide emission reduction in the built environment as an absolute priority in achieving the carbon reduction targets set out in the Climate Change Act 2008.

Our submission below has been developed for the public benefit and is informed by feedback from our members, in particular our Carbon Action 2050 group.

General Comments

The Chartered Institute of Building (CIOB) welcomes the opportunity to respond to this Call for Evidence on the *Costs and Benefits of Energy Efficiency Measures* from the Energy Efficiency Partnership for Homes.

Summary

The CIOB believes that, while refurbishment and retrofitting measures afford the opportunity to improve the energy efficiency of existing buildings, the various benefits that can be accrued from good building-maintenance and repairs must be a chief consideration. Good maintenance and repair work not only helps to minimise energy wastage and living discomfort, but also increases the durability and longevity of a building's fabric, yielding further long-term benefits in terms of the retention of embodied carbon. Poor maintenance means increasing carbon in a wasteful manner, which can also put the carbon invested into the building fabric at risk – best practice repair and maintenance is essential to both reduce this risk and to achieve the carbon reduction targets set out in the Climate Change Act 2008.

An overview of retrofit and refurbishment

Retrofit and refurbishment is essentially about improving building energy efficiency, through making buildings more thermally efficient and sustainable. It principally concerns improving the insulation of the building envelope, which focuses on:

- Walls: insulation of cavities or on external / internal surfaces.
- Roofs: usually loft insulation.
- Doors: usually draught-proofing, but can include additional/replacement doors.
- Windows: very often includes replacement of old windows with double or triple-glazed units, but also includes draught-proofing existing windows and/or the installation of secondary glazing.
- Floors: insulation.

It also focuses on energy use by buildings systems (operational carbon):

- Lighting: new controls, occupancy sensors, LED, fibre optic and other low-energy technologies. Other options, principally for non-domestic buildings, include maximising daylight with motorised external louvres and light shelves.
- Tanks and pipes: lagging.

- Boilers: replacement with high-efficiency condensing boilers, new controls, boiler-burner replacement with higher-efficiency models, connection to low-carbon community heating systems.

- Chiller-plant improvements: upgrade of plant, pumps, piping and controls which all relate to non-domestic buildings.

- Controls and Building-Management Systems: installation of a building-management system, upgrade to include digital controls and greater number of sensors, which all relate to non-domestic buildings.

- Air conditioning: upgrade and provide passive replacement in areas of building where possible, which all usually relate to non-domestic buildings.

- Renewable Energy Systems: photovoltaics (PV), solar thermal hot water, solar ventilation pre-heating, passive solar heating, wind energy, retrieved-methane powered plant installations, wood and organic-waste power-sourced heating or power plant, replacing traditional air conditioning with air-source (ASHP) or ground-source heat pumps (GSHPs), micro-hydro power. This array of options will usually be applicable to non-domestic buildings.

- Water conservation: low-flow water fittings and shower heads, low-flow plumbing equipment, water-efficient irrigation, greywater systems and rainwater harvesting.

- Electrical peak saving: thermal-energy storage, on-site electricity generation. The latter is usually applicable to non-domestic buildings only.

- Advanced metering systems: smart metering (recent government proposals indicate that smart metering will be rolled out nationwide to all domestic buildings beginning in 2014), half-hour metering.

- Distributed Generation: Combined-Heat-and-Power (CHP), Combined-Cooling-Heating-and-Power (CCHP), fuel-cell technology, micro turbines. Not so long ago these options would be confined to non-domestic buildings only, but smaller-scale CHPs can now be installed in domestic buildings.

The above describes the most common ingredients of retrofit and low-carbon refurbishment. It should be realised however, that in an integrated way, it must also focus on keeping buildings in good repair and educating the building operators on how best to maintain and use the retrofit and refurbishment measures.

The elements of what retrofit and low-carbon refurbishment, as described above, can contain promotes an approach that focuses on selecting the options available. This can lead to decisions which may not always be the most

beneficial. All options have a multitude of advantages and disadvantages covering issues that range from practicalities and payback to well-informed embodied carbon data and potential technical problems relating to the original building fabric and the health of occupants.

In a generic sense, the options available must be listed to the general public, as well as the commercial sector, and well understood. Advantages and disadvantages must be worked out and a conclusion reached. From the outset, however, the building must be understood in terms of its condition and its performance in-use (operation); options for retrofit and refurbishment must consider the effects on both these aspects.

In order for maintenance and repair to be sustainable, it must be undertaken properly. This means using compatible materials in repair with the appropriate skills used. Where traditional buildings are concerned, this means using traditional building materials and skills.

Lastly, CIOB recommends ensuring work is not undertaken unnecessarily when alternative solutions, which might be more beneficial in the long-term, ought to have been considered. Advisers need to be fully aware of the benefits of good maintenance and repair; the simple and least expensive options may provide some of the best results, and should always be considered in the first instance.

The benefits, costs, and risks of retrofit and refurbishment

The advantages of retrofit include:

- Rendering buildings more energy-efficient, thus lowering related carbon emissions (operational carbon);
- Rendering buildings more suitable for existing use, or an intended use;
- Greater sustainable use of embodied-carbon investment (capital carbon).

The disadvantages include:

- Certain aspects can be costly and inconvenient;
- Possibly reducing the internal space if internal wall-insulation is installed;
- Importantly, not all risks are understood at this stage – it is possible that retrofit could result in greater carbon-emissions, and lower energy efficiency, if it results in deterioration of the existing building-fabric;
- The simple and least expensive options, likely to be attractive to consumers, do not seem to be given priority;

- Does not always focus on the basics of keeping buildings in good repair to make them last for as long as possible;
- If a building becomes flooded, wall insulation will no doubt have to be removed in order to allow the original building-fabric to dry out;
- Unforeseen harm to heritage assets, possibly caused by the application of untested methods/technologies or arising from cumulative impacts. Potential harm to archaeological burial environments (e.g. trenching for GSHPs).

