



BREAKING BARRIERS

An industry review of the barriers to Whole House Energy Efficiency Retrofit and the creation of an industry action plan

Literature review and full list of barriers and solutions, March 2014



Energy
Efficiency
Partnership
for Buildings



Contents

This report is supplementary to the Energy Efficiency Partnership for Buildings' (EEPB) Breaking Barriers Summary Report. It contains details of a full literature review undertaken in Q1 2013 as well as the full list of barriers and solutions identified on the road to realising an industry action plan.

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Section 1: Literature Review

A literature search was carried out by Jade Lewis from Saint-Gobain in Q1 2013 to identify work that has already been done in the area of whole house retrofit, specifically information on barriers to doing so and solutions found. Sources included trade association reports, academic papers, the EEPB's knowledge base and industry publications.

1.1 Barrier and Solution Summary from Desk Based Research

Ref	Report and General Information	Barriers	Solutions
1	<p>Delivering Whole House Retrofit presentation by David Cartwright</p> <p>View PDF</p> <p>This presentation focuses on community retrofit, however some of the barriers and lessons learned are generic to all retrofit.</p>	<p>The barriers identified are:</p> <ul style="list-style-type: none"> • Current upgrades have been expensive • Complexity of funding arrangements • Focus on Research and Development rather than delivery • Savings in energy efficiency have not been the priority • Scope of works in whole house retrofit extremely challenging for programming • Pride in the estate and properties - changes to external appearances of buildings • Homeowner / tenant engagement and education - huge changes to the norm – coal / electric • Up skilling of local labour force – accreditations for installation • Internal insulation measures can be intrusive and disruptive • Need to keep street scene intact with Victorian Terraces (external visual change) 	<p>Suggested Solutions are:</p> <ul style="list-style-type: none"> • Consultation with homeowners / residents over their choice and how improvements should be focused • Almost all private homeowners opted into the scheme after seeing the properties completed - Local examples • The report recommends that moving forwards the industry needs to produce an integrated proposition: • Diagnostics and measured surveys • Identification of necessary physical treatment • Development of products which will make the task more secure and less disruptive • The logistics of assembling labour and materials for the execution of the works • Accreditation of those responsible for the work • Customer care throughout the process • Customer instruction in the operation of the building and its systems on completion • Ensuring compliance • Insurance and financing packages • The programme management of all of the above

Ref	Report and General Information	Barriers	Solutions
2	<p>Market Research Report -The provision of advice to Housing Associations and Private Developers, and the barriers to incorporating sustainable energy measures in housing new build and refurbishment – by the Sustainable Housing Action Programme (SHAP)</p> <p>View Site</p> <p>The Sustainable Housing Action Programme (SHAP) was commissioned in August 2005 by Sustainability West Midlands, in partnership with Energy West Midlands and the Energy Saving Trust.</p> <p>This report focuses on new build social housing.</p>	<p>The barriers identified are:</p> <ul style="list-style-type: none"> • Lack of knowledge • No legislative or local requirements to go beyond building regulations • Lack of end user demand for energy efficient homes • Cost • Pay back periods of some renewable technologies • Technologies are not seen to be proven • Fear of vandalism or damage to ‘different’ installations • Lack of, or difficult to access funding • Lack of recognition of the increasing importance of sustainable energy • Unfamiliarity or awareness of the benefits of such technologies • Age of tenants (particularly if elderly) - unable to use new technologies effectively or maintain systems on a day to day basis • Generational barriers against using alternative construction or new technologies over those more familiar - the need to modernise peoples thinking • Installer expertise • Fears over the maintenance and repair of systems • Awareness of the architects designing new developments • The cost-energy efficiency balance • The need for integration from the early design stage • Undeveloped supply chains for alternative and sustainable energy technologies (size of industry) • Variety of suppliers involved and possible delays to completion targets 	<p>Suggested Solutions are:</p> <ul style="list-style-type: none"> • Raise minimum standards for energy efficiency – planning policy • Exemplar projects • Promotional and awareness raising method <ul style="list-style-type: none"> – Booklets with information on technologies and direct benefits – Best practice examples / case studies – Seminars to share knowledge, best practice, and experience – Feasibility studies (cost / benefits) – Education to suppliers, installers and surveyors – Literature on funding – Maintenance, repairs and health and safety training on any installed technologies • Careful planning from the design stage and consultation with all key partners • Engaging and training architects involved in the design of new homes

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3	<p>The Sustainable Housing Action Programme(SHAP) 2005-2006 Final Report for Sustainability West Midlands</p> <p>View Site</p> <p>The Programme was commissioned in August 2005 to demonstrate how high specification energy efficiency and renewable energy measures could be mainstreamed into existing regional housing new build and refurbishment programmes and included a series of research projects and events.</p>	<p>The barriers identified are:</p> <ul style="list-style-type: none"> • Access to funding • Training of staff and tenants • Lack of legislation • Lack of demonstrated commercial advantage in investing in sustainable energy technologies • Lack of end user demand for energy efficient homes • Low minimum standards • Need for education and training in the use of • Sustainable energy technologies and their economic, • Social and environmental benefits 	<p>Suggested Solutions are:</p> <ul style="list-style-type: none"> • The programme carried out research to identify case studies to be showcased at a “Best Practice Case Study” event and developed into a database • They determined the barriers and best practice for discussion at workshops and open days at the properties with the aim of sharing knowledge. These were covered by the media • Created an action plan to overcome some of the key barriers in social housing • Knowledge transfer from experts and exemplar organisations to colleagues involved in planning and development controls, homebuyers and tenants is fundamental • Robust and appropriately targeted marketing campaigns can be very effective in promoting key messages • Demonstrating the cost benefits of installing sustainable energy measures and the promotion of case studies • Communicating with the appropriate individuals and with appropriate information is of key importance • Single technology pilots to increase the uptake of the most economically viable energy saving measure for the region could be developed. This could be supported by research into low or zero carbon technologies most advantageous for the region e.g. in areas off mains gas • Work with local and regional media to ensure appropriate messages are communicated in all features about climate change and sustainability • Consider developing a certification scheme that accredits individuals and organisations according to their sustainability credentials

Ref	Report and General Information	Barriers	Solutions
4	<p>Community Green Deal report – Developing a model to benefit whole communities – SHAP, January 2011</p> <p>View PDF</p>	<p>The barriers identified are:</p> <ul style="list-style-type: none"> • Unless economies of scale (and concentration) can be achieved the cost of delivering programmes will be too high and additional Government subsidy will be needed • Existing stock improvement programmes will need to be tailored to the distinct property archetypes found in each local area, and in response to the distinct concerns and aspirations of owner occupiers and landlords in each local community • Refurbishment programmes will need to reach out to all tenures of housing, each of which create different challenges in seeking to coordinate improvement works • Trust that improvement works will be carried out to a high standard and that everyone will share in the benefits 	<p>Suggested Solutions are:</p> <ul style="list-style-type: none"> • Aggregate existing stock improvement programmes, enabling procurement processes to be standardised and partnerships with lead private sector contractors to be developed • Identification of a replicable ‘kit of parts’ which can then be used to build the supply chain • Effective coordination in order to pool different sources of funding and manage contractual arrangements • Bring together trusted local partners • Aggregate programmes for communities • Kickstart by investment in social housing with improvements rolled out across private tenures • The community could play a key role in delivering programmes • Combine a number of income streams, including energy company contributions, FIT and RHI revenue, private finance • The report also outlines roles that different parties can take to make community schemes work

Ref	Report and General Information	Barriers	Solutions
5	<p>Study on improving the energy efficiency of existing homes – by the Joseph Rowntree Housing Trust.</p> <p>View PDF</p>	<p>The barriers identified are:</p> <p>The study shows that by sequencing the installation of retrofit measures, it is possible to achieve the challenging targets on existing housing stock required under Green Deal, but it costs a lot of money, and energy savings in reality are different to calculated:</p> <ul style="list-style-type: none"> • The modelling tools used to calculate carbon savings and performance were inaccurate; • Measures that were installed performed significantly worse in situ than in test lab conditions; • Measures were not installed correctly <p>Measures installed could be damaged by subsequent trades not understanding the requirements.</p> <p>No two existing houses are the same and certain measures are not suitable for some houses or locations. A refurbishment project should not be undertaken without a comprehensive survey of the house.</p> <p>The installation of some measure can have significant knock-on effects on performance of other measures and create issues with moisture, etc.</p>	<p>Suggested Solutions are:</p> <p>The involvement of experienced research teams in the whole house retrofit projects helped to minimise the gap between predicted and actual performance.</p> <p>Allowance needs to be made in energy saving calculations for the actual performance of products in-situ.</p> <p>Provide good advice, based on a thorough understanding of the home's construction 'status'.</p> <p>Improvements should be made to education and training throughout the industry in order to replicate the design and construction skills, knowledge and experience gained through experimental retrofit projects.</p> <p>Design intent needs to be communicated to all those in the supply chain who could potentially affect the performance of the measures installed.</p>
6	<p>Guide to Whole House Retrofit (on-line tool) - Institute for Sustainability View PDF</p>		

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7	<p>Helping to inform the Green Deal: green shoots from Pay As You Save - B&Q, the London Borough of Sutton and BioRegional:</p> <p>View PDF</p> <p>This report provides a summary of the Pay As You Save (PAYS) pilot</p>	<p>The barriers identified are:</p> <ul style="list-style-type: none"> • Planning permission requirements • Long term savings were lower than expected – and this put off one half of interested homeowners from signing up to the scheme • Retrofit installers need to understand from the outset that every home is unique and that there won't be a one size fits all energy retrofit solution • Homeowners need to be inspired and motivated to take action in reducing energy viewed • Major measures such as solid wall insulation were viewed as unattractive by many homeowners due to length of payback and the disruption involved 	<p>Suggested Solutions are:</p> <ul style="list-style-type: none"> • Expanding the scope of home improvements that can be done without planning permission to certain energy saving measures (e.g. external wall insulation) will ensure nationwide consistency and prevent delays • The participation of trusted key partners (such as the local authority) will give reassurance to the scheme and will generally make it more attractive • Selling home energy retrofit on household bills reduction alone would be misguided and may need to be augmented with other messages around a home's increased comfort as a result of the measures, the upward trend of future energy prices protecting households from increasing costs and reducing our environmental impact • A whole house approach managed by a single third party was a major attraction to those who participated in this pilot • Clear communication is needed on the timescales and the level of disruption involved in the installation

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8	<p>Financing the Green Deal - Carrots, sticks and the Green Investment Bank - Ingrid Holmes – May 2011:</p> <p>View PDF</p>	<p>The barriers identified are:</p> <ul style="list-style-type: none"> • 30% of households ('laggards') would not install energy efficiency measures even if they were free of charge • Upfront costs of measures and access to capital (only partly addressed by Green Deal) • Length of payback times • The hassle factor i.e. the disruption caused by major refurbishment and the perceived risks in implementing retrofits due to the complexity of projects and lack of familiarity with some of the technologies required • Lack of reliable suppliers available to assist with planning and carrying out work • Opportunity cost of capital – which means energy efficiency investments are competing with other more attractive spending opportunities such as new bathrooms, kitchens or cars <ul style="list-style-type: none"> – Low value is placed on energy efficiency improvements – Energy efficiency is a fairly intangible asset, physically hidden and hard to quantify – Absence of much higher energy prices • Average homeownership is only 10 years in the UK and a full package of retrofit measures is likely to take much longer than that to pay back • Energy performance not reflected in property value (in both the lettings and the sales market) • Lack of transparency, longevity and certainty in policy design to drive a healthy trajectory for market growth • Issues with balance sheet constraints, liquidity and risk acting as barriers to private firms investing 	<p>Suggested Solutions are:</p> <ul style="list-style-type: none"> • Efforts to stimulate demand should be focused on the 15% of the population who are innovators and will 'make the market'. A range of approaches will be needed to incentivise them to act; cash-back schemes for higher income households, upfront grants worth 40% or more alongside long term Green Deal loans for middle income households; upfront grants worth 55% or more alongside long term Green Deal loans for low income households • Market research to understand what level of incentive may be required to persuade wealthy homeowners to invest in retrofits and designing an incentive programme around those findings • Linking the depth of retrofit to the level of subsidy provided – in order to drive the market toward whole-house retrofits • Regulatory drivers • Provide lower cost capital via the Green Investment Bank (GIB) until rising energy costs make installing more energy efficiency measures self funding • British Gas Council Tax Rebate Scheme, where a cash-back is provided by Councils when households install loft and cavity wall insulation and Pay As You Save Pilots – which offered retrofits at 0% finance have been successful at driving demand • International experience indicates a mixture of cash-backs, grants and soft loans have been successful • Linking energy performance to high profile measures such as taxation. Examples include Stamp Duty and Capital Gains Tax varied according to EPC rating and Council Tax rebates based on measures installed

Ref	Report and General Information	Barriers	Solutions
9	<p>What's in it for me? - Using the benefits of energy efficiency to overcome the barriers – Consumer Focus</p> <p>View PDF</p>	<p>The barriers identified are:</p> <ul style="list-style-type: none"> • Green Deal finance and the new consumer protection framework are enablers but offer neither a carrot nor a stick • Barriers that can prevent action: <ul style="list-style-type: none"> – Lack of awareness and interest – Upfront cost – Inconvenience and disruption – Complacency – Lack of trust • Many projects have, primarily for funding and resource reasons, been unable to evaluate their schemes beyond the short term installation of measures. This limits the potential for scalability and development of best practice 	<p>Suggested Solutions are:</p> <p>Benefits that can prompt action:</p> <ul style="list-style-type: none"> • Saving money • A warmer more comfortable home • The avoidance of waste • Living a greener life <p>Consumer Focus have created a practical planning checklist for those looking to design and deliver projects in order to increase the response and cost effectiveness of energy efficiency initiatives, available from:</p> <p>View PDF</p> <ul style="list-style-type: none"> • Incentives, and allowing people to ‘touch and feel’ energy efficient homes, can help to get initial interest • Positive word of mouth and a respected messenger are key drivers of trust and confidence • A segmented, as opposed to a population wide, marketing approach is needed to move beyond the energy efficiency ‘early adopters’ • Long term energy efficiency behaviour change is vital to maximise the impact of measures <p>Recommendations:</p> <ul style="list-style-type: none"> • Plan from the customer’s perspective <ul style="list-style-type: none"> – Who do they listen to? – What benefits are they looking for? – What might be preventing them from acting? • Segment the audience <ul style="list-style-type: none"> – One size does not fit all – Develop different messages and delivery approaches for each segment

