

Low- and zero-carbon technologies in new homes

Learning from the experiences of consumers and on-site sales teams



Primary research

NHBC Foundation

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About the NHBC Foundation

The **NHBC Foundation**, established in 2006, provides high quality research and practical guidance to support the house-building industry as it addresses the challenges of delivering 21st century new homes. To date we have published over fifty reports on a wide variety of topics, including the sustainability agenda, homeowner issues and risk management.

The NHBC Foundation is also involved in a programme of positive engagement with the Government, academics and other key stakeholders, focussing on current and pressing issues relevant to house building.

To find out more about the NHBC Foundation, please visit www.nhbcfoundation.org. If you have feedback or suggestions for new areas of research, please contact information@nhbcfoundation.org.

NHBC is the standard-setting body and leading warranty and insurance provider for new homes in the UK, providing risk management services to the house-building and wider construction industry. All profits are reinvested in research and work to improve the construction standard of new homes for the benefit of homeowners. NHBC is independent of the Government and builders.

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Foreword

In May 2012, the NHBC Foundation published the report NF 42, which explored the uptake of low and zero carbon energy technologies by house builders and consumer reaction to them. One message emerging from that work and other sources is that while in theory these technologies offer significant benefits, consumers (whether owner-occupiers or tenants) often do not operate them efficiently. As a result, a low carbon home, though equipped for example with the latest solar technologies or energy-saving heat pumps, may not deliver the anticipated savings on bills or reductions in carbon emissions. Understanding this aspect of underperformance is crucial to the success of the low carbon homes agenda and this latest report from the NHBC Foundation is to be welcomed for its insights into what might be done to encourage and support occupants in the effective use of these technologies.

This current research benefits from the recognition that there is a key interplay between those selling or letting 'enhanced' homes with low carbon technologies and those that will be experiencing living in them. It carefully explores this relationship and examines in particular how well the seller promotes the opportunity presented by the technologies. From the experiences logged by the Reading University team, we can appreciate that much progress has been made by house builders in communicating the correct operation of these newer technologies. However in terms of harnessing the imagination of consumers and actively engaging them with the benefits it appears there is still much to do. Equally significant for house builders is the observation that feedback from consumers on these technologies is often not collected on a systematic basis, hence slowing up the emergence of improved guidance for sales teams or the design itself.

As 2016 approaches, the recommendations from this research take on added significance and I hope that house builders and the supply chains associated with low carbon technologies will be able to review their interactions with consumers. They have every reason to ensure that their customers are well-informed and inspired advocates of the benefits that can arise from modern technologies and the better homes they create.

This work is an initial exploration of the improvement cycle proposed by Reading University. More detailed work is needed to examine in particular the early stages of engagement with occupants and owners, and to develop more precise guidance on how to ensure that low carbon energy technologies are operated in ways that optimise their potential.

Rt. Hon. Nick Raynsford MP
Chairman, NHBC Foundation

1 Executive Summary



1. Low- and zero-carbon (LZC) energy technologies are increasingly being adopted in the design of new homes. This trend will continue as Part L requirements are stepped up.
2. Many consumers (owners and occupiers) will not be accustomed to the use of these carbon-saving heat and power technologies, and there is evidence that they are often misunderstood and incorrectly used. There is a risk that this could lead to dissatisfaction with new low-carbon homes, because of higher than expected energy bills, and to carbon emissions targets not being met in practice.
3. The consumer interface with LZC technologies has been the subject of much debate and research, mainly because consumer satisfaction with homes can hinge on their experiences with these technologies. Two questions predominate:
 - can the consumer easily understand how to use the technology?
 - does consumer behaviour need to change to secure the benefits from the technology and can we expect that change to occur?

Much can and is being done to improve user understanding and the findings from this work support that positive direction. However, whenever the correct use of a technology requires a change of consumer behaviour, the situation is more complex. This research explores how occupiers' behaviour can be affected by LZC technologies, and how they might be encouraged to willingly adapt to them.

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4. Two sets of interview case studies were included in this work:
 - consumers and their reactions to LZC technologies
 - house builder sales teams selling enhanced homes with LZC technologies.

Observations from these were aligned with a continuous improvement cycle, which embraced key marketing considerations: Design & Production, Imagination, Purchase, Identification, Function and Feedback & Opinion.

5. With consumers some headline observations were:
 - households did not understand the underlying principles of the LZC technologies, but more than half felt comfortable operating them
 - more than half would recommend their technologies to friends, but consumers were largely unable to articulate the benefits clearly
 - none felt the written guidance on use of the technology was suitable and generally consumers felt that there was insufficient effort made to spark their imagination on the benefits and opportunities of having LZC technologies in their homes.
6. With sales staff the research identified:
 - that site staff and sales staff had taken time to communicate over the technologies installed
 - a varied level of understanding among sales staff of the specific LZC technologies being offered, and no clear feedback route from the consumer to inform the sales approach or the basic design of the home
 - a very limited ability or willingness to communicate the benefits and opportunities in a way that the consumer could understand or be inspired by
7. Recommendations from the report flow from each part of the improvement cycle, however a core suggestion is that house builders should consider how their sales teams appeal to the imagination of purchasers and inspire them to interact effectively with the technologies. House builders should also actively seek feedback on operation, particularly when consumers' lifestyles are compromised in any way by LZC technologies.

2 Introduction



Wider context

All new homes will be required to meet a zero carbon standard from 2016. Significant strides have been made by house builders to deliver this agenda. The enduring success of zero-carbon homes, though, will ultimately be driven by the way consumers aspire for and live in them. These aspirations and practices affect not only the ‘as used’ (rather than ‘as designed’) energy performance of the home, but also broader consumer satisfaction levels with low- and zero-carbon homes. A virtuous cycle of positive consumer experiences is thus critical to strengthen the attractiveness of zero-carbon homes to potential buyers.

The NHBC Foundation published NF9 *Zero carbon what does it mean to homeowners and housebuilders?* in 2008 and NF40 *Today’s attitudes to low and zero carbon* in 2012. Both of these reports have helped house builders to go some way towards understanding consumer requirements. In 2010 the Zero Carbon Hub produced the report *Marketing tomorrow’s new homes: raising consumer demand for low & zero carbon living*, which identified a range of marketing priorities for the house-building sector as a whole and for individual house builders to further develop consumer appetite for low- and zero-carbon homes. One of the central messages coming out of that report (see pages 6-10 in particular) was the need to dissolve the prevailing “*polarisation between the developer and consumer view on zero-carbon homes*” by a “*re-framing of the argument towards a customer-centric [marketing] perspective in which there is a clear, beneficial and recognisably secure sales proposition*”.

The focus of this work

The polarisation between the developer and the consumer forms the starting point for this research. This report complements the findings from the three publications noted above (that drew extensively on questionnaire and focus group data) by presenting detailed qualitative case study work on consumers and on-site sales teams. The research focus on low- and zero-carbon (LZC) technologies* is deliberate because it is known that these have a significant (perhaps disproportionate) impact on occupants' perceptions of their homes. The work gives new insights on the actual consumer experiences of LZC technologies in their homes. Second, carefully building upon the consumer findings, the actual knowledge and practices of on-site sales teams in promoting (or hindering) consumers' awareness of the benefits of LZC technologies and their use are explored.

The report, in summary, provides new real-world insights into the detailed, day-to-day marketing and use of homes with LZC technologies. Further, these insights inform the development and demonstration of a continuous improvement marketing approach for house builders.

