Greater Manchester
Low Carbon Housing Retrofit Strategy

LOGO / Thanks / etc

To be included in the final version

Contents

Exec Summary

The scale of the housing retrofit challenge

Low carbon housing retrofit will be one of the most significant challenges Greater Manchester faces in seeking to mitigate and adapt to climate change. However in bringing such changes to the region's consumers the drive for change in other sectors will be strengthened. The Greater Manchester low carbon housing retrofit strategy sets the scene for what will be needed to achieve the retrofit of nearly 1.2 million homes.

The Greater Manchester low carbon home retrofit strategy sets out a framework for delivering domestic carbon reductions of 55% by 2022. This ambitious target is required in order to:

- Achieve Greater Manchester's commitment to 48% carbon emissions reductions by 2020;
- Establish 'First Mover' economic advantages in Greater Manchester in the emerging North West and UK retrofit market;
- Continue to improve homes, streets and neighbourhoods across Greater Manchester in order to create attractive places to live, protect the vulnerable and to tackle fuel poverty, decline and disrepair.
- Drive programmes to stimulate take-up of the Green Deal as it is introduced, as well as maximising the use of subsidies such as the Feed in Tariff (FiT), Renewable Heat Incentive (RHI) and the Energy Company Obligation (ECO);
- Drive ambition across housing tenures in order to achieve substantial economies of scale and attract private sector investment.

In meeting this target, the Committee on Climate Change's (CCC) projected take-up of retrofit measures nationally for 2027, will need to be achieved in Greater Manchester by 2020.

Developing Greater Manchester's approach to home retrofit

In order to meet this emissions' target, Greater Manchester will need to lead the way in how the Green Deal is implemented. It is proposed that this is driven by the establishment of clear and measurable performance targets, including

90% of housing stock to be at Energy Performance Certificate (EPC) rating B, and 17 kg/CO2 per m2 by 2035. The remaining 10% of homes will need to achieve a minimum of EPC C.

In order to support these targets an approach is proposed that is based on:

- Accurate assessment of performance improvements using detailed SAP-based modelling and 'case-by-case' assessments;
- The grouping of complementary measures into 'packages' that can be more easily communicated, and installed simultaneously to minimise household costs and disruption;
- The creation of a 'pattern book' of best practices, specifications and details in order to promote learning and improvement in the quality of retrofits over time.

What will be needed to meet the targets?

In order to meet these targets a range of essential retrofit improvements will need to be implemented. The strategy lays out a Fabric First approach to housing retrofit through a series of Basic, Intermediate and Whole House packages. The fabric first approach is essential to achieving the carbon reduction targets. However, renewable technologies have an important role

to play in cross-subsidising important but less profitable measures such as solid wall insulation. The strategy recognises that this will accelerate the adoption of these micro-generation measures.

Greater Manchester's ambitious targets require an area-wide approach to the retrofit of whole streets, estates and neighbourhoods. Community scale micro-generation, the insulation of solid walls in pre-1919 terraced streets and whole house improvements will be key challenges.

How will we encourage take up and sustain the benefits?

Whilst social landlords are already playing an important role, it will be private housing, making up around 75% of the housing market, that poses the greatest challenge. An intelligent approach to marketing and communication is required in order to make progress in the private housing market.

- Understanding key trigger points at which retrofit is more likely to be considered e.g. when buying or renovating a property,
- Winning the trust of owner occupiers who will have to consetn to and pay for the changes.
- Working with communities to spread the word, and help deliver.
- Local Authorities and social landlords demonstrating leadership and support across communities and tenures,
- Employing a combination of support, incentives and regulation in order to engage with private landlords.
- Identifying partners that can deliver to the GM Standard

A network of local 'show homes' will be an important early action to demonstrate the scale of activity and potential long-term benefits to others.

The training of frontline staff, volunteers and community champions in energy efficiency will be key to change behaviours and habits in our neighbourhoods long term.

How will we finance and fund the improvements?

Meeting Greater Manchester's proposed domestic retrofit target is likely to require at least £12 billion of investment over the next decade. Given the scale of the challenge and increasing restrictions on public finances, the role of private sector finance will be critical. The strategy has identified three broad categories of investment that could be used in order to finance low carbon home retrofit:

- Prudential borrowing and bank debt
- Community and mutual finance
- Institutional investment

Alongside these, other major sources of funding - such as ECO and European grant funding - and subsidy - such as the Feed in Tariff (FiT) and Renewable Heat Incentive (RHI) - will have an important role to play. They are key to delivering early wins, and for attracting and underwriting private finance for domestic retrofitand making less profitable measures viable.

How will we maximise the economic benefits?

A co-ordinated and planned approach will be required in order to maximise the value added to Greater Manchester's economy and position the retrofit sector to support economic growth. To respond at scale, four key challenges will need to be addressed:

1. The creation of enough certainty and confidence in demand to support investment in new supply chain capacity, to reduce reliance on imported products.
2. The diversification and re-skilling of local industry to respond to the opportunities.
3. Ensuring access to high quality products that meet required codes of practice and related accreditations,
4. Using the learning from local retrofit activity to improve products and specifications, and drive local innovation and supply capacity.

Social enterprises can play a significant role in supporting the retrofit market, and retain the economic benefits within the heart of our local communities.

Delivering this strategy will create significant demand for a wide range of skills, - from behaviour change, surveying and assessment of properties to design, site co-ordination, installation, customer care and ongoing maintenance.

In order to support the broad range of skills that will be required it will be necessary to engage with Sector Skills Councils, National Skills Academies and training providers across Greater Manchester to ensure provide the breadth of up-skilling required. This will need to extend to the manufacturing sector in order to support expansion and diversification.

Action Plan

1. Adopt the revised governance structure laid out in Fig 1.1 to meet the changing needs of the programme as it moves into the delivery phase.

2. Strengthen tie-in with other work programmes within the LCEA, particularly around supply chain and skills in order to avoid duplication and maximise impact.

1 –
Setting The Scene

Household energy use accounts for 36% of Greater Manchester's CO2 emissions. In order to achieve significant reductions in emissions by 2020 and 2050 and realise first mover economic advantages, Greater Manchester requires a strategy that will set the scene for the retrofit of nearly 1.2 million homes.

Key Messages

— The aim of Greater Manchester's low carbon home retrofit strategy is to create a framework for delivering 55% carbon reductions on 1990 levels in the domestic sector by 2022. This ambitious target is required in order to:

> Contribute to national carbon reduction commitments under the Climate Change Act 2008 and Greater Manchester's commitment to 48% reductions by 2020;

> Confer the conurbation with 'First Mover' economic advantages in the emerging North West and UK retrofit market;

> Improve homes, streets and neighbourhoods across Greater Manchester in order to create attractive places to live, protect the vulnerable and to tackle fuel poverty, decline and disrepair.

> Drive programmes to stimulate take-up of the Green Deal as it is introduced, as well as maximising the use of subsidies such as the Feed in Tariff (FiT), Renewable Heat Incentive (RHI) and the Energy Company Obligation (ECO);

— Meeting the target would require the majority of the current housing stock of 1.2 million homes to receive 'intermediate' and 'major' improvement packages with a long-term performance standard of and average of 17 kg/CO2 per m2 by 2050.

— Low carbon housing retrofit will be one of the most significant challenges Greater Manchester faces in seeking to mitigate and adapt to climate change.

— With the limited availability of public sector funding it is critical therefore that the Strategy sets a course to achieve large-scale delivery across housing tenures in order to attract private sector investment.

— The role of 'Green Deal Trailblazers' in the private and social housing sector will be important in seeking to meet the objectives of this strategy. This will include the use of FiT, RHI and ECO subsidies, and early engagement in the development of the supply chain and skills base.

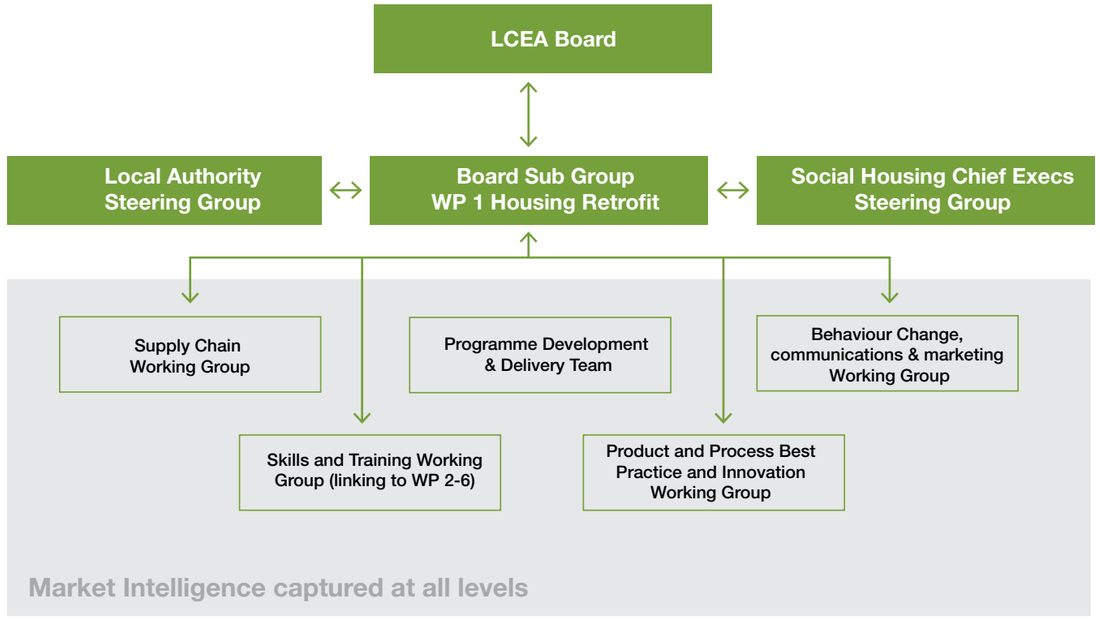


Figure 1.1

Proposed future Governance structure for LCEA WP1 Housing Retrofit programme

1.1 Supporting the Climate Change Strategy for Greater Manchester

A Climate Change Strategy has been adopted that aims to achieve emissions reductions of 48% on 1990 levels by 2020[1] . A central theme of the Strategy is a co-ordinated programme of activity to reduce carbon emissions from the built environment. This is supported by overall objectives to achieve a rapid transition to a low carbon economy and a culture of 'environmentally smart behaviour'.

The strategy recognises the importance of reducing domestic emissions, highlighting the challenge of addressing a housing stock of nearly 1.2 million properties, the majority of which were built prior to the introduction of modern Building Regulations addressing energy efficiency. Central to the Strategy is 'securing investment to support the retrofit of our building stock' which it estimates could require as much as £25 billion of investment over the next 20-30 years.

The Climate Change Strategy takes a cross cutting approach to realising the 'mutual benefits' of carbon reduction and to 'multiply the opportunities for a more prosperous future'. Table 1 proposes a framework for how the Greater Manchester Low Carbon Housing Retrofit Strategy could support this approach by generating a range of social, economic and environmental benefits that cut across key policy areas. An attempt to value the full range of benefits from domestic retrofit has recently been piloted by Salix

[1] AGMA, LEP and GMCA, the Greater Manchester Climate Change Strategy 2011-2020, Final draft v21, July 2011

[2] Salix Homes, New Barracks estate retrofit - Social return on investment, Report prepared by Arup, January 2011

GM LCEA programme

The role of 'Green Deal Trailblazers'

The Green Deal Trailblazer partners consist of social landlords and private partners, as well as utilities such as British Gas. The partners including Ashden Award winning Northwards Housing (Manchester), Salix Homes (Salford), Stockport Homes and New Charter Homes (Tameside).

The partners will use their trailblazer projects as a testbed for the Green Deal, not just from a technical point of view but also in terms of finance, how the occupants can be engaged and how the wider benefits to tenants can be valued. The partners are focussing on three key areas:

- Insulation: They will focus on building fabric improvements first, as they deliver the most direct benefits to tenants,with planning to anticipate what will be required to achieve the 2050 target.
- Energy generation: Early experience with biomass heating and solar photovoltaics will develop the supply chain, but will also generate income for future re-investment.
- Behavioural change: Each project will provide data and feedback on what works/what doesn't and will also involve occupiers in the selection of measures and post-completion monitoring.

Northwards Housing

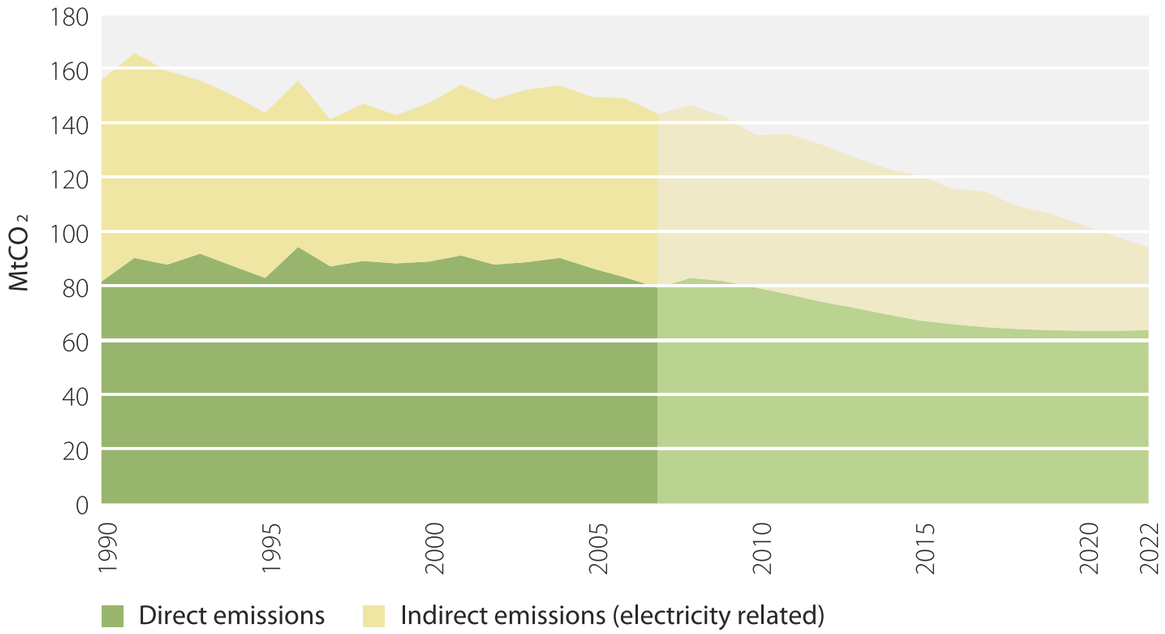


Figure 1.2

Domestic emissions trajectory to 2022

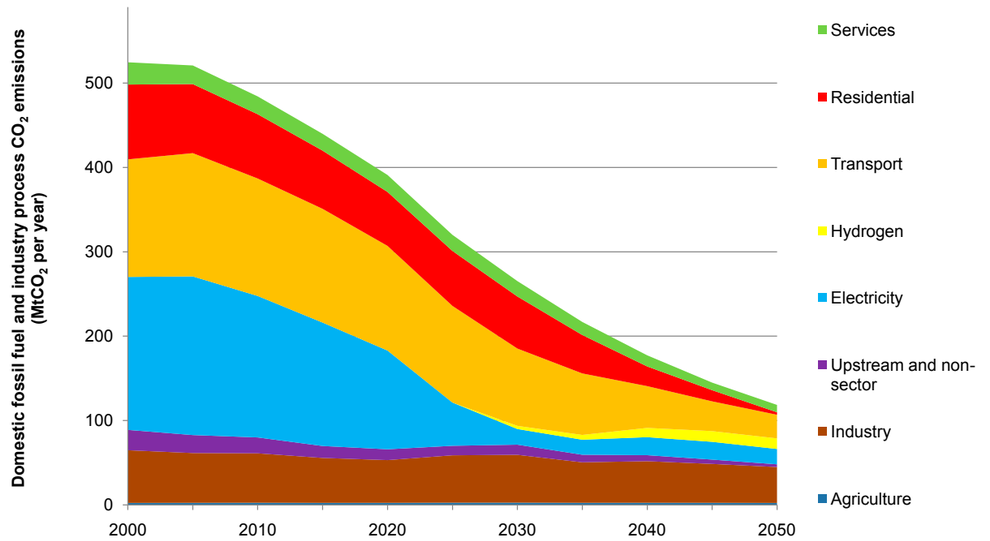


Figure 1.3

UK sectoral CO2 emmissions to 2050 0n an 80% emissions reduction path (MARKAL)

Source: MARKAL modelling based on CCC assumptions (2008)

Homes in Salford[2].