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9			<p>Suggested Solutions are:</p> <ul style="list-style-type: none"> • Offer instant gratification <ul style="list-style-type: none"> – Short term benefits are often more powerful than long term ones – Bring the issue of energy efficiency into the present • Make it personal <ul style="list-style-type: none"> – Make it about the person: their house, family and locality • Give them the feel for it <ul style="list-style-type: none"> – Provide opportunities to ‘touch and feel’ through exemplar homes, or the experiences of neighbours • Develop partnerships <ul style="list-style-type: none"> – Work with partners that the audience will listen to and trust – Make it attractive and easy for organisations to partner with you • Encourage word of mouth <ul style="list-style-type: none"> – People trust their friends and family – Consider how your customers can influence others • Your contractors are your ambassadors <ul style="list-style-type: none"> – Contractors spend most time in the home and have most – Opportunity to inform and influence residents – Involve contractors early, their buy-in to messaging is vital • Take a long-term approach <ul style="list-style-type: none"> – It may take time for the desired action to take place – Consider long term behaviour change as well as the installation of measures • Plan to evaluate <ul style="list-style-type: none"> – Define success in terms of actions

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10	<p>Top Tips No 1: Making Best Use of Void Times - RETROFIT SOUTH EAST: Refurbishment Pioneers Network South East</p> <p>View PDF</p>		<p>Suggested Solutions are:</p> <p>The time when a property becomes void offers one of the best opportunities for undertaking low energy and water retrofit measures in a property's life cycle.</p> <p>What is needed is a 'Green Void Standard', such as some form of checklist of all measures housing associations would follow when a property becomes void ideally be supported by appropriate regulation & KPIs which encourage and reward this behaviour.</p> <p>The report gives other solutions to overcoming barriers to the installation of energy efficiency measures during void periods in rented properties.</p>
11	<p>Moving Consumers to Action – The Existing homes Alliance – Dec 2010 (summary report also available)</p> <p>View PDF</p>	<p>Lack of consumer trust and confidence. In the UK, additional consideration needs to be given to preventing mould and damp that can occur from increased insulation and poor ventilation.</p>	<p>Recommendations for delivering deep, low carbon refurbishment:</p> <ul style="list-style-type: none"> • Government must put in place both area-based and individual dwelling backstops that ensure that even the hardest to reach people and hardest to treat homes are included in the retrofit programme • There needs to be either a tipping point, at which the benefits outweigh the barriers, or a trigger point, at which it is most opportune to undertake the work • There is a key role for Local Authorities and Registered Providers in either coordinating or delivering the step change in refurbishment activity needed. Steps must be taken to incentivise Local Authorities to prioritise refurbishment within existing spatial planning so that opportunities for investment and action add up to more than the sum of their parts • More needs to be done to integrate energy efficiency improvements with other household works. There must be more investment in the up-skilling of small contractors to do this

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Ref	Report and General Information	Barriers	Solutions
11			<p>Recommendations for delivering deep, low carbon refurbishment:</p> <ul style="list-style-type: none"> • Policy framework needs to be to be long-term and provide certainty for businesses looking to operate in this space • Government should keep the cost of capital for investment in low carbon technologies low • It is important that Government establishes tariffs and subsidies that provide a level playing field for energy efficiency and renewable energy or even to favour long-life energy efficiency measures that 'lock in' CO₂ reductions for the long term • A delivery mechanism should be adopted that will reduce the cost impact on the householder • Energy savings estimates must be accurate and the report gives recommendations for improving the current Energy Performance Certificate process • Develop a trusted, robust system of quality assurance covering a wide range of measures and minimising cost and burden for new entrants. A single overarching brand that existing schemes can link with is proposed • Increase mandatory minimum standards of energy efficiency for homes incrementally across all tenures • An aspirational standard should be introduced that will encourage householders to go above the minimum level • Government to introduce 'carrots', as well as 'sticks', including forms of subsidy, financial incentives (and disincentives)

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12	<p data-bbox="188 164 624 188">EeB PPP Project Review – July 2012</p> <p data-bbox="188 220 412 260">View PDF</p> <p data-bbox="188 292 624 675">The Energy-efficient Buildings (EeB) Public Private Partnership (PPP) is a joint initiative of the European Commission and the E2BA to promote research on new methods and technologies to reduce the energy footprint and CO₂ emissions related to new and retrofitted buildings across Europe. E2BA is an initiative that span out of the European Construction Technology Platform (ECTP).</p>	<p data-bbox="669 164 1014 188">The barriers identified are:</p> <ul data-bbox="669 212 1290 379" style="list-style-type: none"> <li data-bbox="669 212 1290 268">• On-site production is inefficient with regard to cost and construction time <li data-bbox="669 292 1290 379">• Retrofit sector is negatively associated with poor quality as well as an unsafe and unhealthy working environment 	<p data-bbox="1373 164 1697 188">Suggested Solutions are:</p> <ul data-bbox="1373 212 2029 643" style="list-style-type: none"> <li data-bbox="1373 212 2029 308">• Using well-designed, prefabricated elements can drastically reduce the construction time, cost and minimise the social disturbance for tenants <li data-bbox="1373 323 2029 643">• Through the E2rebuild project they have developed monitoring guidelines that define a common approach and unified methodology for metering and monitoring of the building's energy performance and indoor environment including thermal comfort for tenants Guidelines explaining the surveying and planning process and give an overview of the features of a comprehensive digital survey, including the development of a fully featured 3D model for planning and production have also been developed. <p data-bbox="1395 659 1608 699">View Site</p> <ul data-bbox="1373 722 1955 818" style="list-style-type: none"> <li data-bbox="1373 722 1955 818">• The Efficient energy for cultural heritage project shows case studies of energy efficiency retrofit solutions for heritage buildings. <p data-bbox="1395 834 1608 874">View Site</p> <ul data-bbox="1373 906 2022 1145" style="list-style-type: none"> <li data-bbox="1373 906 2022 1002">• The ICT4E2B Forum project is developing a roadmap of Information and Communication Technologies (ICTs) for energy-efficient building <li data-bbox="1373 1018 2022 1145">• Establishment of a stakeholder community with the development of an extensive shared workspace and a knowledge repository to support networking of the above community

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13	<p>HEATING SECTOR: Condensing boilers and advanced controls fact sheet – EEPH, October 2009</p>	<p>The barriers identified are:</p> <ul style="list-style-type: none"> • Cost – the considerable cost of what is essentially a ‘distress purchase;’ • Disruption – installation is likely to be disruptive to a household; • Lack of consumer awareness of the benefits of more energy efficient technology and the use of advanced controls; • Insufficient ‘push’ under current Government schemes such as the Carbon Emissions Reduction Target (CERT) • Installers in this sector have an ageing profile and that there is a need to introduce training and apprenticeship schemes to make sure installation skills are not lost to the industry 	
14	<p>INSULATION SECTOR FACT SHEET – October 2009 - EEPH</p>	<ul style="list-style-type: none"> • The main barrier to the installation of Solid Wall Insulation and some other forms of insulation is cost • External wall insulation can change the appearance of a property and is disruptive • Internal wall insulation potentially reduces the living area and necessitates redecorating which is again disruptive • Both suffer from low public awareness • As the requirement to insulate solid wall homes becomes more of a priority, there will be a need to develop appropriate training courses to deliver the skills required for solid wall insulation • Further development of technology and skills will also be required to address other challenges, such as difficult to treat cavity walls and suspended floors • The industry requires clear signals on the post 2011 landscape. Without such signals there is a risk that the products, skills and resources will not be maintained 	<ul style="list-style-type: none"> • More active promotion, incentive schemes and technological innovation

Ref	Report and General Information	Barriers	Solutions
15	MICROGENERATION SECTOR FACT SHEET – October 2009 – EEPH	<p>The barriers identified are:</p> <ul style="list-style-type: none"> • Renewable technologies are expensive and disruptive • Different measures will often be competing for the same space • Sales of microgeneration technologies are currently low and so there are few economies of scale that would be associated with mass-market products • The long payback period on capital expenditure • Planning laws restricting developments • Complexity of selling electricity back to the grid • Lack of promotion and therefore low public awareness of the benefits of microgeneration technologies • The low number of installations carried out to date has meant that equipment suppliers and installers have had little incentive to invest in the sector • As the sector grows there will be a requirement for higher numbers of skilled technicians to install and maintain microgeneration systems • It is crucial that heating systems use technologies that are suitable for the households in question. If technology unsuited to the building is installed or if customers do not understand how to operate the system most efficiently, the result can be higher emissions rather than a reduction 	<p>Suggested Solutions are:</p> <ul style="list-style-type: none"> • Microgeneration technologies can be installed by other trades, such as plumbers, heating engineers, electricians and even roofers, depending on the technology in question • Developing a comprehensive renewables skills strategy to help provide the skilled workforce that will be required (HM Government UK Renewable Energy Strategy 2009) • Route-maps for the various products so that technology suppliers and installers can make secure and appropriate investment, driving cost reduction through technology improvement and volume sales • It is important that consumers are told of the benefits of microgeneration technologies and also that they obtain reliable and authoritative information and advice on the relative merits of alternative technologies for their own particular buildings • It is essential that robust system design methods are developed for installers and consumer education is made a priority
16	GLAZING SECTOR FACT SHEET - October 2009 – EEPH	<ul style="list-style-type: none"> • Lower consumer spending on renovations • Lack of availability of finance for house purchasing and renovations 	

Ref	Report and General Information	Barriers	Solutions												
17	<p>Regional Supply Chain for Energy Efficiency Measures to Retrofit to Existing Housing: Scoping Study for the Yorkshire and Humberside Region - Final Report – the University of Sheffield – 2010</p> <p>View PDF</p>	<p>The barriers identified are:</p> <p>The study found that the Energy Efficiency sector sees a strong prevalence of region-based micro-businesses, employing a limited number of people, working on small turnovers and basically concentrated on the regional Market. Also, regional businesses provide a skewed and unequal coverage of the wide range of available measures.</p> <p>The supply chain is fractured and critical components are often shipped from overseas.</p> <p>Barriers identified include:</p> <ul style="list-style-type: none"> • Regional businesses find bidding and participating in publicly funded Energy Efficiency large-scale projects difficult • Most of the work related to publicly funded projects seems to go to large contractors • Implementation, verification, accreditation and commercialization of new technology are often too onerous and costly for small businesses • Lowering of specifications has made market more competitive but reduced quality available • A general lack of education and knowledge on Energy Efficiency products and/or services 	<p>Recommendations for overcoming the barriers were made and tested using a focus group. These are summarised in the table below and on the next page.</p>												
		<table border="1"> <thead> <tr> <th>Problem</th> <th>Intervention Proposal</th> <th>Body / Institution to be involved</th> </tr> </thead> <tbody> <tr> <td>Difficulty in bidding and participating in publicly funded Energy Efficiency large-scale projects</td> <td>Creating a Database of Regional Businesses operating in the Energy Efficiency sector.</td> <td>Regional Development Agency</td> </tr> <tr> <td>Energy Efficiency publicly funded projects' size prevents local businesses to get involved due to capacity constraints</td> <td>Smaller work packages could be managed by local and regional resource, possibly to a better standard and at a lower cost</td> <td>Local Authorities</td> </tr> <tr> <td>Most of the work related to publicly funded projects goes to large contractors out of the regions with their own sub-contractor lists</td> <td>In framework contracts, Local Authorities should seek that a quota of sub-contracts has to be awarded to regional business</td> <td>Local Authorities</td> </tr> </tbody> </table>	Problem	Intervention Proposal	Body / Institution to be involved	Difficulty in bidding and participating in publicly funded Energy Efficiency large-scale projects	Creating a Database of Regional Businesses operating in the Energy Efficiency sector.	Regional Development Agency	Energy Efficiency publicly funded projects' size prevents local businesses to get involved due to capacity constraints	Smaller work packages could be managed by local and regional resource, possibly to a better standard and at a lower cost	Local Authorities	Most of the work related to publicly funded projects goes to large contractors out of the regions with their own sub-contractor lists	In framework contracts, Local Authorities should seek that a quota of sub-contracts has to be awarded to regional business	Local Authorities	
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Problem	Intervention Proposal	Body / Institution to be involved
Main National contractors winning large projects are acting as a 'middle man': This adds costs and squeezes margins for sub-contractors. Quality is not assured	An assessment of the quality of the work delivered by contractors and sub-contractors should be provided	Local Authorities by promoting independent bodies
Lack of Education and Knowledge on Energy Efficiency products and services, even in the Local Authorities	Moving from a "Product-Driven" to a "Solution-Driven" approach in designing large-scale interventions	Local Authorities and Regional Development Agency
Pre-qualification schemes are a major problem for regional businesses	Moving to more "local friendly" pre-qualification schemes	Local Authorities
Cost of Suppliers	Better use of a centralised purchasing system, based on a IT platform, where firms can aggregate their purchases	Regional Development Agency
Delivery Punctuality		
Critical Components shipped from overseas		
Lack of awareness of funding schemes	Better use of a central point for funding schemes, like an online-database or a dedicated website	Regional Development Agency / Local Authorities
Lack of information about arising work opportunities	Utilising a database of regional companies for creating a mailing-list in order to promptly inform firms when new opportunities arise	Regional Development Agency / Local Authorities

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Problem	Intervention Proposal	Body / Institution to be involved
Lack of energy-efficient consciousness	Education should stem from school up, with children educated at a young age on energy efficiency and related areas	Regional Development Agency / Local Authorities / Education Departments
Lack of Supply Chain capability and skills	Funding Foundation Degrees	Central Government
	Promoting Energy Efficiency-orientated degree programs or projects	Universities
	Participation of sub-contractors into training, qualification and apprenticeship schemes	Regional Development Agency

Ref	Report and General Information	Barriers	Solutions
18	<p>“Renovation tracks for Europe up to 2050 - building renovation in Europe – what are the choices?” – Ecofys report for EURIMA – June 2012</p> <p>View PDF</p> <p>The aim of the study was to evaluate different building renovation strategies at the EU level. It showed that the 88%-91% CO₂-emission savings target for 2050 can be achieved by either Shallow renovation and high use of renewable energy, or deep renovation and high use of renewable energy, but not by shallow renovation alone. Therefore whole house retrofit is key to achieving these EU targets.</p>	<p>Increased building renovation with a high level of energy efficiency faces various barriers for implementation, such as the need for upfront financing, investor / user conflict, necessary building capacity, etc.</p>	

