

# KNOWLEDGE AND ATTITUDES OF SMALL BUILDERS TOWARD SUSTAINABLE HOMES IN THE UK

Ming Sun<sup>1</sup>, Erik Geelhoed<sup>2</sup>, Praminda Caleb-Solly<sup>2</sup>, Andrew Morrell<sup>2</sup>

## ABSTRACT

Residential homes account for the largest share of carbon emissions in the UK. Making new homes and existing ones more sustainable is essential to achieving the legally binding target of 80% reduction in carbon emissions by 2050. Small builders have an important role to play in this regard. They usually carry out the majority of refurbishment work of existing houses and small scale new build developments. Their attitudes toward, and knowledge of sustainable homes are crucial to the overall success of the UK's sustainable development strategy. Despite numerous government initiatives in recent years, the uptake of sustainable home building methods is still low. The aim of this study is to investigate the problem from small builders' perspective by examining their current practice and their opinions. Data are collected through an on-line questionnaire survey. Analysis of the results reveals that there is an elementary level of awareness amongst small builders as far as sustainable building is concerned. However, the level of their knowledge is still limited and their attitudes toward sustainable homes are diverse and ambivalent. More efforts are needed to promote sustainable building methods, particularly amongst small builders.

## KEYWORDS

sustainability, small builders, code for sustainable homes, attitudes survey

## INTRODUCTION

Residential homes contribute 27% of the total carbon emissions in the UK (Boardman, 2007). To meet the 80% carbon reduction target by 2050 (Crown, 2008), there needs to be major improvements of the design standard of new homes and refurbishment or upgrade of existing ones. In recent years, higher design standards for new build homes have been introduced in the form of Building Regulations Part L and the Code for Sustainable Homes. However, there are around 26 million existing homes in the country; most of which will still be in existence in 2050 (DCLG, 2007). Large scale retrofits are also required in order to improve the energy performance of the existing housing stock.

1. School of the Built Environment, Heriot-Watt University, Edinburgh, UK

2. Faculty of Environment and Technology, University of the West of England, Bristol, UK.

The majority of existing homes (82.5%) are privately owned by individual households (DCLG, 2011). The heterogeneous nature of private ownership determines that retrofit work is usually dispersed and often carried out by small builders. Despite the important role of small builders in this regard, there is limited research on their attitudes towards and knowledge of sustainable homes. Most existing studies on sustainable building focused on other stakeholders of the construction supply chain. For example, Myers (2005) carried out a review of attitudes towards sustainability of large construction companies. Carter and Fortune (2007) investigated the sustainability of the social housing sector from the landlords' perspective. They identified the gap between perceptions and practice towards sustainability and highlighted the need for social housing clients to generate the demands for sustainable housing with the right policies. Similarly, Sterner (2002) also focused on the demand side and examined factors that influence client's decisions on procurement of sustainable buildings. Studies on the supply side of sustainable buildings, understandably, often focus on the design stage and the role of designers, since they are regarded as the key decision makers during design and specification (Osmani et al, 2008; Knudstrup et al, 2009; Davies and Osmani, 2011). An early study by Revell and Blackburn (2007) found that small construction firms "tend to have low levels of engagement with the environmental agendas" and "have a low level of eco-literacy". In the last few years, the drive for sustainable homes at the policy level has intensified with the implementation of various government schemes and the update of Building Regulations and the introduction of the Code for Sustainable Homes. So far, there has been a lack of investigation on the impact of these initiatives in practice. This study addresses this knowledge gap, with a particular focus on small builders by looking at their knowledge and attitudes in relation to sustainable homes.

## LITERATURE REVIEW

### *Building Regulations and Code for Sustainable Homes*

In the UK, policy instruments for improving building performance began with the introduction of Building Regulations Part L in the mid-1960s (Dowson et al, 2012). Initial performance requirements were focused on thermal properties of buildings by setting out maximum u-values for main building components, such as walls and roofs. The standard has been gradually raised in subsequent updates of the Building Regulations. In 1995 a maximum window area was introduced as a proportion to total floor area of a house. A carbon emissions rate requirement was included in the 2006 update. It was expressed as the Dwelling Emission Rate (DER), calculated using the Standard Assessment Procedure (SAP) (BRE, 2011). The DER of a new home is not allowed to be greater than a Target Emission Rate (TER), based on a notional dwelling of the same type, size and heating fuel. In 2010 the compliance level was raised by 25% over 2006 standards. There is an on-going consultation to increase the requirement further to 44% improvement over the 2006 standard in another update this year.

Building Regulations Part L primarily focuses on the energy efficiency of homes. It outlines a minimum level of performance new homes need to achieve. However, sustainability requirements go beyond energy alone; the consumption of other essential resources also needs to be considered. In response to this, several sustainable home rating systems have been

developed and adopted in different countries, such as LEED in the USA (USGBC, 2009); HQE in France (Bidou, 2006); Green Star in Australia (GBCA, 2014); DGNB in Germany (DGNB, 2014); and Code for Sustainable Homes (CSH) in the UK (DCLG, 2008). These rating systems assess a building using multiple criteria and encourage performance higher than the building regulations minimum level (Giama and Papadopoulos, 2012). Take the UK's CSH as an example, in addition to "energy and CO<sub>2</sub> emissions", it also considers "water", "materials", "surface water run-off", "waste", "pollution", "health and wellbeing", "management", "ecology". It assesses a new home against these nine criteria and awards points to each category. The total points tally will determine the CSH rating for the house, on a scale of lowest level 1, to highest level 6. Amongst the nine categories, "Energy and CO<sub>2</sub> Emissions" is the most important and has the greatest weight. There is also a minimum point threshold for this category for each of the CSH level ratings. Different weights are allocated for other criteria. CSH was first introduced in 2007 as a voluntary national standard for new homes (DCLG, 2008). It has been adopted by many local authorities and housing associations for developments that require public funding. McManus et al (2010) explored the potential of CSH to deliver genuine 'sustainable energy' in the UK social housing sector. They concluded that applying the CSH alone will not automatically achieve the desired results. More consideration needs to be given to details of the technical solutions and the right policy drivers are also needed to influence practice.

While the different sustainable home rating systems in various countries share the same objective of promoting more sustainable homes, there are some variations in the number of criteria and weighting for each criterion. For example, in the dry and hot climate of Australia the weighting for water is higher than other countries. Similarly, for the relatively crowded UK, a higher weighting is given to land use. Due to these variations, it is difficult to have a direct comparison between the different systems. For the purpose of illustration, a CSH level 5 rating is roughly equivalent to a LEED platinum certificate; and both are slightly better than a six-star rating of the Green Star in Australia.

### ***Policy drivers for low carbon refurbishment***

Low carbon housing refurbishment aims to improve the energy performance of existing homes through retrofitting measures. The enormity of this task is demonstrated by findings of the annual English Housing survey, which showed that the average energy efficiency rating of existing homes, measured using the Standard Assessment Procedure (SAP) method, is 57 in 2012 (DCLG, 2012). To meet the 2050 carbon reduction target requires houses in the UK to have an average SAP rating of around 80 (Boardman, 2007). In 2007, in response to the EU Energy Performance of Building Directive, an Energy Performance Certificate became mandatory in the Home Information Pack for house sale. This helped to raise awareness of energy performance of homes amongst the general public. In the meantime, the UK government has introduced several programs to provide incentives for energy improvement of homes. For example, the Decent Homes Program, launched in 2000, aims to improve the condition of homes for social housing tenants and vulnerable households in private sector accommodation (NAO, 2010). The program has set a 'decency' standard to which all social rented homes should meet and, in some cases, allocated funding to enable necessary improvement to be made. The Warm Front Scheme offers a package of up to £3,500 (or £6,000 where oil central heating or other alternative technologies are recommended), for heating and

insulation improvements. The Green Deal program is the latest government effort to encourage households to undertake energy-saving home improvement (Dowson et al, 2012). Other schemes include Carbon Emissions Reduction Target (CERT), Smart meters, Energy Companies Obligation (ECO), Warm Home Discount scheme, etc. The bewildering number of schemes increased the difficulty for ordinary households and small builders to understand and use them effectively. As a result, the number of homes benefiting from these programs is still limited (Ravetz, 2008).

