Housing market transformation

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Abstract

Reducing energy use in the existing building stock requires a substantial and rapid transformation of the whole sector. Using a market transformation approach provides a useful framework and poses some new problems in comparison with appliances: houses don't break down in the same way as fridges, but can be improved piecemeal. The Energy Performance in Buildings Directive provides the foundation (and the x axis) for policies to achieve substantial reductions in residential energy use and carbon emissions by 2050. The technology is known, but has to be chosen by the householder – it cannot be incorporated in the factory by a manufacturer. Education and awareness are, therefore, more important, both for the householder and for the installers. What is the role, if any, of mandatory minimum standards? The types and mix of policies require a clear understanding of the challenges provided by low-income groups, capital shortages, the length of residence in the house, the landlord-tenant split and user knowledge. This paper reviews the challenges and examines the extent to which the well-known market transformation theories work for the housing sector. Most of the examples are from the UK, but have been developed into generic principles.

Context

The EU and most Member States are acquiring stringent greenhouse gas targets: the French want a 75% reduction over 1990 by 2050 and the British are committed to an 80% cut. Energy use in the built environment is responsible for around 40% of all emissions, and turnover of the existing stock of buildings is relatively slow. In the UK, if the present rate of demolition stays the same, then 95% of today's homes are still going to be in use in 2050. The UK housing stock is amongst the least efficient in Europe, for example even when the effect of the climate and the size of the houses is taken into account, the UK uses nearly twice as much energy for space heating as the Nordic countries in both new and existing homes (Lapillonne and Pollier 2007, Olivier 2001). Hence, improving the energy efficiency – and reducing the carbon emissions from – the housing stock, particularly the existing housing stock, is a major challenge for UK and EU level policy.

Market transformation strategy

INTRODUCTION

There is already considerable experience of the ways in which market transformation can work, successfully, with lights and appliances (Boardman 2004). The main components of a market transformation strategy are labels, information, minimum standards, procurement, grants and rebates. Market transformation occurs when these policies operate together in a synergistic way to deliver a permanent improvement in the efficiency of products on the market. Such an approach could form the basis of an overall UK housing and energy strategy (where the primary aim is to reduce carbon emissions from energy use in the housing stock). However, houses are much more complex, long-lived and expensive than appliances. They are subject to different ownership arrangements, are chosen based on a wide range of criteria unrelated to energy, have a very different sup-

ply chain and, obviously, are not traded goods in the same way as appliances.

Before looking in more detail at the differences between the markets for home and appliances, it is important to recognize the limits of market transformation as an approach for energy saving and carbon reduction. Market transformation will have the same characteristics for housing as it does for lights and appliances:

- it is about energy efficiency not energy consumption;
- it is about technology not behaviour.

Evidence shows that reliance on energy efficiency policy will not necessarily be sufficient to deliver energy savings. For example, in the UK the efficiency improvements in the efficiency lighting and appliances have not led to a decrease in electricity consumption in the domestic sector (BERR 2008). It can be argued that without these efficiency improvements, energy consumption would have been considerably higher. But that assertion can be contested, and is perhaps beside the point given the urgent need to reduce energy use and CO_2 emissions. Maybe it should not be surprising that policy designed to deliver improvements in energy efficiency, does simply that – improve efficiency, but is not on its own sufficient to lead to reductions in energy consumption.

This understanding can lead to calls for more effective and stringent technical efficiency policy, more incorporation of social and behavioural perspectives into efficiency policy or to calls for an absolute cap on CO_2 emissions (Lebot et al 2005). Some analysts go further, and suggest that increasing efficiency itself is part of mechanism driving us to ever higher levels of energy consumption (Wilhite 2007). The authors of this paper are well aware of the limitations of efficiency policy in delivering energy and carbon savings, and have argued elsewhere that efficiency policy should be combined with personal carbon allowances, which would place a decreasing cap on emissions from the domestic sector (e.g. Boardman et al 2005, Fawcett 2004). In this paper, however, we focus on how to make a housing efficiency policy as effective as possible, by learning lessons from previous market transformation experience. This does not imply that we think a market transformation policy for housing would be sufficient to deliver significant energy savings, but it would certainly be a necessary component of a low carbon policy. UK housing is still very energy inefficient and has huge potential for upgrading – so if 'all' that market transformation can achieve is to deliver the technically-available energy efficiency potential, it would be an extremely important advance.

HOW MARKET TRANSFORMATION WORKED FOR LIGHTS AND APPLIANCES

Market transformation is generally accepted to have worked for many appliances in the EU, with particularly good outcomes experienced in the cold appliance (fridges, freezers and fridge freezers) and wet appliance (washing machines, tumble dryers, dishwashers) markets (Odyssee 2009). The power of the market transformation approach for appliances is that it has engaged the manufacturers, retailers and installers as well as the consumers. Manufacturers are generally pan-European (and global) organisations with sophisticated R&D capabilities, which have proved able to bring new, efficient products to the market. This was expected in advance of policy, which had been based on detailed technical studies, proving that there were efficiency gains which could be achieved at a lower life-cycle cost to the consumer (GEA 1993). After some initial reluctance to engage with the efficiency agenda, retailers proved adept at selling the benefits of more efficient products to consumers (Winward et al 1998). Consumers too have responded to the energy labelling, information and subsidies available to change their purchasing patterns. All of the actors in the chain played a part in transforming these markets. Successful market transformations have been underpinned by either voluntary or mandatory minimum standards, which are a very important part of the policy mix. Nevertheless, it is important to remember that market transformation delivers efficiency, and trends toward increasing consumption driven by, for example, purchase of larger refrigerators, cannot be tackled by this policy approach as it is currently designed.

