Non-Domestic Buildings: The missed opportunity

Caleb Report concludes that over 4.7Mtons CO_2-eq annually and that more than 50,000

long-term jobs created through cost-effective insulation measures

SO, WHAT IS THE PROBLEM?

Much of the existing non-domestic building stock can be characterized as having poor energy performance[1]. Many buildings have poor fabric, inefficient plant, poor controls and low levels of occupant energy awareness. Overheating is common, leading to increased cooling demand. Improved controls and the appropriate use of thermal mass, glazing, shading and ventilation are important to mitigate overheating.

There is a wide consensus that Buildings, as major energy consumers and sources of greenhouse gas emissions, must play an important part in mitigating Climate Change. It is estimated that 40%[2] of the buildings that will be standing in 2050 pre-date the introduction of Part L. Although there has been increased focus on measures to reduce the emissions from new buildings, the existing building stock remains largely untouched and many refurbishment projects miss opportunities to reduce emissions and deliver energy efficient buildings.

Energy demand in the existing building stock must be tackled now if we are to meet any of the Government targets for carbon reductions by 2050, and achieve better energy security. Past efforts to reduce carbon emissions from existing non-domestic buildings have had limited success. Reasons for this include:

- Poor understanding and knowledge of the non-domestic building stock
- Poor understanding and knowledge of how people use energy in buildings, how they interact with new technology and how they respond to energy conservation initiatives
- a shortage of openly available energy use data matched with details of physical form, occupant characteristics and installed appliances and services
- High adoption costs (management time) needed to achieve improvements
- Market or regulatory failures such as landlord-tenant problem- where any energy performance improvements are to the benefit of the tenant while the cost of measures fall on to the landlord, who may not be able to recover the investment costs from the tenant
- Attitudes and split incentives within organizations, making the adoption of life-cycle costing approaches (for instance) or communication between energy managers & budget holders more difficult.

A recent review of unpublished data on energy performance of existing public buildings requested under the Freedom of Information Act[3] found that one in six of public buildings that have been through an energy audit to obtain display energy certificates received the lowest possible energy efficiency rating. The energy performance breakdown is summarized overleaf: -

[1] Altering existing buildings in the UK; Energy Policy 36 (2008) 4482-4486; Simon Roberts

[2] Low Carbon Buildings Initiatives: Non-domestic Refurbishment; Carbon Trust, 2006

[3] Government buildings emit more CO2 than all of Kenya; Robert Booth; The Guardian; 23/12/08

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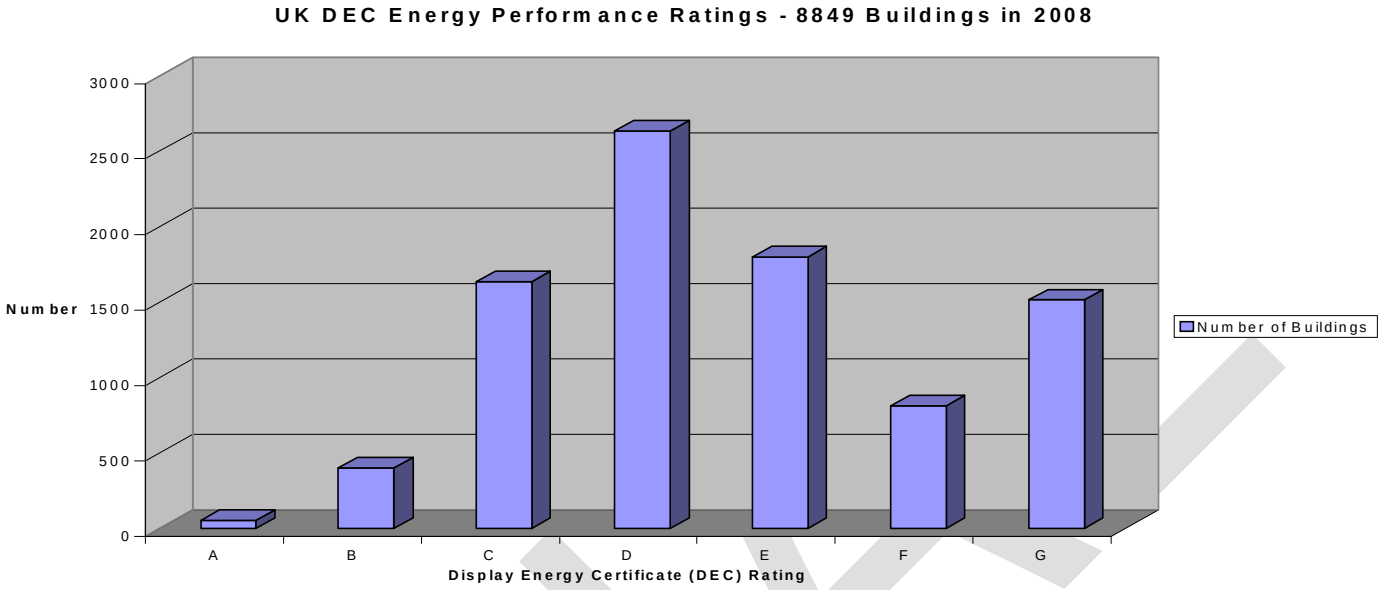