### ***Technical challenges and barriers***

In addition to helping to achieve the carbon reduction target, retrofitting existing homes is also important to alleviating fuel poverty of low income households and improving their living conditions (Jenkins, 2010). However, in addition to the current confusion of policy drivers there are also complex technical challenges, as well as economic and cultural ones. Lowe (2007) explored the implications of some technical options and strategies for decarbonizing UK housing. There is a wide range of possible refurbishment interventions, which can be divided into three broad categories: (1) retrofit building fabrics; (2) use more efficient equipment; and (3) adopt micro generation systems (Xing et al, 2011). Retrofitting building fabrics, including cavity and loft insulation or high performance windows, is relatively simple and easy to implement. Other measures, such as biomass, heat pump, solar panels and wind-mill, require high levels of knowledge and expertise. Not surprisingly, the most popular retrofitting measures so far are building envelope insulation, high performance glazing and low energy light fittings, as found through a survey by Davies and Osmani (2011). They identified a list of existing barriers for low carbon housing refurbishment. These include high costs; discrepancies in legislation requirement and VAT charge for new build and refurbishment; and lack of awareness, skills and technical knowledge by both households and building professionals. Dowson et al (2012) reviewed the existing government incentive programs and identified some barriers to achieving energy efficiency in homes. They further highlighted that refurbishment will not automatically lead to reduction in energy usage. Instead occupants often maintain the level of energy consumption to raise thermal comfort in the home. However, such a discovery does not diminish the importance and value of low carbon refurbishment of homes.

### ***The role of small builders***

While low carbon housing refurbishment requires efforts from multiple stakeholders, the particular focus of this study is on small builders. There are over 230,000 small construction firms in the UK with fewer than 8 employees; more than half of these only have one employee (ONS, 2012). This group provides the main workforce for carrying out small scale housing renovation, maintenance and repairs. In practice, they often design and produce drawings for house extensions, refurbishment or loft conversion without the use of an external designer, especially where the project is a permitted development which simply requires a building notice and does not require planning approval. Small builders can use the government planning portal ([www.planningportal.gov.uk](http://www.planningportal.gov.uk)) to determine whether a particular job needs planning permission. When the work is a smaller refurbishment the builder would just undertake simpler layouts without the need for planning drawings. In both of these cases, the builder makes decisions that have a direct impact on the energy performance of the house. The use of an architect or qualified local designer is only common where planning permission is required, when a job does not qualify as a permitted development. In such cases, a customer would

normally have plans in place before approaching the builder. The builder will be responsible for sourcing materials and carrying out the work according to the design specification. Given the importance of the builders' role in promoting sustainable buildings, it has been the focus of several studies in different countries in recent years. Qi et al (2010), through a survey with 123 companies in China, found that contractors tend to passively respond to government environmental regulations. The apathetic attitude of contractors towards environment concerns was also reported by Wong et al (2013) based on a study in Australia. On the other hand, Ahn and Pearce (2007) found that many contractors in the USA were familiar with the green construction principles and were enthusiastic about the future of green construction. However, the 87 companies involved in this study were selected from those with active recruitment links with three universities in eastern United States. They were large in size and may not be representative of small builders. Furthermore, their experience of green construction was mainly from non-residential sectors. An early study in the USA (Tinker et al, 2006) offered a particular perspective of builders' motivation for residential green buildings. They found that the majority of the existing green homes were developed by large builders. Small builders were not fully embracing green homes due to perceived high costs and lack of buyer demand. With time, new research is warranted to update these findings. There are no reported existing studies in the UK on the role of small builders in the development of sustainable homes. This study is an attempt to address this knowledge gap.

## RESEARCH METHODS

The main investigation method for this study was a questionnaire survey. Its objectives include: (1) to assess the awareness of small builders about key sustainability issues, more specifically about Building Regulations and Code for Sustainable Homes (CSH); (2) to find out the extent to which this group is already adopting sustainable building methods in practice; (3) to establish their views about the incentives and barriers of sustainable building methods; and (4) to analyze the linkage between their attitude and knowledge with their practice patterns. In the UK, Building Regulations and CSH represent the embodiment of sustainable homes knowledge. Therefore, they are selected as the main focus for this investigation.

This study targets small builders who undertake single house building or renovation projects instead of those who engage in volume housing development. This group tends to be very small in size and have fewer opportunities to engage in the latest development of the sustainability agenda. They operate in geographically disperse locations and offer a diverse range of trades. It is difficult to have an accurate estimate about the proportion of 230000 small construction firms in the UK who might be involved in house building and renovation. Therefore, this study can only take a random sample of this unknown total population. An opportunity occurred to carry out this study in collaboration with a company partner, who provides house building software to nearly 4000 small builders. All those on its client list were selected for the questionnaire survey.

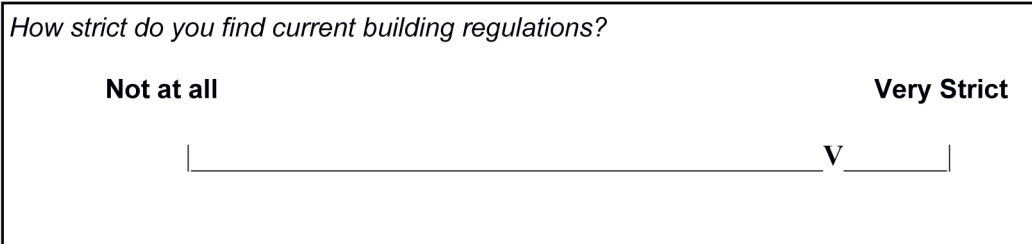
Prior to the survey, a small group of small builders were sought for face-to-face interviews; 8 of those contacted agreed to participate. The objective of the interviews was to gain a preliminary assessment of the target group and to use the findings to inform the design of questions for the subsequent survey. The interviews revealed large variations in both current experience and individual knowledge amongst the small builders. All the interviewees were aware of the Building Regulations Part L because it is mandatory. The survey will ask about

small builders' attitude towards this requirement and its implementation. On the other hand, the voluntary Code for Sustainable Homes was relatively new; several interviewees were not aware of its existence. Even those, who had heard about it, did not have detailed knowledge of it. The interviews found a low level of adoption of sustainable building methods amongst small builders. Common sustainability measures were limited to the use of insulation in compliance with Building Regulations and the use of recycled materials. The adoption of other specific building methods depends on the main trade of the small builders and personal knowledge. None of the interviewees had adopted any integrated sustainable house building solutions due to the lack of knowledge; lack of availability; or perceived high costs.

Following analysis of the interviews, a list of questions was drawn up, as shown later in Table 2, together with some questions asking some background information of the respondents. The draft questionnaire was piloted to ensure that questions were properly phrased and instructions were clear. The finalized questionnaire was put online using service provided by Qualtrics ([www.qualtrics.com](http://www.qualtrics.com)), and an invitation was sent to the targeted small builders via email.