1.2 Supporting a key low carbon growth sector

In 2009 Greater Manchester was designated the UK's first Low Carbon Economic Areas for the built environment with a vision that 'By 2015 Greater Manchester has established itself as a world leader in the transformation to a low carbon economy'.

The programme provides a strong starting point for this strategy. A priority objective has been Work Package 1 (WP1) the aim of which is to 'deliver basic energy efficiency measures to homes at scale across Greater Manchester, with 75% of all remaining homes with under-insulated lofts or un-insulated cavities to be treated by 2013.'

The LCEA vision is now reflected in the Greater Manchester Climate Change Strategy and is supported by high level political and stakeholder commitment to deliver ambitious programmes of investment to 2015 and beyond. It is intended that this programme is framed by Greater Manchester's Low Carbon Housing Retrofit Strategy.

The initial programme is estimated to achieve a reduction in CO2 emissions of 6 million tonnes between 2010 and 2015. The Joint Delivery Plan[3] envisages that this will be achieved by:

- Mobilising sufficient financial resources to enable this physical retrofit work to have been undertaken;
- Ensuring that the supply chain is mobilised to meet demand, with particular benefit to Greater Manchester and the wider UK economy;
- Establishing a suitably equipped and skilled workforce to enable the work to be undertaken;
- Research and innovation to support future programmes.

A series of other LCEA Work Packages are designed realise the economic benefits of the retrofit programme. Work Package 4: Skills and employment and Work Package 5: Supply chain aim to support opportunities for Greater Manchester and North West companies to meet the projected demand.

[3] AGMA (2010) Greater Manchester's Low Carbon Economic Area for the Built Environment - Joint Delivery Plan

Making a rapid transition to a low carbon economy
— Creating greater certainty of delivery: By working with local authorities, landlords, utilities and communities to build trust and create investment opportunities there will be greater certainty of delivering the high levels of take-up that will be required. — Investing for the future: By attracting a wide range of investment with potential sources including prudential borrowing, debt finance, institutional investment, community shares and savings societies.
Promoting 'carbon' literacy
— Knowledge is power: By providing households, communities and landlords with the means to monitor and control their energy use and carbon emissions they will be able to make smarter choices. — Empowering communities to take action: By harnessing the potential of communities to play a leading role in domestic retrofit programmes– whether at home, street, block or neighbourhood level.
Addressing inequality, health and wellbeing
— Making a difference to fuel poverty: By reducing heating bills to <10% of income and running costs to <£8/m2/yr in order to ensure that warm homes are affordable for the most vulnerable households, such as the elderly and single parent households. — Protecting the most vulnerable: By addressing inherent problems with properties such as poor insulation, airtightness and ventilation homes will be easier to keep warm and healthy, thereby protecting the most vulnerable during winter and helping to reduce the burden on the NHS.
Transforming homes and communities
— Protecting and enhancing assets: Investing in the longevity, performance and value of the existing housing stock, including social housing, owner occupied housing, private rental property and empty homes, by addressing poor performance. This will also include resilience to future climate change impacts. — Restoring community pride: By investing in comprehensive home improvements as a means of lifting neighbourhoods and engaging communities in the creation of healthy, self-sustaining local housing markets.
Creating green jobs
— Growing green collar employment: By harnessing the potential of planned programmes and scale to support diversification by local companies, apprenticeships and multi-skills training to develop the skills base and inward investment by UK, EU and international companies. — Creating opportunities for entrepreneurship: By pro-actively responding to opportunities to develop the products and services that will be required now and into the future – from diversification into new markets to the spin-out of ideas from Universities.

Table 1.1
Framework for realising the social, economic and environmental benefits of domestic retrofit

Action Plan

1. Adopt a target of 55% reduction in domestic emissions by 2022 as laid out in Table 2.1

2. Build up a model specific to GM detailing the different ways (ie % take-up of different measures) in which this target could be achieved in order to assist in ongoing monitoring.

3. Develop 3 year targets for the period 2011 and 2020 against which to measure performance, with annual review periods.

2 – Maintaining the right trajectory

Critical to the success of Greater Manchester's retrofit strategy will be its contribution to the City Region's low carbon trajectory. The strategy will need to informed by this trajectory and the implications it will have for the specification and sequencing of retrofit works for nearly a million homes.

Key Messages

— The Committee on Climate Change (CCC) recommendations for the UK's third and fourth carbon budgets to 2022 and 2027 have clear implications for domestic retrofit in Greater Manchester [4].

— The Greater Manchester Climate Change Strategy's commitment to 48% emissions reductions by 2020 implies that the CCC's modelled take-up of retrofit measures for 2027 will need to achieved across Greater Manchester by 2020.

— The success of the strategy, and its contribution to the GM Climate Change Strategy, will depend on how quickly measures highlighted by the CCC can be rolled out, namely:

> Loft insulation upgrades to at least 350mm,

> Glazing improvements to current Building Regulations (u-value of 2.2) and, where possible, to achieve best practice (u-value better than 1.2),

> Upgrades/combinations of cavity wall insulation with the addition of internal or external wall insulation,

> Solid wall insulation in the form of external wall insulation or internal wall insulation,

> The insulation of floors and footings,

> Boiler replacements combined with new heating controls and pipe insulation

> General improvements to air tightness and ventilation, which could include heat recovery.

> Low carbon sources of heat such as solar thermal collectors.

— Assumptions about their take-up will be influenced by a number of factors that are addressed by this strategy, including:

> the age and form of homes, which are discussed in Chapters 3 and 4,

> the tenure of homes, which is discussed in Chapter 6,

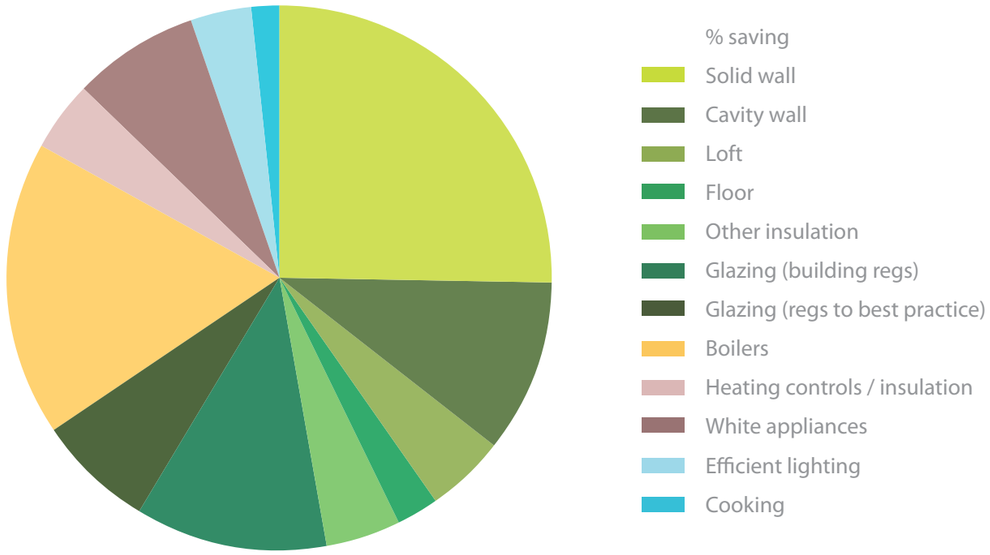
> the ability to influence the decisions and behaviour of tenants and home owners, which is discussed in Chapter 6

> the capacity of the supply chain, which is discussed in Chapters 7 and 8.

[4] Committee on Climate Change, The fourth carbon budget - reducing emissions through the 2020's, 7th December 2010

Figure 2.1

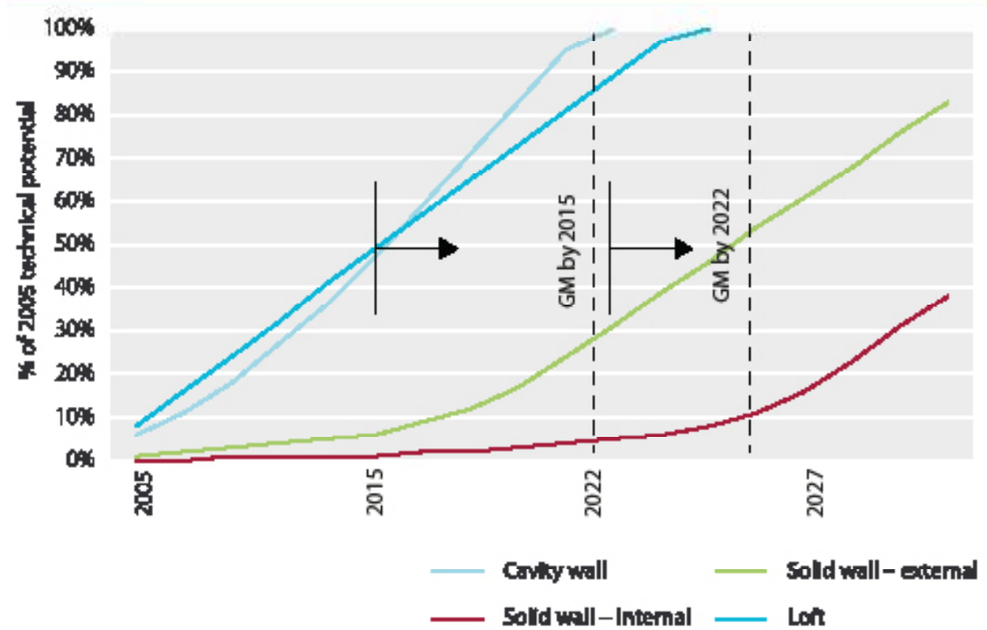
What will be needed to achieve 2027 UK domestic emissions reductions



Source: Element Energy (2009)

Figure 2.2

Levels of uptake for selected retrofit measures implied by national trajectory and GM climate change strategy trajectory



Based on: Element Energy (2009)

2.1 When will progress need to be made by?

The minimus requirement for domestic carbon emissions redustions in Greater Manchester are set out as part of the 2020 and 2050 National targets[5]. These distinguishes between emissions from the use of gas for space heating and hot water (referred to as 'direct' emissions) and electricity for appliances, lighting and plug sockets (referred to as 'indirect' emissions).

'Direct' domestic CO2 emissions from gas use are projected at a national level to follow a steady downward trajectory, with substantial progress required by 2035-2040. By then over 90% take-up will be required of the opportunities for solid wall insulation, upgrades of basic measures such as cavity wall insulation, floor insulation and the installation of low carbon sources of heat such as solar thermal.

'Indirect' domestic CO2 emissions from electricity use are expected to make the fastest reductions with substantial progress towards decarbonisation by 2025-2030. This includes over 75% take-up of basic energy efficiency measures – including A++ energy rated appliances and measures to encourage behavioural change such as energy monitors - as well as micro-generation technologies such solar photovoltaics.

2.2 What does this mean for Greater Manchester?

Domestic carbon emissions projections to 2020 and 2050 were developed with input from the Energy Saving Trust for the Greater Manchester Sustainable Energy Action Plan (SEAP). These suggest that based on current programmes there will be a gap between Greater Manchester's domestic emissions and the National trajectory of at least -6% (by 2020) and -38% (by 2050)[6]. This strongly suggests further impetus will be needed to ensure the level of take-up and impact of domestic retrofit programmes such as the Green Deal across the majority of the housing stock.

In order to explore in more detail the implications for Greater Manchester it is necessary to understand the assumptions behind the national domestic emissions trajectory. Analysis by Element Energy for the Committee on Climate Change provides a detailed breakdown of these assumptions for individual retrofit measures[7]. In Figure 2.2 we present some of these assumptions and use them to compare three possible scenarios for Greater Manchester's domestic emissions trajectory.

[5] Committee on Climate Change, Building a low carbon economy, Markal Projections, December 2008

[6] Manchester Knowledge Capital and Arup, Sustainable Energy Action Plan, Domestic measures and microgenaration projections, July 2010 and Manchester Knowledge Capital Carbon Captured, Developing future energy scenarios for Greater Manchester, March 2010

[7] Element Energy, Uptake of energy efficiency in buildings, Report prepared for the Committee on Climate Change, August 2009

Table 2.1
Developing a GM domestic retrofit trajectory to 2022 and beyond

	Scenario 1 Continue at current LCEA activity	Scenario 2 Stepping up activity in line with CCC adopted national trajectory	Scenario 3 Further increases to GM CCS low carbon economic advantage
What needs to happen	— 70-80% take-up of loft and cavity walls — Social landlord solid wall insulation and FiT/ RHI investments — Utility subsidy through the new ECO programme — Market-led Green Deal roll-out by utility partners	— 70-80% overall take-up of basic measures — 33% take-up of solid wall insulation (internal and external) — 10-15% glazing upgrades to BRegs and/or 'best practice' — 15-20% take-up of floor insulation — 30% A+/++ appliance replacement — 12% take-up of micro-generation technology	— 50-60% take-up of solid wall insulation in terraced streets — 15-20% take-up of 'intermediate' and 'major' improvement packages, including floor insulation, by house buyers and landlords — less than30% appliance replacement through retail partnership — Community-scale micro-generation and DHP/ biomass district heating projects
Emissions reduction	— Projected 6% shortfall against the 2022 target	— At least 39% reduction on 1990 levels by 2022	— Over 50% reduction on 1990 levels by 2022
Opportunities	— Social landlord trailblazers account for a relatively high proportion of the stock — ECO could be used to subsidise the Green Deal	— ECO to be used to subsidise more expensive/difficult measures as well as the Green Deal for fuel poor households — Public:private programmes to promote solid walls, floors and glazing to the private housing market – particularly during renovation/sale — Green Deal providers promote packages of measures	— Promotion of GM packages of Whole house measures to maximise impact and minimise the cost of access. — Promotion and financing package for terraced streets. — Partnership working with property and home improvement market. — Promotion and support though landlord accreditation schemes.
Key Risks	— Social landlords are restricted in what they can borrow. — Limited promotion and take-up of solid wall insulation in private sector — Fuel poor households generate less Green Deal repayments. — ECO subsidy on its own is limited in what it can fund. — Green Deal take-up not achieved due to household perceptions of the utilities and high interest rates — Limited focus on opportunities to reduce electricity use.	— Solid wall insulation for detached/semi-detached homes requires subsidy — Lowest cost solid wall opportunities require targeting of mixed tenure streets — The full range of basic measures are not promoted. — Blanket subsidy programmes miss the opportunity to promote packages of measures	— Supply chain ability to respond to demand and provide quality — Faster take-up requires successful household and community engagement — Revenue from micro-generation is not used to cross-subsidise more expensive measures

Notes:
1. Scenario 1 is based on projections made for the Greater Manchester Sustainable Energy Action Plan (SEAP)
2. 'Basic measures' include cavity insulation, loft insulation, replacement boilers and new heating controls.
3. Take-up rates are the % of the remaining potential for what is technically feasible in houses across Greater Manchester.
4. Scenario 2 take-up rates are based on national estimates made by Element Energy of the potential in 2005.