*The term LZC technology is used to indicate any technology, additional to the fabric, which generates or recovers power or heat, and makes a contribution to carbon emissions reductions.

3 Continuous improvement cycle



Domestic household activities, of course, occur in and around the home. It is no great surprise, then, to find that the home is the setting for many studies that investigate how technologies enter into (or don't enter into) everyday domestic practices. The process of why and how this happens is often referred to as 'domestication' of technology. Any potential disruption of a household's everyday life brought about by the introduction of LZC technologies can lead to dissatisfaction with those technologies and, as a consequence, the home as a whole. Further, the household practices may undermine the potential energy efficiency performance of the home. Yet, without a sustained and appropriate change in household attitudes and behaviours, it is unlikely that any home will reach its 'as designed' energy performance. It is this tension which house builders often refer to as the 'user problem.' House builders are confronted with reconciling the apparently conflicting tasks of making zero-carbon homes attractive in the market by improving consumer satisfaction, whilst all the while encouraging consumers to change their energy use behaviour (often against their wishes).

An understanding of the domestication process of LZC technologies in the home can play a central role in resolving the 'user problem.' The continuous improvement cycle, shown below in Figure 1, describes the whole process of LZC technologies being produced, being desired, being bought, being part of the everyday practices of the household and, finally, being improved. For successful marketing to consumers of the benefits of LZC technologies in new homes, house builders need to consider all parts of the cycle. Table 1 briefly describes each of these phases and their implications for house builders and consumers.

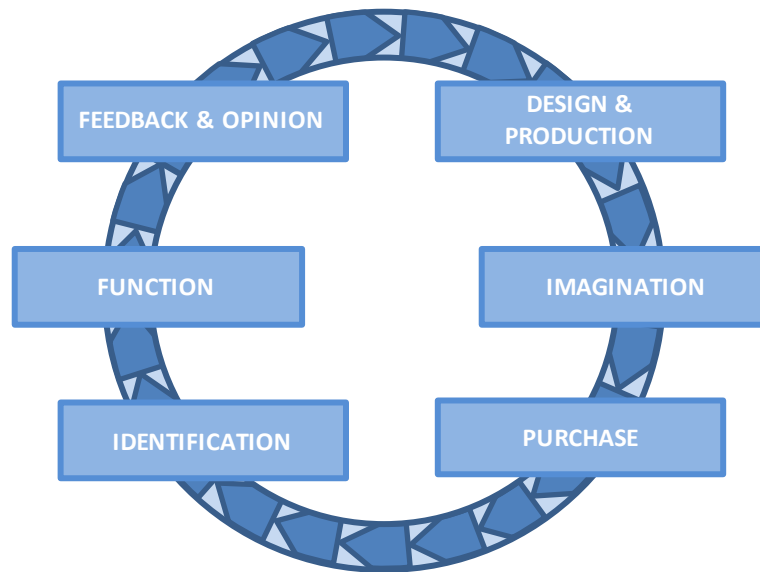


Figure 1 Continuous improvement cycle.

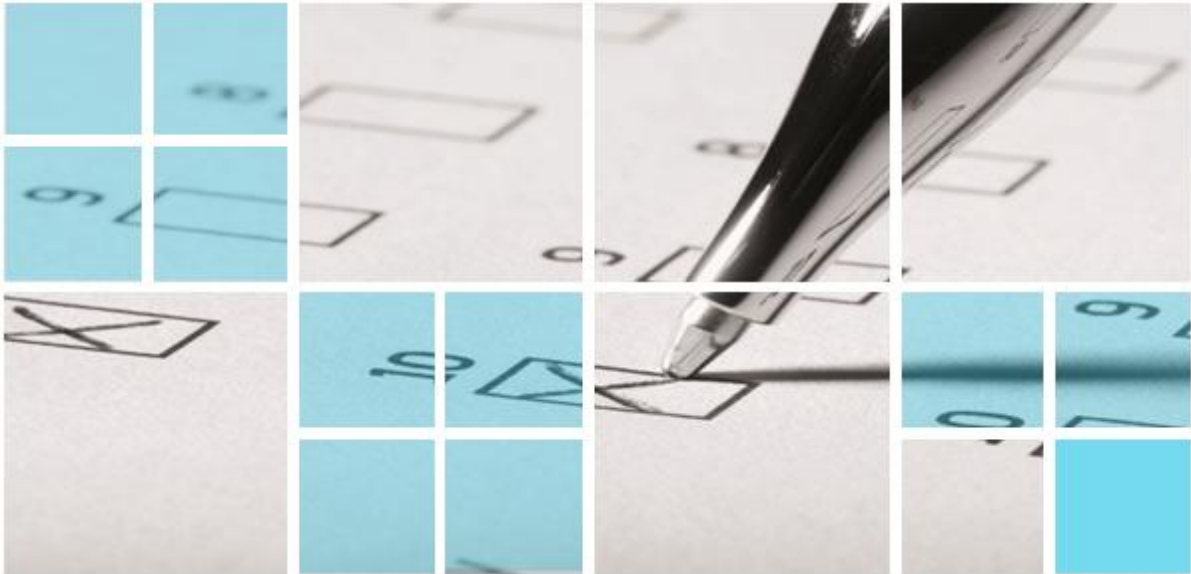
For the house builder the cycle provides a process to design, monitor, evaluate and continuously improve the cycle of design, production, marketing, sale and use of homes that contain LZC technologies. As the case study findings of this report make clear, for example, the house builder has not yet taken full advantage of the ‘imagination’ phase to effectively communicate to consumers the everyday benefits of, and living with, LZC technologies. Throughout this report the different phases of the improvement cycle are used to describe, analyse and evaluate the research findings.

Table 1

Continuous improvement cycle

Stage	Description	House builders' perspective	Consumers' perspective
Design and production	Technologies are created, opened to the influence of the consumer and brought to sale.	Commercially viable LZC solutions that comply with regulatory and consumer requirements.	
Imagination	Through imagination the everyday benefits achieved by the use of technologies are effectively marketed to potential consumers.	Marketing the benefits of LZC technologies to potential buyers.	Be excited by the prospect of the benefits of, and living with, LZC technologies. Understand the whole value proposition (e.g. lower energy bills).
Purchase	A technology, as part of the home, is purchased by an individual or household.	To equip consumers with the necessary knowledge to make best use of their LZC technologies.	Tailored information appropriate for households to make the best use of the LZC technologies.
Identification	Households can seek to express their identities through the technology.	Appropriate on-going support for consumers in the use of the LZC technologies by house builders.	Lifestyle/value statements that consumers identify with from living in a home with LZC technologies.
Function	This is the process of the actual use (or non-use) of a technology. Note: Technologies can be functional but not always in the way that designers intended them to be.		Bespoke hands-on support to realise the benefits of LZC technologies on a day-to-day basis.
Feedback and opinion	The way consumers communicate their aspirations of and experiences with the technology back to the wider society. The process of design and production can pick up the signals to inform future development.	Post-occupancy evaluation data collection mechanisms to inform future design, marketing and sales content and practices.	Formal capture by the house builder of consumers' concerns and experiences.

4 Methodology



Studying the way new LZC technologies are actually used within households or marketed by on-site sales teams is not straightforward. All households, housing developments and sales teams are unique. It is often these differences that accentuate or undermine the attractiveness of the benefits of homes incorporating LZC technologies to consumers. In this work a qualitative approach was undertaken to ‘lift the lid’ on the way households *actually* lived with LZC technologies on a day-to-day basis, and how on-site sales teams went about communicating the benefits and limitations of these technologies to consumers.