A graphic rating scale is used instead of the conventional Likert scales. Graphic scales are in the form of a continuous line between two extremes or anchors (Stone et al. 2008). Figure 1 shows an example, which questions "*how strict do you find the current building regulations?*". Participants are asked to make a mark between the two extremes. The position of the mark indicates their opinion to the question. A mark, as shown by the "V" mark, relatively close to "Very Strict" indicates that the respondent finds current building regulations quite strict. On the other hand, if their mark is close on the "Not at all", it implies that they do not think the regulations strict. Participants were asked to move a slider across a rating scale and position the slider in a place of their choice. Qualtrics generated an integer score between 0 and 100 depending on where the respondent placed the slider. This scale enables us to evaluate subtle differences and similarities between questions and look for behavioral patterns more than those afforded by the rather blunt 5- or 7-point Likert scales.

**Figure 1:** Example of a graphic rating scale.



How strict do you find current building regulations?

Not at all Very Strict

|-----V-----|

For each question, the statistical analysis includes calculation of the mean, standard deviation (SD), the skewness of the normal distribution and the kurtosis. Using the graphic rating scale (0-100), the mean value is an indication of the opinions of the group of respondents. A mean of greater than 50 implies a more positive reply; lower than 50 a more negative reply. In order to assess the validity of the analysis and the reliability to generalize to the larger small builders' population, a number of other calculations have been carried out. Standard deviation is a measure of how much variation exists from the mean. A small standard deviation indicates that most answers to be close to the mean; large standard deviation indicates that answers are

spread out over a large range of values. The more normal the distribution is, the more we can generalize to a larger population. For a normal distribution, it is expected that over 95% of the respondents fall in within two standard deviations on either side of a mean. The Gaussian model is robust and can withstand some severe violations. One of these violations that can be calculated is called skewness. When a normal distribution is leaning towards the left (there are more low values than high values) this results in a positive value for skewness. Conversely, a negative skewness value indicates the data distribution leaning toward the right. Skewness values of up to  $\pm 2$  are acceptable for a distribution to be still considered as normal. Finally, the analysis also included kurtosis value, which is measure of the “peakedness” or “flatness” of a distribution. A value close to zero indicates a shape close to normal. A negative kurtosis indicates a flatter distribution and a positive Kurtosis a more peaked one. As a guideline values of  $\pm 2$  are acceptable for a distribution to be regarded as normal.

## SURVEY RESULTS AND ANALYSIS

### *Profiles of Respondents*

Out of the some 4000 small builders contacted, only 100 responses were received with 76 being valid. It was expected that small builders would be reluctant to give up time to get involved in academic research. Nevertheless, the response rate was disappointingly low; the results need to be viewed in such a context. However, the number of respondents is comparable with similar studies by other researchers; for example Davies and Osmani (2011) had 45; Hung et al (2011) had 47. The 76 respondents mainly consist of “general builders” (72.4%). They can be described as a mature group, with an average age of 49.8 (ranging from 32 to 73). Related to this was the considerable number of years they had been in the trade, on average 27.7 years, ranging from 1 to 58 years. The number of employees is typical for the small nature of these building companies, ranging from 1 to 22, with a mean of close to 4. The number of employees was unrelated to age or how long they had been in the trade. The survey asked participants what best described their work and they were able to select as many options as they felt applied from a predefined list. Table 1 shows the results of the 76 respondents. The total number of answers is greater than 76 because some respondents selected more than one entry.

**TABLE 1:** Number of Job categories selected.

Job category	No of response
General Builder	55
House Builder	17
Carpenter	15
Plumber	12
Taking care of administration	12
Subcontractor	10
Quantity Surveyor	9
Architectural technologist	8
Electrician	4
Architect	4



### Analysis overview

For the nine questions asking participants' opinions on various aspects of sustainability, the analysis results are shown in Table 2. With the exception of question 7, the results for all questions resemble a normal distribution. The standard deviations are relatively high, which indicate the answers are more spread out compared with a perfect normal distribution. The result for question 7 shows that answers are grouped in a narrower band close to the low end of the spectrum. Interpretation of these results is discussed in the following.

**TABLE 2:** Analysis of sustainability related questions

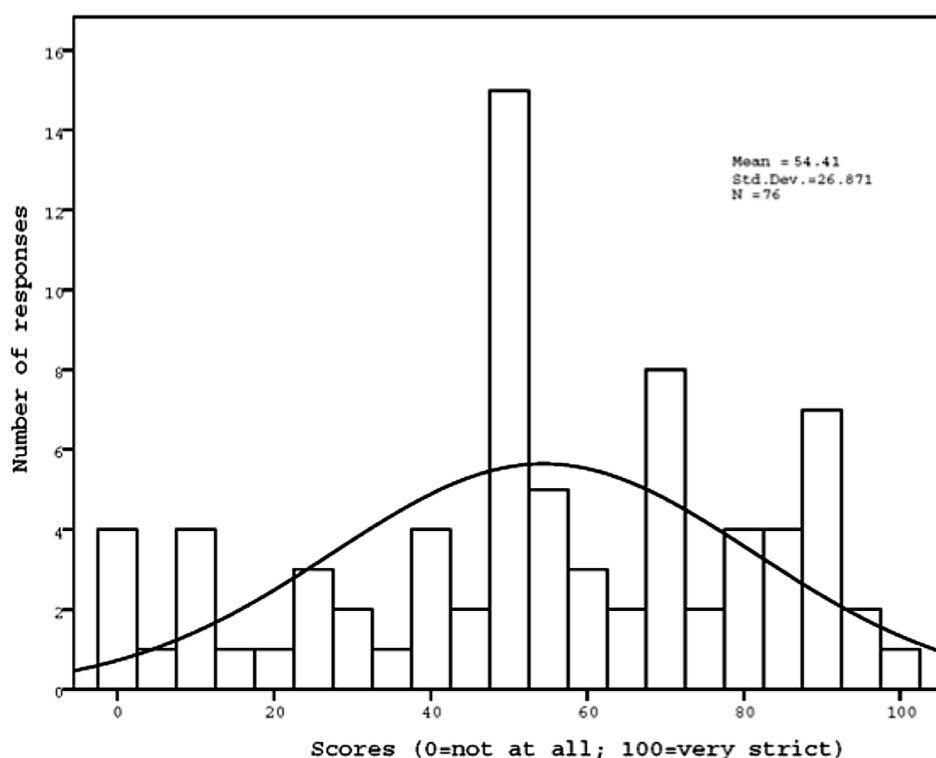
	Survey questions	Mean	SD	Skewness	Kurtosis
1	How strict do you find current building regulations?	54.41	26.871	-0.389	-0.596
2	How much do you agree with current building regulations?	61.26	24.820	-0.437	-0.278
3	How well do you know the building inspector(s) in your locality?	61.05	30.389	-0.389	-1.038
4	Are you familiar with the Code for Sustainable Homes?	42.47	30.123	0.165	-1.113
5	How often do you use sustainable or recycled building materials?	45.74	27.941	0.090	-1.112
6	Do your building merchants stock a range of sustainable building materials?	39.36	26.742	0.666	-0.387
7	Are there enough incentives for using sustainable building methods?	17.62	22.090	2.397	5.834
8	Do you think there is a (economically viable) future for sustainable building?	55.87	28.796	-0.143	-1.093
9	How easy is it to find information on sustainable design or materials?	43.60	29.300	0.315	-0.903

### Most respondents are familiar with building regulations

Building regulations set standards for design and construction which apply to most new buildings and many alterations to existing buildings in England and Wales. They cover many important aspects of building work, from health and safety to energy conservation and access to buildings. Specific requirements of Building Regulations are set out in a series of Approved Documents. The one most relevant to sustainable homes is Part L - Conservation of fuel and power. It specifies the required levels of insulation for building elements, the allowable area of windows, doors and other openings, air permeability of the structure, the heating efficiency of boilers and the insulation and controls for heating appliances and systems together with hot water storage and lighting efficiency. It also sets out the requirements for SAP (Standard Assessment Procedure) calculations and Carbon Emission Targets for dwellings. In addition Part L sets out requirements for robust construction details, now known as "Accredited Construction Details", to limit air leakage and avoid thermal bridging. Builders are required by law to comply with Building Regulations. The survey asked respondents' views on "*how strict do you find current building regulations?*" A histogram, with the normal overlaid curve, is generated where the responses were grouped in blocks of five (Figure 2). The results show that most of the builders do not have strong views one way or the other. The mean value of the answers is 54.41 and there is a peak in the middle. There is no clear difference between builders of different ages and lengths in business. The Pearson Correlation coefficient ( $r$ ) between the answer and age is  $r=0.177$  and  $r=0.025$  for the length of experience; both indicating no obvious correlation. The same index is  $r=0.361$  for the number of jobs, which represents a



