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Exploring the adoption of low carbon technologies by Scottish housing associations†

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Abstract

Housing associations (HAs) are responsible for building and managing approximately one-third of affordable homes in Scotland. The adoption of low carbon technologies (LCTs) by HAs presents an area that could potentially help towards reducing the carbon footprint of affordable housing and the fuel poverty of tenants. This research thus explores the issues pertaining to the adoption of LCTs from the perspective of two Scottish HAs. Semi-structured interviews were conducted with selected members of the management team in both HAs. The empirical findings revealed that HA-related issues (such as organization culture, being a learning organization and training) and tenant-related issues (such as social cohesion, change in behaviour and training) can both impinge on the adoption of LCTs in HAs. It is contended that there is a piecemeal adoption of LCTs and if mass adoption is to be realized, this will require a nationwide programme that is aimed at supporting the adoption of LCT, in addition to building the skills capacity of the construction industry which is seemingly ill-prepared.

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1 INTRODUCTION

According to the Scottish Government statistics [1], housing associations (HAs) are responsible for one-third of the total number of affordable homes in Scotland. The trend of new build by HAs over the past 3 years has increased by ~40%—which reflects a sustained government commitment for investment in affordable housing. Social housing has the potential to make a contribution to minimizing the carbon footprint of the built environment through the adoption of low carbon technologies (LCTs). The focus of this research is thus on the social housing sector with the aim of exploring the issues pertaining to the adoption of LCTs by Scottish HAs. The scope of this work was informed by an earlier work carried out (by the industrial partner) which indicated that HAs/Registered Social Landlords are not generally responding enthusiastically to recent changes in government strategy to 'incentivize' the adoption of LCTs, particularly with the recent introduction of schemes such as the feed-in tariffs and renewable heat incentive. Feed-in tariffs enables households, who use micro-generation to meet their energy needs, to export the excess electricity to the grid and thus generating income thereby offsetting the cost of their electricity bills. Similarly, the Renewable Heat Incentive (RHI) scheme, which was launched in March 2011, provides long-term financial support to renewable heat installations to encourage the uptake of renewable heat (Department of Energy and Climate Change, 2011). Social housing presents particular problems for such 'incentivization', flowing from multiple ownership models (many owners at any given moment and different forms of ownership possible) within the sector and resultant maintenance/metering/tenure 'barriers'.

The research was a fact-finding mission which involved carrying out interviews with two Scottish HAs in the Glasgow area. It is worth noting that in 2009, nearly half of new-built dwellings in Glasgow flowed from HAs—higher than any other Scottish region [1]. The HAs were identified by the industrial

†The names of housing associations are kept anonymous to maintain confidentiality.

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partner in the project as examples of organizations that had both considered the adoption of LCTs, but ultimately made different decisions about adoption. The HAs will be subsequently referred to in this paper as HA1 and HA2, where HA1 was regarded as innovative and cutting edge whereas HA2 was regarded as a more risk averse. This view was further confirmed from the interviews and information provided about each housing association.

The interviews included key members of the management team at different levels of the organization who were directly involved in the decision-making process, such as those responsible for: managing the finance of the organization; planning and conducting the maintenance of existing properties; development of new properties; daily management of client services; and the overall management of the HA. The interviews were semi-structured in order to provide flexibility for eliciting information from the interviewees as far as their experience with the adoption of LCTs is concerned.

LCTs broadly refer to the use of photovoltaic (PV) cells, wind-turbines, etc., which is using renewable/green sources of energy to meet the energy demands of households. The definition of LCTs was fairly kept broad, intentionally, as the aim of the research was to gain an understanding of the issues faced by HAs when adopting LCTs as opposed to the focus on a specific LCT *per se*. It has to be emphasized here that the focus of the study is not on the technical issues in relation to the operation of LCTs, but rather on the soft management issues related to the adoption of such technologies. The interviews were transcribed and a thematic analysis was used to highlight the common issues related to the adoption of LCTs—which were grouped under HA-related and tenant-related. These issues are subsequently presented and discussed, while drawing on quotes from the interviewees where appropriate.

