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Achieving sustainable homes by 2016 in the UK: the current status

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Abstract The code for sustainable homes (CSH), which came into existence in 2006, has not yet been investigated to determine whether its rate of adoption is on course to meet the UK government's 2016 target for full implementation. Therefore, the aim of this investigation is to ascertain the level to which CSH has been implemented and the barriers preventing this. A questionnaire survey was sent to 71 of the Home Builders Federation (HBF) member organisations in the UK, to gauge and ascertain the following: the barriers to the implementation of CSH; the implications of implementation; and the general awareness of CSH amongst practitioners. The results from the analysis of the survey reveal that full implementation by 2016 appears a rather difficult target, as factors like economic downturn are hitting HBF and similar organisations quite hard. However, a government-driven injection of sustainable schemes is helping to bring back confidence to house builders, while also enhancing the way that barriers are handled within the industry. The key findings of the literature review identify barriers preventing the housing sector from achieving zero carbon homes by 2016. These include cost, and legislative, cultural and technical barriers, and are concordant with the results from the data obtained during the primary research. The analysis suggests that with the current trend, achieving full implementation will be difficult. However, comments made by some practitioners appear to suggest that the appointment of a CSH champion for implementation would accelerate the process of full implementation and that the target could be reached by 2016.

Keywords Sustainability · Homes · Policy · Zero carbon

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1 Introduction

The United Nations' activities to propel sustainability to the forefront of international objectives, through all the various summits, protocols and mechanisms, are the motivation for the UK's national target setting for better sustainable development and zero carbon housing. The *Stern Review* (2007) gave rise to an imperative: to ensure homes be built to minimise energy consumption and the detrimental effects therefrom. The assessment portion of the sustainability issue is that which is sought via legislative mechanisms such as adherence to building regulations, in accordance with the code for sustainable homes (CSH). This position is reinforced by Hammond (1998), who agrees that there is wide acceptance of increased measures and strategies for the implementation of sustainable development. He attributes the origin of this mindset to the 1992 Earth Summit in Rio de Janeiro.

Commenting on the *Bruntland Report* (1987), the summit reached a watershed conclusion: forthwith, economy and ecology must be united in order to impose a responsibility upon the wider international community both for causality and consequence of environmental detriment. As it is widely acknowledged, the summit is the birthplace of sustainable development, insofar as currently accepted. It is the baseline source for investigating the extent to which responses to its findings have been acted upon.

In terms of sustainability inclusion within official UK policy, this can be considered to have been instigated by the Conservative administration of 1990–97 (Hammond 1998). Progress included sustainability within the general governmental frameworks via the Department of Environment's Indicators of Sustainable Development for the UK (1996), even if sustainability indicators were more for the benefit of the wider economy and less part of an intrinsic goal to increase the global benefits by reducing carbon emissions associated with development (DTI 1998).

Büchs and Schnepf (2013) point out that since households contribute substantially to the UK's total emissions—around 74 %, including indirect emissions—a reduction from households is essential for meeting the UK's carbon reduction targets. Provided that the UK retains a rate of modest economic growth and that the ratio of pollutants to energy contracts diminishes, it is possible that environmental protection will be achievable. Whether or not it is feasible to manage a reduction in the amount of energy consumed during the development process, in accordance with stated timescales, is a question postulated by many sources (Hammond 2000). This research investigates the impact drivers, as well as those issues affecting the achievement of the 2016 target of zero emissions from homes. The intention of the current study on CSH within this paper is to inform policy makers, government strategists, academics and researchers on the status of the housing stock with respect to sustainability implementation underway within the UK housing market.

The purpose of the study is to ascertain the level to which CSH has been implemented and the barriers to it. In order to achieve this aim, three objectives have to be accomplished:

1. To trace the evolution of CSH and government objectives for zero carbon housing by 2016.
2. To ascertain the current status of CSH.
3. To evaluate the barriers that exist for full implementation of CSH in the UK housing sector, in achieving zero carbon homes by 2016.

