Latent market opportunities for low-carbon housing refurbishment

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Abstract
Scenarios for deep carbon emissions reductions by 2050 concur that there is huge potential for energy efficiency and microgeneration in the existing housing stock. Policy has tended to treat energy-related investments as stand-alone decisions, based on rational economic models of financial payback, and this in turn has generated relevant specialist markets. However, these activities can be viewed as elements in a broader ‘system of markets’, which includes various types of refurbishment activity and different markets for property sales and rentals.

The Energy Performance Certificate (EPC) provides an important link between property transactions and refurbishment activity, although the detailed workings of the EPC are in need of reform if it is to reflect the technical potential for low-carbon refurbishment, which is assumed in scenario-based studies.

Many opportunities for low-carbon refurbishment are captured by the idea of ‘intervention point’: activities which are not motivated by a desire to improve energy performance (such as having a new kitchen) can nonetheless represent a chance to integrate low-carbon works at the same time, with the considerable advantage of only marginal additional cost and disruption.

These opportunities are hard to quantify for want of reliable data on the value of labour in markets for repair, maintenance and improvement. In order to estimate the market potential for integration of low-carbon works with mainstream projects, this paper presents a model using market research data for construction products in various sub-sectors and estimates for labour-intensity of the different types of work involved. The resulting figures combine to give quantified expenditure for products and services, which are cross-referred to headline figures in the Construction Statistics Annual and other government statistics as an indication of overall accuracy.

The potential for integration in mainstream activity is an order of magnitude greater than the specialist energy-specific markets, and this scale of activity is broadly consistent with the assumptions in published scenarios, suggesting that this latent market potential needs to be much more fully exploited if the deep emissions reductions are to be achieved.

Introduction
Several studies have been published in recent years using scenarios to 2050, showing that there is huge potential for energy efficiency and microgeneration in the existing housing stock (eg (Johnston 2003),(Boardman, Darby et al. 2005, Centre for Sustainable Energy, Association for the Conservation of Energy et al. 2008)) and that the contribution of this sector to economy-wide CO2 reduction targets for the UK is important if 2050 targets are to be met (Committee on Climate Change 2009), (Skea, Ekins et al. 2009).
Despite this broad consensus about the technical potential, it is not clear how these deep reductions can be achieved at mass scale in practice. UK policy has tended to treat energy-related investments as stand-alone decisions, based on rational economic models of decision-making, in which cost-benefit analysis is the principal metric. This thinking underpins current proposals for the Green Deal, which applies a model based on payback over twenty-five years repaid as a charge on an individual property not the individual owner (Department for Energy and Climate Change 2010). This focus on longer payback periods also features in the re-cast of the European Energy Performance of Buildings Directive (EPBD), in which the distinction is made between ‘cost-effective’ and ‘cost-optimal’ investments, with the latter relating cost-benefit analysis to the expected life of the building alteration in question, not to the willingness to pay of a notional individual (European Commission 2010, Building Performance Institute Europe 2010).

Killip (Killip 2008) argues for a different approach, suggesting that there are large economic rewards from doing this work, and that the development of the housing refurbishment industry to equip it with the necessary knowledge and skills should therefore be viewed as an investment in support of innovation. In other words, the stage of industry development is one of early adoption, where the application of cost-benefit analysis will tend to stifle innovation and produce only tried-and-tested interventions. If, instead, a coordinated programme of innovation and learning were to be undertaken, that might lead to the development of ground-breaking new products and practices.

The research carried out for this paper aims to add some detailed figures to the case for following this approach based on innovation and learning. In the process, some insights are offered into the functioning of different relevant markets, which further clarify the need for a shift away from treating energy-related decisions in housing refurbishment as different in kind to everyday decisions about the repair, maintenance and improvement of homes.