Ref	Report and General Information	Barriers	Solutions
19	<p>The drivers of and barriers to energy efficiency in renovation decisions of single-family homeowners, Martin Jakob, March 2007</p> <p>View PDF</p> <p>The report includes a survey and analysis of barriers and drivers in retrofit, but specific to Switzerland.</p>	<p>The barriers identified are:</p> <ul style="list-style-type: none"> • With the exception of windows and flat roofs, most buildings can be operated and lived in with hardly any restrictions or problems for decades even without additional insulations. Hence, energy efficiency improvements are generally not triggered by technical factors. • Conflicts of interest between the protection of listed buildings and conservation areas (preservation orders) and the demand for energy-related refurbishments • Legal restrictions due to neighbours' rights might hinder external insulation • Energy efficiency renovations generally call for substantial additional up-front investments and savings are spread over many years • Renovations are in direct competition with other expenses (vacation, car) or needs (health, living in the case of retired owners) • Economic viability: energy savings are often calculated on current prices or wrong assumptions making savings appear to be much less than they potentially could be 	<p>Suggested Solutions are:</p> <ul style="list-style-type: none"> • Opportunities could arise from the requirements for adaptations to dwellings expected from an ageing residential population with higher standards of living comfort, increasing individualisation and the future development for people to work at home. The opportunity is not always recognised by the stakeholders

Ref	Report and General Information	Barriers	Solutions
20	<p>FROM DEMONSTRATION PROJECT TO VOLUME MARKET - Market development for advanced housing renovation – Passivhus Norden</p> <p>View PDF</p>	<p>Currently, renovations with advanced energy performance only exist in the demonstration phase. To achieve the diffusion of such projects and associated technologies it is important to make them available in the general market.</p> <p>The process of moving from a demonstration to volume market is shown in figure 1 below. The first three phases of this process:</p> <ol style="list-style-type: none"> 1. Demonstration phase and introduction phase: Dominated by innovators who are strongly interested in testing or experiencing technology. In this respect, these actors listen to idealistic and value based arguments. 2. Growth phase: Dominated by early adopters who appreciate the potential benefits of technology when they see that its benefits match their own needs and desires. This group includes trendsetters who respond to emotion-based arguments. 3. Volume phase (mature market): Dominated initially by early majority purchasers who are more results-oriented, and therefore wait to see if a new technology delivers what it promises. These persons listen to rational arguments and need good examples from relevant trendsetters before they commit to the new technology or concept. <p>A major challenge for new disruptive technologies that require a change in industry or consumer choices is to cross the gap between the early adopters who participate in the growth phase and the early majority buyers who participate in the mature market phase (marked with a yellow rectangle in figure 1 below).</p>	<p>Demonstration projects should be geographically spread to help the transition.</p> <p>Recommended measures for the introduction phase:</p> <ul style="list-style-type: none"> • Public actors: <ul style="list-style-type: none"> – Create arenas for the exchange of knowledge – Promote public awareness – Establish financial support programs for advanced renovation – Set a national agenda that also includes perspectives for future policies • Research Institutes: <ul style="list-style-type: none"> – Participate in international cooperation – Involve good partners from the industry as well as public actors – Present trustworthy facts in an understandable way • Innovative companies: <ul style="list-style-type: none"> – Research in order to learn about the state of the art – Find complimentary partners to increase financial strength – Communicate how the solution fulfils the customers' needs <p>Recommendations for the growth phase:</p> <ul style="list-style-type: none"> • National and local authorities <ul style="list-style-type: none"> – Public buildings as showcases – boosting the demand side – Comprehensive plans for dissemination of advanced renovation including information, education, R&D, quality control and funding – Implement energy labelling and quality assurance systems

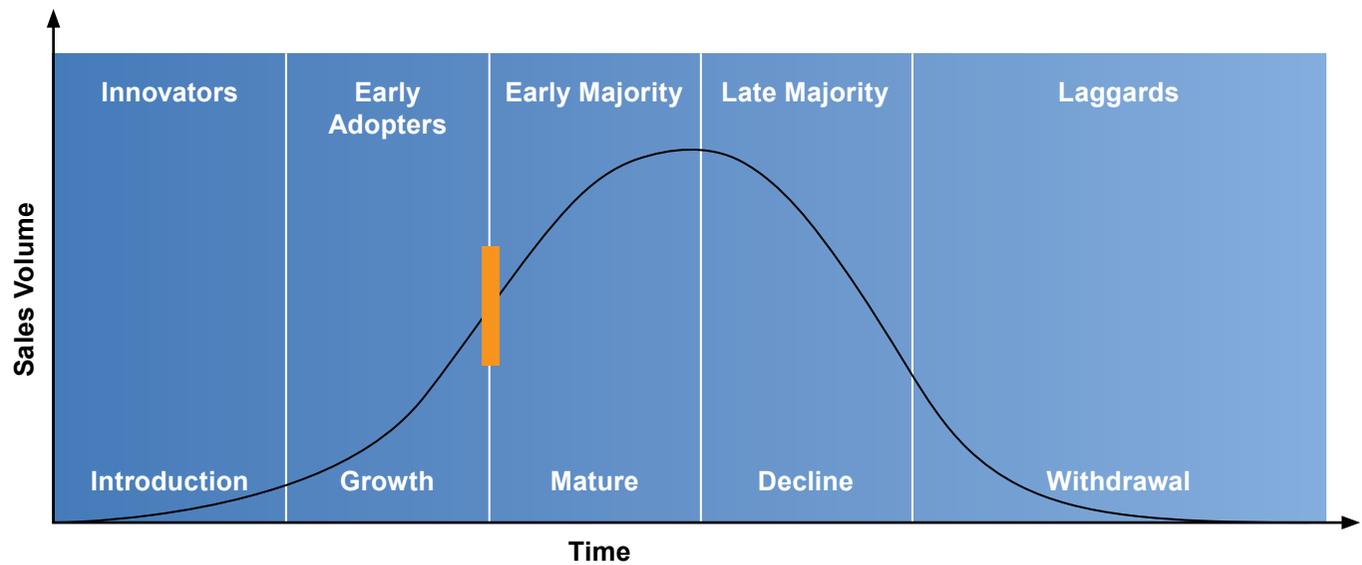
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Ref	Report and General Information	Barriers	Solutio
20		<p>The main barriers in the introduction phase are lack of knowledge, lack of funding and difficulties in attaining the homeowners' interest.</p> <p>Some of the most important barriers in the growth phase are lack of cooperation and coordination, lack of knowledge, and insufficient quality assurance and that the 'added value' is unclear, both on the supply and demand side.</p> <p>Important barriers for crossing the gap to the volume phase are lack of influential and trustworthy forerunners, lack of knowledge of benefits among early majority, difficult decision making processes, legislation and high renovation costs.</p>	<ul style="list-style-type: none"> • Educational institutions <ul style="list-style-type: none"> – Educational programs at all levels, including professional training and development • Early adopter companies (trendsetters) <ul style="list-style-type: none"> – Network through the supply chain by creating arenas for all actors to meet – Use demonstration projects as showcases and learning opportunities – Develop 'one stop shops' for complete solutions directed to owners of detached houses (unprofessional customers) – Implement tools that create advantages for complete solutions <p>Recommendations for crossing the gap to the volume phase:</p> <ul style="list-style-type: none"> • All actors <ul style="list-style-type: none"> – Market attractive and trustworthy examples of well proven solutions from the growth phase with a main focus on rational arguments – Announce advanced renovation as the standard renovation policy • National and local authorities: <ul style="list-style-type: none"> – Strengthen legislation on required level and performance of renovation – Where necessary, change legislation not to hinder renovation (such as issues on investment and rent) – Making the tools and acquired experience available to all actors, for example, calculation tools and prescriptions for concepts, technologies, construction details, etc.

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Ref	Report and General Information	Barriers	Solutions
20			<ul style="list-style-type: none"> • Companies: <ul style="list-style-type: none"> – Reduce prices to open up new markets and enable large scale production – Implement educational programs for in-house consultants, planners and on site workers and / or invest in technology clustering as a way to overcome technology dependant lack of skills and competences • Housing cooperatives: <ul style="list-style-type: none"> – Educate project managers / members how to run advanced renovation projects – Initiate large scale affordable advanced (social) housing renovation projects

Figure 1: Product Life Cycle with Major Actors and Phases



Source: Adapted from Rogers, Diffusion of Innovation

Ref	Report and General Information	Barriers	Solutions
21	<p>IDENTIFYING BARRIERS TO ADDRESS DURING THE DELIVERY OF SUSTAINABLE BUILDING RENOVATION PROJECTS, Corey Cattano, December 2010</p> <p>View PDF</p> <p>A study to identify barriers and potential solutions to renovation in the US.</p> <p>The four most relevant papers used in this study were:</p> <ul style="list-style-type: none"> • Panagiotis Mitropoulos and Gregory Howell's "Renovation Projects: Design Process Problems and Improvement Mechanisms" • Victor Olgyay and Cherlyn Seruto's "Whole-Building Retrofits: A Gateway to Climate Stabilization" • The McGraw-Hill Construction SmartMarket Report on "Green Building Retrofit & Renovation" • Amory Lovins' "Energy-Efficient Buildings: Institutional Barriers and Opportunities" <p>Victor Sanvido and Leland Riggs' "Managing Retrofit Projects" technical report was important in identifying project constraints associated with typical renovation projects</p>	<ul style="list-style-type: none"> • Typical renovation projects do not coordinate energy retrofits with building system renovations, resulting in poor use of resources and inefficient building performance • Interactions between building systems <ul style="list-style-type: none"> – Siloed thinking approach • Financial analysis <ul style="list-style-type: none"> – Design teams use first cost and simple payback more than life cycle cost analysis • Lack of experience, education, and awareness • Budget • Time constraints <ul style="list-style-type: none"> – Time is money – Narrow window of opportunity (holidays for tenants) – Owner has to move out temporarily • Space constraints <ul style="list-style-type: none"> – Physical space available – Access – Disturbance (both of infrastructure functions due to construction, and the disturbance of construction functions due to infrastructure) • Information <ul style="list-style-type: none"> – Limited information about the existing structure – Conditions that cannot be reasonably foreseen such as asbestos or location of utilities • Environment <ul style="list-style-type: none"> – Condition of the existing building may be poor – Existing building components that contain hazardous materials such as asbestos, polychlorinated biphenyl, or lead – Building occupants impose constraints on activities and equipment that produce air or noise pollution 	<ul style="list-style-type: none"> • Reaping multiple benefits from single expenditures and optimizing planned capital costs • Whole-systems thinking can be applied to the delivery processes to optimize the building as a whole for resource and energy efficiency • Select the project team early and accelerate iterative design process with a team-based rapid development of schematic design • Comprehensively analyze life cycle cost and energy together • Reap multiple benefits from single expenditures and optimize the planned capital expenditures • Professional education • Setting effective benchmarks and measures and ensure these benchmarks are met through operation and commissioning. Simulation models using • Building Information Modelling (BIM) software can help the owner estimate a renovation project's future energy performance and track a buildings current performance • Increase project reporting, transparency, and end-user education. Public reporting of such data not only promotes energy efficiency but also creates a competitive environment, especially for commercial building owners • Educating the end-user on behavioural issues that impact building performance • Identify project constraints that design and construction have to meet early in the planning phase and accelerate the discovery of existing conditions • Carry out a thorough inspection of the existing building and exploratory demolition measures in design process <p>These solutions were trialled in a case study, 'Raritan Inn Strategy'.</p>

Ref	Report and General Information	Barriers	Solutions
22	<p>The next frontier for sustainable energy: Tackling the third of homes that are hard to treat, EEPH, January 2008</p>	<p>Hard-to-treat properties require higher investment and more technically challenging improvements. Key barriers are:</p> <ul style="list-style-type: none"> • We need to move on from pilots. The solutions to tackling the hardest to treat homes needs to become part of mainstream action and that requires funding and long-term planning • It's hard for customers to understand product features. They need to be able to compare products on a like for like basis – marketing messages at the moment all highlight different parameters and features. We need to co-ordinate marketing approaches • Though grants are available to install (e.g.) microgeneration measures, there are costs in applying for grants that put many people off such as the time taken to apply and claim the grant • As a sustainable energy industry we need to manage the deployment of new technologies and carefully manage the publicity and expectations around new technologies. Bad exemplars and bad publicity has led to set-backs for the whole industry • We need to ensure that messaging and strategies around carbon reduction are aligned with, rather than in conflict with, strategies and messages around affordable warmth; • There is a basic challenge around raising awareness of new technologies. Potential customers must know that new products and new solutions are out there • Householders may be unaware of cheaper energy tariffs (e.g. Economy10) that can make their homes more affordable to heat; and • We need to help householders manage their energy use as effectively as possible 	<ul style="list-style-type: none"> • Local authorities can be encouraged to include tackling climate change within their local area agreements. • Help products enter the mainstream through the following mechanisms: <ul style="list-style-type: none"> – Government intervention in the market – Collective purchasing of products – making them cheaper – between local authorities or RSLs • Encouraging landlords and owner-occupiers to take advantage of the windows of opportunity for energy efficiency improvements at the time they're making other improvements e.g. re-roofing, planned maintenance • Ensure awareness of effective products by encouraging: <ul style="list-style-type: none"> – Customers to use the appropriate technology in the appropriate setting – Learning from each other and sharing best practice – Ensuring that we put out correct information, e.g. through myth busting publications • We need to build a level playing field to encourage innovation through: <ul style="list-style-type: none"> – Consistent testing standards – Reasonable costs for certification • Shared intelligence / raising awareness: <ul style="list-style-type: none"> – An information portal or one stop shop – A medium of proactively disseminating information to stakeholders and focused, regular collection of information from stakeholders

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Ref	Report and General Information	Barriers	Solutions
22			<ul style="list-style-type: none"> • Working with the Partnership Local Authority Group and EST, clarify the 'rules' on planning for renewable energy technologies • Market transformation <ul style="list-style-type: none"> – Building bridges between the industry players (e.g. manufacturers, distributors and installers) and markets (e.g. social housing landlords and grant scheme managers) • The social housing sector <ul style="list-style-type: none"> – Promote successful pilots and information on new technology to local authorities and housing associations, via Practical help and other media – Consider local authority training and support needs – Investigate and promote outcomes of tenant participation and trials / pilots to help promote the benefits of energy efficiency installations • The private rented sector <ul style="list-style-type: none"> – Ways for energy suppliers to reward landlords for leads to tenants – Lobbying for landlords to be treated as businesses (to receive tax benefits from investment in energy efficiency) – Financial incentives – Licensing of landlords – Green indicators for university guides and approved landlord lists – Raising awareness of HHSRS requirements
23	<p>Heat and Energy Saving Strategy: Delivery Workshops, EEPH, May 2009 and Sept 2009</p>	No barriers or solutions identified	