The value of the qualitative approach taken in this report is not only the ‘rich picture’ that it produces of consumers and on-site sales teams’ actual experiences; but it also provides house builders with the insights necessary to better design, for example, consumer satisfaction surveys.

Data collection approach

The data used in this report comes from households and sales teams from nine case study housing developments. For the consumer research, two 60 – 90 minute interviews were conducted with each household in their home. This approach avoided the artificial effects caused by taking the households into an unfamiliar environment or placing them in a situation influenced by external social pressures to ‘say the right thing’, such as in a focus group. The two interviews for each household were spaced apart by at least two weeks. This gave time for the households to reflect upon the issues raised in the first interview and for a level of trust to be developed with the research team. In addition to the interviews, ‘walk

rounds' were conducted with household members in their home. During these the participants were asked to demonstrate how they used (or, in a number of cases, did not use) the LZC technology and to elaborate on points made during the two interviews. The research team took photographs and made notes where appropriate. The interviews and 'walk arounds' were supplemented by telephone and e-mail communication between the households and the research team when clarification on an issue was required.

The interviews were open in structure to allow the participants to direct the conversation towards aspects of their new homes and the LZC technologies that they felt important. In addition, the interviewers asked the participants to talk through their purchase of the property, a 'day in the life' of the household and seasonal differences.

For the sales team fieldwork, nine staff were interviewed across six housing developments from the same house builder. Each interview ranged from one to two hours in length. In addition, sales brochures for the case study developments were examined where available, and photographs taken of the homes and relevant promotional posters in the sales offices.

Data analysis approach

All interviews were analysed in the following way. Transcriptions were made and anonymised (to protect the confidentiality of the house builder and the interviewees). The transcripts (amounting to over 1000 pages) were thematically analysed using NVivo 9 research software. The continuous improvement cycle set out in Section 2 was used to structure the emerging themes from the analysis. Only the aggregated key findings are given in the main body of this report. The aggregated findings, of course, hide the different experiences that individual households have of the LZC technologies in their home. The detailed household case study given in Appendix A, therefore, provides an illustration of the specificity of household experiences.

5 Findings - the household case studies



The findings from this research, to reiterate, are qualitative in nature. The purpose was to develop a deeper understanding of the way in which households are actually living with LZC technologies in their homes. First, the case study housing developments and households are briefly described. Second, Table 2 sets out the common themes identified across the case studies. The Table is structured from top-to-bottom through the continuous improvement cycle phases and from left-to-right across each of the housing developments and households. The response to the thematic questions for each case study is given as a simple 'Yes' or 'No' to reflect the majority opinion. Responses which are deemed to have a positive contribution to the household's understanding and use of the LZC technology have been coloured green. Those that may undermine the consumers' understanding and use of the technology are coloured red. The colouring helps also to show patterns of similarity and contrast across the household case studies.

Development 1

Development 1 is a large multi-phase development in a small village. The development is built on a mixed brownfield and greenfield site and is built to Code for Sustainable Homes Level 4. The phase used in this study comprises 26 houses which incorporate air source heat pump (ASHP) systems as the only source of domestic hot water and energy supply for the heating system. The ASHP system contains an electric immersion heater. All of the houses are private-owner occupied.

Two households from Development 1 took part in this study.

Development 2

Development 2 is a three house terrace. The housing association development is part of a larger local portfolio it manages in a village. The houses contain solar thermal systems which supplement gas central heating systems that also have electric immersion heaters.

Two households from Development 2 took part in this study.

Development 3

Development 3 consists of 149 units of houses, apartments and flats over garages on a brownfield site. The tenure is mixed with the houses occupied by both private owners and housing association tenants and the apartments are occupied by housing association tenants only. The development uses three LZC technologies in different combinations. The apartments have solar photovoltaic technology (PV) and mechanical ventilation with heat recovery (MVHR) systems installed. The houses have solar thermal systems fitted. All dwellings are built to a Code Level 3 standard.

One household from Development 3 took part in this study.

Development 4

Development 4 is a large urban redevelopment of dwellings and retail properties (including several small convenience stores) on a brownfield site. The dwellings are a mixture of owner-occupier and social renting, consisting of 106 houses and apartments. The development has been built to Code Level 4 standard.

There are four different LZC technologies installed at the site: PV, ASHPs, MVHR and solar thermal, with a mix of technologies incorporated into each house or apartment depending on unit type and size. One household from development 4 took part in this study.

Table 2

Key findings from the consumer case studies

Phase	Key themes	Development: Household:	Dev. 1		Dev. 2		Dev. 3	Dev. 4
			1a	1b	2a	2b	3	4
Design and production	Did the household feed into the design of future homes?		No	No	No	No	No	No
	Was the LZC technology set up to work well for the household?		Yes	Yes	Yes	Yes	No	No
Imagination	Could the household clearly articulate a wide range of benefits relating to the LZC technology?		No	Yes	No	No	No	No
	In relation to the LZC technology, was the 'home demonstration' effective?		No	No	Yes	Yes	No	No
	Was the written information on the LZC technology suitable?		No	No	No	No	No	No
	Was the household's imagination in relation to the LZC technology effectively harnessed?		No	No	No	No	No	No
Purchase	Was the sale/decision to rent rushed?		Yes	Yes	Yes	Yes	Yes	No
	Was the LZC technology a factor in deciding to purchase the property?		No	No	No	No	No	No
Identification	Did the household practices support the 'as designed' performance of the LZC technology?		Yes	No	Yes	No	No	No
	Could the household quantify the savings generated by the LZC technology?		No	No	Yes	No	No	No
Function	Did households demonstrate an understanding of how, in principle, the LZC technology worked?		No	No	No	No	No	No
	Was the household comfortable operating the LZC technology?		Yes	Yes	Yes	Yes	No	No
Feedback and opinion	Did the LZC technology perform as the household expected?		Yes	No	Yes	Yes	Yes	No
	Has the household been able to feedback their experiences of the LZC technology to the house builder/housing association?		No	No	No	No	No	No
	Would the household recommend the LZC technology to a friend?		Yes	No	Yes	Yes	Yes	No

6 Findings - The sales teams case studies



Introduction

The key message from the household case studies is that the house builder was not always successful at following parts of the continuous improvement cycle:

- to assist consumers in the imagination phase through appropriate communication of the benefits and limitations of LZC technologies in their homes in a way that they could personally relate to and, thus, properly understand and become enthusiastic about; and,
- to provide consumers with appropriate user information during the 'purchase' phase to equip them to properly operate and maintain the LZC technologies and, in so doing, positively confirm and reinforce their prior imagination.

Further, the findings identified that the on-site sales team played a critical role in the success (or otherwise) of these two phases of the cycle. This section develops a better understanding of what on-site sales teams actually think and do when it comes to marketing the benefits of homes with LZC technologies. This interest extends to how the sales teams are supporting consumers through the purchasing process in a way that allows them to realise those marketed benefits after the sales process is complete.

Development 4 is the only site used for both the consumer and on-site sales team case studies. The key findings are presented in Table 3 using the same approach taken for the consumer case studies. The response to the questions for each case study is given as a simple 'Yes' or 'No' to reflect the dominant position. If the position is not clear then the response is given as 'Partially'. Responses which are deemed to have a positive contribution to the sales team's ability to sell to consumers in a way which develops their understanding and use of the LZC technology have been coloured green. Those that may undermine consumers' understanding and use of the technology are coloured red. The colouring helps also to show patterns of similarity and contrast across the house case studies.