It has been estimated that we spend 90% of our time indoors, with most of this time spent at home. With approximately 30% of the UK's energy consumption used by homes and about 57% of this energy use attributed to space heating, the need for a focus on energy conservation is clearly evident.[1]

Making buildings more fuel-efficient with the optimum type of heating and lighting will save energy and therefore reduce carbon emissions. Each type, however, will have different financial payback periods.

Heat-loss from each element of a building will vary according to the type of building and its construction, but it is in the order of the following for solid-wall buildings:

- Roofs: 15%;
- Walls: 35%;
- Ground floors: 15%;
- Windows: 10%;
- Doors: 15%.

This information relates to the financial payback of elements of retrofit. For example, windows could take 97.6 years. This would suggest that replacement windows should not be a priority. Insulating solid walls may have a payback of only seven years. There are, however, risks to contend with (below).

There are numerous options for making buildings more thermally efficient and less draughty. However, at present there is insufficient understanding of existing thermal-performance. Studies have indicated that the energy-efficiency of buildings have been underestimated when considering RdSAP estimates compared with actual performance. Assumed published U-values of solid walls compared to *in situ* test data betrays a wide range of differences and studies that highlight the comparisons of buildings of different construction types and ages, also highlight this point. This would suggest that many buildings, and in particular those that are known as hard-to-treat

[1] Nesbakken, R. *Energy Consumption for Space Heating: A Discrete-Continuous Approach* (2001)

(HTT), such as traditional solid-wall buildings, are more efficient than currently realised. This strongly suggests that they do not require increased thermal insulation to the degree that is often proposed.

Common retrofit and refurbishment solutions may not always provide the most cost-effective or energy-efficient measures. For example, research has indicated that there are numerous options available to reduce energy-loss through window openings which do not involve replacing existing widows with new UPVC double-glazed units. For example, installing secondary glazing, which would leave the original window intact, would retain embodied carbon and alleviate the cost of a new window.[2]

Internal building-environmental conditions affect the building and occupants in different ways and certain forms of retrofit and refurbishment can have varying effects. Traditional buildings, for example, rely on air-circulation to disperse any moisture that evaporates from the building's fabric, and too little air-circulation can have detrimental effects on the health of occupants.

There are many parts of the British Isles that are susceptible to heavy rainfall to the degree that cavity-wall insulation is likely to result in penetrating dampness. This will no doubt result in occupants turning up the heating to dry-out the damp walls, thus increasing carbon output (operational carbon) in the process. This is the type of scenario that could occur and should be avoided.

There are a substantial number of hard-to-treat (HTT) buildings in the UK. In England, HTT homes equate to an estimated 9.2 million dwellings and solid-wall homes account for 72% of this stock, of which 5 million in England are known as traditional buildings.[3]

Traditional buildings have solid walls which breathe. They absorb moisture and this must be allowed to evaporate. Inhibiting this process can cause serious decay which itself has the potential to reduce the lifespan of existing building-fabric, thus necessitating carbon-generating remedial work and reducing the building's energy efficiency. Wall insulation can also affect the performance of existing building-fabric. For example, the installation of internal wall-insulation will isolate the original wall from the effects of warm interiors. This will reduce the thermal performance of the original wall and also result in it remaining damp and cold for longer periods of time, thus increasing the risk of frost damage (cryoturbation) and that possibly caused by invasive vegetation (floralturbation). This is further exacerbated if a building is not kept in good external repair.

Penetrating dampness and rising dampness are also problems that must be understood, particularly where traditional buildings are concerned.

Interstitial condensation is another risk. This could affect any timber elements in the structure of a building, possibly resulting in dry rot, wet rot, infestation or the appearance of invasive species. It could also severely affect the quality

[2] Historic Scotland, *Improving the thermal performance of traditional windows* (2008)
[3] Energy Efficiency Partnership for Homes, 2008

of the internal environment potentially leading to ill health, often termed 'sick building syndrome'.

The benefits of retrofit and refurbishment may not be achieved if the design (and in particular the detailing), methods deployed and the standard of work is not satisfactory. This will require the correct skills and expertise with a proper knowledge of existing buildings. Before work is undertaken, it must be ensured that the causes of any dampness are treated and the building permitted to dry out. Otherwise, enclosing spaces that are damp could result in a host of serious problems.

Insufficient research has been undertaken into many of these issues, which is possibly the biggest risk of all. This has the possibility of leading to ill-informed decision-making and taking; the consequences of getting things wrong are severe in terms of the performance of the buildings, the health of occupants, along with the waste of time and substantial amounts of money. The acquisition, use and dissemination of data are essential for monitoring success, or lack of; this applies not only to the 'performance of measures' but also the effects (short-, medium- and long-term) on building fabric, structures and living environments.

Skills for retrofitting

Whilst evidence or information on skills and training is not specifically requested in this Call for Evidence, we are aware that ConstructionSkills, Asset Skills and Summit Skills are aiming to pull together a list of National Occupation Standards and qualifications that will potentially sit within the Green Deal. There will be many issues around training and qualifications that will affect the construction sector across its many facets from traditional buildings through to new build.

However, we believe that education and training should have a much broader base with a greater emphasis on understanding building performance along with maintaining and repairing buildings for all those involved with retrofit. We would be happy be involved in this debate as it develops.