The remaining sections of this paper are the following: the literature review; research methodology; a critical understanding of the evolution of CSH; key drivers of sustainability in the built environment; factors affecting the implementation of sustainable homes and its implications; results of a survey of practitioners; discussion; and conclusion.

2 Literature review

This section provides a brief discussion of the timeline and the dominant factors for sustainable homes in the UK. The main review commissioned by the UK government, as well as documents relevant to the development of CSH, are also investigated.

2.1 Stern review

The major focus of the *Stern Review* is the impacts arising from uncontrolled climate change and an examination of major policy challenges, both national and international, in moving to a low-carbon global economy.

As the risks of climate change were examined in terms of their economic impact, the review estimated that the detrimental effects of climate change upon the UK could alter gross domestic product (GDP) by as much as 20 %. It made claims that the cost of mitigating the potential effects of climate change, attributed to greenhouse gasses, equated to 1 % of global GDP per annum. The review estimated that the need for low-carbon technologies could exceed a market value of $500 billion by 2050 (Stern 2007). Ultimately, the findings of the *Stern Review* were that inaction in tackling climate change is effectively to undermine economic growth. Therefore, it is essential to ensure that homes are built in a way that minimises the use of energy and reduces these harmful emissions (DCLG 2006). The imperative to ensure that homes be built to minimise energy consumption and the detrimental effects therefrom led to the creation of CSH. The preamble to CSH identified environmental impacts of construction as water use, waste generation and use of pollutants. CSH asserts that the detrimental effects of these factors can be reduced through the integration of higher sustainability performance standards during the design process. Further, it claims that better sustainable homes can serve to improve the quality of life and standards of living. However, prior to the *Stern Review*, EcoHomes and its variants had been in existence in the built environment (BREEAM 2000).

2.2 Evolution of CSH

The main aim of this review is to consider the feasibility of the government's objective of achieving newly built homes with zero carbon by 2016, through the implementation of CSH.

2.2.1 Development of CSH

CSH is an outcrop of the EcoHomes scheme developed by Building Research Establishment (BRE) and also meets the non-industrial sector for the Building Research Establishment Environmental Assessment Method (BREEAM) equivalent, which is widely accepted and adopted in the industry. The BRE EcoHomes system was used as a basis for developing CSH, which was launched in December 2006 and was itself an extension of previous codes applied in 2004. A revised version of the code was published in October

2008, based on feedback received from all involved in the implementation of CSH, including developers, assessors and industry stakeholders. The implementation of the code started in England in April 2007 and became mandatory for all new homes in May 2008 (DCLG 2008). Management of its implementation is the responsibility of BRE.

EcoHomes had been instrumental in shaping the relevant indicators for the affordable and social housing sectors. CSH improved upon those measures introduced under EcoHomes in the following ways:

- Minimum requirements for energy and water efficiency at every level of the code were introduced.
- Awarding of points used in the system became simpler as the complex weightings were removed.
- New areas of sustainability design, such as lifetime homes and inclusion of composting facilities, were added to the system.
- The code aligned with the planning system, which guides sustainability in broader locational and aesthetic issues (DCLG 2006).

The purpose of the code is to measure the sustainability of a home against significant design categories and to rate the whole residence unit as single package.

CSH, it is hoped, will become a singularly accepted national standard guide for new home developers to achieve certain levels of sustainable homes and it intends to deliver to the customer (home buyers) a baseline means of choice in their purchase. CSH is to be implemented into UK building practices through its serving as a basis for modifications to the standards of building regulations, in respect both of energy use and carbon emissions attributed to housing.

The Department of Communities and Local Government (DCLG 2006) believes that via the mechanism of CSH, developers will be able to differentiate themselves from their competition, through offering a more sustainable product to meet consumer demand. At the time of its introduction (2006), it was claimed that between then and 2050, the volume of new homes could constitute a third of the total UK housing stock (DCLG 2006:2). Emphasis was placed, therefore, upon the opportunity presented by CSH for the construction of sustainable homes for the future, satisfying both human needs and those of the environment.