2.3 Learning from other cities and programmes

The Centre for Sustainable Urban and Regional Futures (SURF) at Salford University is exploring how other cities are responding to the retrofit challenge[8]. Their Retrofir 2050 project will enable scenarios for the future take-up of the Green Deal to be tested. Greater Manchester's involvement in the Core Cities network is also enabling the sharing of emergin best practice.

The message from other cities is that a low carbon housing retrofit programme at GM scale is a complex challenge that is almost without precedent and will require more than just technical solutions. The design of incentives and the level of trust households have in how the work is carried out will be critical to success – as demonstrated by the contrasting experiences of Germany and Australia (see Table 2.1) and earlier feedback from UK projects such as Birmingham Energy Savers[9] , Bristol Greendoors[10] and Future Fit in London[11] .

Experience and progress made by GM stakeholders

- Low carbon trajectories and future scenarios were developed by Manchester Knowledge Capital and Carbon Captured to inform the Sustainable Energy Action Plan (SEAP).
- SURF are working with Oxford Brookes University, Cardiff University and the University of Cambridge on the Retrofit 2050 project which aims to explore and model how cities can respond to the complex challenge of building retrofit.
- The Core Cities Group has emerged as a potential forum for knowledge sharing and best practice in low carbon economic development and domestic retrofit programmes.

[8] Centre for Sustainable Urban & Regional Futures (SURF) Re-engineering the city 2020-2050: Urban foresight and transition management, EPSRC funded project, www.retrofit2050.org

[9] Allport, D, Thinking big - Birmingham Energy Savers, Birmingham City Council presntation, December 2010

[10] Bristol Greendoors (2011) www.bristolgreendoors.org

[11] Affinity Sutton (2011) Future Retrofit report, www.affinitysutton.com/news and resources/articles/futurefit report.aspx

[12] See reference 4

[13] Schonborn, M, Germany's 'pot of gold' - paying for retrofit, KFW Bank presentation to LSE conference, December 2009

[14] Horne. R, Freeman. H and Dalton. T, Transitions in surburbis - eco-innovation in housing retrofit and renovation in Australia, RMIT University, April 2010

[15] Australian Government, Home Insulation Safety plan, 2011, www.climatechange.gov.au/governemnt/programs-and-rebates

Good practice Energy efficiency in buildings programme, Germany [12] [13]	Poor practice Home insulation programme programme, Australia [14] [15]
	
Take-up Over 1.2 million homes tackled between 2001-2008. Over 500,000 homes in 2009.	Take-up 600,000 home assessments and 1.2 million homes improved between 2009-2010
Key features: — The programme is a key element of the national climate change strategy — Loft insulation is now mandatory — Government subsidy of up to 18% of costs for efficiency measures — Low interest loans up to £67,000 are provided by private banks underwritten by the public KFW bank — Cash back scheme of 12.5% for some measures — More favourable terms for combinations of measures have encouraged take-up — Feed in Tariff and subsidised loans for micro-generation have built a strong domestic manufacturing base	Key features: — The programme formed part of an economic stimulus package — An interest free Green Loans package was designed to support households — 50% subsidy was provided for accredited assessor training — Health and safety concerns quickly arose following rapid roll-out of the programme — Fraudulent assessor training claims were made and many home assessments were not completed — Poorly installed insulation required a costly inspection programme — The programme had to be closed, affecting reputable installers and suppliers

Table 2.2
What can we learn from other large-scale retrofit programmes?
Source: SURF (2011)

Action Plan

1. Sign up to a clear 'fabric first' approach to housing retrofit, recognising the role of micro-generation in cross-subsidising other measures

2. Develop the detailed specifications and quality standards that underpin each of the 'packages' laid out in table 3.1

3. Pilot innovative and best practice products and processes in GM schemes – as identified by the Innovation Working Group

4. Use the development of Show Homes and Show Streets to test a recommended GM "Kit of Parts" and build up a Pattern Book of installation methods.

3 – Knowing what will be needed

Progress will be defined by the actual take-up of measures to retrofit homes. Knowing what needs to be done to each home will be fundamental to the retrofit strategy. This will be influenced by the form, age, location and tenure of homes across each district together with an understanding of improvements that may have already taken place.

Key Messages

— Every pre-1995 home in Greater Manchester will require major retrofit improvement measures in order to contribute to the domestic carbon trajectory.

— In seeking to assess what level of carbon redustion and therefore what measures should be taken on each home, improvements that have already been made will also need to be taken into account.

— The method of assessment for the Green Deal as currently proposed does not set an overall target reduction for a property, instead focussing on providing a shopping list of accredited measures that can form the basis for a Green Deal plan.

— It is proposed that a target performance for housing in GM by 2035 is adopted of EPC B and 17kg/CO2 per m2 for 90% of the stock, to be achieved in 2-3 possible steps. All other homes would need to achieve a minimum of EPC C and 34kg/CO2 per m2.

— The GM low carbon housing retrofit strategy will lead the way in how it implements the technical side of the Green Deal, focussing on:

> Accurate assessment of potential performance improvements using precise SAP-based modelling and 'case-by-case' assessments;

> Development and promotion with GM partners of complementary 'packages' of measures that could be installed at the same time in order to minimise costs;

> Building up a 'pattern book' of best practices, specifications and details to be shared across the supply chain in order to promote learning and improvement in the quality of retrofits over time;

> Promoting the use of private housing stock condition surveys as a means of obtaining intelligence to design area-wide programmes;

— This approach will ensure a higher quality of service for households and greater opportunities for CO2 reduction whilst supporting the supply chain to respond to and innovate in order to meet the emerging demand for retrofit products and services.

— It will require the development of a number of assessment tools for homes in GM including an expert system to aid in the selection of packages of measures and, depending on the outcome of the Government's review of RDSAP, and abridged version of SAP

GM LCEA programme
Domestic Retrofit Standards Sub-Group

The aim of the Sub-Group has been to develop a common standard and framework of retrofit measures to be adopted across Greater Manchester. The Sub-Group has carried out some modelling of the most common houing 'archetypes'[16], informed by the following process:

- Identification of nine major archetypes representative of the main forms of housing acress Greater Manchester;
- Modelling to identify RDSAP and EPC ratings required for each archetype to meet the 2020 and 2050 national emissions targets;
- Identification of suites of retrofit measures that can be applied to each archetype in order to maximise energy savings, emissions reductions and running costs for property owners.

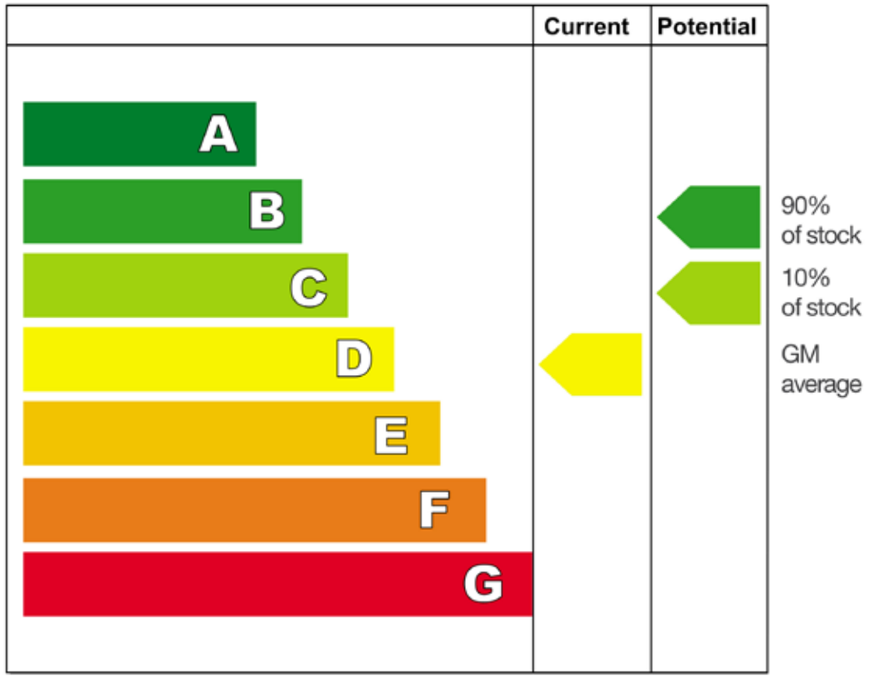
It is intended that their findings will enable all users, from individual householders to large scale landlords and those involved in planning and installing retrofit measures, to understand the potential range of energy efficiency measures and the most efficient order in which to install them. The suites of measures have been grouped into three broad categories – basic, intermediate (required for the 2020 target) and major interventions (required for the 2050 target).

The findings from the Sub-Group have informed the development of this Chapter of the Domestic Retrofit Strategy.

[16] LCEA WP1Retrofit Standards Sub-Group, Your Journey from G to A - An assessment of the archetype requirements and recommendations for improving the energy erriciency of a dwelling, Report prepared for the LCEA, Spring 2011

[17] Technology and Strategy Board, Low carbon buildings database, Retrofit for the Future programme, www.retrofitforthefuture.org

Figure 3.1
Proposed Greater Manchester EPC Targets



Source: DCLG

3.1 Establishing standards and performance targets

In order to align Green Deal assessments and plans with Greater Manchester's domestic carbon trajectory a performance target will need to be defined for domestic properties. It is proposed that this is set as at an Energy Performance Certificate (EPC) of B and 17 kg CO2/m2 by 2035– in line with the national emissions trajectory and the target used by the Technology and Strategy Board's 'Retrofit for the Future' programme[17].

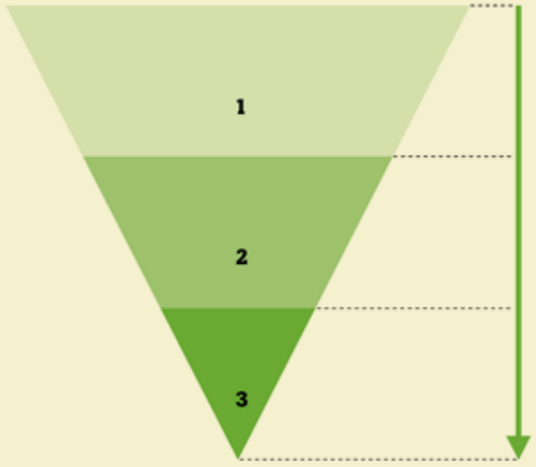
By expressing the target as an EPC rating and an absolute kg CO2/m2 benchmark it will be possible to establish a standard that the majority of properties will need to work towards. It is anticipated that standard this would apply to the majority of post-1919 properties (75% of the stock in 2007) and at least 40% of pre-1919 properties.

However, it is recognised that for a small proportion of properties this may be prohibitively expensive or technically unfeasible within the short to medium term. For some of these properties the target could be achieved cost effectively by investment in micro-generation technologies. However it is therefore proposed that all remaining properties for which this is not reasible are brought up to a minimum performance of EPC C 34 kg CO2/m2.

Each house type will then require a package of measures to be tailored to achieve this target – either in one step or up to three steps. The WP1 Retrofit Standards group has defined three broad groups of measures:

1. 'Basic measures': Roof insulation, cavity wall insulation, draughtproofing and ventilation improvements;
2. 'Intermediate measures': Roof insulation, cavity wall insulation, new doors and windows, heating systems and controls, draughtproofing and ventilation improvements;
3. 'Major measures': Solid wall insulation, floor insulation, detailing to reduce cold bridging, micro-generation technologies.

Fabric first!
The GM energy hierarchy approach



1. Investment should first be made to reduce energy use - by improving the building fabric of homes (e.g. insulation, glazing and air tightness) and their fit-out (e.g. lights, appliances and sanitary ware)

2. Occupiers should be engaged to promote greater 'carbon literacy'. This should form a part of all activities, and should be supported in each home by investment in energy monitoring devices and simple measures such as master switches.

3. Then investment can be made in renewable energy technologies to supply the remaining energy needs (e.g. solar photovoltaics, biomass boilers).

It is proposed that in selecting measures the principle of the 'energy hierarchy' is adopted, with the primary focus on fabric improvements as these generate the greatest potential benefit for occupiers (see box).

The approved method for modelling energy use and emissions savings for homes is the Standard Assessment Procedure (SAP). THis allows detailed apects of a home such as the form of construction and amount of insulation to be taken into account. A pared down version if SAO can be used to obtain EPC ratings - Reduced Data SAP (RDSAP). However, experience has shown it is not an accurate enough tool as it can vary from full SAP by as much as 2-3 EPC bands.

The use of a full version of SAP, or at the very least the revised version of RDSAP being developed for the Green Deal[18], will therefore be required to build trust in assessments by enabling the benefits of selected measures to be accurately benchmarked against the as-built performance of a house type.

3.2 Using stock condition surveys to identify retrofit requirements

A number of factors will influence the packages of retrofit measures that may be suitable for each property, street or neighourbood. These can be summarised under four broad categories which it is proposed are used as a framework to inform district private housing stock condition surveys (see Figure 3.2).

It is envisaged that over time, and in response to the distinct forms of housing in each district, a Greater Manchester 'pattern book' of retrofit measures would be built up, linked to with the experience of 'early adopters' of the Green Deal (see Chapter 6). As more properties are retrofitted different combinations of measures, details and specifications will be tested and worked up for specific house types and instances. By collecting feedback on how each of these have worked in practice the 'pattern book' will provide an invaluable knowledge base to support supply chain development (see Chapter 7).

Informed by the work of the Retrofit Standards Group nine example housetypes have been selected to illustrate how these factors will influence the selection of packages of improvement measures (see page 18).

3.3 Developing cost effective packages of measures

In order to meet the proposed GM targets for low carbon houing retrofit the majority of homes will require 'intermediate' and/or 'major' improvement measures. The cost of gaining access and the level of disruption required in order to carry out these improvements will be high. Evidence suggests that overall it could cost between £16,000 and £34,000 per home[19] – significantly more than the £10,000 cap proposed for Green Deal plans.