2 WHAT ISSUES TO BE CONSIDERED FOR THE ADOPTION OF LCTS IN HAS

2.1 HA-related issues

HA1 has expanded to its current position of managing over 5000 properties, whereas HA2 has around 1700 properties. The housing stock of both these organizations comprises mainly traditional tenement flats, new-built flats and townhouses. Any HA aspires to provide good-quality affordable homes. HA2 described its mission as 'continuing to improve the quality of life of residents' and 'making the areas where it operates better places to live in'. HA1, however, described its vision in a more ambitious way and that is to 'be an innovative and responsive organisation, playing a leading role in the regeneration of their area'.

The organization culture of each HA, which is defined as the assumptions, values, norms and tangible signs (artefacts) of organization members and their behaviours [2], has an important role to play when it comes to the adoption of LCTs. HA1 had a culture of openness and the management team in general were receptive of new ideas and innovations; moreover, it was keen to be perceived as forward-looking regarding trialling the adoption of LCT. The resultant organization culture was described by the Development Officer of HA1 as a 'positive culture of openness and communications internally . . . there is a culture within the organisation of being open to innovative and new ideas which is one of the things that attracted me to working here'. HA1 has incorporated renewable energy, where possible, in its new developments, in addition to a fabric-oriented approach (adding insulation, etc.) that flows from current building regulations requirements.

HA1's past experience with the adoption of LCTs (a solar PV system installation in one of its developments) was reasonably successful in terms of addressing fuel poverty for tenants in most need (elderly) as evidenced by reduced electricity bills. However, it was keen on learning from its past experience through reflection on its individual performance. For example, there was a need identified for having a robust monitoring system for LCTs. The Development Officer at HA1 explained 'I think there are a number of improvements. . . . I think on the solar stuff although it's working quite well I would say that we haven't got quite as good monitoring and maintenance systems in place to check it'. As a result, HA1 has set-up a monitoring system in its new development, where a solar hot water system was installed. The Development Officer of HA1 explained that 'a log of all the calls that have been made from the client, the user, and explore, in relation to the heating and hot water, and explore what these items were and what the problem was and what the action taken was, and then so that we can establish actually strategically what's gone wrong'.

HA1 took a pragmatic approach to the adoption of solar hot water by learning from its past experience, some of which had been problematic. The rationale for selecting the solar hot water system was that it represented a good payback for investment and also avoided the requirement to deal with the statutory authority where problems related to tracking the meter readings become inevitable due to the involvement of multiple companies.

The Development Officer at HA1 explained that 'there's a company that installs the meters and there's a company that reads the meters and there's a company that comes to your door and sells you the electricity and because of data protection they no longer enjoy the relatively good communications that they previously had'. In the light of the above discussion, HA1 can be clearly regarded as a learning organization as stated by its Development Officer 'there is a culture of learning in the organisation in general'.

HA2 could be contrasted with HA1 as being risk averse when it comes to innovation as described by one of its managers: 'It is OK to be innovative but it does not have to be us'. Such an attitude to innovation was attributed to a bad experience in the past when adopting an LCT. This past bad experience has affected the views and behaviour of HA2 when considering the adoption of further LCTs, particularly as it had put its

reputation and image at risk. This past bad experience involved the malfunction of a specific LCT (a communal heating system based on a ground source heat pump) resulting in the HA finding itself in a difficult position. The residents complained of feeling cold, especially during cold winter nights, and they escalated the matter to their local Member of Scottish Parliament (MSP). This created bad publicity for HA2 and it certainly would not want to find itself in such a position in the future, especially if the application of LCTs is not mandatory or a priority. As such, HA2 will play it safe and avoid the uncertainty associated with trialling any 'novel' LCTs. Instead of taking any positive learning from past experience (such as any aspects that worked well), HA2 made the decision to avoid the adoption of LCT altogether, as it was deemed too risky.

Training for installation of LCTs can be a major issue. It appears that contractors may take on work of the installation of LCTs based on their well-established reputation (usually built on experience that does not include LCT installation work), but later find that they are unable to deliver. According to the finance manager of HA2, 'there has to be an element of training and it has to be more out there, people have to be more aware that these systems are there and then you know if you make people aware, then the individual contractors they're gonna have to wise up, you know, when they say I need to find out about a system lets speak to these people etcetera, etcetera and it struck me that a well established company that we're using are kind of struggling . . . you know with the principles behind it and you know they're used to repairing straight forward systems, dead easy'. This situation becomes unsurprising when considering the patchiness of vocational training in LCT which emanates from a lack of an understanding of the skills requirements for its wider application.