2.2.2 *Features of CSH*

The code tests nine different success factor (SF)—energy/CO_2, pollution, water, health and well-being, materials, management, surface water run-off, ecology and waste. Each of these elements will have a rating score based on the dwelling's compliance with Part L

Table 1 Code level for CSH

Code level	Total percentage points score
1	≥36
2	≥48
3	≥57
4	≥68
5	≥84
6	≥90

2010 of the building regulations (DCLG 2010). Part L is an approved document that deals with energy efficiency (conservation of fuel and power in new and existing dwellings and buildings) in the building regulations. The achievement of the sustainable code level is the relative value of all the SFs to provide sustainable homes. The SFs are weighted relative to each other, and the code level is determined by the product of the final score (i.e. rating × weighting). In order to assess the performance of dwellings, CSH employs a star rating system to credit the overall standards of the dwelling above the optimum level required by Part L. The system provides an increasing rating, from a single star, denoting a 10 % improvement on the 2010 regulations benchmark, progressing to six stars for achieving zero carbon (DCLG 2010). The value of this final score is judged by where it falls in Table 1 shown below.

The key feature of CSH is the requirement for newly built homes to meet stipulated energy efficiency and emission levels. In order to reach the highest level of CSH and achieve carbon neutrality, Code Level 6 requires that all energy consumed in the dwelling, including appliances and cooking, is offset by or obtained from renewable resources (renewables). Stringent stipulations of CSH pertaining to waste and water usage, in addition to its energy requirements, position CSH at the forefront of housing standards when compared to its international equivalents.

It is the intention of CSH for its standards to be actuated through gradual improvements to the building regulations standards. CSH employs a rating system for the attainment of its six levels of sustainability. Each star awarded denotes the performance of the home, assessed upon the basis of the nine categories identified earlier. When the code was first introduced, the award of a single star was equivalent to the first increment of achievement—ranking above the minimum building regulations in place at the time (DCLG 2006). By 2010, building regulations had progressed to set the minimum standard of performance at a 25 % improvement above Part L of the building regulations 2010. The next mandatory standard of improvement to building regulations came into effect during 2013, to achieve level 4 of CSH through a 44 % improvement (DCLG 2007). Prior to the introduction of the CSH star rating system, there was the BRE EcoHomes award (Sponge Sustainability Network 2007). Osmani and O'Reilly (2009) argue that this system was far more constrained than that provided by CSH, as the latter enables greater assessment of the value of performance improvements.

3 Methods

The research method designed and used to achieve the above-mentioned aim and objectives is an eclectic approach, embracing both qualitative and quantitative methods. For the qualitative aspect of the research, primarily the literature review, document analysis was used. Document analysis is a useful tool to investigate decision-making that aligns strategic planning and policy with outcomes (Bowen 2009). This research tool was employed to understand the evolution of CSH and also previous related works. The primary sources consulted were based on a range of documents: academic journals, conference proceedings, textbooks, government publications and reports, dissertations and theses, and websites. The documents were categorised according to their importance to CSH. After reading all of this information, the more relevant documents were later used in the detailed document analysis. For this, no computer approach was used, rather key words and phrases (e.g. water, waste and energy) related to CSH served to inform the research when reviewing existing

documents. The information garnered from the documents was developed into a survey through a descriptive questionnaire. This instrument was designed to gain an understanding of the outcomes of CSH strategies from the viewpoint of practitioners and others within the built environment, with the overall aim of gauging the extent of CSH implementation towards 2016.