Three quarters of the tested buildings received an energy efficiency rating of below 'C'. While Caleb has not found comparable aggregated data for non-domestic EPCs, we nevertheless conclude that the EPC ratings distribution is unlikely to be better than the DEC rating distribution. A study by the University of Oxford's Environmental Change Institute does provide an EPC distribution for domestic buildings.[4] This indicates that 94% of the UK domestic building stock falls below a 'C' rating. While these ratings are not directly comparable, ECI's findings are broadly in line with Caleb's conclusions that around 80% of non-domestic buildings could be rated below 'C'.

Despite the increasing legislative and market drivers for low carbon buildings, the principal drivers for the decision to refurbish a building are still primarily to update the brand format, improve the quality of the building for the occupants or attract higher rental values and new tenants, rather than reducing carbon emissions. The level of ambition for improving the existing non-domestic stock tends to be relatively low when compared to the emission reduction targets we must achieve. There appears to be little expectation that the relatively low targets we currently work towards will be achievable much before 2020.

There are a range of policy and market barriers that prevent refurbishment efforts. These include a misplaced regulatory focus on energy supply-side measures as opposed to efficiency; a preference of high-tech, complex solutions over 'tried and tested' solutions such as thermal insulation; a lack of easily accessible & up front capital funding and a low recognition of the energy security and employment growth potentials associated with accelerated refurbishment efforts.

Continued focus on supply-side measures

Current energy efficiency obligations do not support the transformation of the energy supply business model to one of providing energy services. There are aspects of the energy market and its regulatory framework that could make it more difficult for building owners or occupiers to benefit from or consider energy efficiency.

[4] Home Truths: A Low-Carbon Strategy to reduce UK Housing Emissions by 80% by 2050; Boardman; 2007

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Examples include: limits on the types of contracts offered by suppliers, assignment of responsibility for metering, and treatment of distributed generation.

Focus on complex solutions

Delivering a low carbon refurbishment doesn't require significant increases in complexity, or adoption of high risk or unproven technical solutions. On the contrary, nearly all refurbishments offer opportunities to reduce carbon emissions beyond the standards set by building regulations through tried & tested solutions that 'design out' energy consumption. Conventional refurbishment projects often miss the opportunities available, leading to unintentional and unnecessary increases in energy use and associated emissions. It is also important to consider the whole life cost of buildings. Whole life cost refers to the costs of running a building, repair and maintenance, refurbishment and disposal. These costs are often not considered when designing a new building or refurbishing an existing building.