The potential for integrating low-carbon works with Repair, Maintenance and Improvement markets

Markets and intervention points

Required under the European Union’s Energy Performance of Buildings Directive, the Energy Performance Certificate (EPC) provides an important link between property transactions and refurbishment activity, providing – in theory at least – for the value of energy-efficient and low-carbon properties to be reflected in property prices (Figure 1).
However, for this A-G rating to be an effective tool for motivating pro-environmental consumer choices, a number of a study of over 300,000 EPCs showed that the headline A – G rating on the EPC suggests a very modest potential for improvement in performance, with the average difference between ‘current’ and ‘potential’ ratings being so small as to represent at best a shift of one band on the A-G rating and, in most cases, no shift of band at all (National Energy Foundation 2009). If a property has a current rating of F, say, then the chances are that its ‘potential’ on the A-G rating will also be F. A more ambitious estimate of potential is given in the EPC report accompanying the A-G rating, but this is not publicised to anything like the same extent as the A-G rating.

The reason why the A-G rating makes such a low estimate of ‘potential’ is because the technical interventions which it promotes are linked to only one possible market, the market for energy efficiency measures supported by government policy (ie cavity wall insulation and loft insulation). In fact, there are two other markets with which the A-G rating could be linked – the market for microgeneration and the market for repair, maintenance and improvement (Figure 2).
There have been many pioneers of a more integrated approach, many of whom have contributed to case studies and good practice guides over many years (H M Government 1995, Sustainable Energy Academy 2007, Energy Saving Trust 2010). In terms of the system of markets shown in Figure 2, many of the pioneers of low-energy and low-carbon refurbishment have taken the opportunity to do low-carbon works at the same time that other works are being undertaken, i.e. for repairs, maintenance or improvement.

Many opportunities for low-carbon refurbishment are captured by the idea of ‘intervention point’, when mainstream construction activity without a primary motivation to improve energy performance represents a chance to integrate low-carbon works. Where such work is synchronised with projects that are being planned anyway, there can be considerable advantages in keeping the additional cost and disruption marginal. Thus, if a new kitchen is being planned that involves disruptive works (including the removal of old kitchen units, appliances, and alterations to existing wiring and pipework), this is an ideal time to incorporate low-carbon tasks, such as floor and wall insulation, as well as providing good opportunities to achieve some of the more advanced ‘integrated’ solutions implicit in advanced refurbishment standards, such as the minimisation of thermal bridging, improving airtightness and ventilation, and the minimisation of associated technical risks (e.g. moisture damage from interstitial condensation in insulated structures).

There are clearly additional costs involved, which have been estimated in the range of roughly £12,000 - £25,000 per dwelling for an 80% CO2 reduction target. Exactly what these costs are depends to a large degree on the ambition of the standard (advanced standards with a greater need for renewable energy technologies will be more costly to achieve, for instance).

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1 A branch with no ‘daughter’ label indicates that the ‘mother’ has an incomplete set of market activities in the diagram. Associated markets for domestic energy assessments (providing EPCs) and installer training are not shown, in the interests of clarity.
and whether they are marginal or ‘full’. Physical and other constraints (eg Conservation issues) may add to the cost burden in specific circumstances.

**Estimating the market potential**

The Construction Statistics Annual (CSA) records data on construction activity in the UK economy every year, with a broad split between domestic and non-domestic work; a split between new construction and refurbishment activity; and regional disaggregation of many of the figures. The headline figure for the size of the UK’s market for refurbishing homes (housing RMI) was almost £28bn in 2008 (Office for National Statistics 2009). The data reported in the CSA also distinguishes expenditure by the public and private sector, but does not analyse the market in terms of the type of work done, which means that it does not provide enough detail to estimate the potential for integrating low-carbon works into the mainstream market. The Office for National Statistics confirmed that data at this level of detail is not collected ‘as it would be too burdensome on respondents’ (Ormerod 2009 pers. comm.).

