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Developing a database of energy use for historic dwellings in Bath, UK

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ABSTRACT

Historic dwellings in the UK make up to 20% of all homes. In the Georgian city of Bath this rises to 30%. These buildings are a mongst the most poorly performing part of the English housing stock in energy use terms, with the lowest SAP rating and highest average annual CO_2 emissions.

The legal aim to reduce CO_2 emissions of 80% by 2050 will involve all existing dwellings, including historic buildings. The degree to which proposals to retrofit the UK housing stock can reduce emissions depends on how much energy they currently use, what it is used for and how much CO_2 they emit.

This paper establishes a benchmark of energy use and CO_2 emissions for historic dwellings in Bath. This permits comparison of their energy performance against other parts of the housing stock and will facilitate evaluation of potential retrofit adaptations.

1. Introduction

We are entering a new low carbon paradigm [1], as a result Oreszczyn and Lowe [2] state the main thrust for research is how to decarbonise the built environment. The UK Government recognises that the existing domestic sector could make a significant contribution to the overall reduction of national emissions [3]. But to achieve this, the scale of change needed in the built environment over the coming decades dwarfs anything achieved historically, and must be brought about over a timescale of 20–30 years [2].

In the UK, dwellings account for 26% of CO_2 emissions [4] and are at the centre of the governments focus to reduce emissions, along with transport and industry. At the same time it is accepted that the majority of homes in England that will be standing in 2050 have already been built. However, the exact percentage can only ever be an estimate; consequently figures vary (85% Palmer et al. [5], 80% Sustainable Development Comission [6], and 70%, Lowe [7]). Regardless of the exact numbers, it will clearly be necessary to make existing buildings energy efficient rather than focussing primarily on new dwellings.

Within the group of domestic homes, historic dwellings are those built before 1919 (which is considered as the date for the introduction of damp proof courses and the start of the use of cavity wall construction). Fig. 1 shows that in England, 21.5% of all dwellings were built before 1919.

2. Performance of historic buildings

Bath is one of the only two complete cities with World Heritage status (the other being Venice), but this heritage status cannot avoid the emerging low-carbon paradigm that questions the energy use, and by proxy, CO_2 emissions of historic buildings.

Despite government statistics showing higher CO_2 emissions from the historic building stock [8] there are differences on how the energy efficiency of these buildings is viewed. English Heritage [9] views their energy efficiency as good whereas Boardman [10] considers their energy efficiency as poor.

A common measure of the energy performance of a dwelling is the rating derived from the Standard Assessment Procedure (SAP),[1] this is the National Calculation Method (NCM) for England as mandated by the EPBD. The English House Condition Survey [8] reveals a close correlation between the age of a building and its energy performance. Homes built before 1919 have an average SAP rating of 39 (Band E), the effect of this is demonstrated by their average 9 tonnes CO_2 emissions for heating and lighting, twice those of the post 1990 stock (Fig. 2).

To put this into perspective in energy use and emission terms, using Elmhurst 2009 software, a SAP rating of 39(E) equates to approximately 320 kWh/m^2/year and 81 kg CO_2/m^2/year.

Within these statistics it is recognised that there are differences in typical size between older and newer homes, which is why such

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[1] SAP rating is calculated from an estimate of annual heating, hot water and internal lighting costs per m^2 of a property. The SAP scale runs from 1 to 100, with 100 being the best [11].

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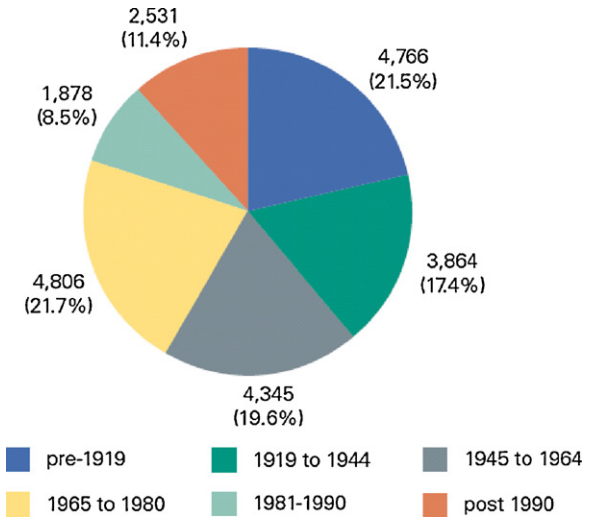

Fig. 1. Number (000s) and percentage of homes by age in 2007.
Source: English House Condition Survey (EHCS) [8].