Training for maintenance of LCTs can present a challenge for an HA. An HA would simply not necessarily have the 'know-how' internally for maintenance and so it may resort to hiring a specialist contractor. However, it can start building-up its expertise internally through training in order to further its development as an organization. As explained by the development officer of HA2, they wanted initially to get 'domestic sized boilers so that they would be within the scope of what our guys are trained for, now I think the boilers are just outside that scope but it wouldn't be a big deal to train them up to another level'. Another issue for maintenance is the cost because according to HA2, there is no readily available information on annual maintenance costs which is a hindrance for incorporating it in its long-term cost plans.

Finally, the availability of funding was surprisingly not regarded as a barrier for the adoption of LCT. HA1 managed to secure government funding from the Department of Trade and Industry, whereas in the case of HA2, the LCT was already paid for by the developer as it was already included as a part of the development proposal. As put by the finance manager of HA2: 'It's being paid for, so. . . . It's a given good' and he further added about how the LCT was financed 'Free money. . . . No one would say No to that'. The free money was already secured by the developer from a government grant which was regarded as a way of both saving money and meeting the non-financial objectives of a project.

2.2 Tenant-related issues

The tenants' perspective is important in informing the decision of HAs, as well as its own organizational context, particularly given that both HAs in the study regarded active engagement and consultation with tenants as an important part of the process for offering good-quality accommodation. If an HA is to invest in LCTs, it cannot finance it through putting up the rent as many tenants are living on benefits, which are now being capped due to government funding cuts arising from the current economic situation.

Residents' basic needs are to live in a warm place, have hot water, good lighting and have modest utility bills. In terms of where the heating should come from, it is a secondary issue, although residents preferred gas heating because it is better understood and is perceived to be more controllable than electric heating—as put by one of the interviewees 'people want Gas'.

Decarbonizing the energy supply that is used for heating (space and water) through the use of LCT linked to a FiT scheme may help in addressing the problem of fuel poverty and hence reducing tenant's fuel bills. This clearly underlines the need to raise awareness amongst social housing tenants about the potential benefits of LCTs, e.g. through seminars.

Nonetheless, this brings into question as to whether the adoption of LCT is a necessity or an unaffordable luxury? Certainly, HAs work with fixed and sometimes tight budgets and this may lead to resource constraints that create a need to prioritize their spending, bearing in mind the needs of the residents. An HA is confronted with a choice to make: (A) Service existing facilities, e.g. replacing worn-out pipe-work; or (B) implement LCT. Certainly, an HA would go for option A, especially to maintain an adequate standards for its tenants. Nonetheless, an HA can invest in LCT, provided that initial funding is secured, from the HA's own budget or elsewhere, so that tenants can potentially reduce their bills (as described by one of the interviewees 'an investment in tenants savings'). HA2's investment in a solar hot water system resulted in a substantial reduction in bills; tenants had to only pay £25 every 2 months for their electricity bill. From the perspective of an HA, an investment in LCTs is certainly an expensive option. According to the finance manager of HA2 'a lot of housing associations . . . simply can't afford to build houses that are sustainable and full of renewables. . . . I think we're going through a period of change and, you know, if you're looking at it from one to ten we're almost still sitting at about two I think'.

It was found that social cohesion is an important factor when it comes to the application of LCTs in HAs. Social cohesion is a term used in social policy, sociology and political science to describe the bonds or 'glue' that bring people together in society, particularly in the context of cultural

diversity, although in the context of this paper, it refers to the extent that community act together as one unit for a common goal. The adoption of a communal LCT system, for example, can be problematic. HA1 installed a communal ground heat source (CGSH) technology and pre-paid meters (Quantum meters) were installed so that tenants had to pay up-front before they can use CGSH for heating. The meters were installed due to the mistrust amongst tenants. There was the perception that some tenants might misuse or abuse the system (i.e. use more than their share of energy and pay less) at the expense of others.

The case of the HA1 community can be contrasted with an HA in a different study (not HA2) where there was a champion and active leader in the community who instigated the adoption of measures to make their property more environment-friendly by adding insulation along with co-ordinating efforts with other tenants for the adoption of LCTs [3]. The point to be made here is that social cohesion can indeed play a pivotal role for accelerating the adoption of LCTs, but only if tenants are actively engaged in the decision-making process and willing to cooperate as a single unit for the benefit of their community. A communal heating system can also have a *ripple effect*; instead of one family being affected by the breakdown of a central heating boiler, there were 18 families affected, which resulted in the matter being escalated to local MSP in the case of HA1 (as previously mentioned).