Lack of up-front capital funding

There is a lack of financial packages which help spread the upfront costs of measures over time, thus making them more affordable. The persistence of the use of payback as criterion for energy efficiency decisions acts against a number of technologies.

Available finance based incentive schemes can be seen as insufficient, overly complex and/or poorly targeted. As an example, the Enhanced Capital Allowances Scheme is not an effective mechanism for key energy efficiency measures in buildings, as it is only available on equipment. It doesn't make efficient options cost competitive on an initial cost basis – which can be crucial to decisions as to whether they will be included in a refurbishment as standard. It is difficult for smaller companies to use, and requires a good understanding of finance, tax status and tax rules. ECA's are only available to a small percentage of the property industry, and many of the other grants and loans systems are challenging to access.

Low recognition of energy security & employment benefits

Much of the emphasis of reducing emissions from non-domestic buildings has been on fuel-switching. While using a decarbonised fuel supply is an important goal in its own right, it is not a credible strategy for either energy security or the improvement of the building stock. Efforts to improve the building stock have a positive impact on the creation of construction employment. The best way then to contribute towards a better level of energy security and employment creation is to focus on energy demand reduction in existing buildings – preferably via thermally improving building envelopes.

WHY ARE WE PRODUCING THIS REPORT NOW?

There are a number of policies and initiatives in the pipeline or already underway that has a bearing on the fate of non-domestic buildings refurbishment. The newly amalgamated Department of Energy & Climate Change is due to respond to proposals by the Committee on Climate Change during spring 2009. The UK Government must set out policies to achieve the budgets, including an interim emission reduction target of 26% against a 1990 baseline by 2022. Efforts are also currently underway to upgrade Part L of the Building Regulations and to address the recast EPBD provisions. Meanwhile, the UK Green Building Council is due to make recommendations on a potential code for sustainable buildings (CSB) – also in the next few months. The UK Government and the opposition parties are also in the process of preparing or promoting various 'green new deal'

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policies designed to arrest loss of employment and/or the generation of new 'green' jobs. Very few of these interventions are, as yet, taking much account of the potential climate, energy security, employment or financial benefits available from accelerated buildings refurbishment of non-domestic buildings. Caleb and Kingspan are therefore taking this opportunity to contribute to the debate.

ACCELERATED BUILDINGS REFURBISHMENT – A MISSED OPPORTUNITY

The UK has already missed opportunities for cost effective emission reductions in existing buildings that could have led to the retention and creation of employment in the construction industry. In as far as the climate change impacts of buildings are being addressed at this time, the focus largely remains on the performance of new buildings and the decarbonization of buildings energy supply.

There are then several benefits from an accelerated refurbishment effort. These include the opportunity to achieve early emission reductions, a reduction in the need for costly new energy supply infrastructure – offering a contribution to energy security goals, a proven 'engine' for employment creation and the financial savings that feed through to the wider economy. The Carbon Trust estimates that £1bn/pa can be saved from a large scale implementation of non-domestic building refurbishment, using existing technologies[5].

Non-domestic buildings emit over 100 million tons of CO_2 per year. This represents some 18% of the UK's total emissions. Of this, there are different assessments of what might be the technical potential and realistic potential emissions savings. The Carbon Trust[6] identified a technical potential for 37 million tonnes (Mt) of carbon dioxide savings, of which 20 - 23 Mt are a realistic potential.

Earlier findings by the BRE[7] support this assessment, showing that the cost effective potential is 20% of total emissions for a package of measures that include loft and cavity wall insulation, the fitting of low energy heating, lighting equipment and timers and the use of low energy electrical equipment and accessories. The Committee on Climate Change (CCC) identified a technical emissions reduction potential of almost 34 Mt CO_2 for non-domestic Buildings, of which 13.5 $MtCO_2$ is available at a cost of <£40/tCO_2.