From a UK perspective, the European-wide nature of the policy was of particular benefit. In the UK there were fewer efficient appliances on the market than was the case in many other EU countries when the policy was first introduced (Winward et al 1998), and the availability elsewhere of more efficient products undoubtedly helped the UK market move forward.

There is less certainty that the market transformation approach has worked for lighting. Despite EU labels for light bulbs being introduced in 1999, and vigorous supporting policy at national level, the UK lighting market is still dominated by the least efficient incandescent bulbs, as is the market in other countries (Odyssee 2009). Many reasons why people choose not to buy efficient lighting or may be unable to make that choice were identified some years ago (Palmer and Boardman 1998). These included personal preference, incompatibility of light fittings with efficient bulbs, unavailability of efficient bulbs in the shops, and negative beliefs about efficient bulbs. Given the pre-dominance of incandescent bulbs, presumably some of those factors still apply today. From a market transformation point of view, it could be argued that the element of policy in the lighting market which has been avoided to date – removing the worst through minimum standards – is shown by this experience to be vital for success.

The market for boilers (water and space heating appliances) has been transformed. In this case, by far the most important policy was the introduction of a succession of increasing minimum standards which prevented sales of the inefficient boilers which had previously dominated the market. Attempts to transform the market for more efficient boilers through consumer pull may have made it easier to introduce the minimum standards, but in the UK efficient boilers did not achieve a significant market share prior to the introduction of standards (Shorrock 2005). The fact that consumers – householders – do not generally directly choose or purchase their own boiler, relying on the installer to do this for them, is an important influence on how policy can deliver change.

This brief review demonstrates that a market transformation strategy can be extremely effective at delivering increased efficiency, but that the synergies hoped for from different policy elements are not always delivered, particularly in the absence of either key actors (consumers in the case of the UK boiler market) or policies (minimum standards in the case of light

Table 1: Comparison between lights and appliances and housing

	Lights and appliances	Housing
End of life	When most appliances break down they need to be replaced: there was going to be a new purchase anyway	Only ceases to exist as a result of demolition and this happens rarely.
Extending life through repair	Repairing or mending a broken appliance may not be possible (light bulbs), or is a disappearing skill in many countries.	With housing, however, improvements and modifications take place on a regular basis, often involving the home owner (DIY).Modifications can be an opportunity (often ignored) for improving energy efficiency.
Components of the product	All assembled by the manufacturer – user rarely involved with the individual components. All components of equal calibre.	Home owner involved in choosing new components, to improve the energy efficiency of the product. Involves discussion with the installer. Neither may be well informed. Calibre of installation varies.
The value of old products	Old-fashioned appliances may be thrown-out, or relegated to 'spare' status, just because they look dated or new technology has replaced them (TVs, VCRs), even though they have not broken.	Old buildings are often much loved, just because they are old, part of a familiar townscape or of special architectural heritage. Considerable effort is made to retain old buildings.
Role of financial incentives	The traditional market transformation approach provides financial incentives to encourage the take up of the best, most energy-efficient models.	In the UK, financial incentives are used to prolong the life of the worst houses and to enable them to remain inhabitable by bringing them up to a higher and more modern standard of insulation and energy efficiency. The grants effectively fossilise the building stock.
Owning or renting	Very few appliances are rented – televisions were for a time, but this practice has almost ceased in the UK.	A sizeable proportion of households rent their homes, rather than own them. This means that any investment in energy efficiency improvements has to be of benefit to the landlord.

bulbs). An efficiency strategy for housing based on a market transformation approach will not necessarily deliver savings beyond those from individual policy elements, such as rebates or minimum standards. The key will be to develop a sophisticated understanding of the housing market: the major actors, their relationships, opportunities for influence, financial flows, the ability of the building industry to deliver efficient new homes and high quality renovations, and a host of other factors which determine how the housing market (or markets) actually works and how efficiency can be made a more central part of market decisions.

COMPARISONS BETWEEN THE HOUSING AND APPLIANCE MARKETS

There are many differences between the housing and appliance markets, some of which are highlighted in Table 1.

As noted in Table 1, the actors in the housing market are different from those in appliance markets. The construction industry is made up of small number of very large firms and a large number of small firms. New construction is a different industry from repair, maintenance and improvement – with this work being primarily undertaken by small and medium enterprises (SMEs) (Killip 2008). The suppliers of efficient homes and efficient upgrades to existing homes are much more diverse than appliance manufactures (and include homeowners themselves for DIY improvements).

The change required in the housing market before it is transformed will not be delivered by replacing the existing housing stock by more efficient property. It will be delivered by a combination of increasingly efficient new housing and upgrading the existing housing stock. Upgrading the stock will be the biggest challenge, but will also deliver the vast majority of energy and carbon savings (Boardman 2007). This is a very different and more complex process than delivering more efficient lights and appliances.

WHAT IS THE MARKET FOR HOUSING?