To achieve objectives 2 and 3 of this research, questionnaires were sent to practitioners whose operations include the construction of houses, either wholly or partially. A representative sample was used in this investigation, as it would give the researcher an accurate insight into what builders of new homes are doing about CSH implementation. To ensure that the sample chosen was representative of the overall population, a list of the targeted population of developers who construct houses as part of their development operations was identified. To ensure that the population was consistent, it was decided to use the list of house builders within the Home Builders Federation (HBF) directory. HBF is the voice of the industry in England and Wales. A representative sample of developers was chosen for participation in the study, ensuring that all of the population had the same probability of being sampled (Fellows and Liu 2009). HBF provided details of 143 house builders (HBF 2012). Therefore, in accordance with the recommendations of Fellows and Liu (2009), in order to ensure sufficient depth and quality of results, a selected sample of developers was chosen to complete the questionnaire. All even numbers were chosen to form the random sample, thereby constituting a total of 71. Stoker, as quoted by Strydom and De Vos (1998: 192), gives guidelines regarding sample size. For example, the reliable sample percentage suggested for a population of 200 is 32 % and the number of respondents is 64. Neuman (2006: 241) argues that for a smaller population (less than 1000), a relatively large sampling ratio is needed (about 30 %). Thus, our own respondent total of 71 exceeds these figures, as we are dealing with a survey population size of only 143. The sampling size has taken care of the variability of the data set in terms of size of the organisation, regional variation and annual organisational turnover.

3.1 Questionnaire design

The questionnaire was designed to include both subjective questions and those that require the respondent to use rating scales, in order to seek out a subjective opinion. The latter provided valuable insight into those barriers which render CSH infeasible in assisting the new housing sector with delivering zero carbon homes by 2016. Most of the questions in the questionnaire were "closed ended" for those which required a specific response, such as "yes" or "no", or they used a rating scale to rank importance of factors or level of agreement by the subject (the person) with the object (the question) (Naoum 2007). These questions were used to obtain the quantitative data. A number of the questions were of a qualitative nature, requiring respondents to provide levels of agreement, with reasons. Certain questions or statements were designed simply to count the number of answers as to whether or not a respondent adopted a certain process. Then, some subjective information was obtained to make a qualitative analysis of respondents' reasoning, motivation or choices as to the quantitative data. Respondents were asked to comment on the content of the questions. These comments were then used in the qualitative analysis of the information provided.

The questionnaire was split into six main sections to provide clarity. The sections are as follows: respondent work profile information; generic organisational information; organisational knowledge of CSH; organisational financial perspective on the consequences of implementing CSH/producing low-carbon homes; technologies and methods of

achieving requirements of CSH; and feasibility of government aims for zero carbon newly built homes by 2016.

In advance of the general distribution of the questionnaire, a pilot study was undertaken. Comments made upon the clarity or difficulty of questions, provision of instruction and presence of ambiguity were analysed and used to amend the questionnaire and assist completion. Where there were issues of clarity, some of the practitioners were asked informally about their comments, to allow them to elaborate further on themes contained within the questionnaire.

The survey investigated 143 housing developers from the HBF database. HBF members deliver around 80 % of new homes built each year. Of the 71 questionnaires distributed, 26 were returned. This constitutes a response rate of 36.6 %. This rate is lower than the anticipated response rate of 40–60 % (Naoum 2007). The majority of responses were received within 5 days, which adheres to the response time recommended by Naoum (2007) that a majority of respondents should return a questionnaire within 2 weeks of distribution.

3.2 Respondents' demographic characteristics

The industrial experience of respondents has been analysed, showing that the majority have 15–20 years of experience (Table 2). This is a reasonable consideration, as most are of management level and above. Experience within the 5- to 10- and 10- to 15-year categories is equally rated (27 % for each), which indicates a sufficient degree of experience. Respondents belonging to the 1- to 5-year group are of the lowest level of experience in terms of the current study. This lower level of experience may not prove disadvantageous; however, as CSH, the primary concern of this study is a relatively late industry development.

4 Perception of current status

This section presents the analysis of the questionnaire survey on the feasibility of achieving zero carbon newly built homes by 2016, as well as the barriers that stifle all-out adoption of CSH by the industry.