1.2 Other Reports of Interest

Other reports of potential interest were identified but due to the limited time available these have not been included within the summary

Ref	Report and General Information	
24	Trigger points: a convenient truth Promoting energy efficiency in the home, EST	View Site
25	Green Deal: Opportunities for Industry, CPA and EEPH, April 2012-10-12	View Site
26	Existing Housing – Creating a Roadmap to 2050, EEPH, Oct 2010	
27	Greening UK cities' buildings - Improving the energy efficiency of our offices, shops and factories, All Party Urban Development Group	View PDF
28	Assessing Energy Efficiency, post note number 409, Parliamentary office of science and technology, May 2012	View PDF
29	An introduction to low carbon domestic refurbishment, CPA	View PDF
30	Refurbishing the Nation - Gathering the evidence, National Refurbishment Centre, September 2012	View PDF
31	Low carbon existing homes, UKgbc, October 2008	View PDF
32	DRIVERS AND BARRIERS FOR REGISTERED PROVIDERS, Luke Smith, KTP Associate (Salford University), Oct 2010	
33	Resilient Homes: Reward-based methods to motivate householders to address dangerous climate change, Professor Erik Bichard and Aleksandra Kazmierczak, University of Salford, July 2009	View PDF
34	Retrofit insights: perspectives for an emerging industry, Institute for sustainability, 2012	View PDF

1.3 Companies and Organisations Involved

Companies and Organisations Involved	
Affinity Sutton launched their FutureFit programme to explore the practical challenges of mass retrofit in social housing	View Site
The Association for Environment Conscious Building (AECB) is a network of individuals and companies with a common aim of promoting sustainable building. It brings together builders, architects, designers, manufacturers, housing associations and local authorities, to develop, share and promote best practice in environmentally sustainable building	View Site
The Carbon Co-op is a community benefit co-operative that promotes the development of carbon reduction measures and offers free retrofit surveys for customers	View Site
Constructing Excellence is an organisation aiming to drive change in construction by improving industry performance in order to produce a better built environment	View Site
DECC Green Deal Maximising Energy Efficiency in Buildings Forum – maximising energy efficiency (chaired by Andrew Warren)	
The Energy saving Trust (EST) operates a network of advice centres across England, Scotland, Wales and Northern Ireland. Their main function is to provide residents with free and expert impartial advice about saving energy in the home	View PDF
They also manage the Energy Efficiency Best Practice in Housing programme on behalf of DEFRA	View Site
The Existing Homes Alliance sets out the action required from businesses, housing and environmental organisations and government to put the UK housing stock on the road to deep cuts in carbon emissions and energy bills	View Site (UK) View Site (SCO)
Gentoo were one of five organisations chosen to trial a Government-backed initiative, the Pay As You Save (PAYS) pilot scheme, which was sponsored by the Department of Energy and Climate Change (DECC) aimed at improving the environmental performance of housing stock in the UK	View Site
Green Building Advisor offers advice on building, designing and retrofitting homes	View Site
Greenspec offers advice on building products, design, etc	View Site
Hook Norton Low Carbon Limited (HNLC) is a Co-operative and Community Benefit Society set up to help the community reduce its energy consumption, carbon emissions and save money, with a range of community-based schemes and individual household projects based on interest-free loans	View Site

Companies and Organisations Involved	
Low Carbon Trust is a not-for-profit organisation that was formed in 2001 to set up, manage and promote environmental projects	View Site
Parity projects offer independent low-energy retrofit services to homeowners, housing providers, and the wider building industry. Also, advice, training and project management	View Site
Pacific Gas and Electric Company's (PG&E) offers customized retrofit incentives for business energy efficiency retrofit projects involving the installation of high-efficiency equipment or systems	View Site
Passivhaus Trust is an independent, non-profit organisation that provides leadership in the UK for the adoption of the Passivhaus standard and methodology. It aims to promote the principles of Passivhaus as a highly effective way of reducing energy use and carbon emissions from buildings in the UK, as well as providing high standards of comfort and building health. A new Passivhaus refurbishment standard has been introduced, "EnerPHit"	View Site
Solarcrest are a company offering complete ECO retrofits (one-stop-shop)	View Site
SuperHomes is a campaign run by the Sustainable Energy Academy (SEA). By establishing a network of retrofit 'show homes' up and down the country, their aim is to share experienced based knowledge	View Site
Sustainable Housing Action Partnership (SHAP) – their vision is to provide leadership in sustainable housing by promoting, researching and disseminating best practice in the environmental, social and economic aspects of sustainable housing. Supported by partners from leading Social Housing providers, contractors and suppliers including RSLs, ALMOS and Local Authority Housing Services, together with housing bodies and builders merchants	Visit Site
Technology Strategy Board - the UK's innovation agency http://www.innovateuk.org/ During 2009-2010, the Technology Strategy Board implemented a £17m programme known as Retrofit for the Future (RfF), to kick-start the retrofitting of the UK's social housing stock. This became the low energy building database	View Site
The University of Salford and Property Tectonics have developed the "Carbon in homes driving license", an on-line training course that provides a foundation level introduction to the national quest to reduce the carbon footprint of our homes	View Site
Verco (formerly Camco Advisory Services), providing consultancy services on energy, carbon and climate change, helped establish the Existing Homes Alliance, which sets out the action required from businesses, housing and environmental organisations and government to put the UK housing stock on the road to deep cuts in carbon emissions and energy bills	View Site
Willmott Dixon has produced a retrofit brochure outlining their work on whole house retrofits	View PDF

Section 2: Full list of Barriers Identified from Initial Workshop and Desk Based Research

Category	Sub-Category	Barrier	Source
Economics	Economic Situation	Trends	Workshop
Economics	Economic Situation	Disposable income	Workshop
Economics	Economic Situation	Economic situation in the UK (household budgets / unemployment)	Workshop
Economics	Economic Situation	Lower consumer spending on renovations	Research, Report 16
Economics	Cost	Cost	Workshop and Research, Report 2
Economics	Cost	Cost – the considerable cost of what is essentially a ‘distress purchase;’	Research, Report 13
Economics	Cost	Very expensive to do whole-house refurbishments (whether done in one go or in piecemeal)	Workshop
Economics	Cost	An important barrier for crossing the gap to the volume phase is high renovation costs	Research, Report 20
Economics	Cost	Upfront capital cost (even Green Deal won’t fully cover)	Workshop and Research, Report 10
Economics	Cost	Upfront costs of measures and access to capital (only partly addressed by Green Deal)	Research, Report 8
Economics	Cost	Not affordable	Workshop
Economics	Cost	Current upgrades have been expensive	Research, Report 1
Economics	Cost	Total cost (ave £25,000 per house)	Workshop
Economics	Cost	The main barrier to the installation of Solid Wall Insulation and some other forms of insulation is cost	Research, Report 14
Economics	Cost	Costs! – capital and maintenance	Workshop
Economics	Cost	High cost / long payback	Workshop

Category	Sub-Category	Barrier	Source
Economics	Cost	Energy efficiency renovations generally call for substantial additional up-front investments and savings are spread over many years	Research, Report 19
Economics	Cost	Length of payback times	Research, Report 8
Economics	Cost	Is it known what will it cost → what should it cost?	Workshop
Economics	Cost	The long payback period on capital expenditure	Research, Report 15
Economics	Cost	Pay back periods of some renewable technologies	Research, Report 2
Economics	Cost	Budget	Research, Report 21
Economics	Funding	Access to funding	Research, Report 3
Economics	Funding	Increased building renovation with a high level of energy efficiency faces various barriers for implementation, such as the need for upfront financing	Research, Report 18
Economics	Funding	Lack of, or difficult to access funding	Research, Report 2
Economics	Funding	Lack of low cost finance	Workshop
Economics	Funding	Lack of availability of finance for house purchasing and renovations	Research, Report 16
Economics	Funding	Green Deal Finance Company interest rate of 7% higher than mortgage rates	Workshop
Economics	Funding	Finance – 9% GD → lowest 5.6% loan can not obtain – restrictive	Workshop
Economics	Funding	Cost of Green Deal loans and interest rates	Research, Report 14
Economics	Funding	Cash to invest – less	Workshop
Economics	Funding	Cost: for many energy-saving measures, cost is not the primary barrier, finding the cash for insulation, new windows or a new boiler is a challenge for many householders	Research, Report 24
Economics	Funding	ECO funding levels not enough to achieve Golden Rule	Workshop

Category	Sub-Category	Barrier	Source
Economics	Funding	Complexity of funding arrangements	Research, Report 1
Economics	Funding	Though grants are available to install (e.g.) micro-generation measures, there are costs in applying for grants that put many people off such as the time taken to apply and claim the grant	Research, Report 22
Economics	Associated Costs	Survey / cost of assessment and this not being seen of value	Workshop
Economics	Associated Costs	VAT	Workshop
Economics	Associated Costs	The cost-energy efficiency balance	Research, Report 2
Economics	Associated Costs	Cost-effectiveness	Workshop
Economics	Associated Costs	Cost effectiveness to build in	Workshop
Economics	Associated Costs	Cost of extras not funded by ECO for EWI / IWI	Workshop
Economics	Associated Costs	Redecoration costs not included	Workshop
Economics	Associated Costs	High failure rate costs	Workshop
Economics	Associated Costs	Cost and challenges of finding Hard To Treat cavities	Workshop
Economics	Associated Costs	Maintenance Costs	Workshop
Economics	Economies of Scale	Unless economies of scale (and concentration) can be achieved the cost of delivering programmes will be too high and additional Government subsidy will be needed	Research, Report 4
Economics	Economies of Scale	The main barrier to the installation of Solid Wall Insulation and some other forms of insulation is cost	Workshop
Economics	Economies of Scale	Lack of community deals	Research, Report 15
Economics	Economies of Scale	Sales of micro-generation technologies are currently low and so there are few economies of scale that would be associated with mass market products	Research, Report 15

Category	Sub-Category	Barrier	Source
Economics	Property Value	No value of Energy Efficiency in house prices (yet)	Workshop
Economics	Property Value	Value when complete	Workshop
Economics	Property Value	Will my house value increase?	Workshop
Economics	Property Value	Energy performance not reflected in property value (in both the lettings and the sales market)	Research, Report 8
Economics	Energy Prices	Energy prices	Workshop
Economics	Energy Prices	Absence of much higher energy prices	Research, Report 8
Economics	Energy Prices	For many energy bills are still a small % of household expenditure	Workshop
Economics	Energy Prices	Energy still seen as affordable	Workshop
Economics	Analysis	Economic viability: energy savings are often calculated on current prices or wrong assumptions making savings appear to be much less than potentially could be	Research, Report 19
Economics	Analysis	Financial analysis - Design teams use first cost and simple payback more than life cycle cost analysis	Research, Report 21
Economics	Analysis	Energy efficiency is a fairly intangible asset, physically hidden and hard to quantify	Research, Report 8
Economics	Other	Issues with balance sheet constraints, liquidity and risk acting as barriers to private firms investing	Research, Report 8
Education and Skills	Skills	Skills	Workshop
Education and Skills	Skills	Shortage of skills	Workshop
Education and Skills	Skills	Lack of knowledge and skills	Workshop
Education and Skills	Skills	Sufficient technical skills (e.g. surveyors)	Workshop
Education and Skills	Skills	Lack of building designer skills. Lack of skills on site	Workshop

Category	Sub-Category	Barrier	Source
Education and Skills	Skills	Installer expertise	Research, Report 2
Education and Skills	Skills	Trades	Workshop
Education and Skills	Skills	Not many tradesman for retrofit	Workshop
Education and Skills	Skills	As the sector grows there will be a requirement for higher numbers of skilled technicians to install and maintain microgeneration systems.	Research, Report 15
Education and Skills	Multi-Skills	Few experts that understand all the issues	Workshop
Education and Skills	Multi-Skills	Few multi-skilled installers	Workshop
Education and Skills	Knowledge	Limited knowledge. Skills are not the main issue	Workshop
Education and Skills	Knowledge	Lack of knowledge	Research, Report 2
Education and Skills	Knowledge	Lack of knowledge – presumption we do know what to do!	Workshop
Education and Skills	Knowledge	A general lack of education and knowledge on Energy Efficiency products and / or services	Research, Report 17
Education and Skills	Knowledge	Do we know enough about how Whole House Retrofit actually works (affects buildings)?	Workshop
Education and Skills	Knowledge	Knowledge amongst industry and trades of how it all fits together	Workshop
Education and Skills	Knowledge	Lack of experience, education, and awareness	Research, Report 21
Education and Skills	Knowledge	Builders are confident in their energy-efficiency knowledge, but not always sure when or how to offer it	Research, Report 24
Education and Skills	Training	What training is required and how can local builders access this?	Workshop
Education and Skills	Training	Up skilling of local labour force – accreditations for installation	Research, Report 1
Education and Skills	Training	Training of staff and tenants	Research, Report 3

Category	Sub-Category	Barrier	Source
Education and Skills	Training	Need for education and training in the use of sustainable energy technologies and their economic, social and environmental benefits	Research, Report 3
Education and Skills	Training	Installers in this sector have an ageing profile and that there is a need to introduce training and apprenticeship schemes to make sure installation skills are not lost to the industry	Research, Report 13
Education and Skills	Training	As the requirement to insulate solid wall homes becomes more of a priority, there will be a need to develop appropriate training courses to deliver the skills required for solid wall insulation	Research, Report 14
Education and Skills	Training	Further development of technology and skills will also be required to address other challenges, such as difficult to treat cavity walls and suspended floors	Research, Report 14
Education and Skills	Quality	Skills issue: poor installations = poor quality	Workshop
Education and Skills	Quality	Quality of product / work – accreditation	Workshop
Political	Government	Government	Workshop
Political	Government	Lack of clarity from Government (market mechanics, but no real push)	Workshop
Political	Government	No long term vision from Government	Workshop
Political	Government	Lack of policy vision and coordination (coherence)	Workshop
Political	Government	Lack of transparency, longevity and certainty in policy design to drive a healthy trajectory for market growth	Research, Report 8
Political	Government	Roadmap	Workshop
Political	Government	Government plan – no plan – not robust enough	Workshop
Political	Government	Lack of Government plan or debate	Workshop
Political	Government	Not on Government agenda	Workshop