It will therefore be important that costs are minimised for every tonne of CO2 saved. It is proposed that this is achieved on individual homes by developing packages of related measures. This would minimise the cost of access and maximise the opportunities for CO2 reduction where there is a willing household, landlord or community.

This strategy has sought to identify an example set of 9 packages, grouped to reflect the three levels of performance improvement highlighted by the Domestic Retrofit Standards Sub-Group. These packages are illustrated on page 18.

[18] LCEA domestic retrofit intelligence sub-group, Green Deal intelligence review, Interim report, July 2011

[19] Sustainable Housing Action Partnership (2010), Beyond Decent Homes Standards 2009, Report prepared by URBED and Faithful & Gould

1. Individual property or block form

What is the breakdown of flats, terraces, semis or detached properties?

What does it influence?

This factor influences how much energy a home uses and the cost of retrofitting, for example by dictating how much insulation will be needed.

- Window area
- Internal floor area
- Surface area to volume ratio
- Roof type and area
- Form of access to properties
- Type of household alterations

2. Neighbourhood density and layout

What is the density and layout of the neighbourhood?

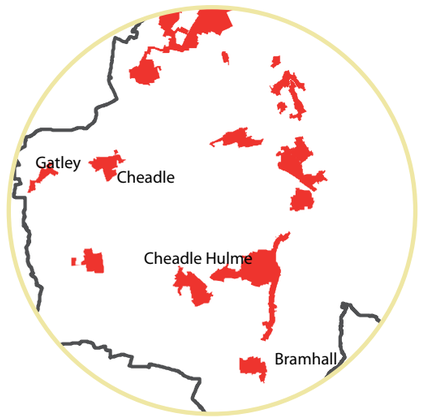
What does it influence?

This factor influences how many homes are suitable for micro-generation technologies and heating networks.

- Building line and servicing
- Roof orientation/obstructions
- Heat network pipe density

3. Neighbourhood heritage

What is the age and character of a neighbourhood?



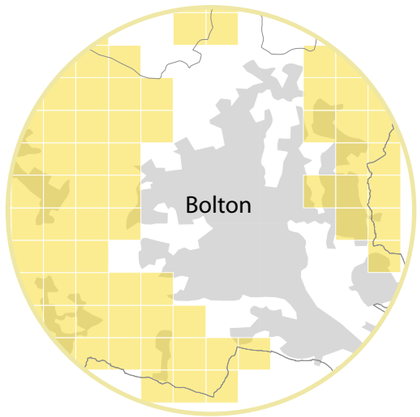
What does it influence?

This factor influences the type of wall construction and may restrict how retroofit can be carried out and whether certain measures can be used, for example external insulation.

- Wall construction (by age)
- Floor construction (by age)
- Distinctive building details
- Listed heritage area details
- Conservation Areas details

4. Geographical location

Where are the properties located in Greater Manchester?



What does it influence?

This factor influences exposure to wind and water, which in turn may increase energy use and require the use of retrofit solutions with specific performance characteristics.

- Exposure to wind/rain
- Location within flood risk area

Figure 3.2
Physical influences on domestic retrofit across Greater Manchester

Basic measures packages
Roll out 2011-2015

Basic measures 'GM plus'
Ensuring that the performance of loft insulation, cavity fill, double glazing and doors are to the highest specification available together with measures to address air tightness;

Basic measure 'heating system upgrade': Bringing together a basic measures package with high effeciency boiler replacement and new heating controls;

Intermediate improvement packages
Roll out 2011-2020

Solid wall 'GM plus': Bringing together external wall insulation, insulated footings, new windows and roofline detailing into one air tight package accompanied by an assessment of ventilation options. This package will eventually also be targeted at properties that have already had 'basic measures' cavity wall insulation;

Kitchen 'energy aware'
Installing A+/A++ appliances with hardwired individual appliance metering and LED lighting as part of a kitchen refurbishment package.

Intermedate measures 'heating system upgrade': High effeciency boiler replacement and new controls at the same time as packages of major measures. This could include biomass and large solar thermal storeage as an option;

Major improvement packages
Rolled out 2011-2030

New home 'internal upgrade'
Installing internal wall insulation, roof insulation (where there are rafters) and floor insulation as appropriate and at the point of minimal disruption during a house sale. This package will eventually also be targeted at properties that have already had 'basic measures' cavity wall insulation;

Conservation area 'heritage upgrade': Installing combinations of internal and external insulation, floor, roof and glazing improvements tailored to the different requirements of Conservation areas;

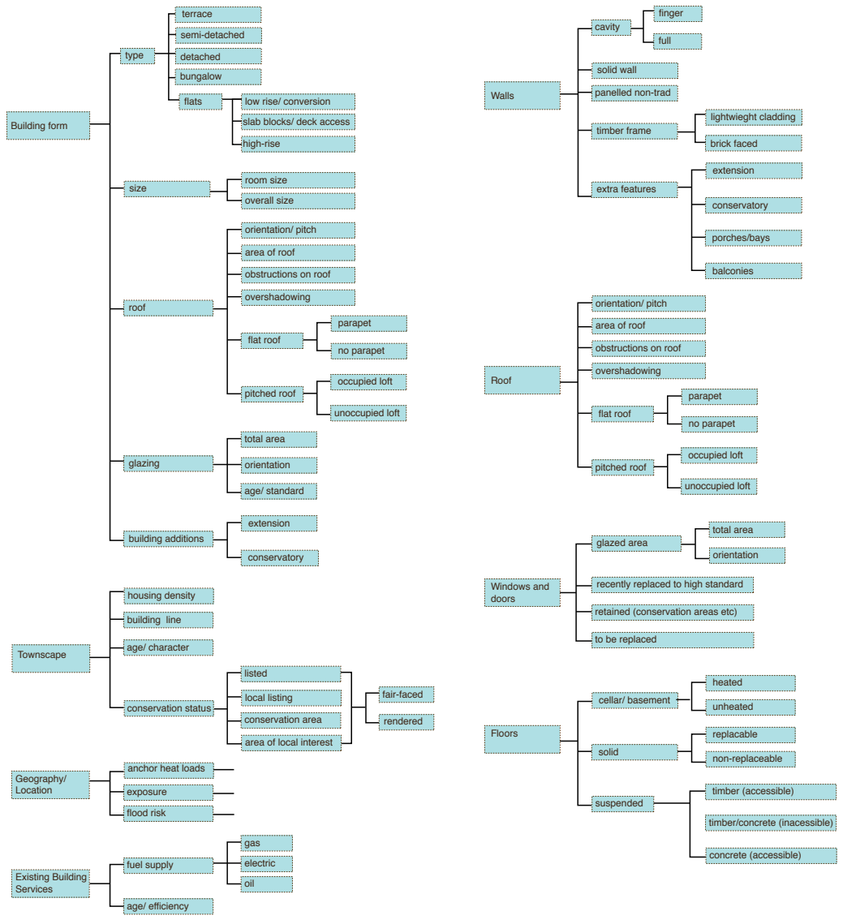
'Communal heating system upgrade': Installation of district heating infrastructure for neighbourhoods or groups of properties, requiring the connection of homes and the replacement of individual heating systems.

Whole house '2050 upgrade'
A single package of measures that will deliver 80% carbon reductions and/or meet the GM kg CO2/m2 target. The package would incorporate detailing to address cold bridging and assessment of ventilation options. This package will eventually also be targeted at properties that have already had 'basic measures' cavity wall insulation

'microgen upgrade': Installing solar photovoltaic's or solar thermal and/or storage at the same time as other major improvement packages;

Figure 3.3

Whole House Assessment Method



Whilst the development of packages such as these would clearly have a range of benefits – including creating greater certainty of investment in the supply chain – they are not intended to be applied rigidly and it is anticipated that they could evolve as the GM low carbon housing retrofit market grows in response to emerginging best practice and new products.

3.4 Using Green Deal assessments to support the GM approach

To facilitate the roll-out of packages of measures all Green Deal Advisers will need to be trained to deliver assessments and plans in a way that supports the GM low carbon housing retrofit strategy. This could include the promotion GM-specific packages of accredited measures.

A decision-making tree could be designed which assessors could use to identify appropriate packages of measures. This could form the basis for a 'Whole house assessment method' which could be programmed into an 'expert system' software package. This could be used to support Green Deal assessments and plans, with homes subsequently entered onto a GM retrofit property database. The functions of a possible GM database are discussed further in Chapter 4.

An indicative set of decision-making trees for a Whole House Assessment Method to inform Green Deal assessments and plans is illustrated in Figure 3.3. Full versions can be found in the Appendix.

Experience and progress made by GM stakeholders

- Pioneering retrofit projects such as Northmoor in Longsight (Manchester) and Decent Homes programmes that have focussed on energy efficiency improvements have clearly demonstrated the wider benefits of a whole house approach.
- The LCEA WP1 Retrofit Standards sub-group has analysed combinations of retrofit measures for nine different archetypes in order to develop a standard and framework for promoting measures.
- A large-scale programme to ensure 'basic measures' are installed in all private households by 2013 (400,000 separate measures) has been initiated across Greater Manchester.
- The Green Deal Trailblazer partners will provide a testbed for different measures starting with a series of projects funded by ERDF. Partners include Ashden Award winning Northwards Housing (Manchester), Salix Homes (Salford), Stockport Homes and New Charter Homes (Tameside).
- AGMA is coordinating a programme to deliver Solar PV in the social housing sector. The initial programme will deliver panels on upto 10,000 roofs before March 31st 2012 through a rent-a-roof model. Development work on a longer term delivery model, post April 2012 will be undertaken in parallel.

Action Plan

1. Through the analysis of 2011 Housing Stock Intelligence survey review and communicate progress versus the baseline position in 2010. (Dec '11)

2. Maximise the opportunity of the basic measures Toasty campaign to test mechanisms for capturing household data across different housing archetypes and tenures. Test ability and constraints in sharing this information within a central GM database.

3. Develop a dynamic housing retrofit database to track activity and progress. Phase 1 of this, will require a 'feasibility' study to scope out the exact requirements of a GM system, analyse existing / emerging products and advise on resources required for its development.

4. Develop a library of case studies and best practice from across the 10 AGMA districts and covering the 9 different housing archetypes found within Greater Manchester, linked to national collections of best practice such as BRE. Its purpose to inspire future activity, and be the beginning of a GM "Pattern Book"

5. Following further clarification on Green Deal accreditation and quality standards, consider the need and scope of a GM 'Kitemark' to assure residents of the quality of installers and contractors delivering in their neighbourhood.

4 – Keeping track of progress

Intelligent data gathering will be the key to monitoring progress across Greater Manchester. At a basic level its role will be to track the uptake of measures and the response by tenure, but it should also be pro-active, creating feedback loops to accelerate learning and schedule the promotion of future improvement measures.

Key Messages

— Whilst high level intelligence on Greater Manchester's housing stock is available it is not yet sufficiently detailed, consistent or dynamic enough to support the design and implementation of an ambitious domestic retrofit programme – particularly for the private housing stock.

— The basic measures campaign has highlighted the opportunity, however, now exists to establish new forms of intelligent data gathering as part of Greater Manchester's approach.

— In order to define future requirements for data gathering the Intelligence Sub-Group have highlighted the importance of clearly defining why the data is required and what it will be used for.

— This strategy proposes that the approach to intelligence gathering should carry out the following functions:

> Reactive monitoring and tracking of the uptake of measures by stock age, house form, tenure, household demographics and consumer segment (which can then be related to behaviour and decision-making);

> Feedback loops which capture the response of households and learning as different tenures and forms of properties are retrofitted with packages of improvements;

> Pro-active promotion of future improvements to properties that still remain to be implemented, linked to GM performance standards and targets.

— 'Top down' Local Authority private housing stock condition surveys and 'bottom up' Green Deal property assessments will be the primary source of intelligence for this approach, linked through a GM portal to the national NEED database and the BRE best practice database.

— Clear definition of intelligence requirements will ensure that systems are created that support programme delivery, linking to other areas of activity such as technical best practice, customer care and the design of social marketing.

GM LCEA programme
Domestic Retrofit Intelligence Sub-Group

The aim of the Sub-Group has been to consider how Greater Manchester might respond to the intelligence needs of the Green Deal through the potential development of a shared information system[20].
A review of available intelligence and proposals for how the Green Deal data systems will work suggest that there is a complex interaction between:

- A physical understanding of the stock and its performance,
- Issues of maintenance and operation,
- Energy costs,
- Behavioural issues,
- Household finances.

What may be seen as a relatively simple concept from the high level becomes more complex as the detail is investigated. This complexity is compounded when trying to deliver transformational change on a City-Region scale.

It is important to look at intelligence needs in the context of the on-going development of the National Energy Efficiency Data-Framework (NEED), the proposed successor to the Home Energy Efficiency Database (HEED).

The findings from the Sub-Group have informed the development of this Chapter of the Domestic Retrofit Strategy.

4.1 What do we know about Greater Manchester's housing stock?

Detailed 'top-down' stock condition surveys of all housing have been undertaken by the ten districts, providing data ward by ward. However, whilst this does enable a picture to be put together for Greater Manchester, surveys are carried out at different times and the methodologies used are not always consistent. A summary of their current status is provided in Table 4.1.

District	Last survey undertaken	Scheduled revision
Bolton	2011	-
Bury	2008	Every 5 years
Oldham	2010	2015
Rochdale	-	-
Manchester	-	-
Salford	2007	2010/11
Stockport	2009	2013
Tameside	-	-
Trafford	-	-
Salford	2005	2010/11

Table 4.1
Status of Greater Manchester housing stock condition surveys

High level data commissioned by New Economy for the Greater Manchester Strategic Housing Market Assessment provides more detail on the tenure, age and form of Greater Manchester's housing market[21] - for example:

- There is a relatively high proportion of social housing (+5% on the national average), with Manchester, Salford, Oldham, Rochdale and Tamesidehaving the highest concentrations.

[20] See reference 19

[21] New Economy an AGMA, Greater Manchester Strategic Housing Market Assessment, Breakdown of Housing type, May 2010 update

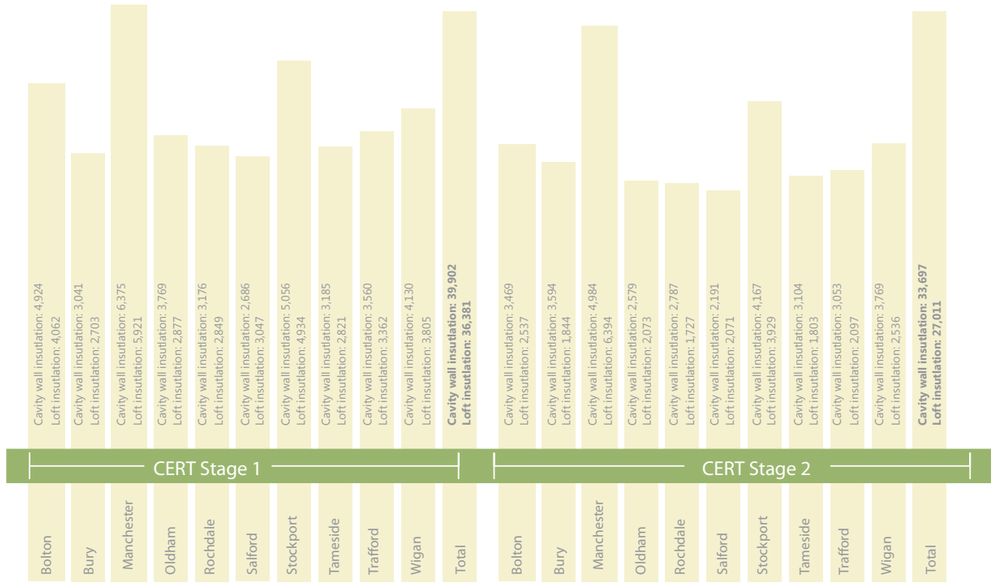


Figure 4.2

Programme impacts to date on measures uptake- illustrating a data shortage as are unaware of the numbers that still need work completed on.