**Figure 2:** How strict do you find current building regulations?

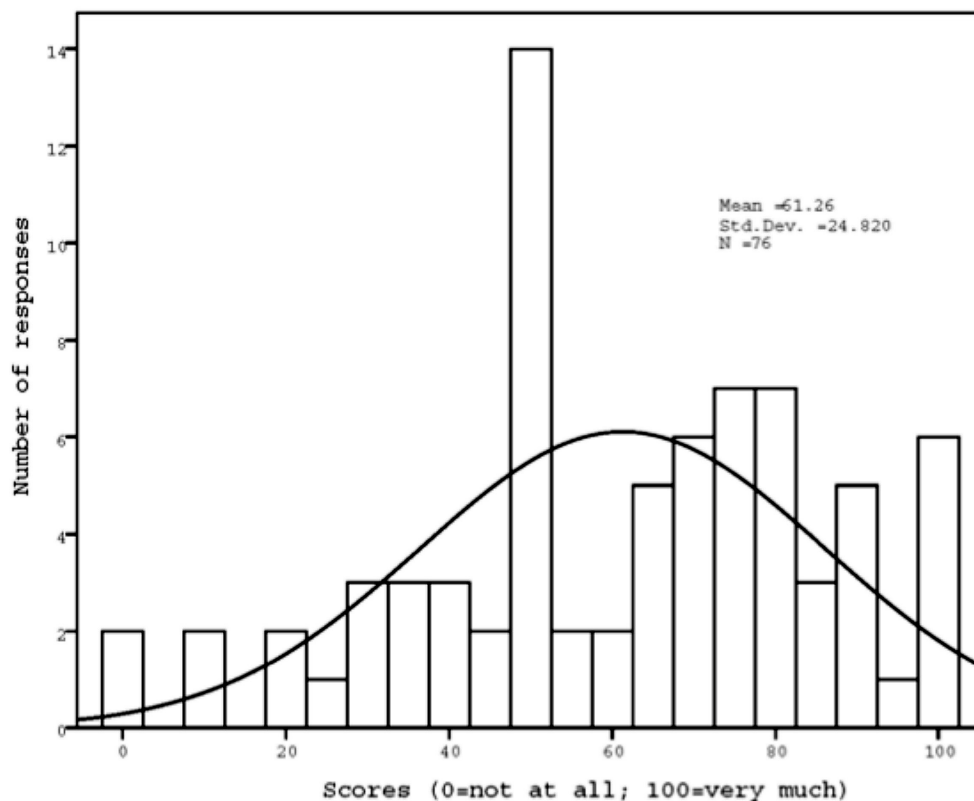


correlation of significance at  $p=0.01$  level. In other words, it appears that the more jobs small builders do the more likely they are to regard the Building Regulations as strict.

The respondents gave a more positive answer to another related question “*how much do you agree with current building regulations?*”, with a mean of 61.26. Again there is a peak in the center, a “bump” between 60 and 80, and a lack thereof below the 40 mark (Figure 3). Thus, based on these results, it seems that majority of respondents agree with current Building Regulations more than they find them strict, but this difference did not reach a level of significance. Also surprisingly, there is no correlation between whether they regard the Building Regulations as strict and they agree with them or not. However, it is surprising that there is a positive correlation ( $r=0.276$  and  $p=0.016$ ) between the level they agree with the building regulations and the number of jobs they do. This, combined with result for the previous question, indicates that the more jobs builders do, the more they think the building regulations are strict, but the more they agree with requirements of the regulations.

Building Regulations are enforced through a building control system and are supported by technical guidance documents. These technical documents, known as Approved Documents, provide guidance for meeting the requirements of the regulations. When carrying out building work that is subject to building regulations, builders are required by law to make sure the work complies with the relevant regulations. They have to use an approved building control service, which is usually provided by the local authority or private sector approved inspectors. Building inspectors, or building control officers, are responsible for controlling building work and its compliance with the Building Regulations. Therefore,

**Figure 3:** How much do you agree with current building regulations?

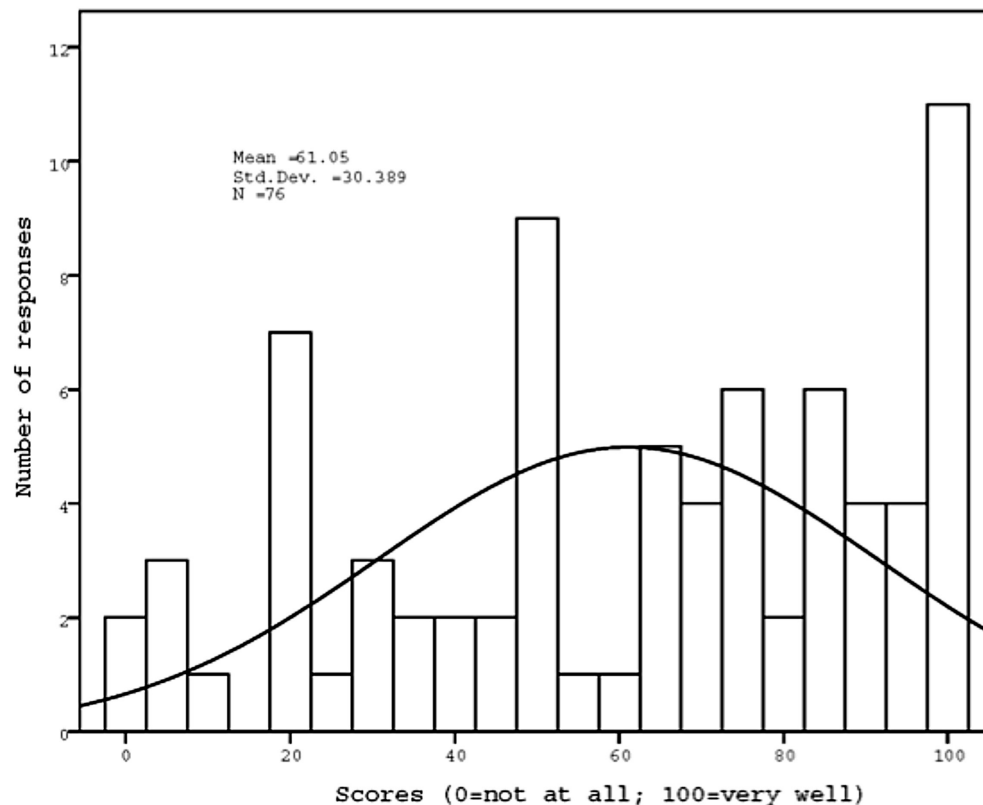


there should be an effective working relationship between the builders and building control officers. The survey tried to find out the nature of this relationship, by asking “*How well do you know the building inspector(s) in your locality?*” It appears that the majority of builders know their building inspectors reasonably well (Figure 4). The mean for this question is 61.05; distribution is skewed toward the higher end of the spectrum, reflecting that the surveyed group of small builders knows their building control inspectors fairly well. However, worryingly there is still a sizeable group who reported that they did not know their building inspectors well at all.

