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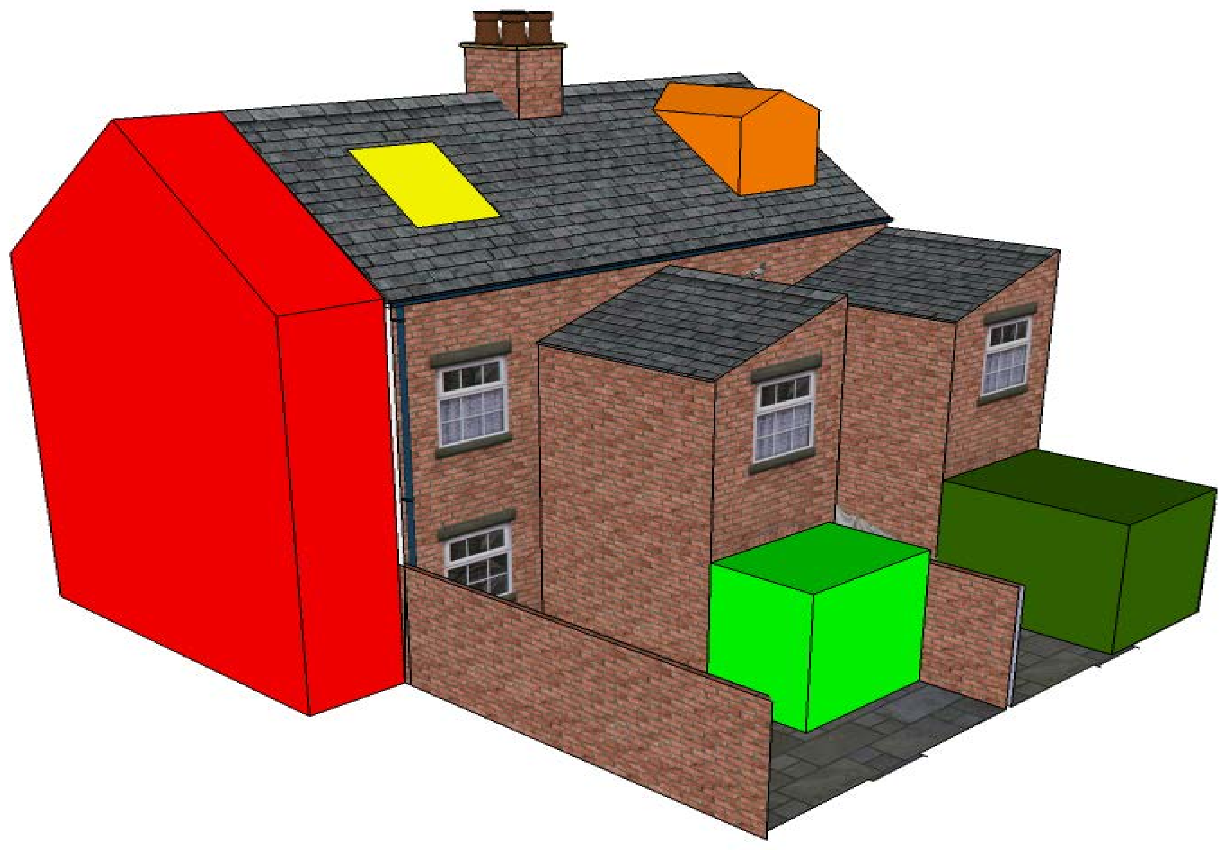
The Expanding House: Extensions to Domestic Buildings and their Impact on Energy Consumption

Richard Jack (r.jack@lboro.ac.uk)
Supervisors – Prof. Kevin Lomas and Dr David Allinson

This study seeks to define the size, shape and prevalence of extensions to buildings within the UK and to analyse the contribution of these extensions to England's total domestic energy demand.



Context

In 2010 the residential sector represented 17% of the UK's total carbon emissions [DECC, 2011], reducing this demand is a policy priority [H.M. Government, 2008]. Accurately measuring the effectiveness of these policies will be crucial over the next few years.

One approach to assessing the likely effectiveness of energy CO2 reduction interventions is the use of 'bottom-up' domestic stock models. These models break the housing stock up into groups of similar dwellings represented by a single 'typical' building (termed an archetype) and calculate the energy demand of each based upon a the properties assigned to it.