Source: Energy Saving Trust, HEED Database, Accessed 2011

Bramall Construction

Retrofit for the future with Bramalls Construction

- Private owner occupiers and landlords are currently combined into one dataset so it is not possible to disaggregate these.
- There is a relatively high proportion of pre-1920 housing stock (+4% on the national average).

Of the nearly 1.2 million homes in Greater Manchester the majority consist of semi-detached properties (38% compared to 32% nationally), followed by terraces (33% compared to 26% nationally), flats and maisonettes (15% compared to 19% nationally), detached properties (14% compared to 21% nationally) and shared houses (x% compared to 5% nationally).

The highest concentrations of each of these property types can be found in the following districts:

- Detached and semi-detached properties: Bury, Stockport, Trafford and Wigan.
- Terraces: Manchester, Rochdale, Oldham, Bolton and Tameside.
- Flats and maisonettes: Manchester, Salford and Trafford
- Shared houses: Manchester and Trafford

In terms of age, which can be used as a proxy for the number of solid wall properties, there are approximately 293,000 properties built prior to 1919 (25% of the stock). There are approximately 650,000 properties built between 1920 and 1975, which can be used as a proxy for properties that, based on the work of the Domestic Retrofit Standards Sub-Group, may still require solid wall insulation subsequent to the filling of 25mm or 50mm cavities.

Broad mapping of housing across Greater Manchester has been completed by the University of Manchester, allowing the spatial distribution of house types to be identified[22]. However, there appears to be limited historical information to assist in determining more accurately when specific building practices such as cavity walls or concrete floors were adopted – as illustrated by a resource developed by the University of the West of England[23].

4.2 How is intelligence about the take-up of measures currently gathered?

The Energy Saving Trusts HEED (Home Energy Efficiency Database) database[24] together with the recent AGMA survey of social landlords[25] has enabled the impact of Warm Front, CERT/CESP, Housing Market Renewal and Decent Homes programmes to be monitored and reported on. This 'bottom-up' data has therefore begun to provide more detailed intelligence on the impact of programmes, but only for around a quarter of Greater Manchester's stock.

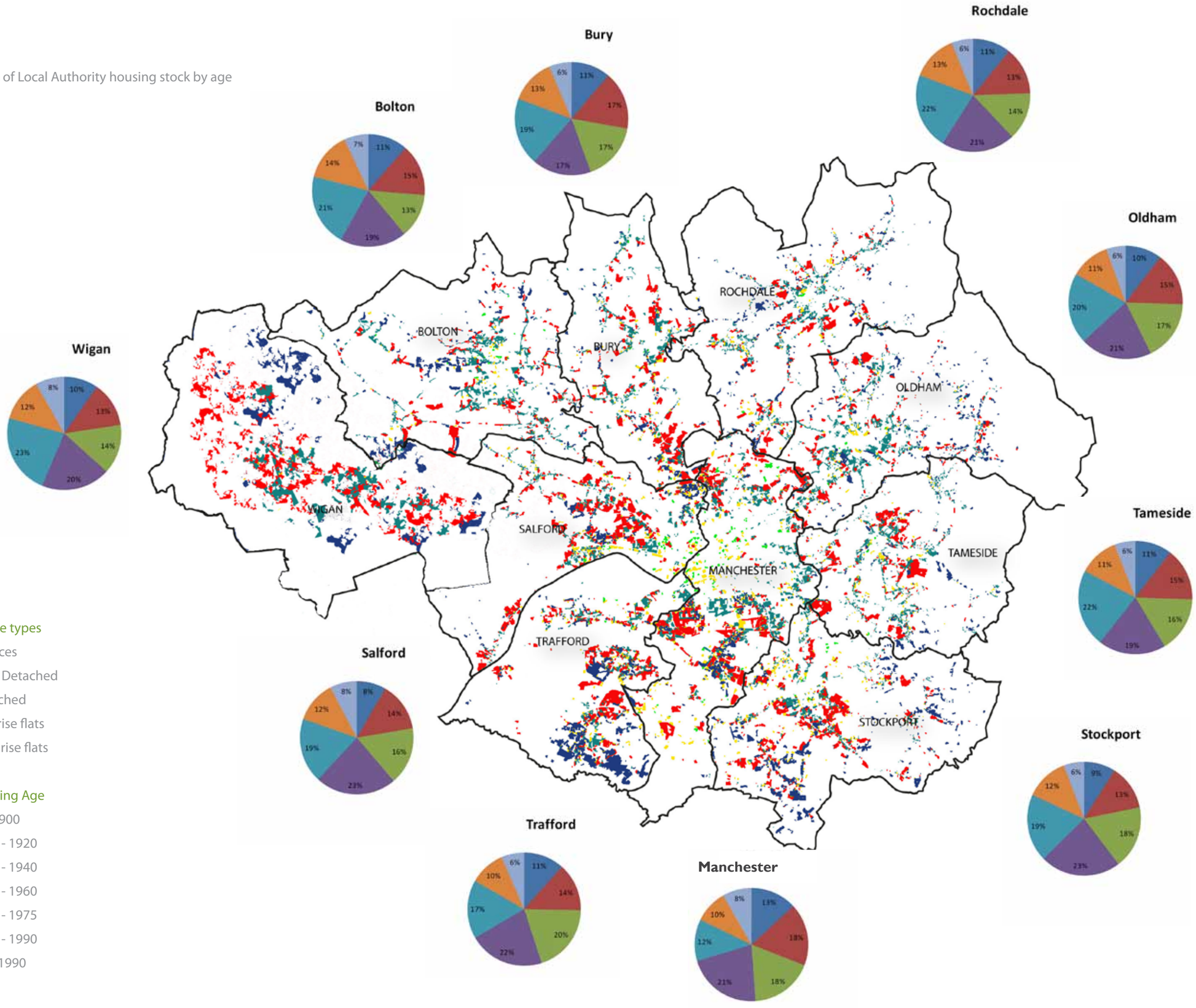
[22] The University of Manchester and English Heritage (2011) Greater Manchester Urban Historic Landscape Characterisation Project, Housing character areas.

[23] University of the West of England, The construction web site, 2011, environment7.uwe.ac.uk/resources/constructionsample/conweb

[24] Energy Saving Trust, Home Energy Efficiency Database (HEED), Programme impact and measures take-up data.

[25] Energy Saving Trust, Housing intelligence data gathering, Data colated from GM social landlords for the LCEA programme during 2010

Figure 4.2
Breakdown of Local Authority housing stock by age and form



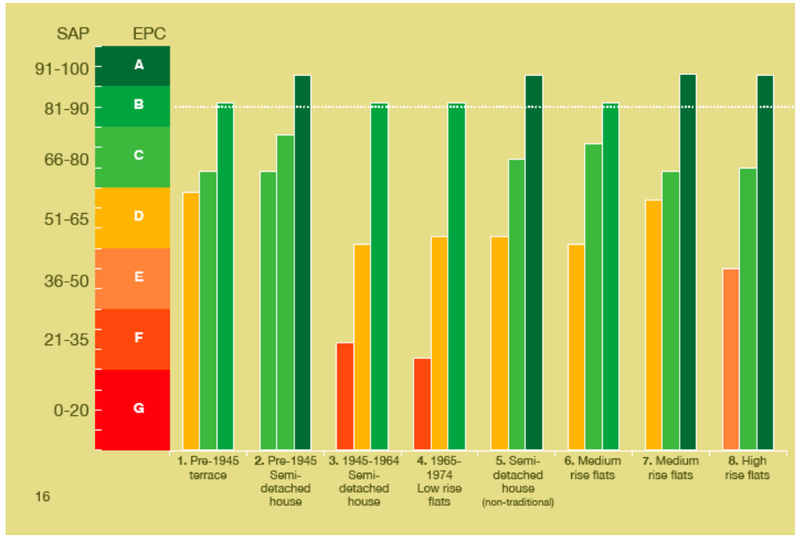


Figure 4.2
Chart showing rising EPC performance to meet target

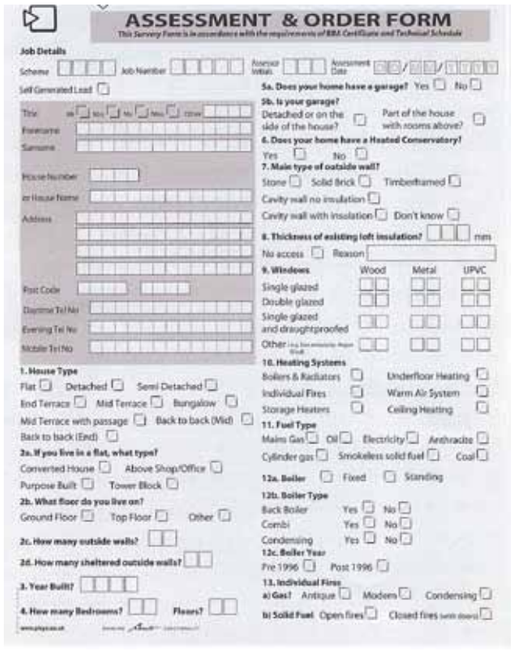


Figure 4.3
Basic Measure Assesment Forms already contain most of the infomation required

High level intelligence on the take-up of measures across the private housing stock is of a relatively poor quality because it does not yet provide a complete picture. This could be improved in the future intelligence from Green Deal assessments and plans was to be used to track the take-up of a wider range of measures. The basic measures programme currently being rolled out across Greater Manchester has begun to provide more detailed intelligence on take-up for the private housing stock.

4.3 How could intelligence be used to support the strategy in the future?

The Committee on Climate Change's carbon trajectory to 2027 suggests that homes that have had basic measures (such as cavity wall insulation) are likely to require a repeat visit in order to carry out further works if Greater Manchester is to maintain its low carbon trajectory[26].

This suggests that a dynamic GM retrofit property database – similar to social housing asset management databases such as Promaster - should be established in order to track progress from the 'bottom-up' as homes are assessed. Importantly, it could potentially also enable the pro-active promotion of measures that still remain to be carried out on each home.

Upon the first contact with a household GM Green Deal Advisers would enter the property onto such a database – would act as a front-end to the new National Energy Efficiency Database (NEED) as well as linking to the BRE's Refurbishment portal which acts as a database of best practice. A SAP assessment of the property together with an evaluation of improvement measures carried out would be logged on the database. Additional supporting items of data collection could include:

- Disclosure of up to three years billing data in order to help benchmark improvements;
- A questionnaire (which could be web based) designed to identify the consumer segment that the household belongs to (using Experian segments as proposed for the NEED database)- See Chapter 5;
- A requirement for smart metering to be installed so that accurate data can then be collected remotely.

This approach would then allow for remaining measures to be identified as part of a 'Whole House Action Plan' and households encouraged to implement as part of future campaigns. The proposed process is illustrated by figure 4.3.

Feedback and learning from the measures installed – both from the household and contractors - could also be logged, potentially drawing upon work by the National Refurbishment Centre at the BRE[27].

This dynamic approach to the assessment and planning of improvement measures in the private housing stock, whilst not guaranteeing take-up, could have the benefit of creating greater certainty of certain packages of measures being brought forward in order to underwrite growth in the supply chain (see Chapters 6 and 7).

All these would be additional functions to those currently proposed for NEED. They would therefore require funding to establish and maintain. These could be jointly funded through contributions from partner Green Deal providers who benefir, as well as GM households, who in turn would benefit from a better service and lower rerofit costs.

[26] See reference 4

[27] BRE, National Refurbishment Centre, 2011, www.rethinkingrefurbishment.com

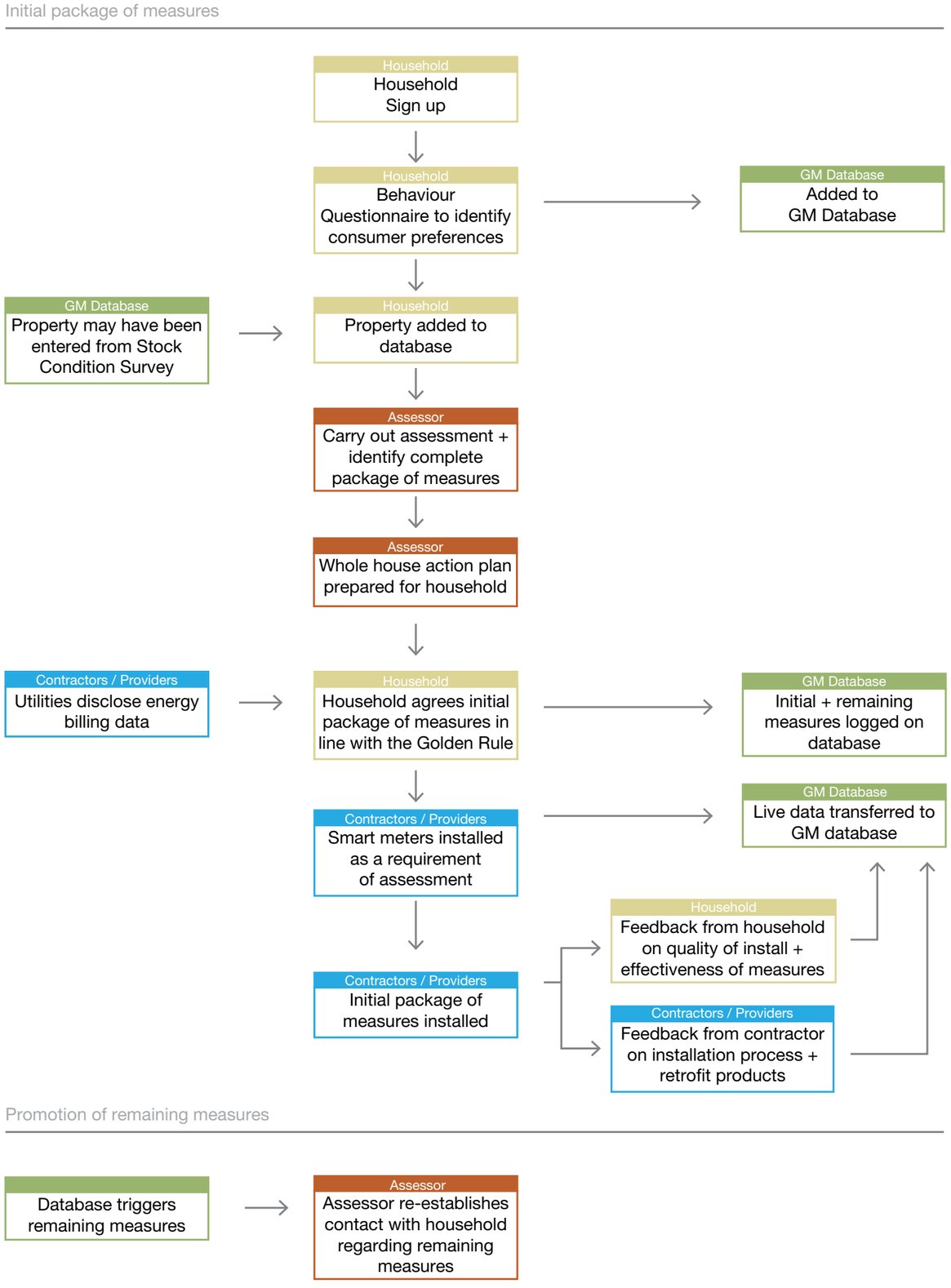


Figure 4.3
Proposed GM Green Deal assessment and intelligence gathering process

Experience and progress made by GM stakeholders

- The Energy Saving Trust working with AGMA have surveyed Greater Manchester's social landlords in order to build up a more accurate picture of their stock.
- The HEED database has been upgraded to provide more accurate data related to the uptake of measures (including micro-generation) and the impact of programmes to date.
- New Economy working with the ten Local Authorities of Greater Manchester have liaised with the Housing Officer Group in order to survey the status of Housing Stock Condition Surveys in support of the GM Housing Market Assessment.
- The University of Manchester has been working with English Heritage to map 'urban character areas' for all ten Local Authorities, including distinct forms of housing by form and age.