Development 4

Development 4 is a large, urban, mixed-used redevelopment of an ageing inner town shopping street in a small city. 106 houses and apartments are being developed on a brownfield site. There are four different LZC technologies installed: PV, ASHP, MVHR and solar thermal, with a mix of technologies incorporated into each house or apartment depending on unit type and size.

Development 5

Development 5 is a large development on the outskirts of a small town. The development uses solar thermal technology.

Development 6

Development 6 consists of 134 privately owned homes and 66 homes rented through a housing association. The development is located on the outskirts of a large town and includes solar thermal technology on a small number of properties.

Development 7

Development 7 is a large two phase development including both houses and apartments on a greenfield site. A range of LZC technologies (MVHR, PV and solar thermal) are used but not necessarily all in each house.

Development 8

Development 8 consists of 99 units, 49 of which are part of an extra care facility. All private units have either a solar thermal system or an ASHP.

Development 9

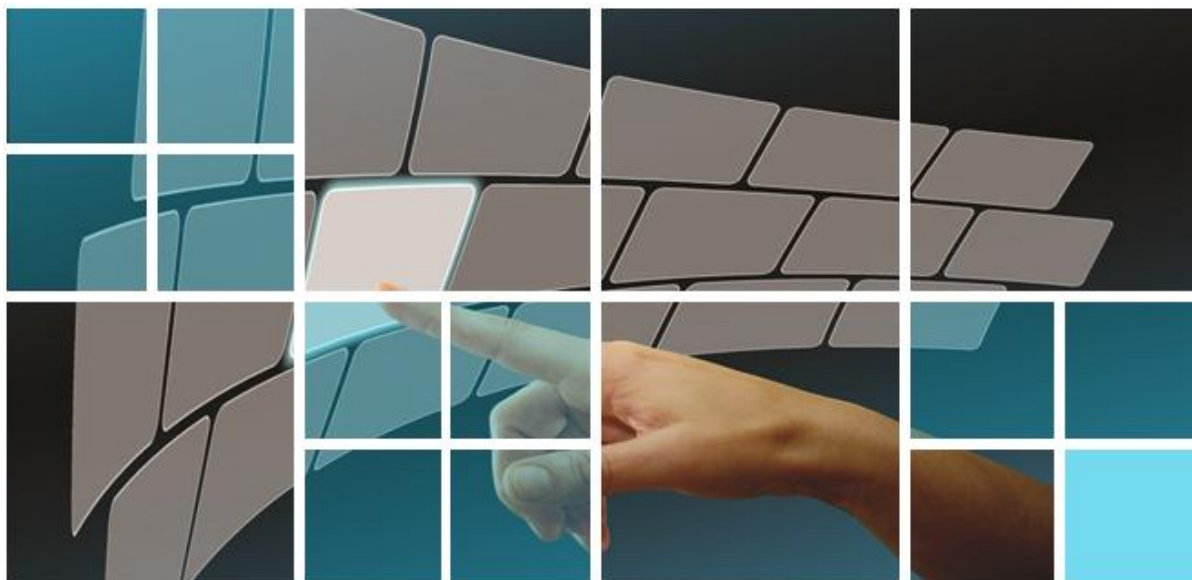
Development 9 is a new build development on a brownfield site of 33 houses located in a small village. The technology is not the same on all houses; it is a mixture of ASHP and/or solar thermal systems.

Table 3

Key findings from the sales team case studies

Phase	Key themes	Dev. 4	Dev. 5.	Dev. 6	Dev. 7.	Dev. 8.	Dev. 9
Design and production	Did the sales team demonstrate a good understanding of the LZC technology?	Yes	Yes	No	No	No	Yes
	Was there a close working relationship between the sales team and the site team?	Yes	Yes	Yes	Yes	No	Yes
	Did the sales team feel able to make specific claims about the LZC technology's performance?	No	No	Not stated	No	No	No
Imagination	Were the benefits and limitations of the LZC technology introduced early in the sales process by the sales team?	No	Not stated	No	No	No	No
	Was information about the LZC technology kept simple and basic?	Partially	Yes	No	Partially	No	No
	Did the sales team feel that the household was overwhelmed with information?	Yes	Not stated	Yes	Yes	Yes	Yes
	Did the sales team relate to consumers the day-to-day use of the LZC technology in such a way that the households' imagination was harnessed?	Partially	No	No	No	No	No
Purchase	Was a warranty offered for the LZC technology?	Yes	Yes	Yes	Yes	Yes	Yes
	Was the LZC technology considered a sales feature?	Yes	Yes	No	No	No	Yes
Identification	Was the household encouraged to understand and use the LZC technology?	Not stated	No	Not stated	Yes	Not stated	No
Function	Did the house builder setup the LZC technology for the household?	Sometimes	Yes	Not stated	Yes	Yes	Yes
Feedback and opinion	Has the household been invited to feedback their experiences of the LZC technology to the house builder/housing association?	No	No	No	No	No	No

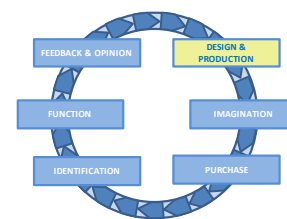
7 Recommendations for house builders



The tables below are structured around the improvement cycle. In the left-hand side column the key findings are summarised: the household findings are shown in the blue boxes and the on-site sales team findings are shown in the yellow boxes. In the right-hand side column recommendations are given which respond to the case study findings.

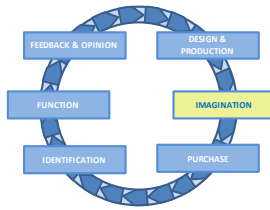
The improvement cycle can help house builders to better engage with consumers to market the benefits of sustainable homes and their technologies and also the desire, knowledge and ability to control the home and the technologies to achieve the designed environment and energy performance. To reiterate, for the successful marketing and use of homes incorporating LZC technologies, all parts of the improvement cycle should be considered by house builders. Further, the critical phases of the cycle are the initial ones. When the house builder gets the design and production, imagination and purchase phases right to begin with, the other phases almost take care of themselves.

DESIGN & PRODUCTION



Findings	Conclusions & Recommendations
<p>Closing the feedback loop to enhance future LZC solutions Across all the households none felt that they had been asked to provide feedback to the house builder or housing association on the LZC technology.</p>	<p>See Feedback & opinion.</p> <p>The closing of the feedback loop creates the 'continuity' in the improvement cycle.</p>

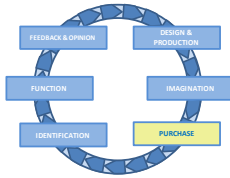
<p>Understanding the LZC technology Across the sales teams there were significant differences in how well the LZC technology was understood. Some had an in-depth understanding of the principles of the technology whilst others had only the vaguest of understanding. In all but one of the cases there was a very strong working relationship between the sales team and the site manager. The site manager was often the primary source of information relating to the LZC technology and was heavily involved in the home demonstrations.</p>	<p>We have seen that there is an adverse lack of consistency in the sales approach to selling homes with LZC technologies. In particular, there appears to be confusion as to whose responsibility it is to provide technical information to consumers about the LZC technology – the sales team or the site team. This ambiguity may lead to gaps in provision, to the detriment of the consumer.</p> <p>House builders may want to consider:</p> <ul style="list-style-type: none"> • Ensuring that for each development the allocation of responsibility between the sales team and/or site team roles for responding to consumers' queries relating to LZC technologies is clearly defined, • Providing onsite training to match the role and specific site technologies. <p>It is critical that the approach put into place is sympathetic to developing consumer awareness of the LZC technology, as outlined below.</p>
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IMAGINATION