Category	Sub-Category	Barrier	Source
Political	Government	The industry requires clear signals on the post 2011 landscape. Without such signals there is a risk that the products, skills and resources will not be maintained	Research, Report 14
Political	Government	Legislation	Workshop
Political	Government	Lack of legislation	Research, Report 3
Political	Government	Not really on Government agenda. Answer = heat pumps	Workshop
Political	Government	Priority from Carbon Plan and Carbon Budgets is on microgen plus grid de-carbonisation. Refurbishment needs to be given the same national importance / priority	Workshop
Political	Government	Further incentives are required	Workshop
Political	Government	Insufficient 'push' under current Government schemes such as the Carbon Emissions Reduction Target (CERT)	Research, Report 13
Political	Government	Funding = red tape	Workshop
Political	Government	Stop / start grants	Workshop
Political	Government	We need to ensure that messaging and strategies around carbon reduction are aligned with, rather than in conflict with, strategies and messages around affordable warmth	Research, Report 22
Political	Planning / Conservation	Planning permission requirements	Workshop and Research, Report 7
Political	Planning / Conservation	Planning laws restricting developments	Research, Report 15
Political	Planning / Conservation	Planning listed buildings – AONB restrictions	Workshop
Political	Planning / Conservation	Planners! Conservation areas restrictive policy	Workshop
Political	Planning / Conservation	Planning and aesthetics = constraints	Workshop

Category	Sub-Category	Barrier	Source
Political	Planning / Conservation	Conflicts of interest between the protection of listed buildings and conservation areas (preservation orders) and the demand for energy-related refurbishments	Research, Report 19
Political	Planning / Conservation	Need Environmental Health on side i.e. conservation areas	Workshop
Political	Planning / Conservation	Legal restrictions due to neighbours' rights might hinder external insulation	Research, Report 19
Political	Green Deal	Green Deal will be a distraction	Workshop
Political	Green Deal	No PR plan by Government, to sell the scheme (market driven)	Workshop
Political	Green Deal	Golden rule precludes whole house	Workshop
Political	Green Deal	Too many eggs in the Green Deal basket (if no Green Deal, opportunity lost?)	Workshop
Political	Green Deal	Green Deal finance and the new consumer protection framework are enablers but offer neither a carrot nor a stick	Research, Report 9
Political	Green Deal	Green Deal not well suited to Whole House Retrofit (particularly timing)	Workshop
Political	Green Deal	DIY not included within the policy	Workshop
Political	Green Deal	Whole House refurbishment clearly goes beyond Green Deal. Is Government serious about going beyond GD?	Workshop
Political	Standards	Low minimum standards	Research, Report 2
Political	Standards	No legislative or local requirements to go beyond building regulations	Research, Report 3
Political	Policy	An important barrier for crossing the gap to the volume phase is legislation	Research, Report 20
Political	Policy	In England and Wales, consequential improvements only apply for buildings over 1000m ² – which excludes the vast majority of homes	Research, Report 24
Political	Policy	Ban on renting poor homes too little too late (2018)	Workshop
Consumer	Consumer	Homeowners	Workshop

Category	Sub-Category	Barrier	Source
Consumer	Consumer	Hard to find customers	Workshop
Consumer	Consumer	Accessing vulnerable customers (who may need it the most)	Workshop
Consumer	Consumer	Who is the pioneering audience? - early adopters	Workshop
Consumer	Consumer	How to create a market place – targeting? Audience (rich)	Workshop
Consumer	Awareness / Information	Lack of awareness	Workshop
Consumer	Awareness / Information	Lack of awareness and interest	Research, Report 9
Consumer	Awareness / Information	An important barrier for crossing the gap to the volume phase is a lack of knowledge of benefits among early majority	Research, Report 20
Consumer	Awareness / Information	Information and awareness: many homeowners simply aren't aware of key measures, or overestimate the cost and trouble involved	Research, Report 24
Consumer	Awareness / Information	Lack of client: awareness, interest, understanding	Workshop
Consumer	Awareness / Information	Lack of awareness of technologies	Workshop
Consumer	Awareness / Information	Lack of consumer awareness of the benefits of more energy efficient technology and the use of advanced controls;	Research, Report 13
Consumer	Awareness / Information	SWI and IWI both suffer from low public awareness	Research, Report 14
Consumer	Awareness / Information	There is a basic challenge around raising awareness of new technologies. Potential customers must know that new products and new solutions are out there	Research, Report 22
Consumer	Awareness / Information	It's hard for customers to understand product features. They need to be able to compare products on a like for like basis – marketing messages at the moment all highlight different parameters and features. We need to co-ordinate marketing approaches	Research, Report 22
Consumer	Awareness / Information	Unfamiliarity or awareness of the benefits of such technologies	Research, Report 2

Category	Sub-Category	Barrier	Source
Consumer	Awareness / Information	Lack of promotion and therefore low public awareness of the benefits of micro-generation technologies	Research, Report 15
Consumer	Awareness / Information	Lack of knowledge	Workshop
Consumer	Awareness / Information	An important barrier in the growth phase is a lack of knowledge	Research, Report 20
Consumer	Awareness / Information	Customer (home owner / occupier) confidence / knowledge	Workshop
Consumer	Awareness / Information	Uneducated occupiers over renewable? Maintenance – see it on a save all	Workshop
Consumer	Awareness / Information	Lack of information	Workshop
Consumer	Awareness / Information	Understanding	Workshop
Consumer	Awareness / Information	Customer lack of understanding opportunities	Workshop
Consumer	Awareness / Information	Lack of consumer understanding (and concern)	Workshop
Consumer	Awareness / Information	Lack of independent advice	Workshop
Consumer	Awareness / Information	Consistent advice not available	Workshop
Consumer	Awareness / Information	Do we know who should lead in stimulating interest / demand?	Workshop
Consumer	Awareness / Information	Marketing	Workshop
Consumer	Awareness / Information	Lack of Above The Line marketing / awareness campaign	Workshop
Consumer	Awareness / Information	Awareness of benefits	Workshop
Consumer	Awareness / Information	Awareness – perceptions – not interested	Workshop
Consumer	Awareness / Information	Don't know how to go about it	Workshop
Consumer	Awareness / Information	General public unaware of Green Deal	Workshop
Consumer	Awareness / Information	Lack of householder awareness of the Green Deal	Workshop

Category	Sub-Category	Barrier	Source
Consumer	Awareness / Information	The main barriers in the introduction phase are lack of knowledge, lack of funding and difficulties in attaining the homeowners' interest	Research, Report 20
Consumer	Demand	Lack of consumer demand	Workshop
Consumer	Demand	lack of end user demand for energy efficient homes	Research, Report 2 and 3
Consumer	Demand	30% of households ('laggards') would not install energy efficiency measures even if they were free of charge	Research, Report 8
Consumer	Incentives	Un-sexy	Workshop
Consumer	Incentives	Lack of incentives	Workshop
Consumer	Incentives	Lack of incentives for households (sticks and carrots)	Workshop
Consumer	Incentives	Lack of incentive to prioritise – against competing demands for time and money...	Workshop
Consumer	Incentives	Renovations are in direct competition with other expenses (vacation, car) or needs (health, living in the case of retired owners)	Research, Report 19
Consumer	Incentives	Limited incentive – Fuel bills, NIMBY's, wellbeing...	Workshop
Consumer	Incentives	Prioritisation – food vs. car vs. refit	Workshop
Consumer	Incentives	Unseen gain – kitchen / driveway / conservatory vs. IWI / boiler / floor insulation	Workshop
Consumer	Incentives	Opportunity cost of capital – which means energy efficiency investments are competing with other more attractive spending opportunities such as new bathrooms, kitchens or cars	Research, Report 8
Consumer	Incentives	People don't value low energy bills as much as other things	Workshop
Consumer	Incentives	Low value is placed on energy efficiency improvements	Research, Report 8
Consumer	Incentives	Savings in energy efficiency have not been the priority	Research, Report 1
Consumer	Incentives	Lack of recognition of the increasing importance of sustainable energy	Research, Report 2

Category	Sub-Category	Barrier	Source
Consumer	Incentives	No perceived added value	Workshop
Consumer	Incentives	An important barrier in the growth phase is that the 'added value' is unclear, both on the supply and demand side	Research, Report 20
Consumer	Incentives	Homeowners don't know how little energy an energy-efficient home could use	Workshop
Consumer	Incentives	Consumers aren't interested – not a priority	Workshop
Consumer	Incentives	Triggers	Workshop
Consumer	Incentives	Trigger points identification and exploitation e.g. void / new kitchen	Workshop
Consumer	Incentives	With the exception of windows and flat roofs, most buildings can be operated and lived in with hardly any restrictions or problems for decades even without additional insulations. Hence, energy efficiency improvements are generally not triggered by technical factors	Research, Report 19
Consumer	Incentives	Comfort – undersold	Workshop
Consumer	Incentives	Perceived need	Workshop
Consumer	Incentives	Customer perceived need – not enough	Workshop
Consumer	Incentives	Other household priorities	Workshop
Consumer	Incentives	Not worth doing	Workshop
Consumer	Incentives	Understanding the benefits – general public	Workshop
Consumer	Incentives	If I don't get a financial benefit, what do I get after the hassle?	Workshop
Consumer	Incentives	Long term savings were lower than expected – and this put off one half of interested homeowners from signing up to the scheme	Research, Report 7
Consumer	Incentives	Do we need to retrofit? – Government policy – save where we can	Workshop
Consumer	Incentives	Too much emphasis on carbon (and £)	Workshop

Category	Sub-Category	Barrier	Source
Consumer	Incentives	Lack of trust	Research, Report 9
Consumer	Incentives	Trust of assessors, energy companies, builders, etc	Workshop
Consumer	Incentives	Advisers competition is man in pub	Workshop
Consumer	Incentives	Trust in installers (rogue traders, well known brands absent)	Workshop
Consumer	Trust	I can't find trusted skilled builders and suppliers	Workshop
Consumer	Trust	Retrofit sector is negatively associated with poor quality as well as an unsafe and unhealthy working environment	Research, Report 12
Consumer	Trust	Cowboy view by homeowners	Workshop
Consumer	Trust	I can't find trusted sources for advice	Workshop
Consumer	Trust	Breakdown of trust with institutions – Government / corporates	Workshop
Consumer	Trust	Why should I trust to Government promising probable break even in 25 years?	Workshop
Consumer	Trust	Bad press arising from failed projects	Workshop
Consumer	Trust	Bad publicity – news on EWI	Workshop
Consumer	Trust	Trust in people	Workshop
Consumer	Trust	Too many 'greenwash' or poor products	Workshop
Consumer	Trust	Fear of miss-selling	Workshop
Consumer	Trust	Fear of problems with installations	Workshop
Consumer	Trust	Fear of vandalism or damage to 'different' installations	Research, Report 2
Consumer	Trust	Client fear – less floor area – damage to character – building defects	Workshop
Consumer	Trust	After the upgrade, what will my house look like?	Workshop

Category	Sub-Category	Barrier	Source
Consumer	Trust	Won't the upgrades spoil my house?	Workshop
Consumer	Trust	Householder risk	Workshop
Consumer	Trust	Homeowner culture of poor health issues with improvement i.e. air tightness	Workshop
Consumer	Trust	Lack of consumer trust and confidence. In the UK, additional consideration needs to be given to preventing mould and damp that can occur from increased insulation and poor ventilation	Research, Report 11
Consumer	Trust	Uncertainty – inertial scepticism	Workshop
Consumer	Trust	Generational barriers against using alternative construction or new technologies over those more familiar - the need to modernise peoples thinking	Research, Report 2
Consumer	Complexity	Different messages	Workshop
Consumer	Complexity	Differing messages from those marketing to building owners	Workshop
Consumer	Complexity	Measures seen as “specialist” and not available from local builders	Workshop
Consumer	Complexity	Age of tenants (particularly if elderly) - unable to use new technologies effectively or maintain systems on a day to day basis	Research, Report 2
Consumer	Complexity	Fears over the maintenance and repair of systems	Research, Report 2
Consumer	Complexity	Complexity of selling electricity back to the grid	Research, Report 15
Consumer	Complexity	An important barrier for crossing the gap to the volume phase is difficult decision making processes	Research, Report 20
Consumer	Resistance	Imposing a change to lifestyle	Workshop
Consumer	Resistance	Householder resistance to a charge on their property	Workshop
Consumer	Resistance	Householder perception of disruption to have works installed	Workshop
Consumer	Resistance	Homeowners don't want to be put out – nuisance factor – busy lifestyles	Workshop

Category	Sub-Category	Barrier	Source
Consumer	Resistance	Hassle: with a perception that the work will be disruptive, and uncertainty over the benefits, many homeowners find that acting on energy isn't a priority for them	Research, Report 24
Consumer	Resistance	Negative perceptions	Workshop
Consumer	Resistance	Householder doubt / mistrust of Government energy eff. Schemes = FIT	Workshop
Consumer	Resistance	Concerns over placing large debt on home	Workshop
Consumer	Resistance	Too acceptable / normal to be wasteful	Workshop
Consumer	Resistance	Apathy	Workshop
Consumer	Resistance	Complacency	Research, Report 9
Consumer	Resistance	Laissez-faire attitude of general public	Workshop
Consumer	Resistance	Aesthetic – PV is considered ugly	Workshop
Consumer	Resistance	Pride in the estate and properties - changes to external appearances of buildings	Research, Report 1
Consumer	Resistance	Major measures such as solid wall insulation were viewed as unattractive by many homeowners due to length of payback and the disruption involved	Research, Report 7
Consumer	Ownership	Ownership – PRS / Short-termism	Workshop
Consumer	Ownership	Average homeownership is only 10 years in the UK and a full package of retrofit measures is likely to take much longer than that to pay back	Research, Report 8
Consumer	Ownership	Increased building renovation with a high level of energy efficiency faces various barriers for implementation, such as investor / user conflict	Research, Report 18
Consumer	Ownership	Decision: multiple people have to be persuaded	Workshop
Coordination / Supply Chain	Supply Chain	Fragmented supply chain – no 'one stop shops'	Workshop