Action Plan

1. Undertake an options appraisal of the role of GM in the Green Deal (and wider housing retrofit). From this, develop a business case and delivery model for the preferred options ahead of the Green Deal launch.

2. Continue to identify sources of funding to support go early / trailblazer schemes in the social and private housing sector, and to enable larger programmes of projects to join up bringing economies of scale and opportunity for shared learning.

3. Develop and pilot the use incentives around renewable energy / micro-generation to create income for re-investment in wider retrofit activity.

4. Engage with funders at the earliest opportunity to ensure that future delivery models build in their requirements and expertise.

[28] SHAP and HCA (2010) Community Green Deal - Developing a model to benefit whole communities, Report prepared by URBED

5 – Financing and funding the improvements

A combination of funding, subsidy and private finance to reduce upfront capital costs will be needed to deliver cross tenure retrofit on the scale required. The greatest challenge will be attracting sources of long-term, low cost private finance. Investors will need the comfort that the perceived risks associated with domestic retrofit will be addressed.

Key Messages

— Meeting the domestic retrofit target proposed by this strategy could to require as much as £27 billion of investment over the next decade.

— Given the scale of the challenge and increasing restrictions on public finances much of the cost of delivering cross tenure programmes will need to be met by private sector finance.

— This will need to take the form of debt or equity finance for micro-generation and building fabric improvements.

— Sources of funding - such as ECO and ERDF - and subsidy - such as the Feed in Tariff (FiT) and Renewable Heat Incentive (RHI) - will have an important role to play and will need to be used to attract and underwrite private finance for domestic retrofit.

— Used creatively they could also be used to deliver more carbon reductions for each pound invested.

— More profitable measures such as solar photovoltaics could, for example, be used to cross-subsidise highly effective but less financially attractive measures such as solid wall insulation[28].

— The strategy has identified three broad categories of investment that could be attracted in order to finance domestic retrofit:

> Prudential borrowing and bank debt: Lending on a project finance basis, alongside funding from ECO and ERDF.

> Community and mutual finance: Community equity or local bond issues to finance community renewable installations and whole house retrofits.

> Institutional investment: Investment by pension funds, life assurance funds and commercial investors once the risks and returns are better understood.

Characteristics	Bond issue	Institutional finance	Governmental finance	Bank debt	Social financing	Private equity
Description	Capital generally raised from institutional investors	Pensions funds and Insurance companies	European Investment Bank and Green Investment Bank	Private investment banks (structured finance) and high street banks (personal loans)	Building societies, re-investment trusts, dedicated share issues and revolving funds	Private capital, mezzanine finance, subordinated loans
Term of finance	Wide range 5 to 50 years	Term matches lifespan of the asset, typically 5-25 years	Term can match that of matching financing	Up to 25 years	Defined by projects and mortgage terms	3 to 5 years
Cost of capital	1% to 5% over Gilt	0% to 10% over Gilt or EUROBOR	0% to 3% over Gilt or EURIBOR	1.5% to 10% over LIBOR	Dependant on project structure	4% to 15%
Minimum investment	> £50 million	> £200 million	£10m to £500m	up to £25 million	Variety of scales	Variety of scales

Table 5.1
Sources of domestic retrofit finance

5.1 Where will the finance come from?

There is a growing level of interest from finance providers in the Green Deal and micro-generation markets. A number of organisations in Greater Manchester have initiated dialogue with potential institutional investors. Table 5.1 compares the potential different possible sources of finance.

In considering how finance will be made available to fund large-scale domestic retrofit it is important to understand investors views on the risks and barriers to investment. Market research into the attitude of potential investors to domestic retrofit has lead to the following observations[29]:

- Major investors currently perceive domestic retrofit as complex and risky;
- Institutional investors such as pension funds will be unlikely to enter the market until they are confident it can deliver stable returns;
- The barriers to investment could be overcome if trusted local delivery bodies – such as Local Authorities and social landlords - were able to de-risk investment opportunities by demonstrating:
  - A track record in delivering programmes,
  - An ability to attract subsidies and revenue streams,
  - An ability to provide security (assets, income streams or subsidy)
- Institutional investors may enter the market as part of Public Private Partnerships, with the public sector underwriting some of the risk – the model currently being pursued by Birmingham City Council;
- Unsecured lending is likely to become available through the Green Deal mechanism but the interest rates will initially be relatively high (>7-8%), reflecting the perceived risk;

But while there is evidence of active interest from institutional investors there is, as yet, no proven model against which to assign a credit rating, and not enough critical mass of activity from which to create an 'asset class' that meets the requirements of UK investors. At present there is also greater aversion to risk following the collapse of the subprime mortgage market. This position may change with the anticipate formation of consortia of committed institutions, so it will beimportant for GM to develop links with potential finance providers.

[29] Sustainability West Midlands, Scoping study of good practice in finance and delivery models of low carbon retrofit

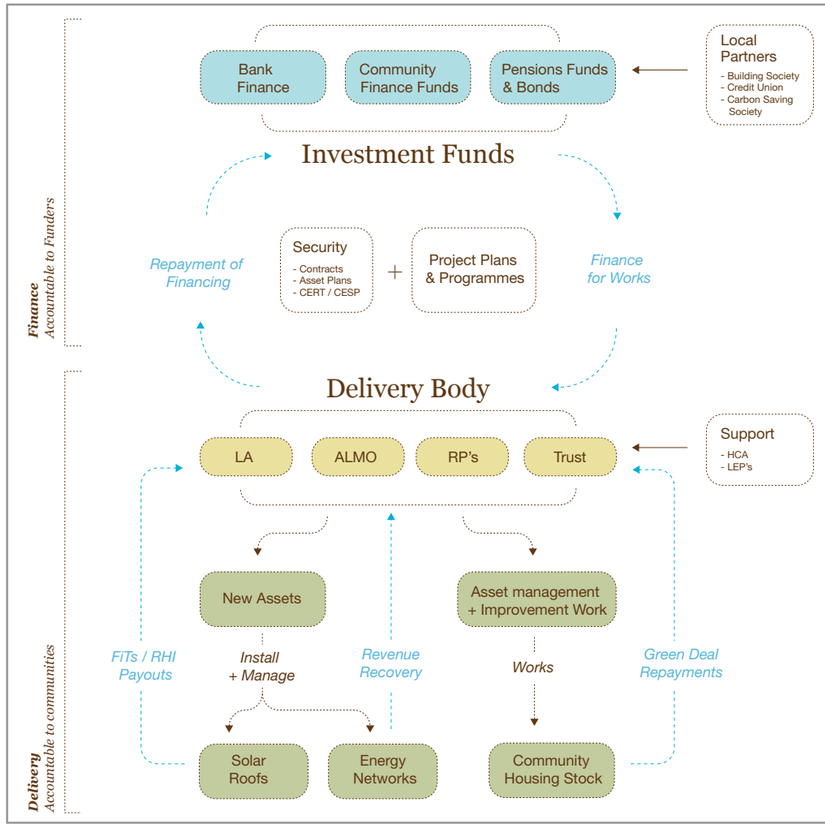
5.2 What role should the public sector play?

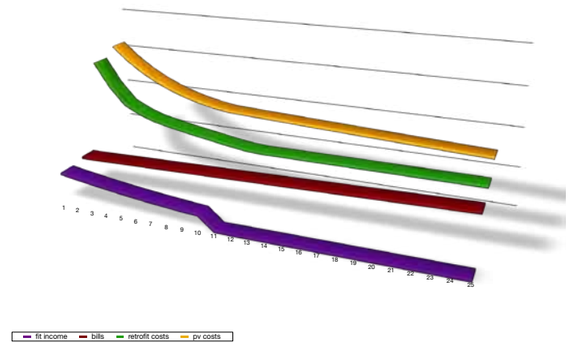
The public sector, working with local partners, will have an important role to play in helping to allay the concerns of potential private sector investors about domestic retrofit. For example, the pioneering Birmingham Energy Savers programme has taken some of the risk by using Prudential Borrowing to finance early phases of a large-scale programme[30].

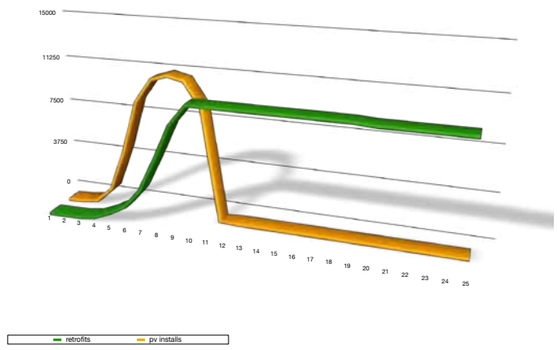
The Combined Authority of Greater Manchester and the Local Enterprise Partnership (LEP) have the potential to play an active role. They could assist in two key areas by:

- Pump priming using funding sources such as ERDF, the Regional Growth Fund and the EU's Seventh Framework Programme;
- Arranging co-financing through partners such as the new Green Investment Bank or the European Investment Bank – as demonstrated by similar financing structures in Germany and across Eastern Europe.

Funding has already been successfully secured from some of these sources for domestic retrofit projects in the social housing sector. Local procurement consortia such as Procure Plus could also play a significant supporting role in driving down costs for large programmes and by creating new procurement routes for social enterprises.







Structure of the Community Green Deal (SHAP / Urbed 2010)

Graphs of the financial model underpinning it now being implemented through the Carbon Co-op. The first graph shows the early roll out of photo-voltaic installations to subsidise the early retrofits while installations are streamlined and the supply chain gears up. The second shows the anticipated reductions in PV and retrofit costs over time while the subsidy reduces but without bills only rising 1% ahead of RPI.

5.3 The potential for innovative forms of financing

In more deprived urban neighbourhoods investment on the scale required will be difficult because of a combination of:

- Limited public funding,
- Short termism by private landlords,
- Limited equity in owner occupied properties,
- Poor individual credit ratings.

This means that Local Authorities working with the HCA, social and private landlords, utilities, social enterprises and community groups will need to develop innovative forms of financing, underpinned by ECO funding, that are more sustainable in the long run.

The lesson from area-wide improvement projects such as Northmoor in Manchester is that mechanisms are needed to clawback the high upfront capital investment[31]. There is the potential for this to be recovered from the uplifts in value, rents and tax revenues. Mechanisms such as Equity loans, Land Trusts and Tax Incremental Finance (TIF) may therefore have a role to play, but initial pump priming would still be required – which is where ECO could play a significant role as working capital.

There could also be a significant role for what has been termed 'social' or 'community' finance. This could take the form of community share issues and new forms or mutual savings societies – as demonstrated by Manchester's newly formed Carbon Savings Society, which is seeking to raise £2.5m over 3 years. It could also involve traditional bodies such as Building Societies, Credit Unions and Home Improvement Agencies – many of whom already have a track record in administering personal loans.

5.4 Funding and finance options

Whilst the exact nature of the funding and finance combinations that will be used in Greater Manchester will emerge over time, based on emerging best practice it is possible to identify three broad forms of financing that could be used:

[30] See reference 9

[31] Feedback from the RENEW Housing Market Renewal (HMR) Pathfinder in Stoke-on-Trent

Option 1
Prudential borrowing and bank debt

This option is already forming the basis for a number of large pilot programmes. Lending is on a project finance basis, secured against the balance sheets of partners and contracts. Gap funding from ECO, ERDF and the Regional Growth Fund can be used as additional security. In order to target mixed tenures Home Improvement Agencies and utilities could assist in arranging financing for private landlords and owner occupiers (including right to buy).

- Precedents: German 'Efficiency in buildings' programme, Birmingham Energy Savers, Kirklees Re-Charge, Housing Finance Corporation, EAGA
- Finance providers: Prudential borrowing, Commercial Bank, Green Investment Bank, European Investment Bank
- Security: ECO funding, FiT/RHI contracts, Green Deal/PAYS repayments, Social landlord investment
- Subsidy: ERDF, Decent Homes Backlog, LSVT programme
- Debt recovery: Local Authority, Registered Provider or Green Deal mechanisms

Option 2
Community and mutual finance

This option is already forming the basis for a pilot in Manchester using a tried and tested model for community investment in other sectors. Community equity or local bond issues can be used to finance community renewable installations to benefit from the guaranteed income provided by FiT and RHI contracts and to build-up an asset base.

This revenue can then be re-invested in whole house retrofit improvements, alongside the use of a pay-as-you save mechanism (such as the Green Deal). Whilst there is potential for a domestic retrofit Building Society there are significant regulatory barriers, including the need for £1m in startup capital.

- Precedents: Carbon Saving Society, Low Carbon West Oxford, Brighton Co-operativeReading Climate Change Partnership
- Finance providers: Member investors, Commercial Bank debt
- Security: ECO funding, FiT/RHI contracts, Green Deal/PAYS repayments, Social landlord investment
- Debt recovery: Home improvement loan administrators (e.g. Local Authority, ART Homes), Building Society partner, Green Deal mechanism

Option 3
Institutional investment

Once Green Deal/PAYS and FiT/RHI take-up have achieved sufficient momentum and the risks and returns are better understood institutional investors may enter the market. At this point they will have the confidence to provide finance to bodies carrying out domestic retrofits.

Recipients of finance could include utilities, Local Authorities, social landlords, contractors and social enterprises. Programmes will need to meet investors requirements for risk management, which could include working within the Green Deal framework.