Findings	Conclusions & Recommendations
<p>Exciting consumers' imagination In many cases the occupants were surprised when confronted with the LZC technology for the first time. Many were unaware of the exact nature of the LZC technology and more often than not this 'surprise' manifested itself as uncertainty and discomfort with the technologies. All households had an underdeveloped imagination relating to the LZC technology prior to moving in. Consumers had been left to their own devices to imagine (or not imagine) the potential benefits of the LZC technologies.</p>	<p>Very little effort was made to develop the consumers' imagination relating to how they might benefit from the LZC technology. The risk for the house builder is that consumers may remain unaware of the potential benefits or have unrealistic or negative expectations of the LZC technologies in their homes. In the sales process it was clear that more might be done to ensure customer satisfaction.</p> <p>House builders may want to consider:</p> <ul style="list-style-type: none"> • Creating an appropriate balance in their sales approaches between selling the benefits of the LZC technologies and creating a realistic expectation of the performance of those technologies. • Collecting data, particularly on multi-phase developments, about the performance of the LZC technologies to inform current and future sales approaches. • Complementing traditional feedback approaches (such as the customer satisfaction survey) with multiple 'soft' and 'hard' evidence. This could include indicative savings (by unit and typical household composition, e.g. family households, single person households, and so on). The savings data will need to be set against benchmarks that would need to be defined (e.g. building type, household type, etc.).
<p>Setting the expectations about performance In every case in which it was discussed the benefits and limitations of the LZC technology were not highlighted or introduced until very late in the sales process. In some cases this was after completion. In all of the cases in which it was discussed the performance of the technology was described in terms of financial savings and yet the sales teams were discouraged from making specific claims about the actual level of savings that could potentially be achieved.</p>	
<p>Exciting consumers' imagination In none of the cases was a significant effort made to harness the consumers' imagination relating to the benefits and limitations of living with LZC technologies other than anecdotal claims relating to financial savings.</p>	

<p>Inflexible information</p> <p>For a number of different reasons each household indicated that, when occupying the property, the written information and home demonstration relating to the LZC technology was unsuitable. Most thought the written information overly detailed and complex, others thought it too simple and some did not read it at all. The demonstration tended to occur when the consumers had many other distractions e.g. in the case of the social tenants whether or not to accept the house.</p>	<p>There is a significant opportunity for house builders to improve the effectiveness of their communication with consumers.</p> <p>House builders may want to consider:</p> <ul style="list-style-type: none"> • The information content and the process of delivery needs to be more flexible and configurable (i.e. so that sales staff (and consumers can tailor the information to particular interest and ability levels). • Exploring the use of a variety of information platforms (not just the traditional paper-based manual), including pod casts, audio guides, mobile phone apps and structured tutorials to the new home.
<p>Appropriate amounts and types of information</p> <p>The sales teams felt that the consumer was often overwhelmed with information.</p> <p>In addition some sales teams questioned the appropriateness of the information. For example, when describing the LZC technologies the home packs were often seen as overly complicated.</p> <p>Sales teams made more of an attempt to tailor the home demonstrations to the ability and motivation of the consumer to understand the LZC technology.</p>	



PURCHASE

Findings	Conclusions & Recommendations
<p>LZC technology hidden during sales In all of the cases the LZC technology was not a priority of the household when selecting the property. However, in a number of the cases the households said that they did not know what questions to ask as they had very little, or no, knowledge of the systems at the time of purchase.</p> <p>Are LZC technologies a sales feature of the home? Currently a very ad-hoc, incoherent approach was found across the case study sites in relation to if the LZC was a sales feature or not. The sales teams held a wide range of opinions about whether or not an LZC technology was a sales feature of the home. This appears to be based more on individual sales team members' personalities, opinions and understandings, rather than a coherent position developed for the specific development. This did seem to depend of the type of technology used (e.g. ASHPs were considered to make sales more difficult whereas solar systems made sales easier).</p>	<p>House builders may want to consider:</p> <ul style="list-style-type: none"> • Establishing a clear position on the sales features and value propositions of the LZC technology for each specific housing development. • Training staff to be able to effectively communicate the sales proposition regarding the benefits and limitations of the LZC technologies on the site which they are based.
<p>Hurried purchase In all but one of the cases the decisions to purchase (or rent) was made in a very short period of time. In some of the cases this was driven by the household wanting to seize an opportunity when it appeared (e.g. another household pulling out of a sale), sometimes it was driven by the house builder (e.g. end of year returns) and for the social tenants it was driven by the housing association processes relating to securing the property.</p>	<p>Hurried transactions are a common feature of the sales/renting process. The rush to purchase (or rent) exacerbates the difficulties relating to the other consumption phases described in this report. This makes it even more critical for the earlier phases to be effectively implemented to ensure that the upfront LZC technology imagination, tailored information to meet specific housing development and consumer needs, and so on are in place.</p>

Easing the customers' concerns

In every case the home was provided with a warranty which covered the LZC technology.

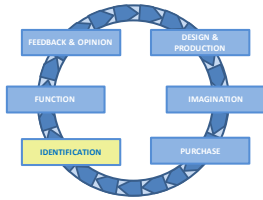
This warranty was used to alleviate any concerns that the customer might have relating to the use, reliability and performance of the LZC technology.

There may also be occasions when the sales teams are making incorrect claims regarding the warranty cover.

The default position of the sales teams was to use warranty of the LZC technologies to ease the concerns of the consumers. Whilst the warranty is certainly a benefit for the consumers, using it in such a way as to stifle the development of the consumers' imagination is potentially creating problems in later phases of the consumption cycle; particularly identification and function. This is particularly true if unrealistic expectations are being developed of the LZC technology.

House builders may want to consider:

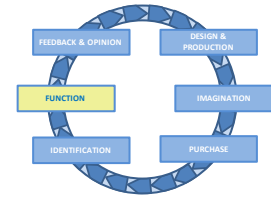
- Striking a balance between communicating the benefits and limitations of the LZC technologies in order to develop realistic consumer expectations of the performance of the technology in use.
- Ensuring that sales teams are trained in the terms and conditions of the warranties offered.



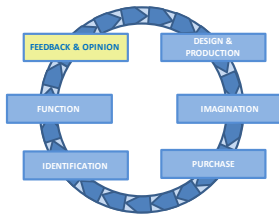
IDENTIFICATION

Findings	Conclusions & Recommendations
<p>Identifying with the LZC technology In the majority of the cases the households did not demonstrate the behavioural or operational routines that would realise the benefits of the LZC technology.</p>	<p>There were very different house routines across the case studies which shaped the degree to which the households were able to realise the full benefit of the LZC technologies.</p> <p>House builders may want to consider:</p> <ul style="list-style-type: none"> • Using stories and narratives in their information provision (see imagination and purchase phases above) to help consumers identify with what type of users they are and, in so doing, guide them on how best to realise the LZC technology benefits for their particular circumstances.
<p>Expressing the benefit All of the households understood the benefit of the LZC technology in terms of financial savings. However, only one of the households was able to quantify the savings generated by using the LZC technology.</p>	<p>It was clear that estimated bills and direct debit payments were hindering the households' ability to establish the savings from the LZC technologies, particularly in the first year of occupation.</p> <p>House builders may want to consider:</p> <ul style="list-style-type: none"> • Collecting an evidence-base of the benefits (and limitations) of the LZC technologies as experienced by occupiers on specific housing development to inform future marketing activity on that site. This is particularly useful for large multiphase developments. For example, such an evidence-based would permit house builders to say to a potential buyer that the energy bills of these type of households (e.g. households with young children or single occupancy) on a particular development are in the £X to £Y range; rather than generic information.
<p>Encouraging interaction The sales teams disagreed as to whether consumers should be encouraged to interact with the LZC technologies or not. The position taken by different sales teams appears to be based more on individual sales teams' personality, opinion and understanding rather than a position developed for the site. These approaches varied from warning the consumer not to touch the technology at all (for fear they would break it or undermine its performance) through to actively encouraging them to experiment with the technology and reassuring them they could not break it.</p>	<p>Across the case studies a very ad-hoc, incoherent approach is found to how consumers are encouraged to either interact with LZC technology in their home themselves or rely on the support functions of the house builders.</p> <p>See engagement recommendation above regarding the establishment of indicative savings data for different types of home and households against a set of clearly defined benchmarks.</p>