In order to provide an estimate of the breakdown of the headline figure, another method is needed. The approach taken here is to analyse market data from AMA Market Research on the size of the market for construction products in various sub-sectors of the domestic market (see http://www.amaresearch.co.uk/AMA_Building.asp for a list of available resources). This method relies on estimates at several stages of the process, which means that the margin for error is potentially large and uncertain. The figures presented here are intended as a first approximation of the make-up of the domestic refurbishment market, rather than anything more definite or robust.

AMA market research reports for this sector are aimed principally at firms in the product manufacturing and wholesale industries. Seventeen of the AMA reports are wholly or partly relevant to domestic RMI activity, some of them being quite specialist:

2. Building insulation market 2009 – 2013
3. Domestic replacement door and window market UK 2009 – 2014
4. Pipes and fittings market UK 2009 – 2013
5. Professional portable power tools market UK 2009 – 2013
7. Trade adhesives market UK 2010 – 2014
9. Domestic kitchen and bathroom worktops market UK 2009 -2014
10. Domestic kitchen furniture market UK 2010 – 2014
11. Ceramic tiles market UK 2008- 2012
12. Floorcoverings market UK 2009 – 2013
13. Paint, coverings and woodcare market UK 2009 – 2013
15. Domestic heating market UK 2009 – 2013
16. Lighting market UK 2010 – 2014
17. The abrasives market report 2005

The data from each of these reports was used to build up a picture of the product markets that are relevant to domestic RMI. Where the products are relevant to other sub-sectors of
construction, estimates were made of the fraction that relates to domestic RMI – with the AMA reports typically providing indicative figures. The data from these reports was then organised into ten more generic categories. So, for example, data from the ‘Domestic kitchen and bathroom worktops market’ report was divided between ‘kitchens’ and ‘bathrooms’. The nine generic categories are:

Windows, doors and conservatories
Building insulation
Décor
Lighting
Heating systems
Roofing
Kitchens
Bathrooms
Power tools & consumables

Although nine sub-sectors provide a better level of disaggregation than the CSA figures, the categories are still fairly broad, and some categories are missing (for example, there are no figures for wiring and cabling; bricks and blocks; cement and concrete products; drainage and rainwater products; timber; building membranes; plaster and plasterboard products; external works and landscaping; tools other than power tools).

Because of the number of estimated factors involved in this model, combined with the fact that the AMA data has significant gaps, it is not possible to triangulate accurately the estimates in this model with the total figures provided by CSA. However, it is to be expected that the total of the figures extrapolated from the AMA data will be smaller than the CSA total because of the missing categories. The total attributed to these missing categories is here listed as ‘other’, and is inferred simply from the difference between the total of the AMA-derived figures and the CSA total.

**Sectoral splits and conversion factors**

The model takes account of two sectoral splits and uses two conversion factors to make a comparison possible between the data presented in the AMA market research reports and the headline figures in the CSA:

- Sectoral split to show the percentage of products in each category used in the domestic market and the percentage used in non-domestic markets
- Sectoral split applied to the domestic market figures to show the percentage used for new-build house-building and the percentage used for domestic RMI
- Conversion from manufacturers selling price (MSP) to retail price
- Conversion factor for inferring the service (ie labour) element from the figures provided for product sales – based on an estimate for labour-intensity in each product category

The final estimate for each sub-sector can be summarised by the following equation:

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2 This category is made up of two sub-categories, both relatively small: ‘Professional portable power tools’ and ‘Abrasives, adhesives and fixings’.
RMI (products and services) =

\[
\text{domestic fraction of products total} \times \text{RMI fraction of domestic products total} \times \text{RPC} \times \text{labour-intensity coefficient}
\]

where:

- **domestic fraction of products total** = percentage of product market used in domestic projects rather than non-domestic projects, £ MSP
- **RMI fraction of domestic products total** = percentage of the domestic-related product market used in RMI projects rather than new-build, £ MSP
- **Labour-intensity coefficient** = labour (service) costs/total of service and product costs
- **RPC (retail price conversion factor)** = retail price/MSP

In most cases the AMA product market figures include figures for products used only in the domestic market, but there are some exceptions, where products are wholly or partly used in non-domestic projects. For example, the AMA glazing report includes a category of ‘commercial windows’, which is assumed to be 100% commercial and 0% domestic. Conservatories, on the other hand, are assumed to be 95% by value for the domestic market and 5% for the non-domestic market. This assumption relates to small business premises, such as pubs and cafes, where domestic conservatories are sometimes installed.