At its simplest, the market transformation effect depends on the actions of buyers and sellers. However, this is an over-simplification: there are many other actors influencing the market, including retailers, installers, other professionals, NGOs. Each product will have a different network of actors influencing the decision about what ends up in a household. For example, in the market for boilers, the installer is most often the key decision maker on which brand and model the householder buys (Fawcett et al 2000). National cultural preferences can be important in determining how markets respond to more

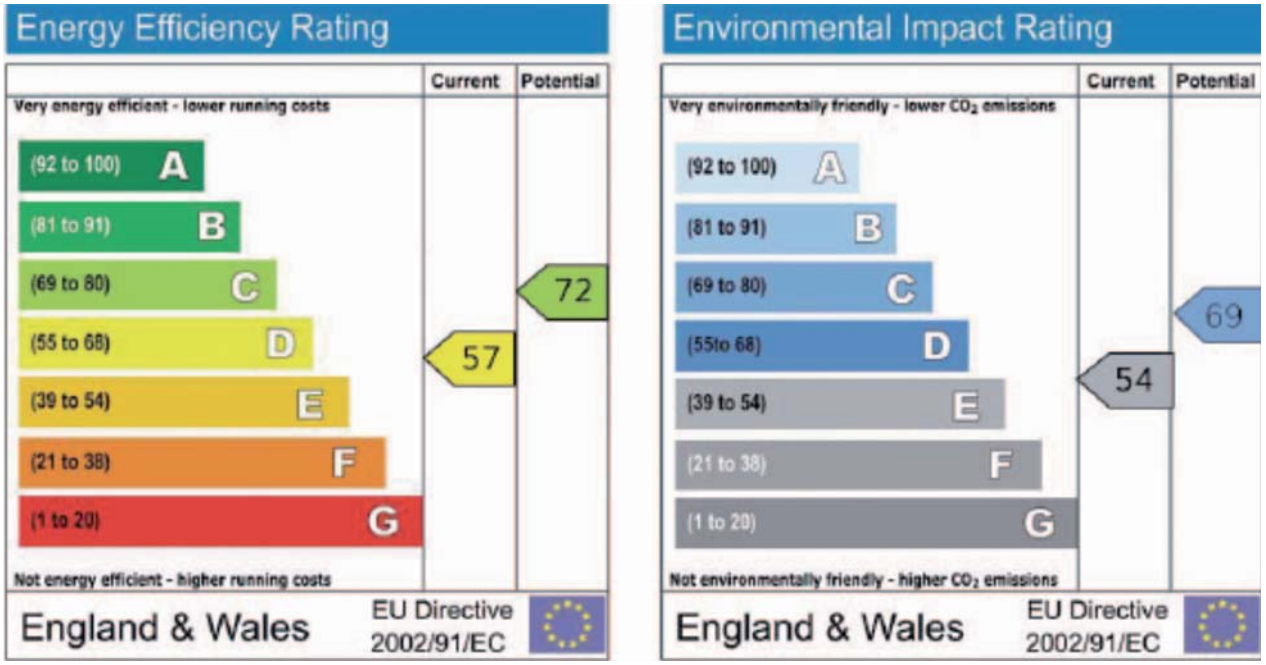


Figure 1: Energy Performance Certificate

efficient products, as illustrated by different tastes in lighting in European countries (Palmer and Boardman 1998). There is considerable complexity in the markets for lighting and appliances, only touched on here, and the market for housing too is complex with many different actors involved.

An important factor is that a considerable proportion of the housing stock is rented rather than owner-occupied. The UK has high levels of owner occupation compared with many other EU countries. In 2006, 70% of properties were owner occupied, 12% were rented from a private landlord, with the remaining 18% rented from a social landlord (either a local authority or housing association) (DCLG 2006a). Owner occupation is lower in most other EU countries, standing at 57% in France, 45% in Germany and 49% in Denmark in 2004 (Federcasa 2006). The rented housing stock operates in a different market from owner-occupied housing, and will require different policies within a market transformation strategy. For example, incentives and information around upgrading the housing stock would have to be targeted at owners (landlords) and not their tenants.

For social housing in particular, it is questionable the extent to which there is a 'market' – in that tenants often have little choice over their housing allocation. Interestingly, the social housing market has been more efficient on average than either private rental or owner-occupied properties for many years, and is improving at a faster rate (DCLG 2006a). This is in part due to policy – funding for social landlords has been tied to high standards of new build, and grants have been available for renovation. For example, in Scotland new housing association dwellings have to obtain an efficiency standard (SAP rating of 85-90), which is above the present English Building Regulations. It also reflects the values of the sector, where concern for the welfare of tenants – including reducing their energy bills – is integral to their decision-making. It seems there are routes to transforming housing, which while using elements of a market transformation strategy, can take place outside of a market environment.

Energy Performance Certificates

The implementation of the Energy Performance of Buildings Directive in the UK has resulted in the development of home energy labels, known as Energy Performance Certificates (EPCs). EPCs have been a requirement on sale of all domestic property since December 2007. The advent of EPCs is an extremely important – and long overdue – policy. For the first time, a market transformation approach can be contemplated for the housing stock because it is possible to compare the energy efficiency of different properties.