FUNCTION



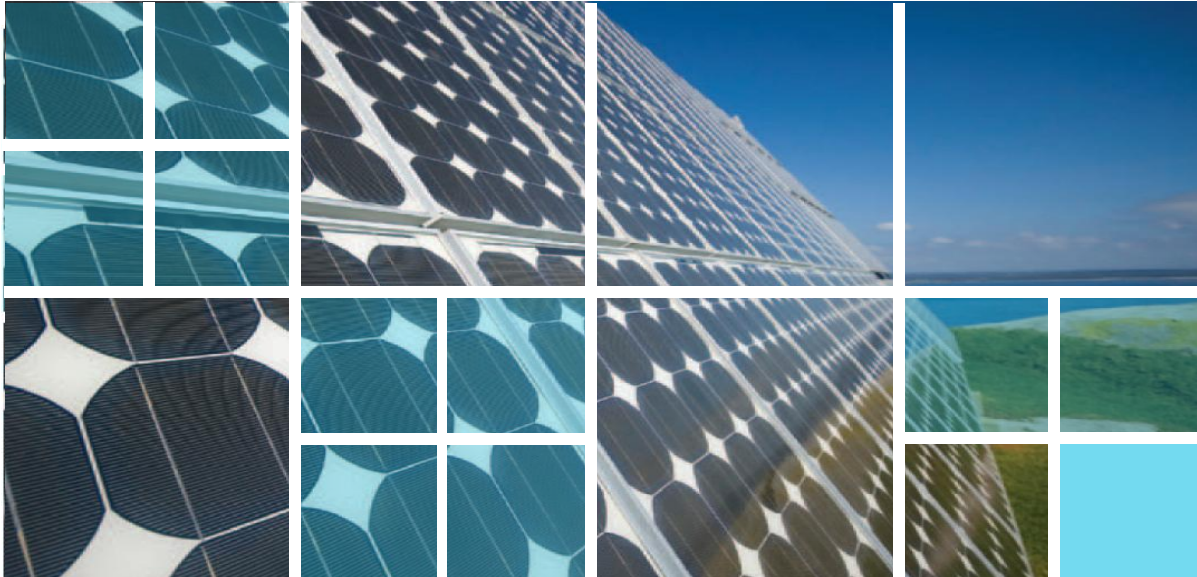
Findings	Conclusions & Recommendations
<p>Meeting expectations Whilst the purported benefit of the technology was likely to be understood in financial terms, satisfaction levels were driven by how well the LZC technology met the thermal comfort, hot water and ease of use expectations of the household.</p> <p>Two of the households clearly articulated that the LZC technologies in their homes were not meeting their expectations.</p>	<p>Helping to shape consumers' expectations of the LZC technology's performance can increase satisfaction with the technology and the home as a whole.</p> <p>See engagement imagination recommendations above. Harnessing the imagination of consumers will significantly reduce the development of unrealistic expectations in the consumers.</p>
<p>Supporting use In all the cases the house builder spent time setting up the LZC technology.</p>	<p>House builders may want to consider:</p> <ul style="list-style-type: none"> Continuing the good practice of supporting consumers in use and attempting to equip consumers with the ability to reconfigure the system in the future.



FEEDBACK & OPINION

Findings	Conclusions & Recommendations
<p>Recommending to friends and family Predictably, in each case where the household was satisfied with the LZC technology's performance they were happy to recommend the technology to friends and family. In each case in which the household was not satisfied with the technology's performance (relating to thermal comfort, hot water supply and ease of use) they were not.</p>	<p>See imagination recommendation above.</p>
<p>Capturing knowledge There is a significant gap in the feedback loop. Sales teams and site managers are exposed to a range of consumer feedback. There do not appear to be any mechanisms to capture this information and use it to inform the next generation of low- and zero- carbon homes. In none of the cases studied had the sales team made an effort to capture and codify any of the informal feedback they had received from occupants. Neither had they reached out to the occupiers in any organised way to gather information to inform the future sales approaches of homes with LZC technologies, whether for the remaining phases on the sales teams' current sites or for future developments.</p>	<p>House builders may want to consider:</p> <ul style="list-style-type: none"> • Developing and formalising mechanisms to capture multiple sources of feedback from sales teams and consumers. • Supplementing current customer satisfaction survey data with qualitative post-occupancy evaluations.

Appendix A Example detailed case study



Introduction

The findings from this research, to reiterate, are qualitative in nature. The purpose was to develop a deeper understanding of the way in which households are actually living with LZC technologies in their homes. The story of the household *from their perspective* is given. There is an emphasis, therefore, in letting the households speak for themselves as much as possible through the extensive use of quotations (given in *italics*).

Development 1

Development 1 is a large multi-phase development in a small village. The development is built on a mixed brownfield and greenfield site and is built to Code Level 4. The phase used in this study comprises twenty-six houses which incorporate air source heat pump (ASHP) systems to supply domestic hot water and space heating. The ASHP system contains an electric immersion heater. All of the houses are private-owner occupied.

Two households from Development 1 took part in this study.

Household 1a

Household 1a is a couple who own their three bedroom end-terrace house and work full-time. The couple have lived in the property for fourteen months. Their son spends three days a week at home when he is not at university. One of the parents works as an electrical engineer.

The story

This is the third home that Household 1a have lived in. The household's previous homes were a timber framed starter home followed by a "cold" conventional brick built home. Electricity was the primary source of heating in their two previous homes. In the first home the occupants installed their own electric storage heaters. They recall paying around £25 a month for their electricity in their first home, around £100 a month in their second home and about £100 month in their current home.

Household 1a moved into their new home a few days before Christmas, a busy family time that they would rather have avoided. The rapid speed of the completion process caused some difficulty with the ASHP system:

"...it was touch and go 'cause the heating system actually froze over ... somebody had turned the pump off and it froze over, so that was the week before we were supposed to move in, so they took it all part, didn't they? Thawed it all out and, well, they got it going and it's been working ever since."

The household is very content with the thermal comfort of the home:

"Yeah, compared to the other one [previous home], it is much, much warmer."

The household feels that the ASHP system is not imposing any undue restrictions on them.

The household were initially concerned that the ASHP would produce excessive noise, but in reality that has not been the case:

"We did wonder in the summer whether we, 'cause we sleep with the windows open, whether we'd be able to hear the air source heat pumps, but there's not, I mean, you can occasionally hear them ... and generally they're off, aren't they? So it's not been a problem as I thought it would be."