The data for these product markets does not differentiate between products used in new-build housing and products used in RMI. The CSA figures show that the total broad sectoral split between new-build and RMI in 2008 was roughly 42% new and 58% RMI: this split is generally used unless there is a good reason to suppose otherwise.

Prices in the AMA reports are given in terms of ‘manufacturer’s selling price’ (MSP), so the figures need to be revised to provide a retail price, if they are to be cross-referred with the sectoral figures provided in the CSA. This can be done by using a coefficient for retail price mark-up. The mark-up between MSP and retail price is assumed to be 25% for all product categories.

The figures for products do not include the cost of service provision, so a figure for the total (product value plus service value) is made by applying a coefficient for labour intensity. The Construction Products Association estimates that products make up 40% of the total construction sector turnover, including all sectors: residential, non-residential, infrastructure projects; RMI and new-build. Across these different sectors, the value of the service element is 60%. This provides a rough guide for construction as a whole, but domestic RMI is classified by the European Union as a labour-intensive service, and it seems reasonable to assume that the service element in domestic RMI is higher than the average for construction as a whole. However, domestic RMI labour is generally lower-skilled and lower-paid than the professions involved in other construction sectors (e.g. architects, engineers), so the higher labour-intensity in person-hours does not necessarily equate to high service cost. The default assumption here is that the intensity of time spent on RMI is negated by the relative low-paid
nature of the work, so the CPA’s figures for the whole of construction are used as a first estimate: 40% of value is assigned to products and 60% to service.

A second-stage estimate is then made for different product groups, based on a judgement that certain product groups are inherently more expensive than others without requiring highly-paid labour for installation (eg doors, windows and conservatories) and – conversely – that some products are inherently cheap (eg abrasives, adhesives and fixings are relatively cheap). These second-stage estimates are summarised in Table 1.

Table 1. Estimates for shares of different market segments for products and service by overall market value.

<table>
<thead>
<tr>
<th>Category</th>
<th>Products %age (£)</th>
<th>Labour %age (£)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows, doors, conservatories</td>
<td>70</td>
<td>30</td>
<td>High product costs</td>
</tr>
<tr>
<td>Building insulation</td>
<td>40</td>
<td>60</td>
<td>Default assumption</td>
</tr>
<tr>
<td>Décor</td>
<td>40</td>
<td>60</td>
<td>Default assumption</td>
</tr>
<tr>
<td>Lighting</td>
<td>40</td>
<td>60</td>
<td>Default assumption</td>
</tr>
<tr>
<td>Heating systems</td>
<td>50</td>
<td>50</td>
<td>High product cost; skilled, well-paid labour</td>
</tr>
<tr>
<td>Roofing</td>
<td>40</td>
<td>60</td>
<td>Default assumption</td>
</tr>
<tr>
<td>Kitchens</td>
<td>60</td>
<td>40</td>
<td>High product costs</td>
</tr>
<tr>
<td>Bathrooms</td>
<td>60</td>
<td>40</td>
<td>High product costs</td>
</tr>
<tr>
<td>Pro portable power tools</td>
<td>100</td>
<td>0</td>
<td>Tools = products</td>
</tr>
<tr>
<td>Abrasives, adhesives, fixings</td>
<td>30</td>
<td>70</td>
<td>Low product costs</td>
</tr>
</tbody>
</table>

Summary of model results

The model is a simple Excel spreadsheet file with separate worksheets for each of the ten AMA market research categories, and a summary page with links to each category page. It estimates that 72% of expenditure on housing RMI (£28bn in 2008) is covered in the AMA market research reports, leaving 28% unaccounted for under ‘other’ (Figure 3).