### ***Respondents have a poor knowledge of the Code for Sustainable Homes***

The Code for Sustainable Homes (CSH) works by awarding new homes a rating from Level 1 to Level 6, based on their performance against 9 sustainability criteria, which are combined to assess the overall environmental impact (DCLG, 2008). Level 1 is entry level, which represents 10% improvement over 2006 version of the Building Regulations in terms of energy efficiency. The improvements for levels 2-5 are 18%, 25%, 44% and 100% respectively. Level 6 is the highest rating and a zero carbon standard, where net carbon emission resulting from all energy used in the dwelling is zero. It is expected that a level 6 rated house still needs energy for the operation of space heating/cooling and hot-water systems, ventilation, all internal lighting, cooking and all electrical appliances. Such energy consumption will be compensated by renewable installations on/in the dwelling, or provided by an energy services company on/offsite. The Code is currently required by all newly built dwellings funded by the Homes and

**Figure 4:** How well do you know the building inspector(s) in your locality?

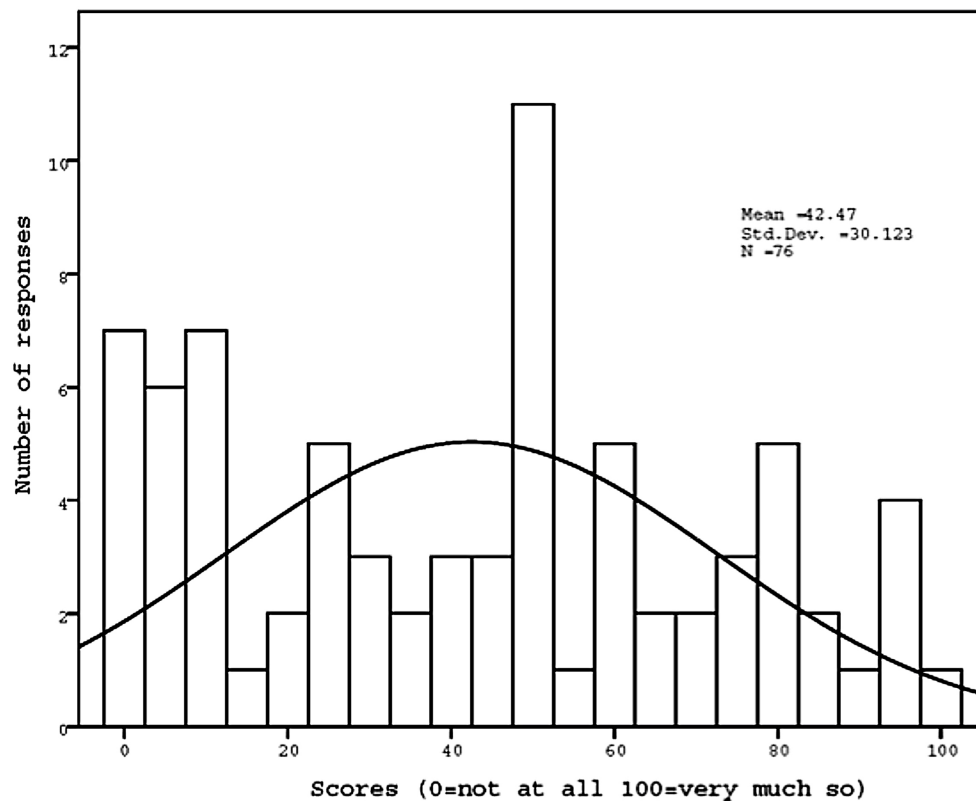


Communities Agency (HCA) in England. A minimum of Code Level 3 is required for all new housing promoted or supported by the Welsh Assembly Government or Assembly Government Sponsored Bodies, and Level 3 is required for all new self-contained social housing in Northern Ireland. The date for mandatory implementation of CSH was postponed as a result of the change of government in 2010. However, to achieve the carbon reduction target in the housing sector, the principles embodied in the CSH need to be adopted in practice by builders and other construction professionals. It is a concern that this survey found a poor level of knowledge of CSH amongst small builders (Figure 5). For the question “*Are you familiar with the Code for Sustainable Homes?*”, the mean score is a lowly 42.47. There is a strong central tendency with a peak at the 50% mark. The only correlation found is with the number of jobs ( $r=0.237$ ,  $p=0.039$ ). Although it is not a very strong correlation, it is evidence that the more projects a builder does, the more familiar he or she becomes with CSH.

### ***Sustainable practice is not common***

Construction and demolition waste in the UK amounts to around 120 million tons per annum, including an estimated 13 million tons of unused material (Osmani, 2012). This not only does great damage to the environment but also results in financial losses for businesses and society. One way of reducing such waste is to promote the use of reclaimed and recycled materials in construction. Reclaimed materials are those taken from one project and reused in a new project without any or with minimum modification. Recycled materials, on the other hand are completely reconfigured, for example melted down, to create new products. In the

**Figure 5:** Are you familiar with the Code for Sustainable Homes?

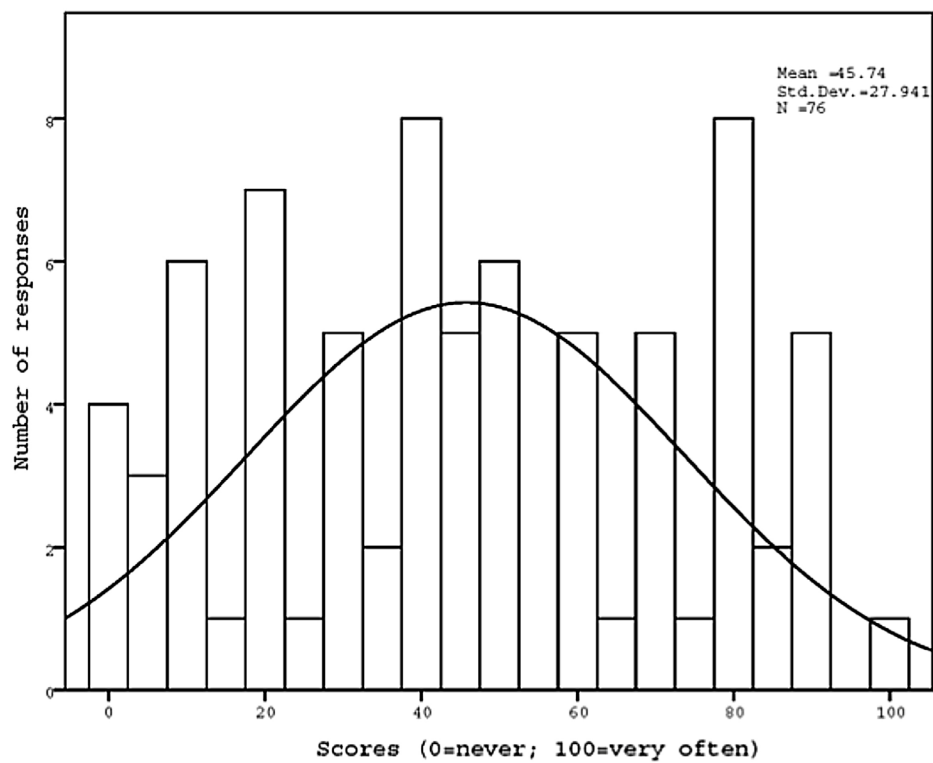


UK, the government seeks a reduction of waste in general through a series of regulations, economic measures and public campaigns. The Strategy for Sustainable Construction set a target of halving construction waste to landfill by 2020 compared with 2008 level (HM Government, 2008). The government introduced the Landfill Tax (£56 per ton in 2011), the Aggregates Levy (£2 per ton on the extraction of aggregates); and Site Waste Management Plans Regulations 2008 (compulsory for all construction projects that exceed the value of £300,000) to encourage waste reduction, reuse and recycling (Osmani, 2012). However, the impact of these measures in the construction industry, especially the SME sector, is still limited. This has been confirmed by this survey; only a small minority of small builders uses sustainable or recycled building materials on a regular basis (Figure 6). This might be explained by the fact that even fewer respondents said that their building merchants have stocks of such materials (Figure 7). There is a strong correlation between these two ( $r=0.549$ ;  $p=0.000$ ).