4.1 Barriers to use of certain technologies

Respondents provided ratings to a number of barriers to the use of technologies and methodologies for the achievement of higher CSH levels than the mandatory minimum

Table 2 Industrial experience of respondents

Years of industry experience	Percentage of respondents (%)
<1 year	0
1–5 years	7
5–10 years	27
10–15 years	27
15–20 years	32
Over 20 years	7
Total	100

standard set by the building regulations (Code Level 3). Participants were asked to rate each barrier (1–5) against the use of each technology or method, using zero if the technology listed in the question was not considered as applicable or was never used. Figure 1 shows the percentage of respondents applying a level 5 rating to each barrier to the use of green or renewable technologies for the achievement of the higher levels of CSH.

4.2 Consideration of feasibility of all newly built housing being zero carbon by 2016

Respondents were asked to consider their own organisation's operations, in order to offer an informed opinion on the feasibility of the government's objective of all newly built construction being zero carbon (Code Level 6) by 2016.

The data demonstrate that the majority of respondents believe that there is a fairly low chance of the government achieving its objective. Indeed, there were more respondents who believe that the likelihood of the objective being met is low than there were optimistic respondents who selected a high or fairly high feasibility of the objective being met.

Respondents were requested to give reasons for their statement of level of feasibility, although only approximately 30 % of the sample did give this further information. The findings obtained were poignant if not representative. Three respondents mentioned the nature of planning regulations and preregistration of developments under current building regulations which may not actually be in place at the time of construction. In other words, preregistering a development site under certain building regulations ensures that the development can be built to those standards. A particular respondent stated, "…locking construction into a certain set of regulations through preregistering a site [development] before the timing cut-off can be a means of avoiding having to build to later, more stringent regulations" (Respondent A).

It would appear obvious that developments are limited to those building regulations in place at the time of approval by and registration with the local authority; but this

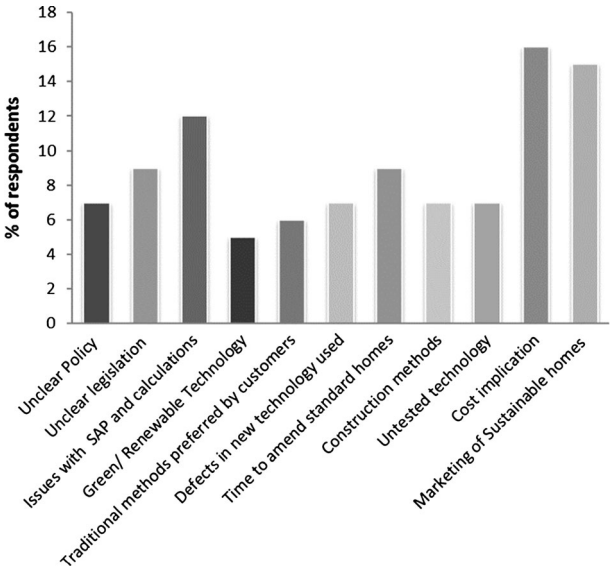

Fig. 1 Level 5 barriers to implementing CSH

consideration provides an interesting nuance to the prospects of all new housing to be zero carbon by 2016. In practical terms then, these three respondents assert that effectively a site may be preregistered under old regulations, so that when the building regulations are updated to Code Level 6 and "zero carbon" by 2016, entire or parts of developments will not have been started on the date that the latest zero carbon building regulations come into effect. This is extremely interesting and arguably very worrying, as it will cause the government's objective for all new housing to fail automatically, if any sites have been preregistered under outdated regulations.

4.3 Organisations with higher levels of CSH than the minimum requirements

The data indicate that only 50 % of respondents are working towards higher levels of CSH than the mandatory minimum (Code Level 4) set by the building regulations. The reasons for this are presented later, but this section serves to provide preliminary information as to the proportion of respondents striving to achieve more low-carbon housing than they are obligated to. This may be higher or lower in actuality, as 15 % of respondents were unsure whether their organisations were working towards higher levels of CSH. The proportion of respondents shown in the figure will be greater or lesser in reality, due to the uncertainty about this 15 % of respondents (Fig. 2).