The household has altered the outside ASHP installation by removing a fence that surrounded the unit. The fence had been added by the house builder to help smooth the air flow into the unit to improve the performance of the system. The occupants were not made aware by the house builder that the fence was anything other than a simple, decorative fence. Figure A1 shows the ASHP unit with the fence (on a different house on the same development) and Household 1a's unit with the fence removed.



Figure A1 The ASHP unit with and without the fencing which smooths the airflow into the unit.

The household removed the fencing to allow easier access to the garden gate, which can be seen behind the ASHP unit in Figure A1.

The household's positive experience of the ASHP is likely to influence their purchasing criteria in the future.

Household 1b

Household 1b is a recently retired couple who live in a semi-detached house and whose children have moved out. They have lived in the property for eleven months. For the majority of the time they live in the UK but spend time at their holiday home abroad. Recently one of the couple, who has specialist knowledge relating to energy supply, returned to work two or three days a week as a senior plant engineer at a large factory.

The story

Household 1b purchased their home when another buyer pulled out at the last minute. They were familiar with the area and the development as they had previously investigated purchasing a house in an earlier phase.

The speed at which the sale happened meant there was little time for the household to consider the ASHP technology in their new home.

As a backdrop to the decision to purchase this house, particularly in reference to the fact that it contained an ASHP system, the household stressed that it had a particularly strong loyalty to the house builder. This helped, initially, to alleviate any fears or uncertainty the household had in regard to the technology:

"... this is the one, two, third house that we've bought from [the house builder]..."

This brand loyalty fuelled an assumption by the household that because they were satisfied with the thermal comfort and the operation of the heating systems in their previous homes, that therefore the new home would perform to the same standard as well. The assumption was such that they were unaware of the ASHP technology at the point of purchase:

"[I] was quite surprised actually. It was only – I think even on the second occasion, when I walked out my garden and see this box, this magic box sitting out there and I thought, oh, what's that? And then they then said, "Oh, well you've got whatever it is,"."

In contrast to Household 1a this household has a number of significant difficulties with the ASHP system. One set of issues centres on the availability of hot water. The ASHP system is the sole source of low temperature hot water (other than the immersion heater). The household quickly felt after moving in that the amount of hot water was not adequate. They shape their routines around this deficiency, particularly when they need to plan ahead for anticipated peaks in hot water demand, something that they did not have to do in their previous homes:

“I mean, we had friends last weekend. Now, one of our friends, she likes to have a bath, so she drew herself a bath. That was it, you know. We all got up the next morning, there was hardly any hot water ‘cause it only comes on for an hour. You know, it just needs – all the time, you’re constantly having to think...”

The household feels that the heating of hot water to supply the heating system and for use in showers and for washing forces them to have to choose between the two at any one time:

“... the hot water, obviously, has the priority. So if the hot water is due to be on, then the heating is off.”

The lack of hot water has led to the household feeling that the house is too cold. This is particularly true, unsurprisingly, in the winter time. Most of the issues relate to the living room at the back of the property which has a significant amount of glazing and an external wall that the occupants note faces the direction of the prevailing wind.

The household’s relationship with the ASHP technology has evolved over time in response to both the weather and the number of occupants using hot water. The realisation that the ASHP cannot cope with the extreme periods of cold in winter has made the household very sensitive to thermal comfort. They are actively monitoring temperature with a number of thermometers around the living room, one of which can be seen in Figure A2.

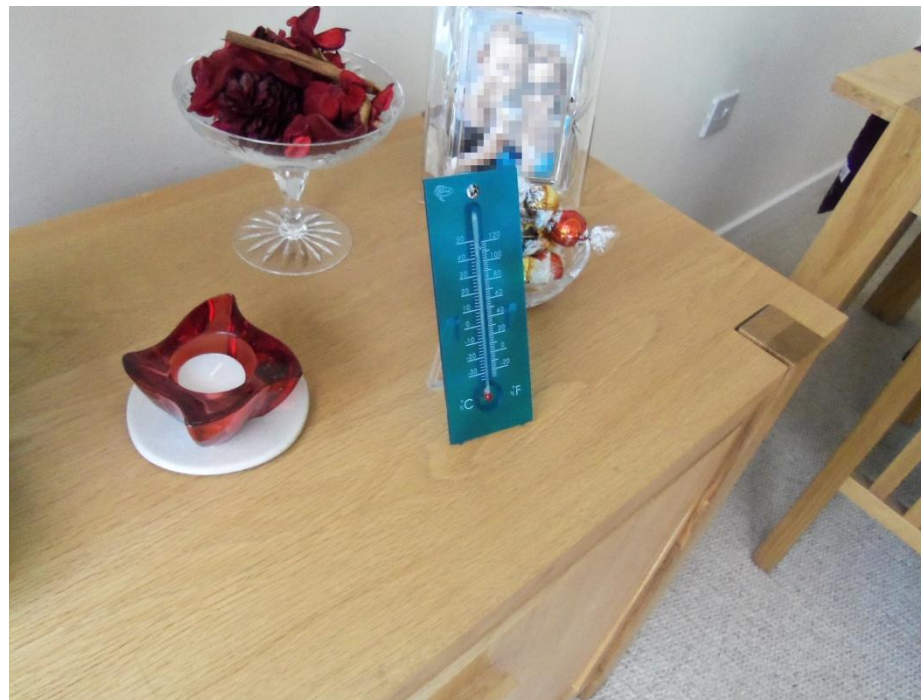


Figure A2 Household 1b are actively monitoring the temperature in the living room.

The increased awareness of the ambient temperature has resulted in the household questioning the controls of the ASHP system:

"[In answer to the observation that there appeared to be a number of thermometers around the living space] Oh, I've got them everywhere. I mean, at the moment, you see, they're saying it should be 21. It's just barely 20 at the moment. I mean, I haven't got it set particularly high, I've got to say, but even if you went out there and set it at 24, it'd never get hotter than 21."

The first set of concerns relate to the ASHP system and the supply of hot water, heat into the home and control of temperature. These concerns come into play even if the ASHP is working normally. The second set of concerns relate to the system not working correctly. The household speak of the system having a tendency to drop in pressure. This results in the occupant having to periodically check the pressure on a gauge in the airing cupboard and manually top up the system:

"And it cut out on the third time. I had another look round the system, emptied out the airing cupboard. You know, take the clothes out, you look and you see a little gauge in there. So I tried to top up the system, 'cause it was showing zero."

The pressure issue does not cause too much difficulty for the household. In fact the technical background of one of the occupants means they feel confident and capable of dealing with this problem. Of greater concern to the household is the tendency of the system to periodically "trip."

The household describes the trip as a build-up of air in the system when it is not working to full capacity that causes the system to shut down (e.g. when the family is away from the home). Whilst most instances of a trip occur in a low use, it also occurs when the house is occupied and the system loaded. The only way to reset the system is for one of the household to go to the unit in the back garden and press the reset button, located behind a panel, with a screwdriver:

"I came in last Wednesday, and this is about the third time it's happened, and, you know, there's no heating, there's no hot water. You've been out for a day or so and it's, here, the system has air entrained in the water, and the boiler unit heat exchanger cuts out, won't cope with that. So you have to go out into the garden, usually about 11 or 12 o'clock at night, and start resetting it."

The household regularly supplements the ASHP with electrical heaters and is considering removing the entire system and replacing it with a gas boiler. The household is actively advising colleagues and friends against using ASHP and is trying to feed their experiences back to the house builder.