Category	Sub-Category	Barrier	Source
Coordination / Supply Chain	Supply Chain	The supply chain is fractured and critical components are often shipped from overseas	Research, Report 17
Coordination / Supply Chain	Supply Chain	Undeveloped supply chains for alternative and sustainable energy technologies (size of industry)	Research, Report 2
Coordination / Supply Chain	Supply Chain	Can't get everything in one place	Workshop
Coordination / Supply Chain	Supply Chain	Industry currently single product focussed	Workshop
Coordination / Supply Chain	Supply Chain	Piecemeal solution delivery	Workshop
Coordination / Supply Chain	Supply Chain	Siloed thinking approach	Research, Report 21
Coordination / Supply Chain	Supply Chain	'Salami' sliced procurement starting goals lost	Workshop
Coordination / Supply Chain	Supply Chain	Lack of joint working → small examples	Workshop
Coordination / Supply Chain	Supply Chain	Firms only supply products	Workshop
Coordination / Supply Chain	Supply Chain	Divided trades on site – no control over interface – no coordination	Workshop
Coordination / Supply Chain	Supply Chain	Supply chain resistance	Workshop
Coordination / Supply Chain	Supply Chain	Supply chain is only now being developed	Workshop
Coordination / Supply Chain	Supply Chain	Do we have supply chain (trades) to deliver?	Workshop

Category	Sub-Category	Barrier	Source
Coordination / Supply Chain	Supply Chain	Insufficient level of trust in effective joint working	Workshop
Coordination / Supply Chain	Supply Chain	Trust that improvement works will be carried out to a high standard and that everyone will share in the benefits	Research, Report 4
Coordination / Supply Chain	Supply Chain	Typical renovation projects do not coordinate energy retrofits with building system renovations, resulting in poor use of resources and inefficient building performance	Research, Report 21
Coordination / Supply Chain	Supply Chain	Who's in for the short game only – the 'cowboys' ('gold rush' syndrome)	Workshop
Coordination / Supply Chain	Supply Chain	Technologies are not seen to be proven	Research, Report 2
Coordination / Supply Chain	Supply Chain	Split incentive	Workshop
Coordination / Supply Chain	Supply Chain	Some client just look on a way of compliance – i.e. energy suppliers see it as a necessary evil	Research, Report 9
Coordination / Supply Chain	Supply Chain	An important barrier in the growth phase is a lack of cooperation and coordination	Research, Report 20
Coordination / Supply Chain	Supply Chain	Suppliers only providing half the solution – not noting downsides or ways to get around the problem	Workshop
Coordination / Supply Chain	Capacity	Increased building renovation with a high level of energy efficiency faces various barriers for implementation, such as necessary building capacity	Research, Report 18
Coordination / Supply Chain	Capacity	Size of supply chain	Research, Report 7
Coordination / Supply Chain	Capacity	Wider lack of industry capacity	Workshop
Coordination / Supply Chain	Capacity	Lack of reliable suppliers available to assist with planning and carrying out work	Research, Report 8

Category	Sub-Category	Barrier	Source
Coordination / Supply Chain	Complexity	Scope of works in whole house retrofit extremely challenging for programming	Research, Report 1
Coordination / Supply Chain	Complexity	Project management of multiple measures	Workshop
Coordination / Supply Chain	Complexity	Is whole house a desirable objective?	Workshop
Coordination / Supply Chain	Complexity	Definition of 'whole house' retrofit	Workshop
Coordination / Supply Chain	Complexity	Lack of agreed terminology around 'whole house'	Workshop
Coordination / Supply Chain	Complexity	Multiple consents needed	Workshop
Coordination / Supply Chain	Complexity	Approvals process (more than one decision maker)	Workshop
Coordination / Supply Chain	Complexity	Different customers with different needs	Workshop
Coordination / Supply Chain	Complexity	Each case is different	Workshop
Coordination / Supply Chain	Complexity	Co-ordination of system installation (don't destroy what's already been done)	Workshop
Coordination / Supply Chain	Complexity	The installation of some measure can have significant knock-on effects on performance of other measures and create issues with moisture, etc	Research, Report 5
Coordination / Supply Chain	Complexity	Measures installed could be damaged by subsequent trades not understanding the requirements	Research, Report 5
Coordination / Supply Chain	Complexity	Few integrated solutions	Workshop

Category	Sub-Category	Barrier	Source
Coordination / Supply Chain	Complexity	Cost effectiveness of applying multiple measures – reducing effect	Workshop
Coordination / Supply Chain	Complexity	Interactions between building systems	Research, Report 21
Coordination / Supply Chain	Complexity	Variety of suppliers involved and possible delays to completion targets	Research, Report 2
Coordination / Supply Chain	Complexity	Existing stock improvement programmes will need to be tailored to the distinct property archetypes found in each local area, and in response to the distinct concerns and aspirations of owner occupiers and landlords in each local community	Research, Report 4
Coordination / Supply Chain	Complexity	Refurbishment programmes will need to reach out to all tenures of housing, each of which create different challenges in seeking to coordinate improvement works	Research, Report 4, Report 2
Coordination / Supply Chain	Complexity	Very quick wins not exploited e.g. controls	Workshop
Coordination / Supply Chain	Design	Design	Workshop
Coordination / Supply Chain	Design	Design system performance. Not components	Workshop
Coordination / Supply Chain	Design	Lack of holistic thinking – lack of whole house plan	Workshop
Coordination / Supply Chain	Design	No integrated provision of design and delivery	Workshop
Coordination / Supply Chain	Design	Few people who can help households create and deliver a plan	Workshop
Coordination / Supply Chain	Design	Incomplete understanding of full range of measures available	Workshop

Category	Sub-Category	Barrier	Source
Coordination / Supply Chain	Design	Awareness of the architects designing new developments	Research, Report 2
Coordination / Supply Chain	Design	Do designers understand how measures will work together?	Workshop
Coordination / Supply Chain	Design	The need for integration from the early design stage	Research, Report 2
Coordination / Supply Chain	Design	Designers / installers not aware of detrimental impact of actions i.e. thermal bridging – hence only after one solution	Workshop
Coordination / Supply Chain	Longterm View	No long term view → or planning	Workshop
Coordination / Supply Chain	Longterm View	Future proofing view	Workshop
Coordination / Supply Chain	Longterm View	Supply chain focus of short term	Workshop
Coordination / Supply Chain	Surveys	No two existing houses are the same and certain measures are not suitable for some houses or locations. A refurbishment project should not be undertaken without a comprehensive survey of the house	Research, Report 5
Coordination / Supply Chain	Surveys	Too many surveys / visits	Workshop
Coordination / Supply Chain	Surveys	Number of surveys	Workshop
Coordination / Supply Chain	SMEs	Lack of and need for SME role in GD (trust and triggers)	Workshop
Coordination / Supply Chain	SMEs	The study found that the Energy Efficiency sector sees a strong prevalence of region-based micro-businesses, employing a limited number of people, working on small turnovers and basically concentrated on the regional market	Research, Report 17

Category	Sub-Category	Barrier	Source
Coordination / Supply Chain	SMEs	Regional businesses provide a skewed and unequal coverage of the wide range of available measures	Research, Report 17
Coordination / Supply Chain	SMEs	Regional businesses find bidding and participating in publicly funded Energy Efficiency large-scale projects difficult	Research, Report 17
Coordination / Supply Chain	SMEs	Most of the work related to publicly funded projects seems to go to large contractors	Research, Report 17
Coordination / Supply Chain	SMEs	Implementation, verification, accreditation and commercialisation of new technology are often too onerous and costly for small businesses	Research, Report 17
Disruption / Practical Installation Issues	Technical Complexity	Hard to treat properties	Workshop
Disruption / Practical Installation Issues	Technical Complexity	Hard-to-treat properties require higher investment and more technically challenging improvements	Research, Report 22
Disruption / Practical Installation Issues	Technical Complexity	Ignorance of building physics	Workshop
Disruption / Practical Installation Issues	Technical Complexity	Internal wall insulation – kitchens etc stairs / doorways	Workshop
Disruption / Practical Installation Issues	Technical Complexity	Retrofit installers need to understand from the outset that every home is unique and that there won't be a one size fits all energy retrofit solution	Research, Report 7
Disruption / Practical Installation Issues	Technical Complexity	Generic or property specific?	Workshop
Disruption / Practical Installation Issues	Disruption	Inconvenience and disruption	Research, Report 9
Disruption / Practical Installation Issues	Disruption	Disruption!	Workshop
Disruption / Practical Installation Issues	Disruption	Disruption – noise, dust, upheaval	Workshop

Category	Sub-Category	Barrier	Source
Disruption / Practical Installation Issues	Disruption	Disruption to home owners	Workshop
Disruption / Practical Installation Issues	Disruption	Disruption – installation is likely to be disruptive to a household	Research, Report 13
Disruption / Practical Installation Issues	Disruption	Perceived as very disruptive	Workshop
Disruption / Practical Installation Issues	Disruption	Disruption of measures (SWI, under floor insulation, etc.)	Workshop
Disruption / Practical Installation Issues	Disruption	Internal insulation measures can be intrusive and disruptive	Research, Report 1
Disruption / Practical Installation Issues	Disruption	Renewable technologies are expensive and disruptive	Research, Report 15
Disruption / Practical Installation Issues	Disruption	Disruption associated with multiple measures	Workshop
Disruption / Practical Installation Issues	Disruption	Decanting	Workshop
Disruption / Practical Installation Issues	Disruption	Owner has to move out temporarily	Research, Report 21
Disruption / Practical Installation Issues	Disruption	The works are often very inconvenient	Workshop
Disruption / Practical Installation Issues	Disruption	Hassel	Workshop
Disruption / Practical Installation Issues	Disruption	Hassle associated with “whole house” retrofit	Workshop
Disruption / Practical Installation Issues	Disruption	The hassle factor i.e. the disruption caused by major refurbishment and the perceived risks in implementing retrofits due to the complexity of projects and lack of familiarity with some of the technologies required	Research, Report 8

Category	Sub-Category	Barrier	Source
Disruption / Practical Installation Issues	Disruption	Mess	Workshop
Disruption / Practical Installation Issues	Disruption	Time of the process	Workshop
Disruption / Practical Installation Issues	Disruption	Decoration	Workshop
Disruption / Practical Installation Issues	Disruption	Building occupants impose constraints on activities and equipment that produce air or noise pollution	Research, Report 21
Disruption / Practical Installation Issues	Disruption	Lofts are for storing overspill not insulation – storage	Workshop
Disruption / Practical Installation Issues	Installation	On-site production is inefficient with regard to cost and construction time	Research, Report 12
Disruption / Practical Installation Issues	Installation	Internal wall insulation potentially reduces the living area and necessitates redecorating which is again disruptive	Research, Report 14
Disruption / Practical Installation Issues	Installation	Different measures will often be competing for the same space	Research, Report 15
Disruption / Practical Installation Issues	Installation	Space constraints	Research, Report 21
Disruption / Practical Installation Issues	Installation	Physical space available	Research, Report 21
Disruption / Practical Installation Issues	Installation	Access	Research, Report 21
Disruption / Practical Installation Issues	Installation	Disturbance (both of infrastructure functions due to construction, and the disturbance of construction functions due to infrastructure)	Research, Report 21
Disruption / Practical Installation Issues	Installation	Limited information about the existing structure	Research, Report 21

Category	Sub-Category	Barrier	Source
Disruption / Practical Installation Issues	Installation	Conditions that cannot be reasonably foreseen such as asbestos or location of utilities	Research, Report 21
Disruption / Practical Installation Issues	Installation	Condition of the existing building may be poor	Research, Report 21
Disruption / Practical Installation Issues	Installation	Existing building components that contain hazardous materials such as asbestos, polychlorinated biphenyl, or lead	Research, Report 21
Disruption / Practical Installation Issues	Time	Time constraints	Research, Report 21
Disruption / Practical Installation Issues	Time	Time is money	Research, Report 21
Disruption / Practical Installation Issues	Time	Narrow window of opportunity (holidays for tenants)	Research, Report 21
Disruption / Practical Installation Issues	Quality Assurance	Assurance of performance – system + workmanship	Workshop
Disruption / Practical Installation Issues	Quality Assurance	Quality control	Workshop
Disruption / Practical Installation Issues	Quality Assurance	Restriction / compliance with third party accreditation i.e. BBA on Hard To Treat Cavities	Workshop
Disruption / Practical Installation Issues	Responsibility	Maintenance and warranty issues	Workshop
Disruption / Practical Installation Issues	Responsibility	Split responsibilities for installation?	Workshop
Disruption / Practical Installation Issues	Appearance	Need to keep street scene intact with Victorian Terraces (external visual change)	Research, Report 1
Disruption / Practical Installation Issues	Appearance	External wall insulation can change the appearance of a property and is disruptive	Research, Report 14

Category	Sub-Category	Barrier	Source
Performance	Performance	Performance gap?	Workshop
Performance	Performance	Incorrect advice by EPC – energy assessors → or installers	Workshop
Performance	Performance	It is crucial that heating systems use technologies that are suitable for the households in question. If technology unsuited to the building is installed or if customers do not understand how to operate the system most efficiently, the result can be higher emissions rather than a reduction	Research, Report 15
Performance	Performance	Will ‘measures’ deliver what they say they will on the tin?	Workshop
Performance	Performance	Can still buy things that are energy inefficient	Workshop
Performance	Performance	Poor products available i.e. uninsulated doors	Workshop
Performance	Performance	Measures that were installed performed significantly worse in situ than in test lab conditions;	Research, Report 5
Performance	Performance	Measures were not installed correctly	Research, Report 5
Performance	Performance	Non appendix Q products overlooked	Workshop
Performance	Savings	Energy savings in reality are different to calculated	Research, Report 5
Performance	Savings	Are savings accurate?	Workshop
Performance	Savings	Can savings be realised?	Workshop
Performance	Savings	We don’t have accurate benchmarks for household energy use	Workshop
Performance	Savings	Modelling energy use data is likely to be inaccurate	Workshop
Performance	Savings	Realising savings	Workshop
Performance	Savings	Providing savings	Workshop
Performance	Savings	Fear that savings will not be achieved	Workshop