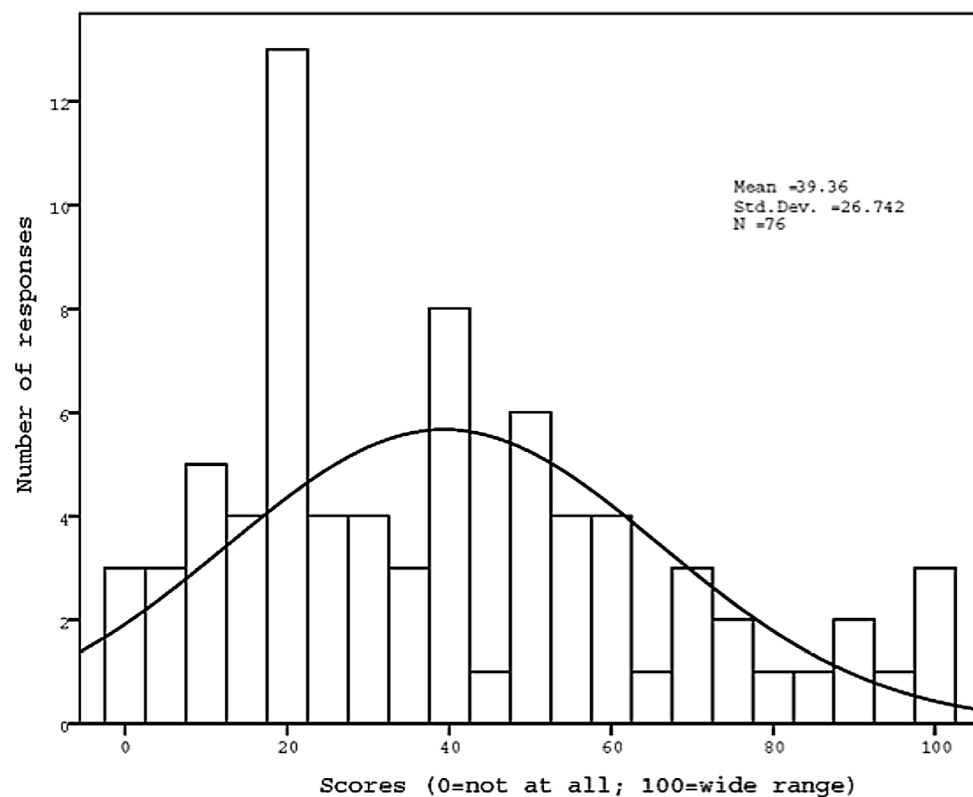
### ***There is not enough incentive for sustainable building methods***

There is a wide spread perception that new sustainable building methods cost more. There are uncertainties on the payback time of the extra investment. In the UK, a number of government sponsored financial incentives have been introduced, such as Feed-in Tariffs Scheme and Renewable Heat Incentive. The uptake of these is still limited to the early adopters rather than the norm for all households. In October 2012, “The Green Deal” was launched, as part of the 2011 Energy Act, as the largest home improvement program in the UK (DECC,

**Figure 6:** How often do you use sustainable or recycled building materials?

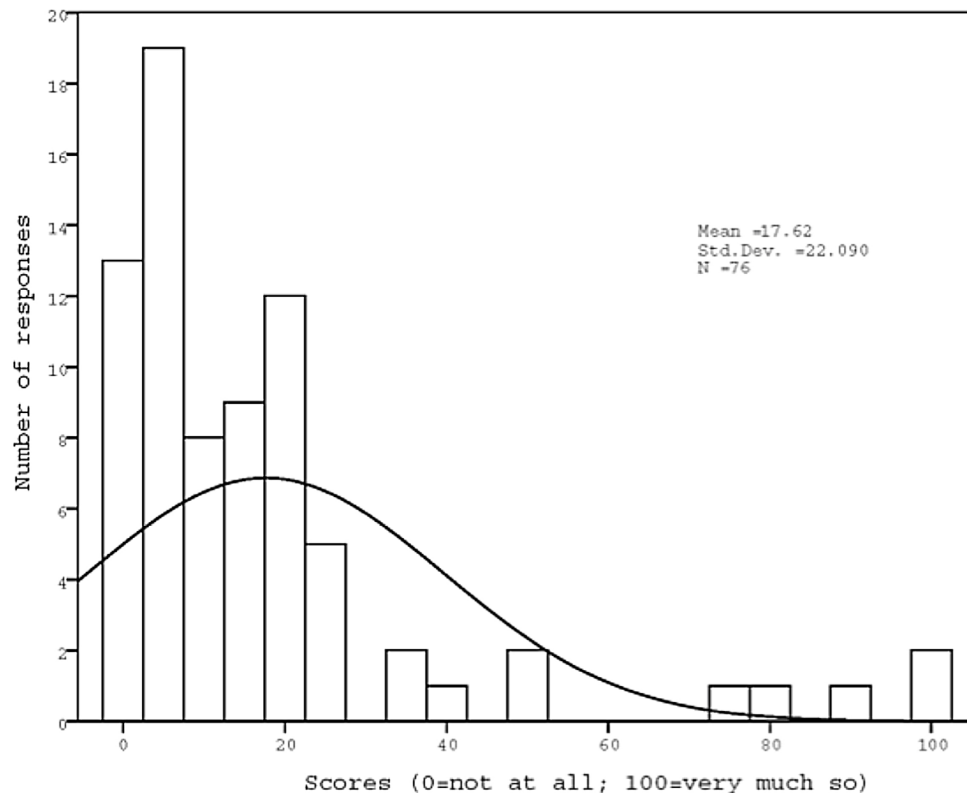


**Figure 7:** Do your building merchants stock a range of sustainable building materials?



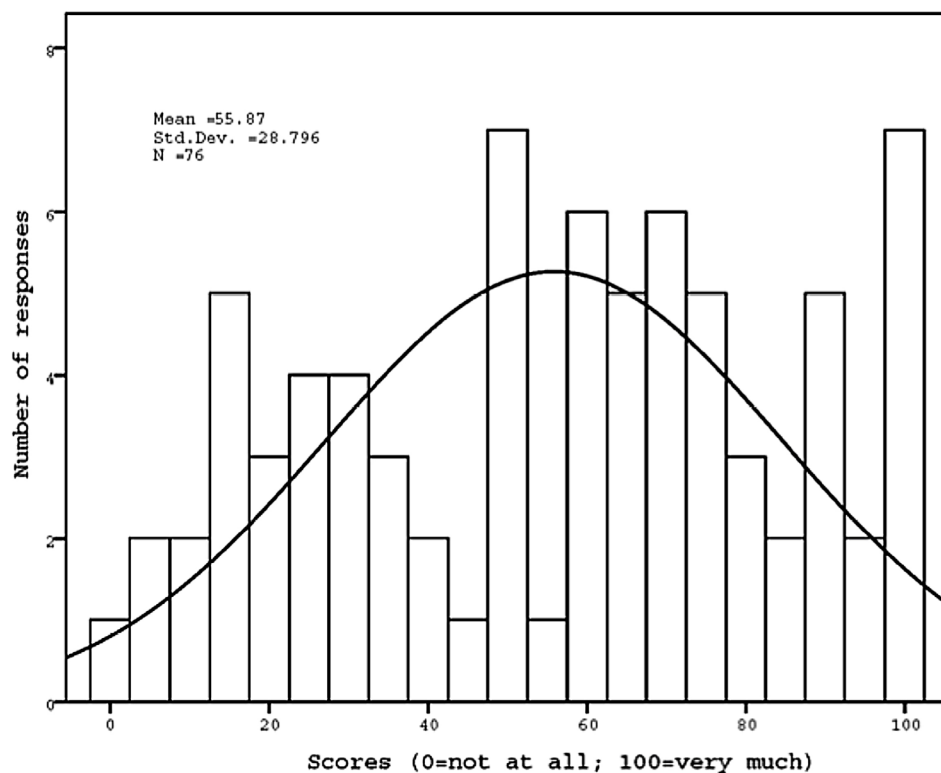
2010). It principally aims at encouraging energy saving measures in existing houses. It enables households to implement energy efficiency improvements to their houses at no upfront costs. Funding is provided by finance companies under a green deal scheme. Repayment is made with the monthly utility bills for 25 years. In theory, energy savings made due to the improvements should reduce the monthly bills. Even with repayment of the finance loan, the new repayment should still be lower than old bills. This is called the Golden Rule. The Green Deal did not come into effect until 2013; its impact is still to be seen. At present, when small builders were asked “*Are there enough incentives for using sustainable building methods?*”, with the exception of a small set of respondents, the answer was unequivocally no (Figure 8). The mean of 17.62 to this question is very low compared to ratings to other questions; the distribution is narrow (SD = 22.09), strongly skewed to the low end (exceeding the +2 value) and very peaked with a kurtosis of 5.834.