UK IMPLEMENTATION OF EU POLICY

The British EPC mirrors the EU Energy Label for lights and appliances: it has categories A-G, coloured green to red (Figure **1**). The example shown in Figure **1** is from England and Wales; the Scottish certificate is similar. The scale is from 1-100, with 100 being the best. This uses the Standard Assessment Procedure (SAP), and reflects the energy costs of providing space and water heating and fixed lighting. The SAP rating is based on energy costs per square metre, and the scale is logarithmic. The carbon emissions that result from this use are shown beside the energy efficiency rating. For both energy efficiency and carbon emissions a 'potential' rating is also given, which is based on adoption of 'cost effective' energy efficiency and low and zero carbon micro-generation measures. In addition to the label, the full EPC report contains information on estimated energy costs, details on how the labels were calculated, a summary of the energy performance of elements of the property (e.g. walls, roofs, windows), details on the costs and energy savings related to potential improvement measures, and suggestions of 'further' measures which have not been included within the

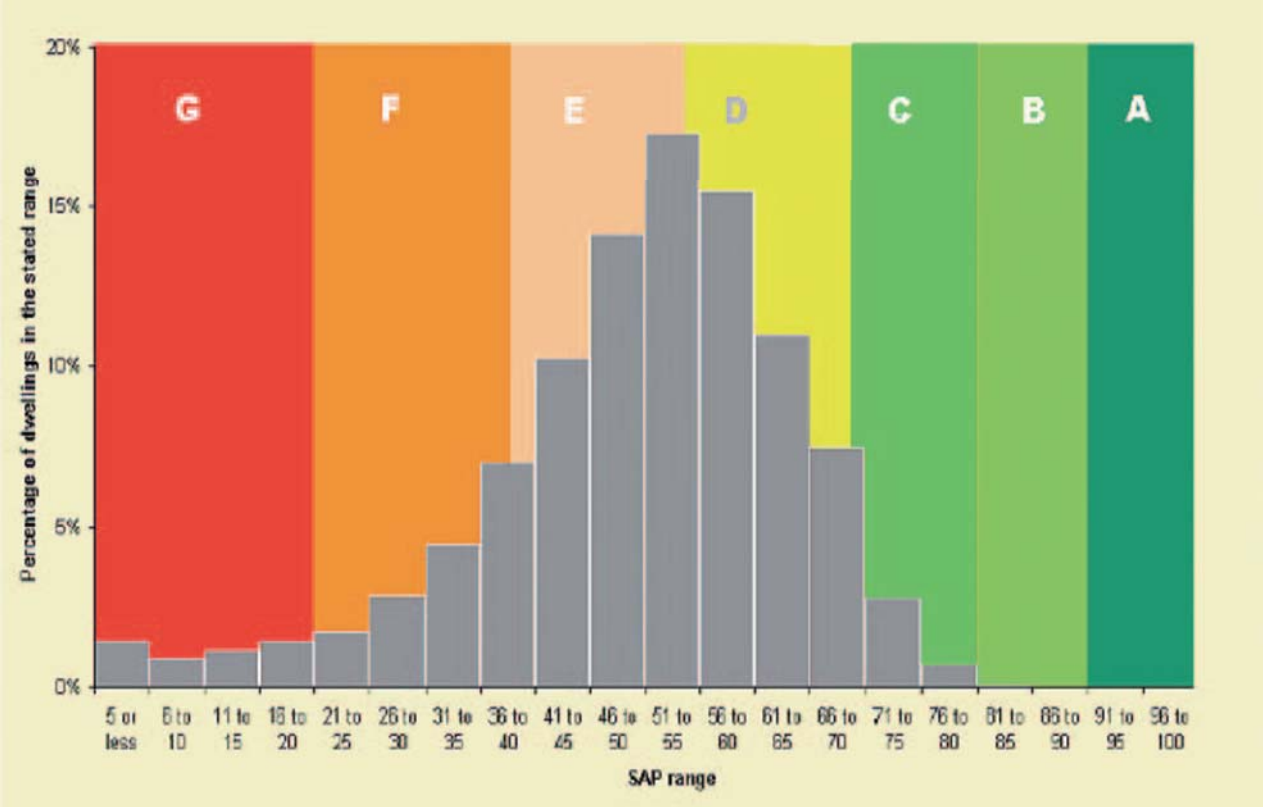


Figure 2: Distribution of the housing stock and EPC energy efficiency rating. Source: based on BRE, 2007

calculation of the energy efficiency / environmental impact rating potential.

The certificates have to be provided by the building owner to the new occupant whenever a building is sold or rented. The assessor, therefore, meets the present owner, not the future occupant who has no opportunity to discuss the findings with the assessor. The EPC does not cover all energy use in the home in the UK, but only the energy used in space and water heating and fixed lighting, because these are the elements of the house that do not change with ownership/tenancy. In all cases, the label is based on a theoretical calculation – for instance, what would be required to achieve a defined internal temperature – rather than reflecting the bills and unknown lifestyle of the occupants.

Prior to its introduction the design and content of the EPC report and label was developed and tested with focus groups of consumers, as well as via consultation with industry and academia. Consumer reaction to the label and report was largely positive with high levels of understanding. Respondents understood both the energy efficiency and environmental impact label, and few were confused by there being two labels. Stated intentions to consider making the improvements suggested exceeded a fifth of those surveyed even for the more expensive 'non-cost effective' measures. The report presenting this research concluded that it "suggests that the introduction of EPCs... will be welcomed by most consumers." (Shorrock and Coward 2007).

CURRENT MARKET DISTRIBUTION OF HOUSING

The distribution of the present housing stock in the UK has been mapped against the EPC A-G energy efficiency categories (**Figure 2**), showing that there are virtually no A or B properties, but a long tail of inefficient F or G homes.

A brand new property, built to comply with the 2006 Building Regulations, would be rated at around the B-C boundary. To achieve an A-rating, a property would have to include some form of micro-generation.