Category	Sub-Category	Barrier	Source
Performance	Savings	Uncertainty of benefits	Workshop
Performance	Savings	We use relative rather than absolute targets	Workshop
Performance	Savings	£ benefits exaggerated	Workshop
Performance	Tools	The modelling tools used to calculate carbon savings and performance were inaccurate;	Workshop
Performance	Tools	Poor tools for ventilation	Workshop
Performance	Tools	Poor tools for condensation	Workshop
Performance	Tools	Poor tools for cold bridging	Workshop
Performance	Commissioning	Poor commissioning of systems for handover to user	Workshop
Performance	Commissioning	Bad commissioning exists	Workshop
Performance	Evaluation	Many projects have, primarily for funding and resource reasons, been unable to evaluate their schemes beyond the short term installation of measures. This limits the potential for scalability and development of best practice	Research, Report 9
Performance	Evaluation	No Post Occupancy Evaluation so still lack of understanding about what works	Workshop
Performance	Evaluation	No positive feedback loop for things well done – so no learning	Workshop
Performance	Behaviour	Behaviour advice poor	Workshop
Performance	Standards	Control	Workshop
Performance	Standards	Standards to achieve	Workshop
Performance	Standards	Lowering of specifications has made market more competitive but reduced quality available	Research, Report 17
Performance	Standards	An important barrier in the growth phase is insufficient quality assurance	Research, Report 20

Category	Sub-Category	Barrier	Source
Pilots	Pilots	We need to move on from pilots. The solutions to tackling the hardest to treat homes needs to become part of mainstream action and that requires funding and long-term planning	Research, Report 22
Pilots	Pilots	Currently, renovations with advanced energy performance only exist in the demonstration phase. To achieve the diffusion of such projects and associated technologies it is important to make them available in the general market	Research, Report 20
Pilots	Pilots	A major challenge for new disruptive technologies that require a change in industry or consumer choices is to cross the gap between the early adopters who participate in the growth phase and the early majority buyers who participate in the mature market phase	Research, Report 20
Pilots	Pilots	Not enough examples	Workshop
Pilots	Pilots	Too many pilots – too few final solutions	Workshop
Pilots	Pilots	Effectiveness of knowledge / examples	Workshop
Pilots	Pilots	As a sustainable energy industry we need to manage the deployment of new technologies and carefully manage the publicity and expectations around new technologies. Bad exemplars and bad publicity has led to set-backs for the whole industry	Research, Report 22
Pilots	Pilots	Focus on Research and Development rather than delivery	Research, Report 1
Pilots	Pilots	Bad existing examples e.g. cavity fill	Workshop
Pilots	Pilots	Lack of demonstrated commercial advantage in investing in sustainable energy technologies	Research, Report 3
Pilots	Pilots	An important barrier for crossing the gap to the volume phase is a lack of influential and trustworthy forerunners	Research, Report 20

Section 3: Full list of Solutions Identified from Initial Workshop and Desk Based Research

Solution	Source
Sector-specific approaches are required for the different tenures, but even within these there are huge variations (age of property, age of householder, measures already done, etc.)	Workshop
Solutions for lack of incentives:	
Energy related KPIs into housing regulations	Workshop
Energy standard for social housing - name and shame	Workshop
Make mandatory	Workshop
Consequential improvements	Workshop
Allow access to other schemes only when all other measures have been completed (e.g. Renewable Heat Incentives / Feed in Tariffs) - offer higher rates with whole house retrofits	Workshop
Council tax reduction (permanent or one-off)	Workshop
Stamp duty	Workshop
VAT	Workshop
Income tax rebate scheme	Workshop
Capital gains tax – rebate	Workshop
Low interest rates	Workshop
Cash back	Workshop
Competition between local Government	Workshop
Teeth to HECA – league table – make public	Workshop
An important barrier in the growth phase is insufficient quality assurance	Workshop

Solution	Source
Fuel tax	Workshop
Higher price energy	Workshop
Visible realisation of energy efficiency	Workshop
Make it aspirational:	Workshop
• Endorsed TV programs	Workshop
• MBEs for people with Superhomes	Workshop
• Competitions – area based approaches	Workshop
Leading by example	Workshop
Brand endorsement	Workshop
Train estate agents regarding the value of an energy efficient home and use them to train consumers	Workshop
Government agenda:	
Joined up Government departments	Workshop
Regulatory mechanisms with marketing	Workshop
Growth through green industry	Workshop
Green construction board	Workshop
Encourage innovation in green	Workshop
Skills on agenda	Workshop
Schools / education	Workshop
Greenest Government ever! – lead by example	Workshop

Solution	Source
Display Energy Certificates (DECs)	Workshop
Stronger enforcement	Workshop
Persuade citizens	Workshop
Industry representation within Government – understand industry needs	Workshop
Expertise in Government	Workshop
Complexity / Design / Delivery:	
Create a matrix of market segmentation by tenure subdivide by type of property and age	Workshop
Education in the benefits of a fabric first approach	Workshop
Determine what order is best to carry out the “chunks” of work	Workshop
Offer choices to consumers – not everything bundled into one estimate	Workshop
One-stop shop	Workshop
Trigger points for example when moving home or installing a new kitchen	Workshop
Whole house sales	Workshop
‘Compare the market’ for whole house solutions	Workshop
Lack of Information:	
TV programmes – reality shows	Workshop
Segment to the right audience	Workshop
Consistent message across Government	Workshop
Set up a “Ministry of information” / central dissemination into an independent hub	Workshop

Solution	Source
Whole house retrofit plans	Workshop
Expert assessment beyond Green Deal	Workshop
Industry funded scheme (subscription service)	Workshop
Generate leads	Workshop
Collective of trade associations	Workshop
“institute of building performance”	Workshop
Government and philanthropic funding (being considered)	Workshop
Coordinate activities	Workshop
Put weight behind provision of centralised knowledge	Workshop
Research what information is missing and identify any gaps - we need evidence	Workshop
Wider distribution of Institute for Sustainability (IFS) retrofit guides offer a quick win	Workshop
Lack of Trust:	
Peer influence	Workshop
Superhomes concept	Workshop
Bring in examples on the journey	Workshop
Community enablers	Workshop
Have “kite marks” / badges for home e.g. Display Energy Certificates for homes, Passivhaus, EPCs, etc	Workshop
• Performance / actual	Workshop
• Installers	Workshop

Solution	Source
Central provision of credible information and qualified design	Workshop
Sanctions for failure	Workshop
Need for Education:	
Delivery of current and relevant education for installers	Workshop
Apprenticeships	Workshop
Apprentice networks	Workshop
Central body	Workshop
Provide leaflets, etc.	Workshop
Peer education – householders	Workshop
More generic qualification that is fit for purpose	Workshop
Refer to Green Gauge	Workshop
Reach to schools	Workshop
CPD	Workshop
Multi-skilled operators and designers	Workshop
Support	Workshop
Lack of Demand / Disruption / Knowledge and skills:	
Disruption and lack of knowledge / skills leads to lack of demand	Workshop
'Diminishing returns' matter less if you have a plan	Workshop
Innovative products - "whiskers" Internal Wall Insulation system	Workshop

Solution	Source
Pilkington Spacia glass	Workshop
Aerogel	Workshop
Ban on worthless products → testing	Workshop
Ban dangerous products (for the chemicals)	Workshop
Off-site construction - "ECOblock"	Workshop
Center Parks Deal	Workshop
Camped out in exemplar home	Workshop
Incentive to overcome disruption	Workshop
Exemplar homes with owners saying "yes it was a hassle, but it was worth it" – spend £30k on exemplars	Workshop
More comfortable, less damp, better health	Workshop
Additional benefits	Workshop
Price of fuel doubled, Green Deal charge +2% annually → future proof your fuel bills	Workshop
Increase value of house by label (e.g. in Australia) – Energy Performance Certificate (EPC) – no impact on value currently (no value attached to EPC)	Workshop
Grand designs G → A	Workshop
VAT reduction (0%) / stamp duty	Workshop
Reducing the perceived risk → clearer proposition	Workshop
People love a bargain (especially time-limited)	Workshop
Aesthetics / looks	Workshop
Comfort measurement – star rating – Cambridge University	Workshop

Solution	Source
Council for Scientific and Industrial Research (CSIR), Australia	Workshop
Getting people involved	Workshop
Use legislation to engage Landlords who have a nothing is in it for me attitude	Workshop
Visible legislation on the horizon	Workshop
Payback → IRR (return on investment) – a TV or car never has to “pay back” so why the house?	Workshop
“Shiny toys” – bits of kit – Smart meter, LED lighting, heat pump, solar PV	Workshop
“Cheque in the post” – dead simple	Workshop
Watts / °C fabric performance measure	Workshop
“Passiv system” intelligent controls (occupancy patterns)	Workshop
Consultation with homeowners / residents over their choice and how improvements should be focused	Research, Report 1
Almost all private homeowners opted into the scheme after seeing the properties completed - Local examples	Research, Report 1
The report recommends that moving forwards the industry needs to produce an integrated proposition:	Research, Report 1
Diagnostics and measured surveys	Research, Report 1
Identification of necessary physical treatment	Research, Report 1
Development of products which will make the task more secure and less disruptive	Research, Report 1
The logistics of assembling labour and materials for the execution of the works	Research, Report 1
Accreditation of those responsible for the work	Research, Report 1
Customer care throughout the process	Research, Report 1
Customer instruction in the operation of the building and its systems on completion	Research, Report 1

Solution	Source
Ensuring compliance	Research, Report 1
Insurance and financing packages	Research, Report 1
The program management of all of the above	Research, Report 1
Raise minimum standards for energy efficiency – planning policy	Research, Report 2
Exemplar projects	Research, Report 2
Promotional and awareness raising method	Research, Report 2
Booklets with information on technologies and direct benefits	Research, Report 2
Best practice examples / case studies	Research, Report 2
Seminars to share knowledge, best practice, and experience	Research, Report 2
Feasibility studies (cost / benefits)	Research, Report 2
Education to suppliers, installers and surveyors	Research, Report 2
Literature on funding	Research, Report 2
Maintenance, repairs and health and safety training on any installed technologies	Research, Report 2
Careful planning from the design stage and consultation with all key partners	Research, Report 2
Engaging and training architects involved in the design of new homes	Research, Report 2
The programme carried out research to identify case studies to be showcased at a “Best Practice Case Study” event and developed into a database	Research, Report 3
They determined the barriers and best practice for discussion at workshops and open days at the properties with the aim of sharing knowledge. These were covered by the media	Research, Report 3
Created an action plan to overcome some of the key barriers in social housing	Research, Report 3

Solution	Source
Knowledge transfer from experts and exemplar organisations to colleagues involved in planning and development controls, homebuyers and tenants is fundamental	Research, Report 3
Robust and appropriately targeted marketing campaigns can be very effective in promoting key messages	Research, Report 3
Demonstrating the cost benefits of installing sustainable energy measures and the promotion of case studies	Research, Report 3
Communicating with the appropriate individuals and with appropriate information is of key importance	Research, Report 3
Single technology pilots to increase the uptake of the most economically viable energy saving measure for the region could be developed. This could be supported by research into low or zero carbon technologies most advantageous for the region	Research, Report 3
Work with local and regional media to ensure appropriate messages are communicated in all features about climate change and sustainability	Research, Report 3
Consider developing a certification scheme that accredits individuals and organisations according to their sustainability credentials	Research, Report 3
Aggregate existing stock improvement programmes, enabling procurement processes to be standardised and partnerships with lead private sector contractors to be developed	Research, Report 4
Identification of a replicable 'kit of parts' which can then be used to build the supply chain	Research, Report 4
Effective coordination in order to pool different sources of funding and manage contractual arrangements	Research, Report 4
Bring together trusted local partners	Research, Report 4
Aggregate programmes for communities	Research, Report 4
Kick-started by investment in social housing with improvements rolled out across private tenures	Research, Report 4
The community could play a key role in delivering programmes	Research, Report 4
Combine a number of income streams, including energy company contributions, FIT and RHI revenue, private finance	Research, Report 4
The involvement of experienced research teams in the whole house retrofit projects helped to minimise the gap between predicted and actual performance	Research, Report 5

Solution	Source
Allowance needs to be made in energy saving calculations for the actual performance of products in-situ	Research, Report 5
Provide good advice, based on a thorough understanding of the home's construction 'status'	Research, Report 5
Improvements should be made to education and training throughout the industry in order to replicate the design and construction skills, knowledge and experience gained through experimental retrofit projects	Research, Report 5
Design intent needs to be communicated to all those in the supply chain who could potentially affect the performance of the measures installed	Research, Report 5
Expanding the scope of home improvements that can done without planning permission to certain energy saving measures (e.g. external wall insulation) will ensure nationwide consistency and prevent delays	Research, Report 7
The participation of trusted key partners (such as the local authority) will give reassurance to the scheme and will generally make it more attractive	Research, Report 7
Selling home energy retrofit on household bills reduction alone would be misguided and may need to be augmented with other messages around a home's increased comfort as a result of the measures, the upward trend of future energy prices protecting households from increasing costs and reducing our environmental impact	Research, Report 7
A whole house approach managed by a single third party was a major attraction to those who participated in this pilot	Research, Report 7
Clear communication is needed on the timescales and the level of disruption involved in the installation	Research, Report 7
Efforts to stimulate demand should be focused on the 15% of the population who are innovators and will 'make the market'. A range of approaches will be needed to incentivise them to act;	Research, Report 8
Cash-back schemes for higher income households	Research, Report 8
Upfront grants worth 40% or more alongside long term Green Deal loans for middle income households	Research, Report 8
Upfront grants worth 55% or more alongside long term Green Deal loans for low income households	Research, Report 8
Market research to understand what level of incentive may be required to persuade wealthy homeowners to invest in retrofits and designing an incentive programme around those findings	Research, Report 8
Linking the depth of retrofit to the level of subsidy provided – in order to drive the market toward whole-house retrofits	Research, Report 8