Sensitivity analysis and model accuracy

A formal sensitivity analysis is not possible with this model, as the method for checking sensitivity would be the same as the method used to construct the model itself. Accuracy hinges on the assumed labour-intensity for each category of service, so if the assumed figure is out by 1%, the result will also be wrong by 1%. It is also possible that the figures for product markets researched by AMA might be inaccurate but there is no alternative source of figures to check against. In any case, if errors or uncertainties could be identified, they would also be recorded as a percentage difference.
Even so, an assessment of model accuracy can be made by cross-referencing to figures from other sources. Thus, the figure for building insulation in the model is £0.85bn, which is reasonably close to the approximately £0.8bn annual figure for CERT. Although CERT covers more than only building insulation, it also seems reasonable to assume that some building insulation activity occurs outside the remit of CERT, for example in those RMI situations where building Regulations part L1B applies (ie major renovations). Although this is not a particularly rigorous sensitivity test, it does suggest that the model is accurate enough to draw at least tentative conclusions. The reliability of the method would be improved if the detailed assumptions about labour intensity of different categories of work were checked with experts in the field, that is the people who make their living from such projects and have enough experience to have developed ‘rule of thumb’ figures. Unfortunately, such fieldwork was not possible for this study due to time constraints.

**Interpreting the numbers**

Four categories of activity in Figure 3 are covered by existing energy efficiency policy. Two of these categories (windows, doors, conservatories; heating systems) are subject to regulated minimum product standards. Of the other two, building insulation is supported by grants under CERT and other energy efficiency programmes, while one aspect of lighting – the provision of replacement compact fluorescent lamps (CFLs) – has also been an activity with strong support from CERT, although the domestic lighting market extends well beyond the market for replacement bulbs. In the modelled output, they together represent expenditure of £5.5bn.

The evidence from case studies suggests that roofing, kitchens, and bathrooms represent opportunities for integration of a low-carbon approach, although there will almost certainly be cases where the opportunity is limited, so the assumption here is that the maximum
potential is 95% of the total market. The category ‘décor’ also includes some opportunities (eg new flooring may be an opportunity for under-floor insulation and improving airtightness). There is insufficient detail in the AMA market report summary to provide an estimate of how much of the £8.22bn spent on décor represents an opportunity for integrating low-carbon works (AMA Research 2009). Similarly, the category ‘other’ undoubtedly covers some extra potential for integrating low-carbon works (eg internal plastering and external rendering are both opportunities to incorporate wall insulation), but the size of that potential cannot be guessed from the available data. If one makes the (cautious) assumption that 10% of the market for décor and 10% of the market for ‘other’ represent opportunities for low-carbon works, then the total market potential amounts to a total of £12.5 bn (Table 1).

Table 2 Estimate of potential for low-carbon works as a percentage of RMI market sub-sectors

<table>
<thead>
<tr>
<th>Market sector</th>
<th>Estimated % potential for low-carbon</th>
<th>Value, £bn per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows, doors</td>
<td>95</td>
<td>1.23</td>
</tr>
<tr>
<td>insulation</td>
<td>95</td>
<td>0.81</td>
</tr>
<tr>
<td>lighting</td>
<td>95</td>
<td>0.83</td>
</tr>
<tr>
<td>heating</td>
<td>95</td>
<td>2.37</td>
</tr>
<tr>
<td>roofing</td>
<td>95</td>
<td>2.02</td>
</tr>
<tr>
<td>kitchens</td>
<td>95</td>
<td>2.13</td>
</tr>
<tr>
<td>bathrooms</td>
<td>95</td>
<td>1.55</td>
</tr>
<tr>
<td>decor</td>
<td>10</td>
<td>0.82</td>
</tr>
<tr>
<td>other</td>
<td>10</td>
<td>0.77</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>12.52</td>
</tr>
</tbody>
</table>

These figures carry significant uncertainties, so conclusions need to be treated with caution, but it seems that approximately 45% of the total RMI market by value is directly linked to energy improvements or has the potential to be an intervention point for more costly and disruptive energy-related works.