RATE AT WHICH HOUSING STOCK IS COVERED BY EPCS

The frequency with which people move around in the housing stock affects the rate at which the housing stock is covered by EPCs. There were 2.55m household moves in England in 2005/6, of which only 0.9m were owner occupiers (Table 2). From this, it appears that 2.7m energy performance certificates would be issued in that one year, i.e. for just over 10% of the stock. This may underestimate the amount of activity, if significant numbers of people put their home on the market, incur the expense of acquiring an energy performance certificate and then do not go ahead with the sale.

The biggest group of movers is private renters, despite this being only 12% of the total housing sector, implying that certain properties are not going to get an EPC for a very long time. Over half of all owner occupiers live in their homes for more than 10 years (DCLG 2006b) and some people will still be in the same house in 2050. Many households will stay outside the system, until the present occupant is old or infirm. This is a substantial problem and one that is going to get worse with

Table 2: Estimated number of number of moves per annum, UK 2005/6

Tenure	England (% of those moving)	UK (m)
Owner occupiers	35	1.08
Privately rented	37	1.14
Social rented	16	0.47
Household ceases*	12	0.36
Total (m)	2.55m	3.05m

Source: based on DCLG 2006b, p53

Note: * households cease when people die, or move in together. New household formation is included in the separate tenures

increasing longevity. The present process will not result in a comprehensive labelling system for many years.

HOW LABELS ARE CURRENTLY BEING USED

Research carried out shortly after EPCs were introduced looked at experience of the scheme, as implemented for properties for sale, from the perspectives of estate agents, solicitors and householders (Banks 2008). If the EPC is to fulfil its role it must be viewed by the buyer at the earliest stages of the house buying process. Consequently estate agents are very important to the success of the EPC. However, Banks suggests that a mix of non-compliance amongst agents and looseness in the existing regulations is impacting the potential effectiveness of the scheme. Estate agents were found not to be enthusiastic about EPCs, and generally viewed them as an expensive irrelevance. Buyers often didn't see EPCs until late in the purchasing process. Sellers had no interest in upgrading the energy performance of the house before selling, believing that choice was best left to the buyer. Neither the buyers nor sellers interviewed for the research showed any great interest in the EPC; the general view being that the energy performance of a house has no influence on the buyer's decision making. By contrast, research by the Energy Saving Trust suggested that energy efficiency is now an important consideration when buying a home for over two-thirds of those surveyed, with nearly 50% saying that they would pay an additional £10,000 for an 'environmentally friendly' property (HC 88-I 2007, p24). Stated willingness to pay may not translate into observed behaviour, but it indicates energy efficiency could be of more relevance than the results of Banks' work would suggest.

A brief survey in Oxford during March 2009 gives a flavour of how EPCs are being used in the marketing of properties for sale and rental. In a suburb of Oxford with eight estate agencies, only two showed EPCs in their windows with pictures of the properties for sale. Of these two, one estate agent displayed an EPC for just one property, whereas the other displayed them for the majority of properties for sale, and a minority of those for rent. The property supplement for the weekly local paper, which includes advertisements from all major estate agents, displayed no EPCs. However, EPC details were available for the majority of sale properties on a well-known website which featured properties from most Oxford estate agents (http://www.rightmove.co.uk).

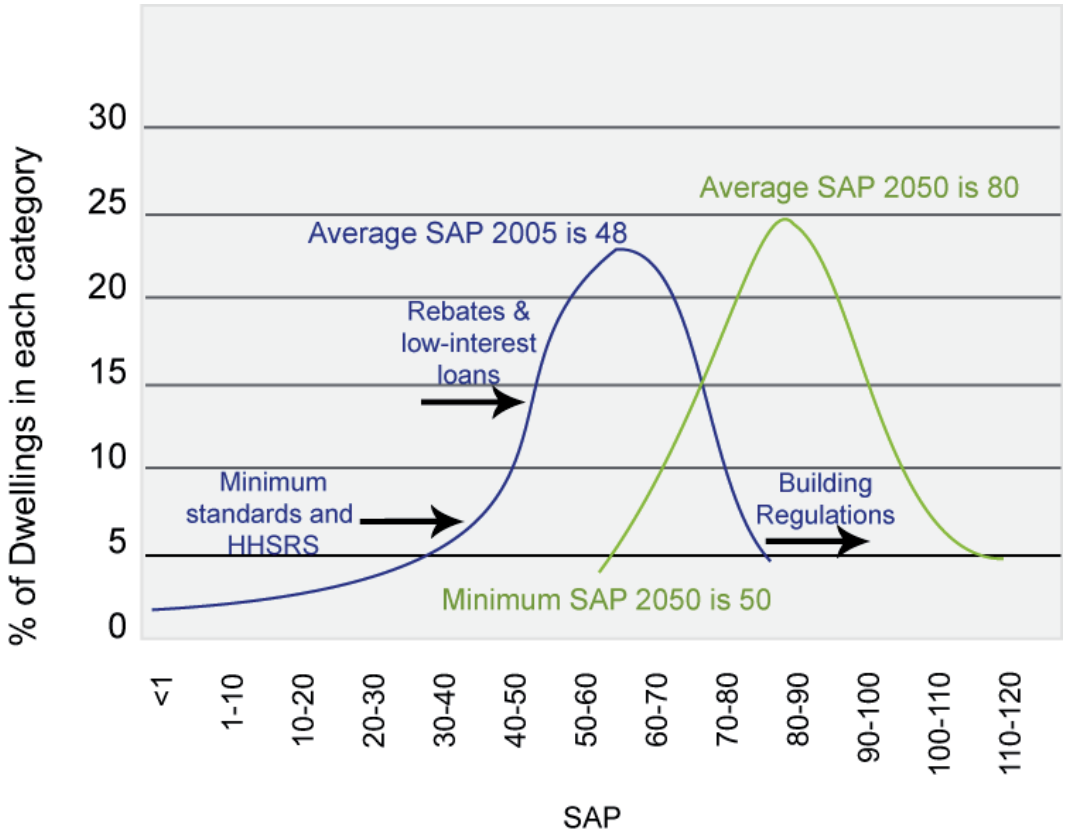
The lack of compliance with EPC regulatory requirements, statements by 'retailers' that buyers have no interest in energy efficiency and poor use of EPCs in marketing all mirror early experience in the cold appliance market (the first appliance which received an EU energy label) (Winward et al 1998). So while the initial response to EPCs may seem discouraging, experience suggests attitudes and responses can change fairly quickly, if the right policy mix is in place.