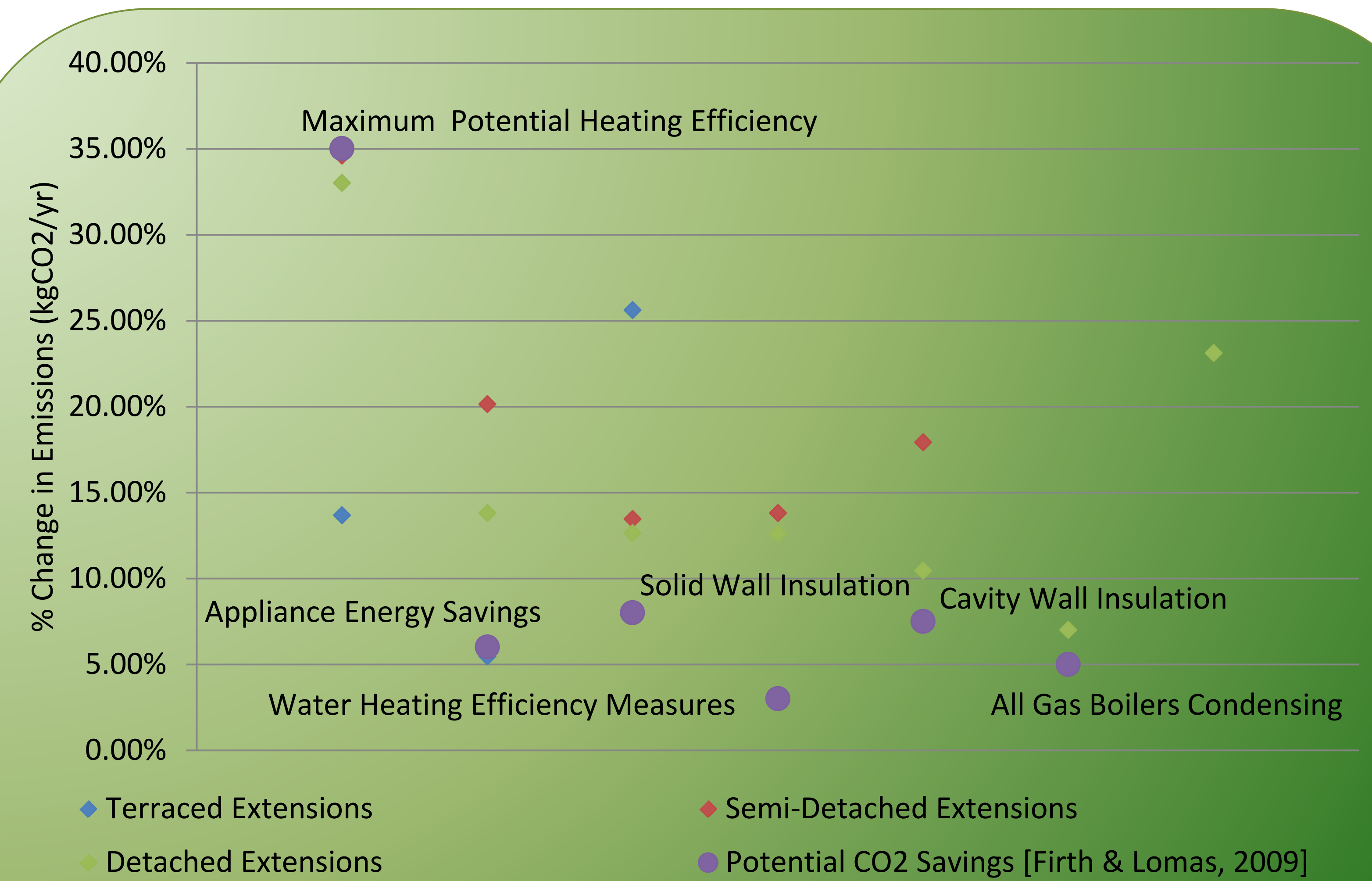
If extensions and conversions to houses contributes a significant percentage of total UK energy demand, and yet remain unaccounted for in the stock models used to inform policy, they could skew predictions and lead to misleading conclusions.

Methodology

The study falls broadly into two research activities:
1) Surveying - in which the size, shape and prevalence of extensions was established. This was achieved through a visual survey of 576 houses in Leicester using publicly available aerial imagery. A catalogue of extensions, divided by building archetype and sub-divided by extension type, was developed. This gave data for typical size and prevalence of each extension type.
2) Energy Modelling – in which the impact of the extension types identified in the survey on house's energy consumption was predicted. A reduced data Standard Assessment Procedure (rdSAP) was used.

Results

•19% of buildings surveyed had an extension or conversion.
•Statistically significant relationships ($p<0.01$) were found between likelihood of extension and tenure, household income and parent building archetype with the relative strength of the relationships in that order.
•A range of increased energy consumption due to an extension of between 7% and 33%, with a mean across all extension types of 16% has been estimated.
•An estimate of the energy impact of extensions on an England-wide scale of 3.8% has been calculated.



A comparison between the increase in CO_2 emissions due to a range of extensions types (♦) and potential CO_2 emissions reductions from various refurbishments (•) if applied to Leicester's housing stock according to Firth & Lomas' *Community Domestic Energy Model* (CDEM).

Conclusions

Extensions have been shown to account for an increase in energy consumption of similar magnitude to the impact of a typical energy efficiency retrofit, such as solid wall insulation. Therefore, **extensions should be specifically accounted for in stock models.** Furthermore, given the possible range in results quantified, the validity of the archetype based stock modelling approach must be questioned.

References:
DECC. (2011). *Digest of united kingdom energy statistics (DUKES). annex A.*
H.M. Government. (2008). Climate Change Act 2008, (2008).
Firth, S. K., Lomas, K. J., & Wright, A. J. (2010). Targeting household energy-efficiency measures using sensitivity analysis. *Building Research & Information, 38*(1), 25-41.

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Central House
14 Upper Woburn Place
London, WC1H 0NN
www.lolo.ac.uk