Of the 50 % working towards Code Level 4, 54 % are also working towards Code Level 5 and none is working towards Code Level 6 (zero carbon), as illustrated by Table 3. Respondents were asked to estimate the average percentage increase across their developments as a consequence of implementing the requirements of CSH. In this instance, costs of implementation refer to the minimum level set through building regulations, compared with build costs prior to CSH coming into effect at a mandatory level. Of the 26 respondents (see Fig. 3), the greatest frequency distribution was in that of increases greater than 10 %. None of the respondents estimated the increased build costs as a separate entity but rather as a percentage.

4.4 Motivating factors for working towards higher levels of CSH

Respondents provided ratings to a number of motivating factors for working towards higher CSH levels than the mandatory minimum standard set by the building regulations (Code Level 3). The rating system required respondents to rate each motivator from 1 to 5

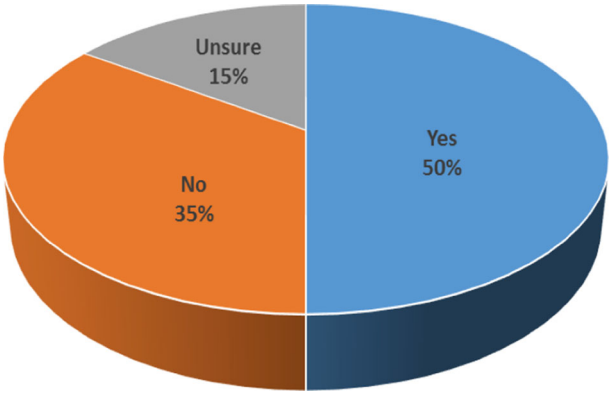

Fig. 2 Respondents working towards higher levels of CSH

Table 3 Respondent's organisation working towards higher levels of CSH

Higher CSH level worked towards	Number of respondents	Percentage of respondents (%)
Code Level 4	13	50
Code Level 5	7	27
Code Level 6	0	0

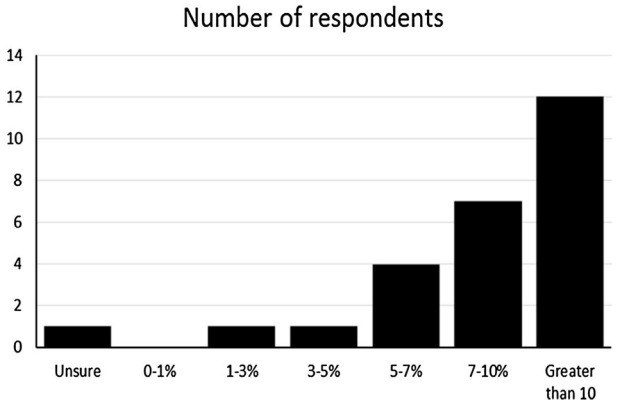

Fig. 3 Estimated increases in building costs due to implementing CSH

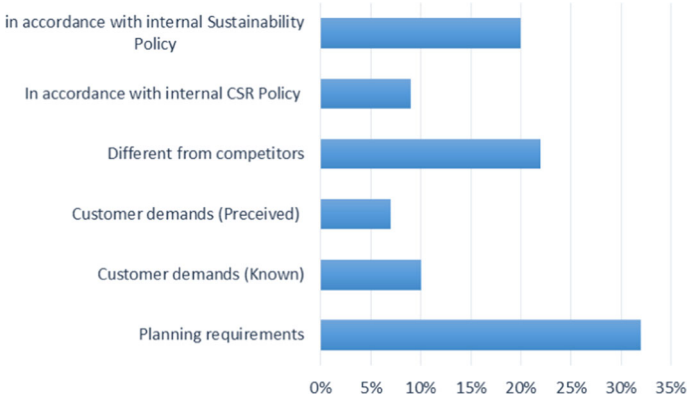

Fig. 4 Motivators for working towards higher-than-mandatory levels of CSH

in order of importance, using 0 if the motivating factor provided was not considered as applicable.