PROBLEMS WITH THE LABEL

The EPC does more than one job. The energy label for appliances tells buyers how efficient each product is relative to the rest of the market (and if they look hard, there is information about energy consumption too). The EPC also does this for energy efficiency and CO_2 emissions (although as SAP is based on energy costs per square metre is not exactly an efficiency measure). In addition, the label presents the potential for increasing the efficiency and reducing the CO_2 emissions of the property. This is arguably its most important function: alerting buyers to potential improvements. At present, the estimates for improvement are based on an analysis of the 'cost-effective' technical potential. Analysis of a relatively small (unrepresentative) sample of houses on sale in Oxford indicates most properties are assessed as only having the potential to move up one energy category, at most. However, there are reasons to believe the basis on which 'potential' is calculated is flawed, and much greater improvements in efficiency could be achieved (Banks 2008, Killip 2008). This issue needs further investigation, if house buyers are being misinformed about the efficiency standard their home could achieve, particularly if they are told it is lower than the reality, this will impact badly on the hoped for market transformation.

Developing a market transformation strategy for housing

This section outlines how a market transformation strategy could be developed for housing. It summarises a low-carbon strategy described more fully in Boardman, 2007. The goal of the strategy is that by 2050, as a minimum, the standard of the worst housing will be equivalent to today's average and the average will be the standard of today's best (SAP 80), illustrated in **Figure 3**. This transformation towards greater efficiency would be achieved by different policies acting on different parts of the distribution, some pushing and some pulling. Vital policy elements are described below.



Note: the SAP 2005 scale stops at 100, but by 2050 properties may be exporting so much electricity, that they have exceeded the scale

Figure 3: Transforming the housing stock, UK 2005-2050. Source: Boardman, 2007

IMPROVING LABELLING

As mentioned earlier, there is evidence that the 'potential' indicators on the label may considerably underestimate the degree to which a property can be improved. In addition, there are long-standing critiques of the SAP methodology which, for example, favours larger properties (Boardman 2007). However, issues surrounding the content of the EPC labels and the methodology used to calculate them are not pursued further here, rather we look at how the labels can be made more effective.

Labels form the basis of a market transformation policy. As identified earlier, the housing stock will only be labelled gradually, with some housing not acquiring a label for many decades. To overcome this problem of incomplete labelling two things are required:

- EPCs have to be issued on more occasions than just at change of occupant;
- The data on EPCs should be made available, at least to local authorities, if not to the public.

At the moment, the information is not available to either the local authority or the public, on the grounds of confidentiality.

Acquiring an energy performance certificate

To spread EPCs through the housing stock as rapidly as possible, it is proposed that they are also obtained when:

- a property is remortgaged;
- planning permission or building regulations approval is sought;
- an energy efficiency improvement is installed, as a result of grants from the utilities or Government-funded programmes. They already have to be given a SAP rating, so it would be a simple process to convert these into an EPC;
- and finally, it would become part of the responsibility of the local authority to complete the housing profile in its area, by not only collating existing data, but also ensuring that missing properties are surveyed.

The database has to be kept up to date, so this is a constant process. The changes allow the local authority to compare with the rate at which carbon dioxide emissions are actually reducing.

Public access to EPC information

It will be important to make information on the EPC bands a matter of public record, at a minimum on a website. At the moment, the EPC has to be publicly available, on the estate agent's details, so this is not much of an extension (Banks 2008). EPC ratings should be visible on all marketing material for maximum effect: the label needs to be constantly in the public eye, as it has become on white goods. If the label is not displayed

prominently (ie it is tucked away in a surveyor's report) then its impact will be drastically reduced. Much wider publicity is required so that people can search to find:

- what properties are for sale in each specific band in their area of interest;
- what properties in their street have already achieved, just as it is possible to find out what your neighbour's home has sold for (e.g. Net house prices, 2007). It cannot be tenable that the information on the energy coding is more sensitive than the information on selling price.

Energy performance certificates are now required to be displayed in public buildings, this may help increase public expectation about availability of such information for private homes.

AWARENESS AND EDUCATION

It would be wonderful if the energy efficiency of the housing stock – and your home - becomes a talking point. Bands A-G have to start meaning something in relation to housing. This will require a major government-led advertising and awareness campaign so that everyone knows that investment in improving the home will improve its value and the ability to sell it, save money and help the environment. This kind of campaign was part of the policy mix when labels were introduced for cold and wet appliances in the UK. Such a campaign recognises the need to create a new social norm around the importance of efficiency in choosing products and now housing.