Variety of Views on Emission Reduction Potential				
Source	**Total Emissions [$MtCO_2$ per year]**	**Technical Potential [$MtCO_2$ per year]**	**Economic Potential @ <£40/t CO_2 saved [$MtCO_2$ per year]**	**Economic Potential @ <£40/t CO_2 saved [$MtCO_2$ per year] *Fabric Insulation only***
CCC Baseline for current policies	100 e	34	5	-
Carbon Trust	100	37	20	-
BRE/Pout	99 e	35	19.8	-
CCC 1st Budget Period Proposal	100 e	34	13.5	<2
McKinsey	-	-	-	3.2 – 4.6
Caleb 98	-	-	-	3.9
Caleb	112	34 - 46	20 – 23	2 – 5.3

[5] Low Carbon Buildings Initiatives: Non-domestic Refurbishment; Carbon Trust, 2006
[6] Ibid
[7] Carbon dioxide emissions from non-domestic buildings: 2000 and beyond; Pout, McKenzie, Bettle; 2002

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The total 'economic potential' identified by the CCC is almost three times the current effort, but is still well short of the cost effectiveness identified by the Carbon Trust, BRE & Caleb. (Ie.13.5 Mt as against 20 - 23Mt).

The potential for cost-effective fabric insulation measures identified by the CCC is below that of other sources. Caleb estimates that the annual emission reduction potential available from cost effective fabric insulation measures is in the range of 3.2-5.3 $MtCO_2$ – with a realistic potential of 4.7Mt CO_2 per year.

The UK already spends £27 billion per year on commercial & public refurbishment[8]. Some 64% of this spend relates to commercial buildings and the rest to public buildings. For a marginal extra cost, these refurbishments could be energy efficient. Energy efficient refurbishment presents a potentially large market and would lead to the creation of thousands of new 'green collar' jobs at a time when jobs in the construction sector and elsewhere are increasingly under pressure.

Improving energy efficiency in buildings is a particularly effective way to stimulate employment in the places where it is needed most, and to employ people who have the greatest trouble in finding jobs. In terms of direct employment, energy efficiency in buildings is a labour intensive sector, engaging many small, geographically dispersed installation companies. Furthermore, lower fuel bills mean more money to spend on non-energy items (and the labour intensity in sectors stimulated by general consumption exceeds that in the energy supply sector). Thus indirect employment is stimulated by the energy savings, for years after the work is completed. Ultimately, energy efficiency contributes to economic efficiency and growth, which creates more wealth and employment opportunities

ACHIEVING ACCELERATED REFURBISHMENT

In order to make an effective contribution towards the UK achieving its climate change reduction targets in the period leading up to 2050, there needs to be a step change in the way that existing buildings are managed and cared for. Arguably, the focus, to date, on improving the energy performance of new buildings, was the 'easy bit'. There is an urgent need to comprehensively thermally improve existing buildings as they come up for refurbishment. This requires a series of interventions, including information support and stimuli that take the pain out of the high up-front cost of making such improvements.

A better application of the 'Trias Energetica' in policy & practice**:** There should be a clear hierarchy for achieving emissions reductions, starting with demand reduction, through passive design measures and high-performance specification. There should be more focus on 'designing out' energy demand from buildings before investing in energy supply or even carbon offsetting. Once high levels of passive performance have been achieved the issue of energy supply can be addressed. Ideally the generation capacity should be located as close to the development as possible in order to avoid unnecessary distribution losses, increase local awareness of energy supply issues, and ensure that all available renewable energy capacity is exploited. The 3 elements of Trias Energetica[9] are:

[8] Caleb estimate based on 2006 GDP & Construction Industry & other data incl. 'Background to the refurbishment & maintenance of Buildings; www.palgrave.com; 2002