The frequency of the motivators, by order of importance as rated by respondents, is illustrated in Fig. 4. The highest-rated motivating factor was that of planning requirements. This demonstrates that the greatest driver for developers to work towards and achieve the higher levels of CSH than they are obligated to under the minimum set by the building regulations is, in fact, an obligation in itself.

Sustainability policy, however, was also rated as a factor of high importance, one serving to encourage respondents' organisations to achieve better sustainable developments than they are mandated to deliver (either through building regulations or planning requirements). This is evidence that organisations are motivated towards achieving lower-carbon housing by factors external to those impressed upon them by government (through policy and legislation) and local authorities (through planning conditions).

4.5 Feasibility of all newly built housing being zero carbon by 2016

Respondents were asked to consider their own organisation's operations, in order to select a specified level of feasibility of achieving the government's 2016 objectives. The data demonstrate that the majority of respondents believe that there is a fairly low chance of this coming to pass. The distribution of respondent views on overall feasibility is illustrated in Fig. 5.

Respondents were requested to give reasons for their statement of level of feasibility, although only approximately 30 % of the sample did give this further information; the findings obtained were poignant, if not representative.

5 Discussion

Of the barriers presented to the housing developers sampled for participation in this study, the following are those rated as the most formidable to the achievement of zero carbon housing by 2016: cost of achieving higher levels of CSH; lack of increased marketability for additional costs employed in achieving higher levels of CSH; lack of trust and reliability in new/renewable/green technologies; unclear legislation; and implications of amendments to standard house types or sets. In the literature (Poyton 2003; Nelson et al. 2004; DCLG 2006; Williams and Adair 2007), cost and reliability issues were identified as barriers to the use of some technologies, which concurs with the results from the data analysed in this study. In addition, respondents did not rate supply issues around these technologies as of high importance in comparison with their rating of other barriers. This indicates that renewables and green technologies are available within the supply chain at acceptable cost, which was a concern highlighted by Keeping and Shires (2004) and

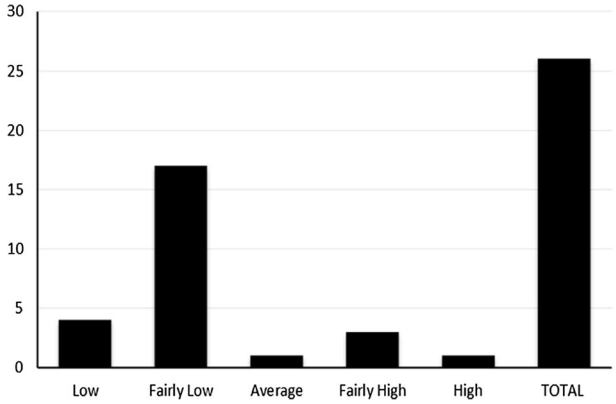

Fig. 5 Consideration of likelihood of zero carbon by 2016

Osmani and O'Reilly (2009). Therefore, supply issues in these technologies are not a major barrier to their adoption in helping to achieve the required CSH levels.

The demographics and social status of the house-owning population indicate that this constituency prefers the traditional style of construction and is not so keen on the uptake of newly built homes. Secondly, technological innovations with better energy rating are slower than the number of new builds and upgrades of old housing. Hence, what is available also has an impact on the future uptake of CSH. Lastly, the long economic downturn, in which the construction industry is the hardest hit, has made HBF and developers hesitant to invest, as banks are unwilling to give loans. This cycle of negativity is creating a very adverse effect on achieving the required level of CSH even several years later. Further, a significant finding of this research is that preregistering a development site under certain building regulations ensures that the development can be built to those standards.