INCREASING THE SUPPLY OF MORE EFFICIENT HOMES

In previous market transformation experience, bringing new more efficient products onto the market has been a vital part of the strategy. It has demonstrated that more efficient products can be manufactured, and has stimulated demand for them, moving the whole markets upwards. With housing, although important, high efficiency performs a different role. Clearly, making new housing as efficient as possible (while still remaining affordable) is a good idea in itself. However, super-efficient new housing will not directly influence the market for existing homes: even with comprehensive renovation older properties will not be able to meet the standard of this new housing or use the same technologies and construction approaches. Nevertheless, efficient new homes may have the power to change aspirations about what makes a good home and be part of the process which makes energy efficiency a more important characteristic of housing.

Current policy already recognizes the importance of improving the efficiency of new homes, and in the UK this is done primarily through Building Regulations. The Building Regulations define the minimum standard of heat loss in new buildings and major conversions. From 2016 onwards, the plan is that all new homes will have close to zero heating demand and substantial improvements in the Building Regulations will take place at regular intervals, including the installation of low and zero carbon technologies in new dwellings. This can be achieved, based on a combination of current technologies such as: highly insulated walls, floors and roofs; building air-tight dwellings with appropriate ventilation; maximum use of passive solar energy; highly efficient windows; passive cooling design; and installation of solar water heaters, solar PV, heat pumps, micro-CHP and other micro-generation options. To achieve this in practice, however, a great deal of skills improvement and training will be required within the UK construction industry (Killip 2008).

There is still room for more ambitious development of advanced housing and of governmental support for procurement and exemplars. A clear policy focus on procurement and the testing of low and zero carbon techniques (in preparation for new Building Regulations) is required. Further research and development, demonstration projects in the UK and learning from experience in other European countries would clarify any lessons and causes of concern surrounding new approaches and technologies, such as ever-wider cavity walls. To date, there are only a few advanced demonstration schemes in the UK, whereas other countries have built more advanced homes (e.g. Passivhaus standard homes in Germany and elsewhere).

Probably of greater importance is the need to advance knowledge of energy efficient and low-carbon refurbishment techniques and technologies. Again, in the UK there are relatively few examples of comprehensive low-carbon refurbishment projects, although interest in these projects is growing and new networks to promote existing examples are being developed (Killip 2008). Two examples of these networks are 'Old Home, Super Home' (http://www.sustainable-energyacademy.org.uk/) and 'Existing Homes Alliance' (http://www.existing-homesalliance.org/).

FINANCIAL INCENTIVES

The traditional role of consumer financial incentives (grants or rebates) in a market transformation strategy is to grow the market for new technologies by reducing the unit cost. This should be a limited initiative, until demand for the product is secure and it is manufactured by several companies. However, this model does not fit the housing market, where the technologies needed to upgrade existing housing are already in mass production. Many energy efficiency measures have been cost-effective for households for many years, but they have not been installed. This is partly because households perceive the cost of insulation measures to be considerably greater than they are and they similarly underestimate the benefits (Oxera 2006; HC 88-II 2007, Q24). Other barriers include the disturbance caused by building envelope thermal insulation measures.

Rather than just financial support, there is a real need for an accurate educational message on both the costs and benefits of energy efficiency measures. The EPCs provide the government with a way of repackaging the message and giving it added salience.

However, there is still a role for government financial support in encouraging households to improve the energy efficiency of their property, albeit most of the finance for the improvements will have to come from the householder themselves. There are three main options for the financial support and inducements that the government could provide: stamp duty rebates, low-interest loans and further VAT reductions. Stamp duty is a levy on the purchase price of the more expensive properties, at the point of sale. In both the former cases, there has to be a clear target for the amount of improvement undertaken. The aim of a rebate is to encourage the new owner of a property to undertake improvements quickly and to recoup what is often seen as an unpopular tax. Low interest loans are being used by the

German government to help bring all pre-1984 dwellings up to the current German new build energy standard over 20 years, at a rate of 5% of properties per annum (SDC 2007). This idea could be adopted in the UK. VAT is still levied at a much higher rate on some energy efficiency improvements than on energy – 17.5% as opposed to 5% - this anomaly should be corrected. All of these measures are aimed at the middle-income groups that have sufficient money of their own to spend, they just need to be encouraged to invest in the energy efficiency of their property, and not just in the bathroom or kitchen.

Other forms of support for people improving the energy efficiency of their home could be provided by the market, through green mortgages (especially green remortgages) and local council tax rebates linked to the utilities' energy efficiency commitment. Using council tax rebates, paid for by energy utilities, as a means of encouraging householder to take up efficiency measures, such as loft and cavity wall insulation, has proved much more effective than traditional utility subsidies. In one scheme, the proportion of householders taking up the grant increased from around 15% to 60% (HC 88-II 2007, Q26).

MINIMUM STANDARDS

The most important measure in a housing market transformation strategy would be the introduction of mandatory minimum standards for the thermal envelope and fixed energy uses (i.e. the determinants of energy use and efficiency included within SAP). This is justified both by the scale of the energy inefficiency in the existing housing stock and by the large numbers of properties that create fuel poverty for their occupants. Over time, the least efficient properties need to be improved and brought up to a higher, minimum standard of energy efficiency. In order to achieve this, the proposal is that, in planned stages, it becomes impossible to sell properties in the lowest bands. A minimum standard progressively increased could initially be built on the existing UK Housing, Health and Safety Rating System. Encouraging all owners to take action, soon, will be an important part of the strategy and this requires clear, advance warning from government about the future of the housing stock and the need for minimum standards. The actual implementation date should be announced several years in advance. This proposal would be by far the most controversial aspect of a market transformation approach.