Development 1 cross-household analysis

Table A1 below uses the continuous improvement cycle to highlight the key similarities and differences in how the two households relate to the ASHP technology. Whilst the experience of the two households relating to the imagination, purchase and feedback phases are common, there is a stark contrast in the identification and function phases.

It is evident that Household 1a was passive and neutral in its day-to-day engagement with the ASHP. In contrast, Household 1b was actively engaged with the ASHP but had a very negative experience. The underdevelopment of the imagination phase may have allowed Household 1b to build unrealistic expectations of the ASHP technology.

Table A1

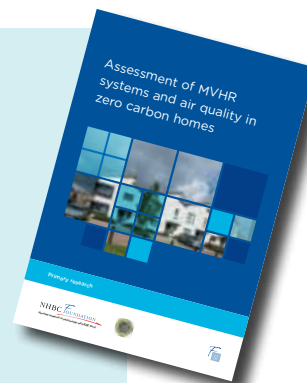
Cross-household analysis using the continuous improvement cycle.

Phase	Occupant expectation	Household 1a	Household 1b
Design and production	N/A	-	-
Imagination	<i>Be excited by the prospect of the benefits of, and living with, LZC technologies. Understand the whole value proposition (e.g. lower energy bills).</i>	Neither household was made aware of the benefits of the ASHP system prior to moving in.	
Purchase	<i>Tailored information appropriate for households to help them on a day-to-day basis to make the best use of the LZC technologies.</i>	In the case of both households the purchase was rushed. Neither household was provided with information that they could relate to in any meaningful way.	
Identification	<i>Lifestyle / value statements that consumers identify with from living in a home with LZC technologies.</i>	The ASHP system is working in the background and the household are not particularly aware of it as a discrete technology. No special effort is made to support the LZC technology.	The ASHP is the focus of a great deal of negative emotion. A number of practices have been created around the technology such as checking the pressure of the system and the temperature of the rooms.
Function	<i>Tailored hands-on support to realise the benefits of LZC technologies.</i>	The household is content with the performance of the ASHP.	The household are very frustrated with the performance of the ASHP. The system is not meeting their expectations in terms of performance or reliability.
Feedback and opinion	<i>Formal capture by the house builder of consumers' concerns and experiences.</i>	Both households note that the house builder has not sought their feedback on the benefits or ease of operation of the ASHP system.	

NHBC Foundation recent publications

Assessment of MVHR systems and air quality in zero carbon homes

This report is based on the experience of MVHR systems in 10 homes built by Scottish and Southern Energy at Greenwatt Way, Chalvey. Built to Code for Sustainable Homes Level 6, these homes provided a perfect test bed for the detailed evaluation of MVHR systems in practice. As well as looking at design, specification, installation, and commissioning issues, the research also gauged the use of these systems by some typical home occupants. **NF 52** August 2013



Fires in cavities in residential buildings

As a follow-up to the 2011 publication *Fire performance of new residential buildings*, this report focuses specifically on fire spread within external walls where the cavity between the external façade and the structural frame is incorporated either as a lining material or as a form of insulation (or both).

In support of the project, a programme of 21 fire experiments on walls containing various options for sheathing and cavity barriers was undertaken. **NF 51** April 2013



Designing homes for the 21st Century

The aim of the guide is to promote a better understanding of the 'whole' without getting drawn into the detail of specific technological solutions or regulations, proposing a model for planning new homes that splits into four stages: evaluation, best practice, integration and optimisation. It advocates a 'fabric first' approach making sure that insulation, airtightness and ventilation are designed to give the best practical performance before low carbon technologies are applied.

NF 50 May 2013



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NHBC Foundation publications in preparation

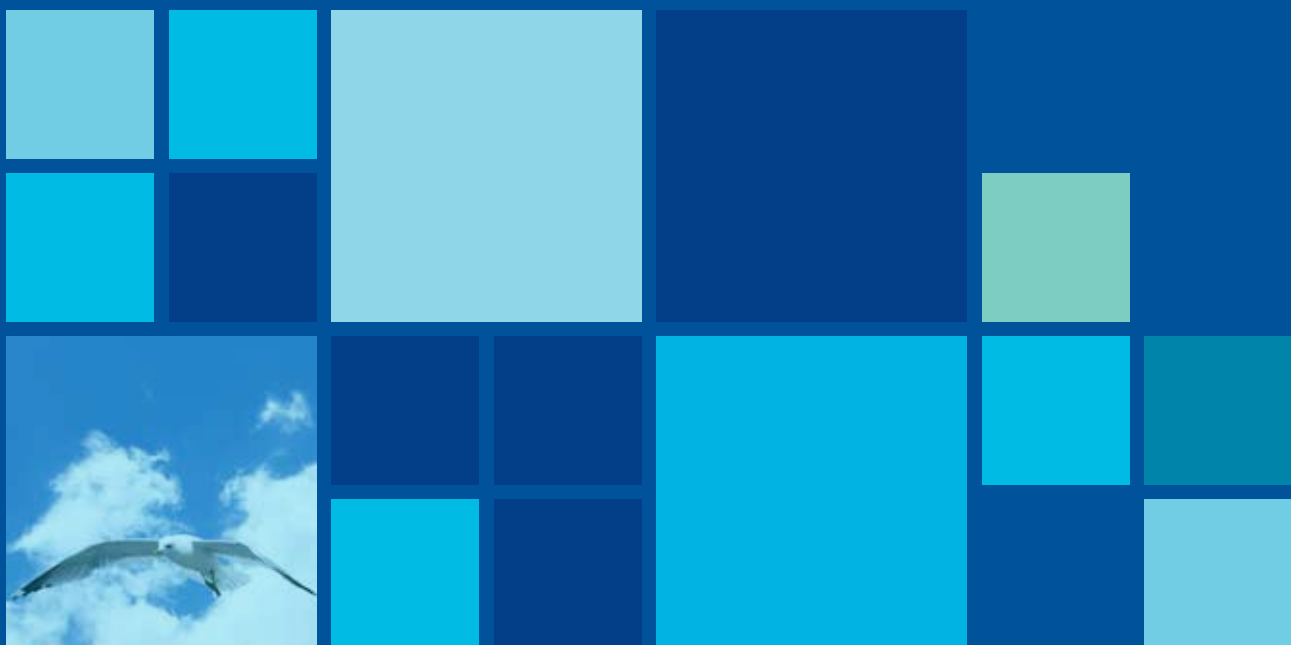
- Cellulose-based building materials – use, performance and potential risk
- Socio-technical analysis of microgeneration technologies in UK and France

Low- and zero-carbon technologies in new homes

Learning from the experiences of consumers and on-site sales teams

The polarisation between the developer and the consumer forms the starting point for this research, which focuses on low- and zero-carbon (LZC) technologies because it is known that these have a significant (perhaps disproportionate) impact on occupants' perceptions of their homes. The work gives new insights on the actual consumer experiences of LZC technologies in their homes. Second, carefully building upon the consumer findings, the actual knowledge and practices of on-site sales teams in promoting (or hindering) consumers' awareness of the benefits of LZC technologies and their use are explored.

The report provides new real-world insights into the detailed, day-to-day marketing and use of homes with LZC technologies. Further, these insights inform the development and demonstration of a continuous improvement marketing approach for house builders.



NHBC Foundation has been established to facilitate research and development, technology and knowledge sharing, and the capture of industry best practice. NHBC Foundation promotes best practice to help builders, developers and the industry as it responds to the UK's wider housing needs. NHBC Foundation carries out practical, high quality research where it is needed most, particularly in areas such as building standards and processes. It also supports house builders in developing strong relationships with their customers.