[9] http://www.ecn.nl/fileadmin/ecn/units/eei/EEI/entrias.gif

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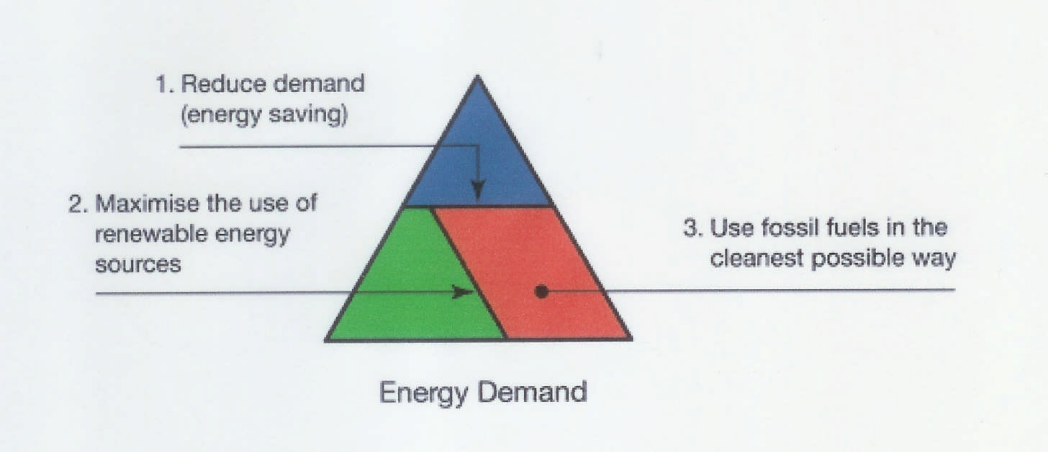

Implementation of readily available solutions

Delivering energy efficient refurbishment does not require significant increases in complexity, or adoption of high risk or unproven technical solutions. On the contrary, nearly all refurbishments offer opportunities to reduce carbon emissions beyond the standards set by building regulations. However, conventional refurbishment projects often miss the opportunities available, leading to unintentional and unnecessary increases in energy use and associated emissions.

Improving the thermal property of the existing building envelope is one of the most logical solutions in order to reduce the building's energy consumption – and thus – one of the most important strategies in building refurbishment. The level of improvement achieved depends on a combination of factors. Interventions may involve windows, doors, walls and roofs – with an unbalanced intervention between different components leading to suboptimal results

Adding insulation is found always to produce cost savings when the measure is done at the same time as the other refurbishment efforts involving that component (e.g. roof replacement) Even when action is taken to solely upgrade insulation levels (not combined with other refurbishment) – it is still cost effective in the case of roof, floor and cavity wall insulation.[10]

Bridging the Capital Gap

Current financing arrangements are not sufficiently large or well enough targeted to support accelerated refurbishment of non-domestic buildings. A more ambitious dispensation is needed. A successful intervention might require a variety of different and complementary financing options based on long-term loan arrangements linked to proven incremental improvements of energy performance. Energy performance improvements could be evaluated via EPCs before and after improvement work, where this work would be based on the EPC energy performance report. Loans should be linked to a whole building approach, where as many measures as possible are taken in the building. A scaled-up Salix Finance type approach could potentially be an interesting financing model – provided it was adaptable for private sector clients and was able to advance up to 100% of capital funds. Salix Finance currently offers 'invest to save' schemes to public sector recipients in England, Wales & Scotland.

[10] Cost-Effective Climate protection in the EU Building Stock; Ecofys; 2005

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In general terms, it should be possible to secure capital funds on the basis of a commitment to implement the recommendations of EPC reports. More specifically, funding could be offered on the condition that the recipient improves existing energy performance ratings to a given rating level. Caleb has modelled the impact of a large number of buildings being improved to a 'C' rating – based on the recommendations offered in the EPC reports.