- Precedents: A Shade Greener (Yorkshire), British Gas (Home Energy Plan)
- Finance provider: Pension funds, Life Assurance companies, Commercial Banks
- Security: FiT/RHI contracts, Home Green Deal/PAYS repayments
- Debt recovery: Green Deal mechanism, Pay as you save intermediaries

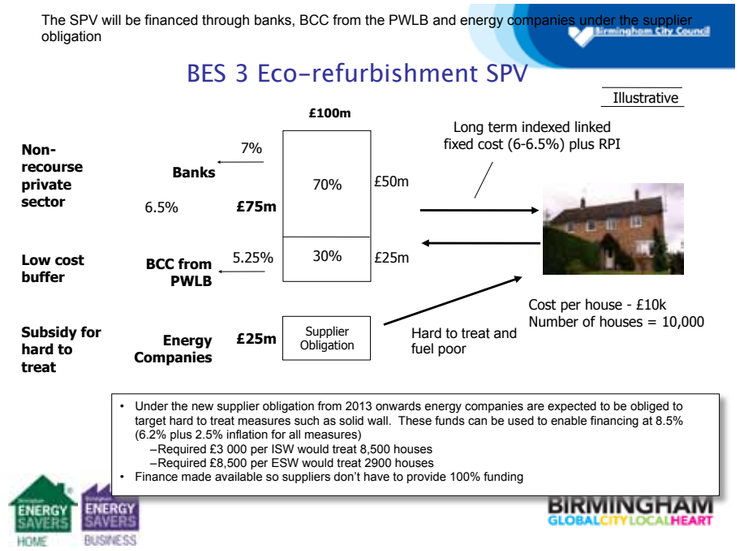


Figure 5.1
Funding supply for Birmingham Energy Savers supply SPV

Action Plan

1. Use existing programmes of basic measures, Solar PV and trailblazer activity to trial Behaviour Change models and approaches. Strengthen the links to GM carbon literacy work, and use this experience to create a recommended approach to behaviour change.

2. Identify key networks, individuals and organisations that can champion and communicate household energy efficiency. Train frontline staff and community members to help pass on consistent and compelling messages.

3. Create a network of local show homes and streets, across tenure, housing archetype and GM districts – to grow awareness, share learning and inspire take-up. Develop the opportunity for a competition across GM to encourage households to become show homes.

4. Engage key stakeholders who are involved at the key trigger points when homeowners and landlords might be more likely to consider house retrofit– e.g surveyors, estate agents, mortgage lenders, rental companies, landlords

6 – Achieving take-up in the private housing market

Acheiving high levels of take-up for low carbon home retrofit packages will require an intelligent approach to marketing and communication of retrofit, moving from an initial focus on socail housing into the private housing market. It will also require engagement with communities and households in order to build trust and enlist their support

Key Messages

— Looking beyond 2015 and the Basic Measures programme this Retrofit Strategy has identified a clear need to gear up in order to deliver packages of 'intermediate' and 'major' retrofit improvements.

— This will create a significant challenge as these measures are invariably more disruptive, complex and expensive to install.

— The Behavioural Change Sub-Group has emphasised that the major challenge will not, however, be technical and instead will be about:

> Winning the trust of owner occupiers who ultimately have to consent to and pay for the work,

> Being able to communicate the benefits of retrofit in clear and meaningful ways,

> Understanding the different contexts in which people make decisions e.g. when buying or renovating a property,

> Working with communities and representatives from communities and their support networks to deliver information and services and to design and manage programmes'

> Local Authorities and social landlords demonstrating leadership in communities and providingsupport across tenures.

— Each sector of the housing market has very different characteristics and will require a very different approach in order to encourage (and consent to) investment in retrofit improvements.

— By working with stakeholders in the housing market – for example, landlords, estate agents, property surveyors, mortgage providers, building firms, DIY chains and the press – it should be possible to target key opportunities to influence decisions;

— The most pre-disposed 'pioneer' households according to Experian's consumer segments should be targeted by marketing campaigns to form the pioneers and early adopters of the programme - 'educated advocates', 'discerning elders', the 'environmentally mature' and 'comfortable conservatives'.

— A network of 'show homes' and eventually 'show streets' should gradually be built up in order to demonstrate the benefits of retrofit improvements to local communities and to ensure that homeowners and communities who participate help spread the word.

GM LCEA programme
Domestic Retrofit Behavioural Change Sub-Group

The aim of the Sub-Group has been to consider how behaviour can be influenced to reduce energy usage in the home in conjunction with retrofit initiatives. It has sought to explain the underlying influences on human behaviours and how this applies to energy consumption. This can then be used to develop consistent messages for use across Greater Manchester.

The Sub-Group's report summarises some of the initiatives that have already taken place and whether these might be transferable across Greater Manchester. One of its main conclusions is that there is no single prescription and that a range of interventions will need to be considered. It also recommends that:

- Retrofit partnerships should comprise organisations that are capable of understanding the target community and having the skills necessary to engage with the householders;
- Programme coordinators, energy advisors and those playing customer service roles should be properly trained in sufficient number to meet the need of programmes.
- Three main elements should be in place prior to the start of any retrofit programme: targeted information, incentives, and local well resourced support groups;
- Programmes should use existing community networks to deliver information or signpost services.

The Sub-Group has also concentrated on exploring ways to develop and implement transactional behaviour change. Transactional behaviour strategies are mainly directed at owner-occupiers who will need to be persuaded on an individual basis to make one-off energy-saving purchases.

The findings from the Sub-Group have informed the development of this Chapter of the Domestic Retrofit Strategy.

Figure 6.1
Timeline for interventions to improve the housing stock to EPC B

6.1 Targeting different sectors of the housing market

6.1.1 Developing a cross tenure approach

Each sector of the housing market has very different characteristics and will require a very different approach to the marketing, communication and incentives to encourage (and consent to) investment in retrofit improvements.

The Strategy therefore seeks to respond to these different challenges and recognise the need to tailor the approach accordingly, but it also recognises the potential interrelationships in seeking to buildup the supply chain and provide technical support.

It is already the intention that social landlords, who own xx% of Greater Manchester's stock, will lead the way on retrofit by improving homes for the most vulnerable. In turn social landlords and their contractors could provide technical support to private landlords, where they operate alongside them in communities, and to private owner occupiers.

Table 6.1 summarises some of the potential challenges for each tenure and the proposed approach under the Strategy.

In the following Chapter we focus on the issues arising from seeking to target private landlords and owner occupiers.

6.1.2 Enlisting the support of communities and social networks

The experience of projects such as British Gas' Green Streets[32], the East Riding of Yorkshire's Changing Steets, the Community Green Deal[33] and local market research by Manchester-based project the Carbon Co-operative[34] have highlighted the importance of working with communities and social networks who can act as trusted and respected intermediaries. This form of engagement is particularly important in order to win trust for more disruptive retrofit improvements.

[32] IPPR, Green streets, strong communities, July 2011

[33] SHAP and the HCA (2010) Community Green Deal - Developing a model to benefit whole communities, Report prepared by URBED

[34] URBED and the Kindling Trust, Carbon Co-operative feasibility study, Report prepared for the Manchester Innovation Fund

Tenure	Retrofit challenges	Proposed approach
Social housing	— The need to consult tenants on improvements and new service charges — How to apportion costs to right to buy apartment occupiers — Fuel poverty can reduce PAYS potential	— Piloting of PAYS using service charges and utility bill repayment mechanisms — Use of ECO to plug gap in PAYS/Green Deal model — Offer retrofit services to local right to buy residents and private landlords
Private rental	— Appetite to make longer term investment tends to be limited — Encouraging Local Authorities to use available enforcement powers — Supporting landlords to respond to future tenant requests (from 2015) — Encouraging them to develop show homes as part of wider programme	— Incorporation of energy efficiency into landlord accreditation, supported by the Green Deal and local social landlords — Use of Selective Licensing to enforce minimum standards — Incorporate energy efficiency into requirements for 'competence'
Owner occupier	— The need to make retrofit easy, convenient, understandable and affordable — Working with communities to build trust, tailor marketing and increase take-up — High standards of customer care to build trust and manage disruption — Increasing local visibility of retrofit homes – to play the role of show homes	— Use of consumer segmentation to shape and inform marketing — Use of a range of novel communication methods — Partnerships with property market stakeholders — Development of a network of pioneers and show homes stimulated by competitions and publicity campaigns — Recruitment of community champions at street and neighbourhood level — Support for retrofit social enterprise and community partnerships

Figure 6.2
How diferent tenures could be targeted

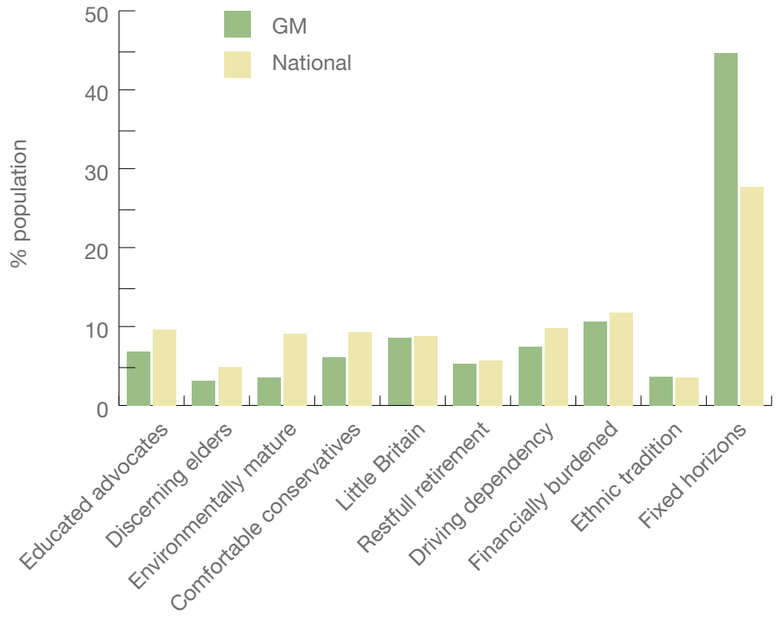


Figure 6.1
Indicative GM Green Deal adoption curve

The overall approach should therefore not just focus on traditional marketing campaigns. Communities who will benefit should be directly engaged in the marketing and delivery of programmes. This could take a range of different forms - from community champions and tenants and residents groups to co-operatives of households and small groups of friends. . Larger groups could be engaged in order to design and manage street and neighbourhood-based retrofit programmes. A range of forms of media could be used to support campaigns, including new forms of social media.

6.1.3 Making energy efficiency and the Green Deal understandable

The Behavioural Change Sub-Group has highlighted the importance of the forms of communication used by marketing campaigns and Green Deal Assessors. Green Deal Assessors should be trained to draw on a range of material to communicate the full range of benefits that retrofit could bring.

Visual techniques such thermographic imaging should be used in order to help home owners and tenants better understand the potential benefits. This technique has been successfully used in a number of forms – ranging from aerial images of whole areas and street by street images to individual properties.

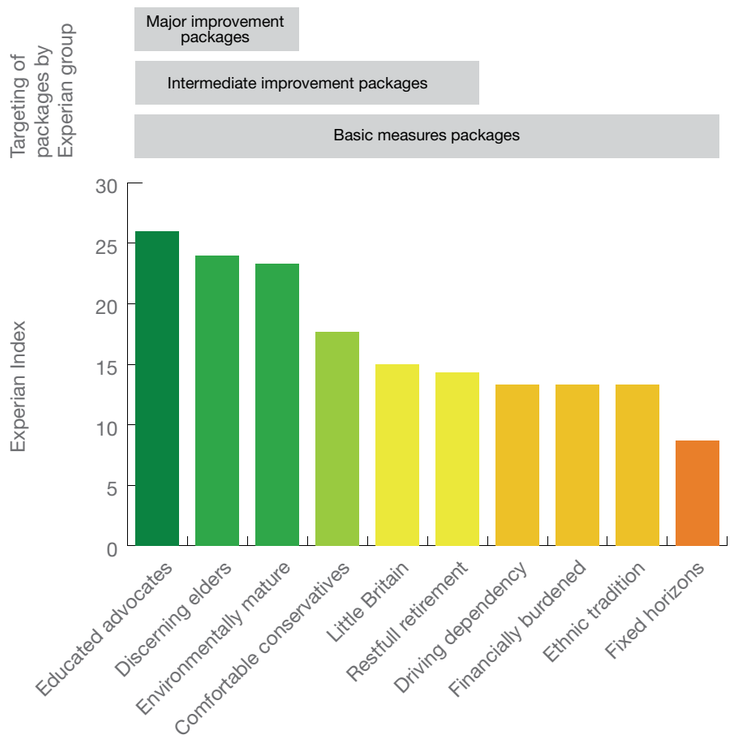
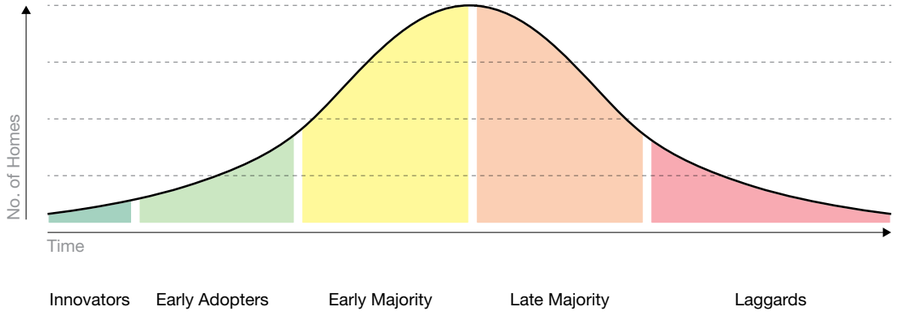
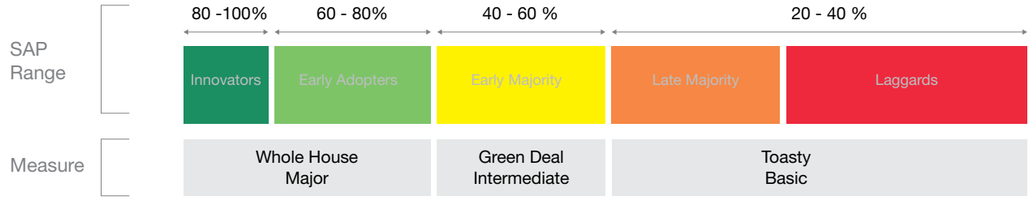


Figure 6.3
How retrofit packages could be targeted at different consumer sections



How adoption is likley to work up to 2035 ^



How packages might be taken up in the early stages ^

Figure 6.4
Retrofit Adoption of Ideas in the short/medium and longer term

6.1.4 Cutting the amount of red tape

The limited resources of Local Authority Planning and Building Control departments suggests that steps will need to be taken to streamline the permitting process. Whilst some retrofit measures are already 'permitted development', dialogue will still be required with officers who, at the beginning, may be unfamiliar with possible retrofit improvements.

This process could be streamlined if specific measures, details and treatments for archetypes could be pre-approved or deemed 'permitted development' – potentially based on a GM 'pattern book' of retrofit improvements as proposed in Chapters 3 and 4.