Analysis of the questionnaire data reveals that a majority of respondents believe that there is a low chance of the government achieving its objective. Indeed, more respondents believe the likelihood of the objective being met is lower than optimistic respondents who selected a high likelihood of the 2016 zero carbon objective being met. Comments by a another respondent, who believes that there is a fairly high feasibility of the government's target being met, appear justified inasmuch as mandatory obligations serve to leave developers with little choice, but to achieve whatever objectives are reinforced by legislation. This is congruent to key findings of other studies (Adeyeye et al. 2007; Baiche et al. 2006; CIOB 2007), which argue that legislation is more effective than policy in achieving conformity with governmental sustainability strategy. Another comment given in the same vein by a respondent is concise in conveying what would appear to be the consensus amongst most respondents: "…unreasonable but not infeasible" (Respondent B).

Data analysis also reveals that developments are limited to the building regulations in force at the time of approval by and registration with the local authority. However, this consideration provides an interesting angle to the prospect of all new homes being zero carbon by 2016. In practical terms, a site may effectively be preregistered under old regulations, with a cost saving to the developer, so that when the building regulations are updated to Code Level 6 and "zero carbon" by 2016, some part or all of the development will not have been started on the date for application of the latest zero carbon building regulations. This is extremely important, as it will likely cause the government's objective for all new housing to fail automatically.

The fact that house builders do not want to invest in issues that will not give them a good rate of return on investment makes them reluctant to spend additional money. In addition, buyers and owners do not have confidence in the market to make initial investment worthwhile at a good price. This break in the cycle of money is leading to a stagnation in the uptake of CSH. The benefit to the industry is that there is a commitment by practitioners to increase the number of new builds substantially, for the real estate market to have confidence to do business again. If this were the case by 2016, most house builders doing business would be CSH compliant.

From the paper by Schweber (2013), most of what she argues about the effect of BREEAM on clients and practitioners is also true for CSH, for which homeowners and developers are the clients. Similar issues should be skilfully monitored and incorporated for CSH implementation, before we could fully appreciate the relative importance of CSH in the future.

6 Conclusion

The purpose of this research is to ascertain the implementation of a CSH rating system for newly built homes in the UK. This objective was met through different research methods. The literature review provides a background for sustainable development. Thus, CSH was developed to form a standard of critical design and construction elements, which will result in substantial improvement to the level of sustainability of a new home. The code quantifies the level of sustainability of the new home by measuring these critical design and construction elements or categories, and rating the whole unit of the home as an overall complete package.

In the literature, different levels expected for CSH by 2016 are discussed, with the expectation that CSH Level 6 would be achieved for newly built homes. However, this is looking increasingly unlikely, as both home builders and owners are feeling the impact of the economic downturn, although it is losing pace. As of now, it appears that the rate of uptake by homeowners is slow and that the percentage of owners with level-6 uptake is very small. The findings of the questionnaire survey also reinforce the literature by showing clearly that there are barriers, both physical and others, that stifle progress towards achieving higher levels of CSH.

An aspect not presented in the literature review, nor included in the questionnaire survey, was a nuance relating to the achievement of zero carbon homes by 2016. A number of respondents mentioned that the nature of planning regulations allows for preregistration of developments under current building regulations, which may not be the best approach for achieving the gradations required by the sector in its target of achieving zero carbon homes by 2016.

Limitations of this study are the extent of primary data garnered and lack of time to investigate the actual degree of implementation reached by those new sustainable house builders that claim already to have achieved the 2016 CSH levels. These require more data to be collected from the occupants or energy and water suppliers over a given period of time.

This research reveals that the building costs of zero carbon homes are in fact higher than those incurred prior to the stipulated mandatory minimum levels within current building regulations, after factoring in inflation and other economic variables. This is certainly an area of further investigation, as estimations of increased costs were not consistent among the sample. A disparity of this nature could also be attributed to a multitude of other factors, such as a lack of resources and knowledge. As it is impossible to offer an informed judgement on the cause of the disparity in increased building costs estimated by participants in this study, that particular area needs to be expanded upon to ascertain what lies behind it.

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