Access to property for maintenance can be another crucial issue from the perspective of tenants. Tenants may simply choose not to cooperate with their HA for whatever reason. In the past, HA1 had to go to court to get a decree which would allow them to enter certain properties in order to service the gas central heating. Such instances were a significant contribution to HA1's consideration of the use of communal as a possible solution to the 'access' problem, thereby leading to their original decision to invest in LCT.

Change in behaviour is another important issue as in the case of HA1, where PVs were installed, and residents began to 'move' most of their use of electricity to the daylight hours when there was sufficient solar energy. Some residents found it easy to change their living habits, whereas others did not. Behaviour could also be related to social cohesion because if tenants living in social housing want to act as one community in meeting the goal of having a better and affordable place to live, then they need to rise above their personal differences and work together for the common good.

Training for usage by tenants (end-users) is essential because a system that uses LCT for power generation is different from a conventionally (fossil-fuel) powered system. The finance manager of HA2 explained that tenants are 'just flicking buttons like it's a conventional system, not really understanding the system fully. . . . I think we're looking at some training for the owners and the maintenance contractor'. Training for end-users and maintenance contractors is essential for ensuring that the system is functioning properly and to avoid malfunctioning flowing from misuse.

3 POSSIBLE IMPLICATIONS FOR GOVERNMENT POLICY

The HA sector has the potential to contribute to the government ambitions targets for carbon reduction. Focusing the application of LCTs on individual dwellings is insufficient for accelerating its wider adoption. Heating and hot water installation systems can utilize LCTs at either a domestic level (for individual dwellings) or a commercial level (for more than one dwelling or for a whole development). According to the development officer of HA2, 'most of the market is solely focused on the domestic-level for the installations of LCTs and it appears that the market is trained for using smaller systems but there are no skills for dealing with bigger systems'. As such, there is a need to consider the development of communal LCT systems and training support that would enable its wider adoption.

Monetary incentives may not be sufficiently large to significantly encourage the wider adoption of LCTs by HAs. As put by the finance manager of one HA: 'The government does not have that kind of money given the current economic situation'. The role of grant schemes, such as the 'retrofitforthefuture.org' initiative, is thus to offer assistance to HAs to initiate investment in LCTs which could be regarded as a catalyst. Whilst seeking to obtain EU grants, such as the 'Financing energy Refurbishment for Social Housing' (FRESH) project, could be one solution to 'supplementing' any available UK grants for funding the adoption of LCTs, there is a need to consider other alternatives to support the mass adoption of LCT by HAs. In other words, how can an HA initially finance the implementation of an LCT, and can such investment payback for itself if it is coupled with the participation in schemes such as the FiT and/or RHI.

HAs can, of course, finance an LCT by taking a loan from a bank. The UK Green Investment Bank which is to be set-up in 2012 with a budget of £1 bn would have an important role to play in accelerating the adoption of LCTs. If an HA embarked on such a finance route, then the next question that needs to be asked is whether the HA, as an organization, will pursue that venture as one-off investment, or will it make a big scale investment that would diversify its portfolio of business activities, thereby becoming an Energy Service Company (ESCo). An ESCo can be defined as [4]:

> a natural or legal person that delivers energy services and/or other energy efficiency improvement measures in a user's facility or premises, and accepts some degree of financial risk in so doing.
>
> The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements and on the meeting of the other agreed performance criteria.

Setting-up an ESCo can have its own complexities in terms of securing initial capital funding and to this can be added the uncertainty associated with embarking on new schemes such

as FiT and/or RHI. The reality of the current financial climate paints a bleak picture for the future adoption of LCTs. Are the government targets overly ambitious and trapped in rhetoric as opposed to the financial realities of the economy, given the ever increasing financial constraints on HAs?

Undoubtedly, there is an uncertainty surrounding funding arrangements, given that the recent call for establishing the Green Investment Bank in Scotland—for which plans and operational details are yet to be seen. In addition, it has to be acknowledged that the feed-in-tariff is a relatively new scheme with an attendant level of uncertainty for any HA considering taking this route. Clearly, the mass adoption of LCT in the UK, and in fact Europe, is still a new and developing area—which underlies the need for future research to fill the current gaps in knowledge.