Implications for policy and industry

The size of this latent market is an order of magnitude larger than the market for energy efficiency or microgeneration, and therefore deserves serious consideration as a vehicle for delivering advanced retro-fit projects on the scale assumed in the various scenarios referred to in the introduction.

From a policy perspective, this approach also fits better with the underlying principle of Market Transformation, which is that stock efficiency improvements can best be achieved by making energy efficiency an inalienable part of consumer choice in markets. The history of Market Transformation programmes in appliance markets has followed this logic and has been shown to be highly successful (International Energy Agency 2000, International Energy Agency 2003). For appliances, the key intervention point is the point of sale for replacement equipment, but the equivalent for housing refurbishment is complex: there are several markets involved, and the market for refurbishment is much more diffuse, varied and labour-intensive, with all the difficult implications that brings for quality assurance. However, the
principle can be summarised in terms of achieving improvements through a process of satisfying market demand. When a consumer wants a new kitchen, what the market should be providing is a low-carbon new kitchen. The focus on cost-effectiveness in traditional policy has led to a situation where the things that are being promoted (cavity wall insulation, loft insulation) have too little technical potential for ongoing improvements across the stock, and too little market presence to achieve work at the necessary scale.

The estimates of market size provided in this study suggest that there are existing areas of activity (new kitchens, new bathrooms, roofing, décor), which are large and may offer significant potential for integrating low-carbon works. More work would need to be done to flesh out the detail of exactly where that potential lies, and how a strategy to engage with one or more of these areas of activity might be developed.

The lessons from Market Transformation in appliance markets suggest that a policy toolkit would be needed, including a regulated minimum standard for energy performance. But how would that be applied in this very diffuse market? Would such a standard apply at the level of the dwelling? If so, given that most of the market potential is for projects at a smaller scale than whole-home refurbishment, how could the whole home standard be translated so that, for example, a new kitchen would be consistent with it?

Can the industry delivering RMI works really do this work? What are the risks associated with taking an approach that relies on such a distributed set of actors and decision-makers, and how can they be managed? But, equally, is there an alternative that can match the scale and reach of this group?

The scale of the challenge is at least as great as the scale of the opportunity, so a step-wise approach would be prudent, working with one sub-sector of the housing refurbishment industry (eg kitchen fitters) before extending the approach to other activities. This approach mirrors quite closely that taken by the Market Transformation Programme, which sub-divides appliance markets for the purposes of technical and market research, policy development and industry engagement.

Who is going to pay for it? In the short-term, this can be viewed as a process of learning, with public money required to support innovation, and to coordinate the lessons learned. However, the ongoing workload, should it become normalised, would mean an increased level of activity of the order of £12 - £25,000 per dwelling at current prices (Killip 2011). To what extent should that extra cost be simply passed on to property owners or should there be some system of financial support?

Is a room-by-room approach the best or only one? The market data provided by AMA suggests that this scale of activity is where most of the market exists, but others have argued for whole-home retro-fits (ie tackling all of a dwelling in one major project) or even scaling up that activity to the level of whole streets or neighbourhoods. However, the market potential for such activity is probably very restricted in relation to the size of the housing stock.

Finally, if the market potential is predominantly at the scale of room-by-room projects, what implications does that have for the technical standard that can realistically be achieved? The integration of different projects carried out at different times by different contractors may
lead to certain compromises that could (in theory at least) be avoided if the whole home were treated in one go.

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