Discussion and conclusions

From the start is has been clear that the market for housing is much more complex, diverse and difficult to influence than the markets for lights and appliances. Indeed, there isn't just one market for housing. The market most like that for appliances is the owner-occupier market, which covers the majority of housing in the UK. The smallest market is for privately rented housing, where energy efficiency faces the classic landlord-tenant barrier. Finally, there is the socially rented sector, which is not a market in the same sense. Most of the analysis in this paper has focused, either explicitly or implicitly, on the owner occupied sector as that has the best fit with previous market transformation experience.

In an appliance market, in theory all manufacturers should be able to offer A or A+ rated products, so that eventually all products will be as efficient as possible. A market has been transformed once no further improvements can be made. The housing market is different. Although the current EPC 'potential' calculations for existing homes may underestimate the improvements which could be made, it is widely acknowledged that new homes can be built to higher standards than renovated homes can achieve. Certain construction types and built forms have greater renovation potential. So, for housing, even a transformed market will have a wide range of housing efficiencies (as shown in **Figure 3**). Not everyone will be able to live in an A-rated home.

The recently introduced EPC could form the basis for a market transformation approach. On its own it is likely to have a minimal impact – there are too many competing factors affecting the way people choose where they live – but it is the necessary first stage and central further policy. This paper has discussed ways in which its effectiveness could be improved, and the rate at which it covered the market increased. As well as increasing the rate of house labelling, this would provide owners with EPC information at times when renovation opportunities may arise (e.g. when extending a home, or doing major building works).

For the EPC to be effective, it must not only stimulate demand for more efficient homes, and thereby raise the price of A-rated homes relative to G-rated ones. This would not do anything (directly) to increase the stock of efficient homes, and might simply push the less-well off into the least efficient housing. The most important effect of the label must be to stimulate efficiency renovation of existing homes. This will require that supporting policy focuses very much on the mechanisms by which this renovation can occur. How can it be paid for? Who has the skills to carry it out? How will the standards of work be monitored and evaluated? This focus on the supply side will be rather different from policy on appliances, where most effort has been put into supporting more efficient consumer choices.

The EPC, being based on the pre-existing SAP rating, does not include the energy used in moveable lights and appliances (which can be over half of all energy used in new homes). While this may not matter to policy makers – as there is already market transformation policy operating in those sectors – it might compromise the effectiveness of the label as far as householders are concerned. Now that the EPC has been in place for over a year, more research on householder understanding and use of the label is required.

At present the EPC is not being used to market homes and there is resistance amongst estate agents (the retailers in this market) who doubt its usefulness. This paper has suggested means of making the EPC publicly available to all potential home owners and renters, and thereby beginning to increase the visibility and salience of energy efficiency. Experience from appliance markets shows that a slow start, does not necessarily indicate that the policy will not work. However, there are probably more barriers to it playing a part in this market, and improvements to EPCs' current implementation are vital.

The most controversial element of a market transformation strategy will be the prohibition on selling or renting the least efficient housing. However, it is hard to imagine that a market transformation strategy could work without this policy. Persuading people to invest money in improving the efficiency of

their homes will be difficult, even given the financial incentives proposed in this paper. In many cases it is already in their financial interests to make efficiency improvements – but they don't, despite the many current policies aimed at helping them (including subsidies from utilities and from government, particularly for disadvantaged groups). The barriers to taking renovation action need to be thoroughly understood to aid in detailed policy development. Experience in the EU lighting market, has shown that without a prohibition on inefficient products, it has proved very difficult to substantially transform the lighting market. Of course, lighting is very different from housing and it would be a mistake to push the comparison too far. Nevertheless, it is probably true to say that all market transformation approaches have included either mandatory or voluntary minimum standards as part of the package.

To make such a policy politically and socially acceptable, it is likely that there would have to be support for renovation costs for low income owner-occupiers. Much government and energy company funding on household renovation and efficiency is already focussed on lower-income households as a matter of social policy. However, it would not only be low income households who were 'losers', anyone living in a G-rated home would eventually either face a bill for renovation or an equivalent loss of capital value. Still, householders invest a great deal of money already in their homes (£23 billion per year (Boardman 2007)), for all sorts of reasons, and indeed without continual investment the capital value of a home will fall relative to the rest of the market. While the challenge of introducing this policy should not be underestimated, in many cases the cost of investing in efficiency may be considerably less than the sums regularly spent on kitchen and bathroom refurbishment. Further research is needed to look at how minimum standards would affect individual householders, who these householders are, what capacity they have to invest in their property, and how they could be helped to respond to this policy at least cost.

In designing a market transformation approach for housing, it is important that government identifies the levels and rates of improvement that have to be achieved. This paper has suggested that by 2050 in the UK, we could realistically aim for the average, existing property to have a SAP of 80 (the level of today's new build) and for there to be no homes with a SAP lower than 48 points (today's average). There has to be a strong combination of carrots (financial incentives) and sticks (mandatory minimum standards) to ensure that the public understand that this transformation has to happen. The balance may need to be quite subtle, to ensure both public commitment and enthusiasm. This challenge is much more substantial than any faced in the lighting and appliance markets, but offers far greater potential for energy and carbon savings, and improvement of living conditions.

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