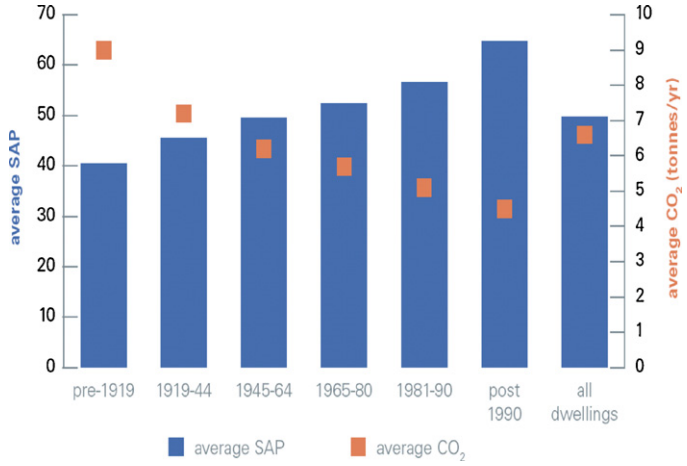

Fig. 2. SAP and CO_2 emissions by building age.
Source: EHCS [8].

data should be normalised by floor area to allow direct comparisons to be made, see Fig. 3

Despite having a higher distribution of larger dwellings it is unlikely to alter the fact that although pre 1919 buildings are a

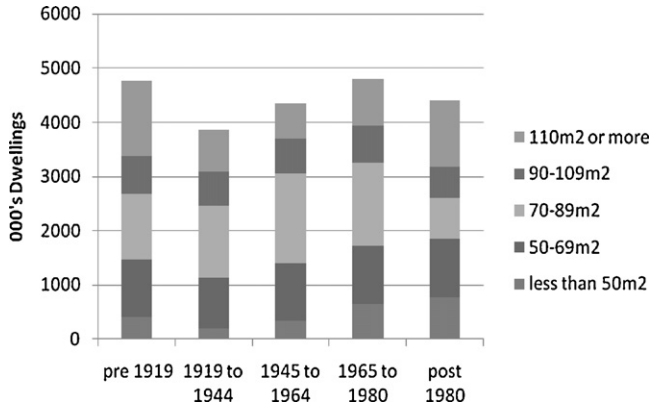

Fig. 3. Floor area for building age.
Source: English House Condition Survey, 2007 [8].

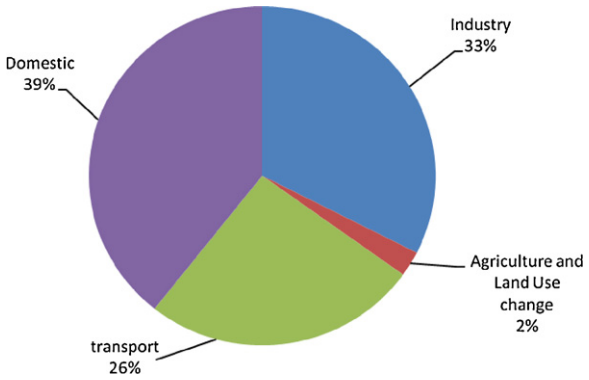

Fig. 4. CO_2 emissions by sector BANES 2009.
Source: DECC 2009 [14].

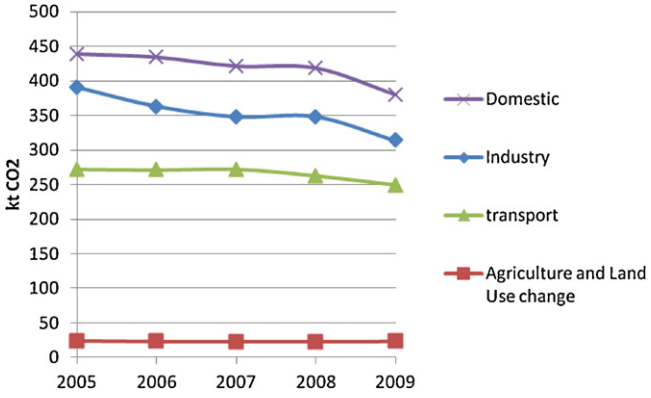

Fig. 5. CO_2 emissions BANES.
Source: DECC 2009 [13].

significant contributor to CO_2 emissions, the whole built environment will have a role to play in future emission targets.

The use of SAP to effectively predict a dwellings energy use regarding space heating is questioned [12]. To make a comparison requires a database of actual energy use, and although the UK has been producing benchmarks for several decades, these have focussed mainly on new domestic dwellings and the commercial sector. The development of a benchmark for historic buildings can facilitate rating the performance of a dwelling through provision of a reference to which the dwellings performance can be compared [13]. Oreszczyn and Lowe [2], recognise that there is very little benchmark data on the energy consumption of the domestic

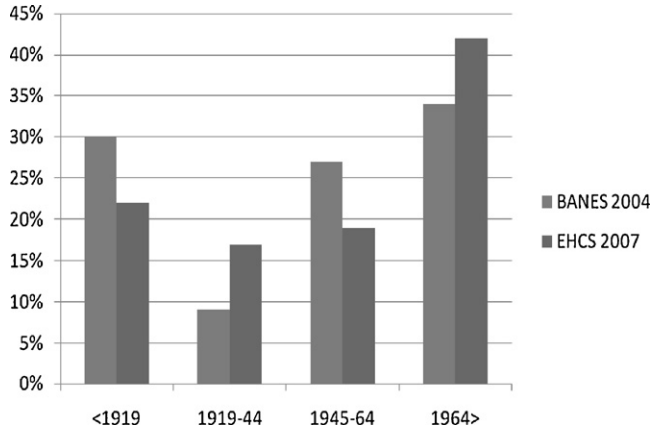

Fig. 6. Breakdown by dwelling type.
Source: BANES House Condition Survey [15] and the English Housing Survey [8].