Caleb proposes that there should be up-front capital funding for beneficiaries willing to commit to achieving EPC/DEC Rating 'C' based on implementing Energy Performance Report recommendations. Caleb has modelled a range of potential benefits and costs associated with building fabric based refurbishment measures to assess the potential impact of accelerated refurbishment, and can confirm that: -

1) A programme of accelerated refurbishment of the non-domestic building stock could be achieved at a cost of £1.96 billion per year. This would save 0.36 $MtCO_2$ per year through a package of thermal insulation measures with an assumed lifetime of 20 years. It would also result in financial savings of £450 million per year

2) Over the period 2010 - 2022, a yearly average of 54 million m^2, or 8% of the non-domestic building stock would be refurbished to a DEC/EPC rating of 'C'. This would achieve annualized savings of nearly 4.74$MtCO_{2e}$ per year in 2022 - approximately 2% of the Government's total 'non traded' carbon dioxide budget for that year* - from tried & tested fabric insulation measures alone

3) The total cost of thermally refurbishing the non-domestic building stock to a DEC/EPC Rating of 'C' by 2022 would be £24.55billion, and related financial savings would be in the region of £5.65 billion per year

4) A accelerated refurbishment programme focusing on 'tried & tested' thermal efficiency measures could be delivered with a cost effectiveness of £30 - £35/tonne CO_2; an average life time benefit of £120 per tonne CO_2 and an average simple payback rate of <5 years

5) Depending on the scheduling of work, between 50,000 and 75,000 long-term jobs could be created on the basis of an average of 100 person years gained from each £1million life-time investment in buildings energy efficiency

6) There could be benefits for Energy Security: Primary energy savings of 24,000 GWh per annum could be made – equivalent to 1.25% of the total UK primary energy requirements in 2022

* CCC interim budget for 2022 from averaged emissions over 3rd Budget Period 2018-2022, as indicated on Page 20; Building a low- carbon economy – the UK's contribution to tackling climate change; CCC, 2008

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Recognizing and maximizing the energy security & employment potential of buildings via thermal refurbishment

The Tres Energetica should be given full consideration by funders when evaluating bids; by building owners deciding on refurbishment strategy and be government in setting the framework for action. By focusing on energy demand reduction goals as a first priority, energy security and employment goals are then easier to achieve – particularly if the strategy involves installing tried and tested technologies. Successful energy demand reduction projects also result in cost savings that are then spent on products and services – leading to secondary job benefits.

HOW PROPOSALS ADDRESS/OVERCOME THE BARRIERS

BARRIER	PROPOSAL	RELEVANCE
Regulation of energy based on supply rather than efficiency	Better application of the 'Trias Energetica' in policy & practice	Focus on the importance of passive energy reduction measures in buildings as priority, with behavioural and/or energy supply aspects as important, but still secondary; Has benefits for energy security; employment; cost & emission savings
Lack of up-front capital finance	A scaled-up Refurbishment Programme with third party (Salix-type) revolving funding guaranteed by Government & paid back from savings	Offer a 'front-funded' resource that makes it easier for landlords or tenants to make refurbishment investments to be paid back from savings. Introduce a large scale programme of refurbishment based on reaching a specified EPC rating achieved by the implementation of EPC report findings as a pre-condition for long-term loans
Preference for higher risk solutions (e.g. some renewables; measures that require consistent occupier behaviour for emission reduction)	Concentrate on implementing readily available solutions	Nearly all refurbishments offer opportunities to reduce carbon emissions beyond the standards set by building regulations. Improving the thermal property of the existing building envelope is, in many cases, one of the most logical solutions in order to reduce the building's energy consumption – and thus – one of the most important strategies in building refurbishment
Low recognition of energy security and employment	Recognition & Maximizing the energy security & employment potential of buildings via thermal refurbishment	Much of current policy & practice is about how to tackle carbon emissions from the supply-side; i.e. – decarbonising the energy system; fitting renewable technologies. Energy security and carbon reductions should also be tackled from the 'demand-side' – by actively reducing demand and thereby ensuring that less energy is needed in the first place. Demand-side strategies also have the benefit of generating 3-4 times more jobs than supply-side strategies

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