Solution	Source
Regulatory drivers	Research, Report 8
Provide lower cost capital via the Green Investment Bank (GIB) until rising energy costs make installing more energy efficiency measures self funding	Research, Report 8
British Gas Council Tax Rebate Scheme, where a cash-back is provided by Councils when households install loft and cavity wall insulation and Pay As You Save Pilots – which offered retrofits at 0% finance have been successful at driving demand	Research, Report 8
International experience indicates a mixture of cash-backs, grants and soft loans have been successful	Research, Report 8
Linking energy performance to high profile measures such as taxation. Examples include Stamp Duty and Capital Gains Tax varied according to EPC rating and Council Tax rebates based on measures installed	Research, Report 8
Benefits that can prompt action:	Research, Report 9
Saving money	Research, Report 9
A warmer more comfortable home	Research, Report 9
The avoidance of waste	Research, Report 9
Living a greener life	Research, Report 9
Consumer Focus have created a practical planning checklist for those looking to design and deliver projects in order to increase the response and cost effectiveness of energy efficiency initiatives	Research, Report 9
Incentives, and allowing people to ‘touch and feel’ energy efficient homes, can help to get initial interest	Research, Report 9
Positive word of mouth and a respected messenger are key drivers of trust and confidence	Research, Report 9
A segmented, as opposed to a population wide, marketing approach is needed to move beyond the energy efficiency ‘early adopters’	Research, Report 9
Long term energy efficiency behaviour change is vital to maximise the impact of measures	Research, Report 9
Plan from the customer’s perspective	Research, Report 9
Who do they listen to?	Research, Report 9

Solution	Source
What benefits are they looking for?	Research, Report 9
What might be preventing them from acting?	Research, Report 9
Segment the audience	Research, Report 9
One size does not fit all	Research, Report 9
Develop different messages and delivery approaches for each segment	Research, Report 9
Offer instant gratification	Research, Report 9
Short term benefits are often more powerful than long term ones	Research, Report 9
Bring the issue of energy efficiency into the present	Research, Report 9
Make it personal	Research, Report 9
Make it about the person: their house, family and locality	Research, Report 9
Give them the feel for it	Research, Report 9
Provide opportunities to 'touch and feel' through exemplar homes, or the experiences of neighbours	Research, Report 9
Develop partnerships	Research, Report 9
Work with partners that the audience will listen to and trust	Research, Report 9
Make it attractive and easy for organisations to partner with you	Research, Report 9
Encourage word of mouth	Research, Report 9
People trust their friends and family	Research, Report 9
Consider how your customers can influence others	Research, Report 9

Solution	Source
Your contractors are your ambassadors	Research, Report 9
Contractors spend most time in the home and have most opportunity to inform and influence residents	Research, Report 9
Involve contractors early, their buy-in to messaging is vital	Research, Report 9
Take a long-term approach	Research, Report 9
It may take time for the desired action to take place	Research, Report 8
Consider long term behaviour change as well as the installation of measures	Research, Report 9
Plan to evaluate	Research, Report 9
Define success in terms of actions	Research, Report 9
The time when a property becomes void offers one of the best opportunities for undertaking low energy and water retrofit measures in a property's life cycle	Research, Report 10
What is needed is a 'Green Void Standard', such as some form of checklist of all measures housing associations would follow when a property becomes void ideally be supported by appropriate regulation & KPIs which encourage and reward this behaviour	Research, Report 10
Government must put in place both area-based and individual dwelling backstops that ensure that even the hardest to reach people and hardest to treat homes are included in the retrofit programme	Research, Report 11
There needs to be either a tipping point, at which the benefits outweigh the barriers, or a trigger point, at which it is most opportune to undertake the work	Research, Report 11
There is a key role for Local Authorities and Registered Providers in either coordinating or delivering the step change in refurbishment activity needed. Steps must be taken to incentivise Local Authorities to prioritise refurbishment within existing spatial planning so that opportunities for investment and action add up to more than the sum of their parts	Research, Report 11
More needs to be done to integrate energy efficiency improvements with other household works. There must be more investment in the up-skilling of small contractors to do this	Research, Report 11
Policy framework needs to be to be long-term and provide certainty for businesses looking to operate in this space	Research, Report 11

Solution	Source
Policy framework needs to be to be long-term and provide certainty for businesses looking to operate in this space	Research, Report 11
Government should keep the cost of capital for investment in low carbon technologies	Research, Report 11
It is important that Government establishes tariffs and subsidies that provide a level playing field for energy efficiency and renewable energy or even to favour long-life energy efficiency measures that 'lock in' CO ₂ reductions for the long term	Research, Report 11
A delivery mechanism should be adopted that will reduce the cost impact on the householder	Research, Report 11
Energy savings estimates must be accurate and the report gives recommendations for improving the current Energy Performance Certificate process	Research, Report 11
Develop a trusted, robust system of quality assurance covering a wide range of measures and minimising cost and burden for new entrants. A single overarching brand that existing schemes can link with is proposed	Research, Report 11
Increase mandatory minimum standards of energy efficiency for homes incrementally across all tenures	Research, Report 11
An aspirational standard should be introduced that will encourage householders to go above the minimum level	Research, Report 11
Government to introduce 'carrots', as well as 'sticks', including forms of subsidy, financial incentives (and disincentives)	Research, Report 11
Using well-designed, prefabricated elements can drastically reduce the construction time, cost and minimise the social disturbance for tenants	Research, Report 12
Through the E2rebuild project they have developed monitoring guidelines that define a common approach and unified methodology for metering and monitoring of the building's energy performance and indoor environment including thermal comfort for tenants. Guidelines explaining the surveying and planning process and give an overview of the features of a comprehensive digital survey, including the development of a fully featured 3D model for planning and production have also been developed	Research, Report 12
The Efficient energy cultural heritage project shows case studies of energy efficiency retrofit solutions for heritage buildings	Research, Report 12
The ICT4E2B Forum project is developing a roadmap of Information and Communication Technologies (ICTs) for energy-efficient building	Research, Report 12
Establishment of a stakeholder community with the development of an extensive shared workspace and a knowledge repository to support networking of the above community	Research, Report 12

Solution	Source
More active promotion, incentive schemes and technological innovation	Research, Report 9
Microgeneration technologies can be installed by other trades, such as plumbers, heating engineers, electricians and even roofers, depending on the technology in question	Research, Report 9
Developing a comprehensive renewables skills strategy to help provide the skilled workforce that will be required (HM Government UK Renewable Energy Strategy 2009)	Research, Report 9
Route-maps for the various products so that technology suppliers and installers can make secure and appropriate investment, driving cost reduction through technology improvement and volume sales	Research, Report 9
It is important that consumers are told of the benefits of microgeneration technologies and also that they obtain reliable and authoritative information and advice on the relative merits of alternative technologies for their own particular building	Research, Report 8
It is essential that robust system design methods are developed for installers and consumer education is made a priority	Research, Report 9
Opportunities could arise from the requirements for adaptations to dwellings expected from an ageing residential population with higher standards of living comfort, increasing individualisation and the future development for people to work at home. The opportunity is not always recognised by the stakeholders	Research, Report 9
Demonstration projects should be geographically spread to help the transition	Research, Report 20
Recommended measures for the introduction phase:	Research, Report 20
Public actors:	Research, Report 20
<ul style="list-style-type: none"> • Create arenas for the exchange of knowledge 	Research, Report 20
<ul style="list-style-type: none"> • Promote public awareness 	Research, Report 20
<ul style="list-style-type: none"> • Establish financial support programs for advanced renovation 	Research, Report 20
<ul style="list-style-type: none"> • Set a national agenda that also includes perspectives for future policies 	Research, Report 20
Research Institutes:	Research, Report 20
<ul style="list-style-type: none"> • Participate in international cooperation 	Research, Report 20

Solution	Source
<ul style="list-style-type: none"> • Involve good partners from the industry as well as public actors 	Research, Report 20
<ul style="list-style-type: none"> • Present trustworthy facts in an understandable way 	Research, Report 20
Innovative companies:	Research, Report 20
<ul style="list-style-type: none"> • Research in order to learn about the state of the art 	Research, Report 20
<ul style="list-style-type: none"> • Find complimentary partners to increase financial strength 	Research, Report 20
<ul style="list-style-type: none"> • Communicate how the solution fulfils the customers' needs 	Research, Report 20
Recommendations for the growth phase:	Research, Report 20
National and local authorities	Research, Report 20
<ul style="list-style-type: none"> • Public buildings as showcases – boosting the demand side 	Research, Report 20
<ul style="list-style-type: none"> • Comprehensive plans for dissemination of advanced renovation including information, education, R&D, quality control and funding 	Research, Report 20
<ul style="list-style-type: none"> • Implement energy labelling and quality assurance systems 	Research, Report 20
Educational institutions	Research, Report 20
<ul style="list-style-type: none"> • Educational programs at all levels, including professional training and development 	Research, Report 20
<ul style="list-style-type: none"> • Early adopter companies (trendsetters) 	Research, Report 20
Network through the supply chain by	Research, Report 20
Creating arenas for all actors to meet	Research, Report 20
<ul style="list-style-type: none"> • Use demonstration projects as showcases and learning opportunities 	Research, Report 20
<ul style="list-style-type: none"> • Develop 'one stop shops' for complete solutions directed to owners of detached houses (unprofessional customers) 	Research, Report 20

Solution	Source
<ul style="list-style-type: none"> • Implement tools that create advantages for complete solutions 	Research, Report 20
Recommendations for crossing the gap to the volume phase:	Research, Report 20
All actors	Research, Report 20
<ul style="list-style-type: none"> • Market attractive and trustworthy examples of well proven solutions from the growth phase with a main focus on rational arguments 	Research, Report 20
<ul style="list-style-type: none"> • Announce advanced renovation as the standard renovation policy 	Research, Report 20
National and local authorities:	Research, Report 20
<ul style="list-style-type: none"> • Strengthen legislation on required level and performance of renovation 	Research, Report 20
<ul style="list-style-type: none"> • Where necessary, change legislation not to hinder renovation (such as issues on investment and rent) 	Research, Report 20
<ul style="list-style-type: none"> • Making the tools and acquired experience available to all actors, for example, calculation tools and prescriptions for concepts, technologies, construction details, etc. 	Research, Report 20
Companies:	Research, Report 20
<ul style="list-style-type: none"> • Reduce prices to open up new markets and enable large scale production 	Research, Report 20
<ul style="list-style-type: none"> • Implement educational programs for in-house consultants, planners and on site workers and / or invest in technology clustering as a way to overcome technology dependant lack of skills and competences 	Research, Report 20
Housing cooperatives:	Research, Report 20
<ul style="list-style-type: none"> • Educate project managers / members how to run advanced renovation projects 	Research, Report 20
Initiate large scale affordable advanced (social) housing renovation projects	Research, Report 20
Reaping multiple benefits from single expenditures and optimizing planned capital costs	Research, Report 21
Whole-systems thinking can be applied to the delivery processes to optimize the building as a whole for resource and energy efficiency	Research, Report 21

Solution	Source
Select the project team early and accelerate iterative design process with a team-based rapid development of schematic design	Research, Report 21
Comprehensively analyze life cycle cost and energy together	Research, Report 21
Reap multiple benefits from single expenditures and optimize the planned capital expenditures	Research, Report 21
Professional education	Research, Report 21
Setting effective benchmarks and measures and ensure these benchmarks are met through operation and commissioning. Simulation models using Building Information Modelling (BIM) software can help the owner estimate a renovation project's future energy performance and track a buildings current performance	Research, Report 21
Increase project reporting, transparency, and end-user education. Public reporting of such data not only promotes energy efficiency but also creates a competitive environment, especially for commercial building owners	Research, Report 21
Educating the end-user on behavioural issues that impact building performance	Research, Report 21
Identify project constraints that design and construction have to meet early in the planning phase and accelerate the discovery of existing conditions. Carry out a thorough inspection of the existing building and exploratory demolition measures in design process	Research, Report 21
Local authorities can be encouraged to include tackling climate change within their local area agreements	Research, Report 22
Help products enter the mainstream through the following mechanisms:	Research, Report 22
Government intervention in the market	Research, Report 22
Collective purchasing of products – making them cheaper – between local authorities or RSLs	Research, Report 22
Encouraging landlords and owner-occupiers to take advantage of the windows of opportunity for energy efficiency improvements at the time they're making other improvements e.g. re-roofing, planned maintenance	Research, Report 22
Ensure awareness of effective products by encouraging:	Research, Report 22
Customers to use the appropriate technology in the appropriate setting	Research, Report 22

Solution	Source
Ensuring that we put out correct information, e.g. through myth busting publications	Research, Report 22
We need to build a level playing field to encourage innovation through:	Research, Report 22
Consistent testing standards	Research, Report 22
Reasonable costs for certification	Research, Report 22
Shared intelligence / raising awareness:	Research, Report 22
An information portal or one stop shop	Research, Report 22
A medium of proactively disseminating information to stakeholders and focused, regular collection of information from stakeholders	Research, Report 22
Building bridges between the industry players (e.g. manufacturers, distributors and installers) and markets (e.g. social housing land lords and grant scheme managers)	Research, Report 22
Working with the Partnership Local Authority Group and EST, clarify the 'rules' on planning for renewable energy technologies	Research, Report 22
The social housing sector:	Research, Report 22
Promote successful pilots and information on new technology to local authorities and housing associations, via Practical help and other media	Research, Report 22
Consider local authority training and support needs	Research, Report 22
Investigate and promote outcomes of tenant participation and trials / pilots to help promote the benefits of energy efficiency installations	Research, Report 22
The private rented sector:	Research, Report 22
Ways for energy suppliers to reward landlords for leads to tenants	Research, Report 22
Lobbying for landlords to be treated as businesses (to receive tax benefits from investment in energy efficiency)	Research, Report 22
Financial incentives	Research, Report 22

Solution	Source
Green indicators for university guides and approved landlord lists	Research, Report 22
Raising awareness of Housing health and safety rating system (HHSRS) requirements	Research, Report 22
Marketing campaigns for owner-occupier sector	Research, Report 22
Householders are enthusiastic about tackling many energy-saving measures when they've already got builders in	Research, Report 24
Landlords continue to be focused on the financial bottom line, but see the logic in tackling energy efficiency when they're improving their properties	Research, Report 24
Therefore addressing energy efficiency alongside other refurbishment projects means fitting key measures like insulation or advanced glazing on a room-by-room basis over several years	Research, Report 24
Make trigger-point guidance available through the consumer advice service, helping householders to build energy efficiency into room-by-room upgrades	Research, Report 24
Pilot new refurbishment guides, to help builders promote energy-saving measures to householders when they carry out other refurbishment work	Research, Report 24
Share this insight with manufacturers and retailers of energy-saving products, showing what measures can be achieved and how to achieve them	Research, Report 24
Carry out additional research on the practicalities of achieving room-by-room refurbishment at a pace sufficient to deliver an 80 per cent carbon reduction from homes by 2050	Research, Report 24
Use consequential improvements as a trigger point to drive whole house retrofit	Research, Report 24
Learning from each other and sharing best practice	Research, Report 24