**Figure 8:** Are there enough incentives for using sustainable building methods?



For the question “*Do you think there is a (economically viable) future for sustainable building?*”, the answer is slightly more positive. With a mean of 55.87 and a good proportion of the respondents scoring high to very high on this rating scale, it seems that most builders see that there is a future in sustainability. There is a weak correlation between answers to the incentive question and this one ( $r=0.255$ ;  $p=0.026$ ). There is no clear explanation about the higher positivity towards the future of sustainability when most of the small builders believe that there is no incentive for it.

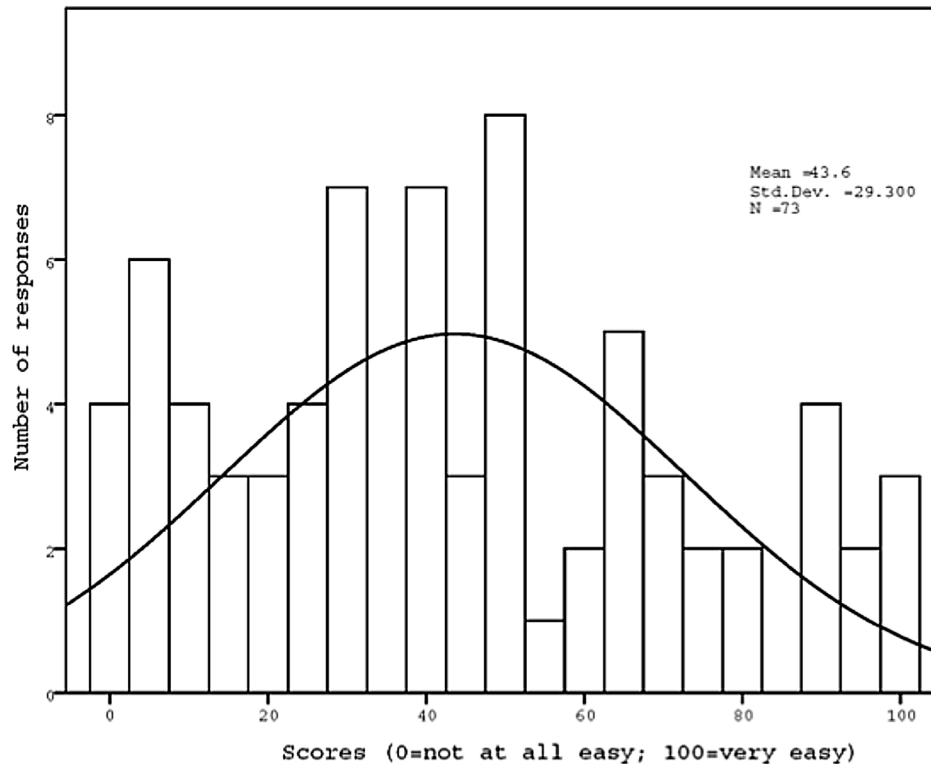
**Figure 9:** Do you think there is a (economically viable) future for sustainable building?



### ***There is a lack of authoritative information source***

The sustainability concern in the construction industry is still fairly recent. In a short period of time, a plethora of government policies and industry initiatives have emerged. The whole supply chain, from manufacturers to research institutions, is responding to this development. As a result, a raft of information has become available in different forms and from a variety of sources. However, much of this information is not in a ready to use format from practitioners' perspective. In particular, a high proportion of the existing information is policy related, which sets of targets. There is a lack of practical guidance for practitioners on how to achieve these targets. In comparison with other construction professionals, small builders often find it even harder to locate the necessary information without the support of a large organization or a professional network. This has been confirmed by this survey. Most small builders believe that it is "not at all" easy finding information on sustainability, when asked "*How easy is it to find information on sustainable design or materials?*" (Figure 10). There is also evidence that builders are more interested in information on specific sustainable products or materials, instead of policy or general technical information. One proof for this is the clear correlation ( $r=0.309$ ;  $p=0.026$ ) between answers to this question and that to the availability of sustainable materials at building merchants (Figure 7). Further evidence can be found from the information sources small builders consult. Table 3 shows the results for the question: "*Where do you look for information on sustainable design or materials?*" Suppliers' websites are the primary source for looking up information on sustainable materials and building methods, closely followed by trade magazines. It is encouraging that almost 46% also consult official sources. Most participants selected between two and four sources of where they look.



**Figure 10:** How easy is it to find information on sustainable design or materials?**TABLE 3:** Sources of sustainable information.

Source of sustainability information	Response (#)	% of total
Suppliers websites	56	74
Trade magazines	48	63
"Official" information	35	46
Internet Forums	29	38
Trade fairs / Events	22	29

## CONCLUSIONS

In the last decade, there has been an incremental improvement in the energy performance of the average home in the UK, as a result of building better new homes and refurbishing existing ones (DCLG, 2011). However, the pace of change is too slow, as indicated by the current low level of adoption of sustainable building materials and low carbon measures during housing refurbishment. Existing government initiatives have not made the necessary impact. This finding complements that of Osmani and O'Reilly (2009) in their study of the issue from the perspective of large house builders.

Policy drivers, such as the Green Deal, have not produced sufficient 'pulling' from the demand side for sustainable housing renovations. On the contrary, clients are often a barrier due to their unwillingness to pay more in return for long term benefits. While cost is not the only barrier, it is one of the most important factors that influence home owners' decisions.

Further study is needed to find the tipping point of the cost and benefit balance and to identify drivers for stimulating effective demands. Small builders, as the main workforce of housing refurbishment, are not doing much 'pushing' from the supply side either. While being more positive about the future prospects of sustainable homes, the majority of the small builders do not believe that there are enough incentives for them to adopt sustainable building methods now. Therefore, future sustainability policies will need to be backed up by either an element of compulsion or clear incentives or both.