4 FUTURE RESEARCH

There is a lack of relevant and easy to understand information that informs the decision-making processes of HAs when it comes to the adoption of LCT; a problem that was a recurring theme in the interviews. Although manufacturers and specialist consultants are able to provide illustrative data, HAs have not found these to be accurate or relevant for their specific cases. HAs need to see data collected from tenants and maintenance figures from other users in order to get a realistic picture of the long-term benefits and commitments involved. It becomes unsurprising that the Royal Academy of Engineering recently contended that the construction industry today is in an urgent need for reliable information on the actual energy and carbon performance of recently constructed or refurbished buildings in order to establish benchmarks and standards, for the validation of new designs and techniques, for the development of robust national policy and for the development of up-to-date and authoritative teaching materials [5].

Such lack of information appears to be largely congruent with the emerging concern that the UK has poor training levels in the area of decision-making for adopting LCTs. In the case of one HA in this study, it was bombarded with a quantity of technical information that proved irrelevant to the decision-making process. This issue underlies the need for developing relevant information about LCTs to aid the decision-making process and move away from overly technical information which has little relevance to the decision-making process as far as adoption of LCTs is concerned. Overly technical information may simply act as a distraction or noise for decision-makers.

Interview material also suggests that there are several factors within this area that would merit more detailed research, which include:

- lifespan of the LCTs (when will they need to be replaced; what is the cost-recovery period);
- consistency of performance (do the technologies retain a consistent level of performance);
- will any drop in performance result in increasing costs and how it would affect tenants;
- how can end-of-life for these technologies be recognized by tenants and/or HAs;
- how can any variation in performance be separated from factors related to use (variation in other costs related to use);
- actual payback time in terms of return-on-investment;
- reliability and maintenance issues.

Clearly, there is a need for the development of a framework for the assessment of the performance achieved by LCTs. Overlooking this information led one HA in this study to risk its reputation—as mentioned above. Furthermore, guidance on life-cycle models based on sufficiently accurate data regarding the recovery of costs are essential to the making of effective decisions. The project findings indicate a concern amongst 'clients' that there is insufficient information available from reliable, independent sources for the development of investment/maintenance planning models. Given that maintenance planning is often carried out in the context of a period up to 30 years in HAs, the impact of information/knowledge 'gaps' is suggested to be acting as a barrier to the adoption of novel technologies.

There is an urgent need for future research that is focused on addressing the aforementioned issues to aid the decision-making process of HAs when it comes to the adoption of LCTs. Exploration of these research areas will undoubtedly help in providing guidance to the HA sector, so that it can make a contribution towards reducing the carbon footprint of social houses and tackling the fuel poverty of tenants.

5 CONCLUSION

This research explored the issues pertaining to the adoption of LCTs in HAs through carrying-out interviews with two Scottish HAs. The range of issues, identified above, highlight the complex environment which HAs are operating in. It is thus unsurprising that the adoption of LCTs amongst HAs could be varied. At one end, there appears to be the more conservative or overly cautions HA and the other end appears to be the more liberal and adventurous HA. Overall, the adoption of LCTs in HAs is piecemeal and could be aimed at enhancing the image of the HA as opposed to a business imperative.

The issues identified in this research represent a plausible starting point for informing the development of a framework focused on aiding the HA decision-making process for future adoption of LCTs. In other words, what questions or issues do an HA needs to consider when it comes to adopting LCT in order to make an informed decision or choice? This approach should provide flexibility, as opposed to giving rigid and prescriptive guidelines which dictates to HA the steps or process it should follow. Most importantly, it will recognize the complex nature of the environment in which HAs are operating, as evidenced, for example, by different business priorities across the

sector. In addition to the development of guidelines or a framework to support HA decision-making, there is an urgent need for relevant information, particularly in the area of performance of LCTs—which is a clear knowledge gap. Can LCTs help in reducing fuel poverty so that tenants can pay less for their energy, perhaps by an HA deciding to become an ESCo, thereby generating a stream of income from feed-in-tariffs through which it can pass savings to tenants on their energy bills. This is at least the intention in theory to eradicate fuel poverty in social housing.

Finally, this research has demonstrated that government rhetoric in terms of pursuing arbitrary targets that are cascaded in a linear fashion across the economy may not be workable in practice. Although the idea of carbon reduction of 80% by 2050 is intuitively appealing, the hard reality as exemplified by this study shows that these targets could be counter-intuitive and that cutting carbon emissions is a complex undertaking in the context of the social housing sector.

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