The poor level of sustainable practice by small builders is partially caused by their lack of knowledge of sustainable building methods. Despite various government initiatives and publicity campaigns in the last few years, there is little change in small builders' awareness of sustainability compared with findings of early studies (Revell, 2007; Revell and Blackburn, 2007). More small builders seem to know about the Building Regulations Part L, because it is mandatory. In contrast, their knowledge of the voluntary Code for Sustainable Homes is very poor. The level of knowledge depends on the individual builders. There is no clear correlation with the age or experience of the small builders or their practice patterns. The current use of sustainable materials is influenced by their availability from the building merchants. While some small builders are self-motivated to acquire sustainability knowledge systematically through training and education, the majority pick up information in a piecemeal fashion through using certain 'green' products and materials. They rely more on suppliers' websites and trade magazines instead of 'official' channels for information. There is also no evidence that they will try to understand the underlying technical principles by consulting multiple information sources.

Small builders are an important group in the drive to raise the sustainability standard of homes. It is worrying to find the current poor level of knowledge and lack of enthusiasm by small builders toward sustainable homes. Such a finding highlights the need for stronger measures to raise awareness and provide incentives, particularly for sustainable refurbishment of existing homes. Changing attitudes and improving capability are essential prerequisites for behavior change by small builders.

## REFERENCES

- Ahn Y. H. and Pearce A. R. (2007) Green Construction: Contractor Experiences, Expectations, and Perceptions. *Journal of Green Building*: Summer 2007, Vol. 2, No. 3, pp. 106-122
- Bidou D. (2006) The HQE approach: Realities and perspectives of building environmental quality. *Management of Environmental Quality: An International Journal*. Vol. 17 Issue 5, pp.587 - 592
- Boardman, B. (2007) Home truths: a low-carbon strategy to reduce UK housing emissions by 80% by 2050. Environmental Change Institute, Oxford. [<http://goo.gl/XIWhA>]
- Building Research Establishment (BRE) (2011) The Government's Standard Assessment Procedure for Energy Rating of Dwellings, Published on behalf of DECC by BRE, Garston, Watford, UK [<http://goo.gl/zb86n>]
- Carter, K. and Fortune, C. (2007) Sustainable development policy perceptions and practice in the UK social housing sector. *Construction Management and Economics*, 25(4), 399-408
- Crown (2008) Climate Change Act 2008. (UK: The Stationary Office Limited) chapter 27 [<http://goo.gl/7gAhY>]
- Davies, P. and Osmani, M. (2011) Low carbon housing refurbishment challenges and incentives: Architects' perspectives. *Building and Environment*, 46(8), 1691-1698
- Department for Communities and Local Government (DCLG) (2007) Homes for the future: more affordable, more sustainable. Stationery Office, July 2007, Eland House, Bressenden Place, London [<http://goo.gl/MeJP4>]

- Department for Communities and Local Government (DCLG) (2008) Code for Sustainable Homes - Setting the standard in sustainability for new homes, February 2008, Eland House, Bressenden Place, London [<http://goo.gl/Umjfd>]
- Department for Communities and Local Government (DCLG) (2011) Dwelling Stock Estimates: 2011, England, Eland House, Bressenden Place, London [<http://goo.gl/5n5lt>]
- Department for Communities and Local Government (DCLG) (2012) English Housing Survey, headline report 2011-12, Eland House, Bressenden Place, London [<http://goo.gl/0WXwU>]
- Department of Energy and Climate Change (DECC) (2010) The Green Deal: A summary of the Government's proposals, Crown Copyright 2010, Ref: 10D/996 [<http://goo.gl/X4b6M>]
- Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB) (2014) An introduction to DGNB. [<http://goo.gl/YhWf3K>]
- Dowson, M., Poole, A., Harrison, D., and Susman, G. (2012) Domestic UK retrofit challenge: Barriers, incentives and current performance leading into the Green Deal, *Energy Policy*, 50(2012) 294-305
- Green Building Council of Australia (GBCA) (2014) Green Star performance: Summary of categories and credit. [<http://goo.gl/vPaoYs>]
- Giama E. and Papadopoulos A. M. (2012) Sustainable building management: overview of certification schemes and standards, *Advances in Building Energy Research*, 6:2, 242-258
- HM Government (2008) Strategy for Sustainable Construction, HM Government in association with Strategic Forum for Construction Clients, June 2008, London, [<http://goo.gl/7GmR6>]
- Hung, Y. H., Smith-Jackson, T., and Winchester, W. (2011) Use of attitude congruence to identify safety interventions for small residential builders, *Construction Management and Economics*, 29 (2), 113-130
- Jenkins, D.P. (2010) The value of retrofitting carbon saving measures into fuel poor social housing, *Energy Policy*, 38 (2010), 832–839
- Knudstrup, A.M., Hansen, H., and Brunsgaard, C. (2009) Approaches to the design of sustainable housing with low CO2 emission in Denmark. *Renewable Energy*, 34(9), 2007-2015
- Lowe, R. (2007) Technical options and strategies for decarbonizing UK housing. *Building Research and Information*, 35(4), 412 – 425.
- McManus, A. Gaterell, M.R. and Coates, L.E. (2010) The potential of the Code for Sustainable Homes to deliver genuine 'sustainable energy' in the UK social housing sector, *Energy Policy*, 38 (2010), 2013-2019
- Myers, D. (2005) A review of construction companies' attitudes to sustainability, *Construction Management and Economics* 23(8), 781-785
- National Audit Office (NAO) (2010) The Decent Homes Programme, [<http://goo.gl/U76Zm>]
- Office for National Statistics (ONS) (2012) Construction Statistics, No. 13, 2012 Edition [<http://goo.gl/yXlRg>]
- Osmani, M. (2012) Construction Waste Minimization in the UK: Current Pressures for Change and Approaches, *Procedia - Social and Behavioral Sciences* 40 ( 2012 ) 37–40
- Osmani, M. and O'Reilly, A. (2009) Feasibility of zero carbon homes in England by 2016: a house builder's perspective. *Building and Environment*, 44 (2009) 1917-1924
- Osmani, M., Glass, J., and Price, A.D.F. (2008) Architects' perspectives on construction waste reduction by design. *Waste Management*, 28(7), 1147-1158
- Qi GY, Shen LY, Zeng SX, Jorge OJ. (2010) The drivers for contractors' green innovation: an industry perspective. *Journal of Cleaner Production* 18: 1358–1365
- Ravetz, J. (2008) State of the stock – what do we know about existing buildings and their future prospects? *Energy Policy*, 36 (2008), 4462-4470
- Revell, A. (2007) The ecological modernisation of SMEs in the UK's construction industry, *Geoforum*, 38(1), pp114–126
- Revell, A. and Blackburn, R. (2007) The business case for sustainability? An examination of small firms in the UK's construction and restaurant sectors. *Business Strategy and the Environment*, 16(6), pp404-420.
- Sterner, E. (2002) 'Green procurement' of buildings: a study of Swedish clients' considerations. *Construction Management and Economics*, 20(1), 21-30
- Stone, H., Sidel, J., Oliver, S., Woolsey, A. and Singleton, R. C. (2008) Sensory Evaluation by Quantitative Descriptive Analysis, in *Descriptive Sensory Analysis in Practice* (ed M.C. Gacula), Food & Nutrition Press, Inc., Trumbull, Connecticut, USA

- Tinker A., Kreuter U., Burt R., Bame S. (2006) Green Construction: Contractor Motivation and Trends in Austin, Texas. *Journal of Green Building*: Spring 2006, Vol. 1, No. 2, pp. 118-134
- U.S. Green Building Council (USGBC) (2009) LEED 2009 for new construction and major renovations. [<http://goo.gl/y8N0Jl>]
- Wong P. S. P., Owczarek A., Murison M., Kefalianos Z. and Spinozzi J. (2013) Driving construction contractors to adopt carbon reduction strategies – an Australian approach, *Journal of Environmental Planning and Management* (advanced publication online)
- Xing, Y. G., Hewitt, N. and Griffiths, P. (2011) Zero carbon buildings refurbishment – a hierarchical pathway. *Renewable and Sustainable Energy Review*, 15(2011), 3229-3236