6.2 How should owner occupiers be targeted?

6.2.1 Targeting different consumer segments

Much of the Government and the Committee on Climate Change's thinking about the marketing of domestic retrofit is based on the concept of 'market segmentation' [35]. It's premise is that people can be categorised according to how pre-disposed they may be to act. It also recognises that people have different motivations and priorities that should be addressed by product design and marketing.

Analysis by Experian for the Energy Saving Trust has shown that Greater Manchester is under represented in consumer segments that are more likely to become 'early adopters' of environmental measures, including retrofit improvements- as illustrated by Figure 6.1[36]. It will therefore be important to target not just the 'educated advocates' but other less committed but 'light green' households in the 'discerning elders', 'environmentally mature' and 'comfortable conservatives' categories. This approach could be used to target retrofit packages - as illustrated by Figure 6.2. This is not exclusive and opportunities to engage other segments should not be omitted such as those in fuel poverty who could benefit from stability in their costs.

[35] Cabinet Office, Behavioural change and energy use, Behavioural insights team, July 2011

[36] Energy Saving Trust, Basic Measures report, A review of implementation requirements to fulfil the basic measures objective, July 2010

Seeing is believing

A retrofit show home in every neighbourhood?

Great British Refurb Campaign

Old Home Superhome Network

The aim of the Superhomes Network is to make sure that there are 'locally and publicly accessible' retrofit homes that have achieved a less than 60%+ reductions in their CO2 emissions within 15 minutes walk of everyone. Evidence has shown that over 55% of people who visit a show home go on to likely to make retrofit improvements to their own home[39].

A network in Greater Manchester could initially be built up from:

- Pioneers: People who decide to make retrofit improvements to their home in order to demonstrate their commitment;
- Social landlords: Landlords who decide to lead the way by improving homes and by working with committed tenants;
- Local Authorities: Each district working to ensure that they have a retrofit show home that they can use in campaigns;
- Competitions: Encouraging people to benefit from retrofit improvements through sponsored competitions;

It will also be important to engage with th elarge proportion of households in the 'fixed horizons' category - with many households falling into this category because they are in fuel poverty and may be restricted in the investment they could make because of their income or credit rating. This portion of population may therefore be addressed in the first instances by investment in social housing and by working with private landlords.

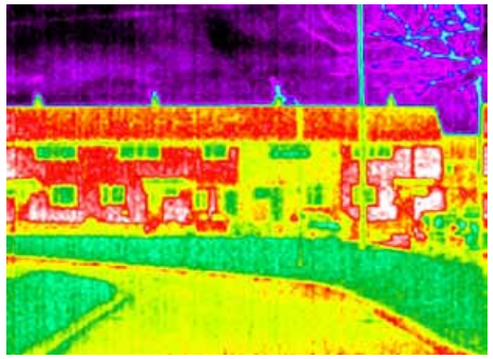
6.2.2 Designing the marketing and communication strategy

The Behavioural Change Sub-Group has recommended that the focus of a marketing strategy for domestic retrofit should be on influencing 'transactional' behaviour – points when home owners make decisions about investment in their homes and associated products and services[37].

There are many possible points of influence in the private housing market. By working with stakeholders in the housing market – for example, landlords, estate agents, mortgage providers, building firms, DIY chains and the press - retrofit improvement packages can be targeted where there is greatest potential to influence take-up – for example, when people buy a new home, invest in a new kitchen or loft extension, or redecorate rooms.

As the retrofit market develops the quality of feedback from transactions will also be vital in building trust in the marketplace. Whilst the Green Deal accreditation scheme will provide a degree of security that improvements will be carried out by by qualified professionals using accredited products, the potential to establish a customer feedback loop will be equally as valuable.

People respond better to positive news stories and personal recommendations from trusted friends or members of the community, so these should form a key element of ongoing marketing campaigns. The full range of benefits emerging from people's experience of retrofit should be emphasised, and could also be turned into forms of rewards and incentives as part of retrofit competitions (see Box 'seeing is believing').



East Riding of Yorkshire Council

6.2.3 Developing a network of show homes

The objective of the retrofit strategy should therefore be to engage these target consumer segments in retrofit activities as early as possible. Building on work by the Greater British Refurb Campaign and the Old Home Superhome Network it is proposed that this takes the form of a network of 'show homes' and eventually 'show streets'[38]. This would help demonstrate the benefits of retrofit improvements to local communities – especially 'whole house' packages.

6.3 How should private landlords and investors be targeted?

6.3.1 Supporting and incentivising

Private landlords are a difficult sector of the housing market to target improvements at because they are generally perceived to under-invest and only think short-term. The response across Greater Manchester has been to put in place landlord accreditation schemes and to work with, and to encourage, the better landlords.

The first step would therefore be to ensure that, firstly, accreditation is in place and that, secondly, energy efficiency forms a key element. Requirements to improve the performance of properties can then be incentivised and supported by making loans, ECO subsidy and technical support available. It could also form part of requirements to be a 'competent' landlord that they receive training in energy efficiency. Selective licensing of private landlords could be used if take-up is too slow.

As social landlords initiate trailblazer retrofit programmes they could also offer technical support to private landlords if they own similar house types. This could also be extended to instances when tenants request energy efficiency improvements once proposed new regulations come into force from 2015. This would be an opportunity to encourage marketing based on the total cost of occupation not just rental.

6.3.2 Influencing property investors

There could be the potential to promote new investment by more enlightened housing developers and landlords in Greater Manchester – for example, to take existing properties and brings them up to GM retrofit standards. Fiscal incentives could be explored to incentivise investment, addressing issues such as those raised by the HCA and Urban Splash in seeking to refurbish terraces at Northmoor in Levenshulme and Chimney Pot Park in Salford.

[37] LCEA WP1 Domestic Retrofit Behavioural Change Sub-Group, An action plan for changing household behaviour to reduce energy consumption, April 2011

[38] Sustainable Energy Academy, Old Homes Superhome Network, www.superhomes.org.uk

[39] Old Homes Superhome Network, Visitor analysis, July 2009

Experience and progress made by GM stakeholders

- A range of different marketing techniques and incentives have been trialled across Greater Manchester supported by EEC, CERT and CESP funding, including the Heat Seekers scheme and Council Tax rebates.
- Home improvement loans have been made available by a number of Local Authorities through Homes Improvement Agencies, such as in Oldham and Rochdale as part of the HMR programme.
- Manchester City Council has pioneered landlord accreditation and supporting improvement schemes and a scheme co-ordinated by AGMA is now up and running across Greater Manchester.
- The EU funded Smarter and DEHEMS programmes in Manchester have field trialled energy monitors with 150 households linked to a web-based database.
- The University of Salford funded by the Environment Agency and Trafford Borough Council has carried out research with households in Trafford looking at attitudes and motivations to make investment in energy efficiency measures.
- The LCEA WP1 Behavioural Change Sub-Group has developed an action plan based on a review of UK programme experience and techniques that have been used to stimulate market uptake;
- The Carbon Co-operative and Carbon Saving Society have been established in Manchester with the support of Manchester City Council following an initial period of market research and business planning;

7 –
Realising the economic potential

Take-up of the Green Deal will create significant demand for retrofit products and services. A co-ordinated and planned approach will be required in order to meet this demand in way that maximises the benefit and value added for Greater Manchester's economy and positions the retrofit sector to support economic growth.

Action Plan

1. Working with the delivery team for the LCEA Work Programme 5, develop a robust communication and engagement network with the local supply chain – to maximise opportunities for local contracts and future growth.

2. Develop a clear communication plan to drive awareness of the GM strategy and targets within the supply chain via existing networks.

3. Through the Supply Chain and Innovation Working Groups, ensure private and voluntary sector involvement in the development of programmes, products and systems.

4. Create cacaptiy to better identify supply and skill gaps both within GM, and nationally in order to target areas for new product, business and social enterprise creation.

Key Messages

— The LCEA vision for Greater Manchester as a low carbon economy specialising in the built environment is compelling and has political support.

— Evidence from pioneering low carbon economies in Germany and the USA is that a co-ordinated and planned approach to supply chain development is required in order to maximise the economic development opportunities.

— This approach will be required in order to meet the challenges in building a supply chain that can respond at scale:

> The creation of enough certainty and confidence to support and sustain investment in new capacity,

> The diversification and reskilling of local industry to respond to the opportunity.

> Ensuring there is access to high quality products that meet required codes of practice and related accreditations,

> Identifying and developing new products and services to meet future programme needs and to substitute imported products,

— This will require the brokering of an ongoing dialogue between retrofit clients – who create the demand – and industry – which will need to respond to the demand.

— The full range of retrofit components required will need to be identified and managed as a supply chain. The opportunities can then be mapped onto the existing industrial base.

— There could be significant potential for social entreprises to support the intermediate labour market and to act as trusted, non-profit intermediaries to engage with owner occupiers

— Industry knowledge of how to carry out retrofit on the full range of archetypes is currently relatively limited. This knowledge will quickly grow and develop as more retrofits are carried out, and to higher specifications.

— Learning from retrofit programmes should be captured and fed back to the supply chain in order to improve and develop products and specifications. A GM supply chain development unit and product quality board could be established to provide independent oversight of this process.

— There would be benefit in establishing an easily accessible GM 'pattern book' of best practice and learning – which could include case studies, products, details and installers related to different archetypes.

— The capabilities of the Universities and other local bodies could be used to support the development and testing of new and existing products.

Supporting existing companies who may wish to supply products or provide installation and maintenance services but may require certainty to invest in new capacity.

Case study: Web Dynamics, Bolton
The company specialised in breathable membranes for construction before diversifying into foil insulation for roofs and walls. They have BBA accreditation for a range of products and supply both the new-build and retrofit markets.

Supporting existing companies who may not currently manufacture, install or service retrofit components but may have the skill set and could be encouraged to diversify into the sector.

Case study: Jacobs Eco-Energy, Salford
A specialist in the construction sector, they has diversified into the installation of solar PV systems. Financial assistance and technical guidance from Envirolink ebabled them to gain Microgeneration Certification Scheme (MCS) accreditation.

7.1 Making the the low carbon economy a reality

7.1.1 The LCEA vision

Analysis by Ernst & Young in support of the LCEA Joint Delivery Plan made an initial assessment of the potential economic benefits. It highlighted the potential for the programme across all work packages to deliver the following benefits:

- Delivery of up to £650m direct additional Gross Value Added (GVA);
- Supporting 34,800 jobs in total (including 18,000 in the supply chain) contributing indirectly approximately £1.4 billion GVA in the built environment in total;
- A reduction in workless and the provision of skills progression for those already working in the sector or related sectors;
- Benefiting the wider North West and UK through developing and sharing best practice, as well as economic spill-over benefits.

By proposing a trajectory for low carbon housing retrofit in Greater Manchester it will be possible to improve the underlying these assumptions for employment creation and the GVA potential for this sector of the GM economy.

Making the headline benefits proposed by the LCEA a reality will rely on the creation of sustained demand for low carbon housing retrofit products and services and the development of a Greater Manchester supply chain and capacity within the construction industry to then meet this demand. The lesson from the UK micro-generation sector and countries such as Germany and the USA is that it will be vital to ensure there is sustained and consistent demand over the medium to long-term in order to provide certainty to industry. Recent experience from the USA also highlights the importance of a balanced approach to training and reskilling – with a focus on protecting employment through reskilling and creating employment through innovation and business development (see case study box).

7.1.2 Identifying opportunities for existing industry

The ability to maximise the value added benefit to the GM economy will depend, to some extent, on the skill set of the existing industrial base and whether it can adapt and respond to the needs of the retrofit supply chain. Based on recent research for the Community Green Deal, the opportunities could take a number of different forms which are illustrated by the 4 case studies on this and the following page.

Initial work to map retrofit supply chain opportunities onto Greater Manchester's existing industrial base has been carried out in support of the LCEA programme. A database has been setup by K Matrix using methodologies adapted from the Department for Business, Industry and Skills. This database has significant potential for use to target companies.

7.1.3 The potential for social enterprise

The experience of intermediate labour projects such as J21 in Oldham[40] and B4Box[41] in Salford suggests that there could be significant role for social enterprise in the construction sector., embedding benefits in the client community. The role played by these organisations can be seen as costly by larger contractors and has had to be driven by requirements as part of Decent Homes programmes.

The experience from countries such as the USA and Canada is that there could also be significant potential for trusted, non-profit intermediaries in arranging private sector retrofit[42]. Social enterprises have the potential to instill greater trust, bring together groups of clients and develop more beneficial realtionships especially given perceptions of the building trade. Acitivities could include carrying out Green Deal assessments and selecting the contractors, installers and products.

[40] J21 (2011) J21 - Linking construction skills to jobs, www.j21.org.uk

[41] B4Box Group (2011) www.b4box.co.uk

[42] See reference 34

Supporting startup companies or University spin-outs who are looking to meet existing/future retrofit requirements but may require investment or mentoring to break into the market.

Case study: OLED Power, Manchester
Based at the University of Manchester's Innovation Centre the company develops and manufactures components for high efficiency LED lighting and is developing components for the next genera tion of organic solar photovoltaic cells.

Attracting inward investment by EU or international companies who may be planning to establish further manufacturing or distribution operations.

Case study: Ünger Diffutherm, Germany
A specialist in wood fibre insulation, they have built a reputation in the German retrofit market. As a result of growing UK interest in vapour permeable insulation their products have featured in the Retrofit for the Future programme.

7.2 Ensuring a dynamic supply chain response to programme needs

7.2.1 Developing the retrofit pattern book

Industry knowledge of how to carry out retrofit on the full range of archetypes is currently relatively limited. This knowledge will quickly grow and develop as more retrofits are carried out, and to higher specifications. The National Retrofit for the Future programme has demonstrated the benefit of bringing together and sharing this knowledge[43]. There would be benefit in establishing an easily accessible GM 'pattern book' of best practice and learning – which could include case studies, products, details and installers related to different archetypes. This could form part of a GM portal to the national NEED database as outlined in Chapters 3 and 4.

7.2.2 Pro-active supply chain development

LCEA and retrofit partners across Greater Manchester will need to actively engage with the supply chain to find, specify, test and develop the retrofit components that will be needed. As we noted in 7.2.1 contractors, designers and social landlords already have experience with a range of existing products, but this range will need to expand and develop as the market grows.

Supply chain development functions that have been identified by previous studies and which could be established in anticipation of large-scale domestic retrofit could include:

- Scanning the market for new and existing products,
- Defining future need for products and/or product improvements,
- Arranging testing and accreditation for new and existing products if required,
- Developing partnerships with potential suppliers and manufacturers,
- Partnering with manufacturers to invest in new products and production capacity,

A supply chain development group and product quality board could be established to carry out some of these functions as an extension of the functions of the proposed LCEA Centre of Excellence and the existing LCEA retrofit standards sub-group (described in Chapter 3). Examples exist of capacity that could be built on such as Procure Plus' Green Hub. Such a group and board would need to play an active and independent role in identifying and breaking down barriers that may be preventing Greater Manchester and North West suppliers and installers from responding to emerging opportunities. They would also respond to feedback from programmes relating to, for example, the quality and availability of products.

7.2.3 Using learning and foresight to improve products

Feedback loops and learning from retrofit projects will be important in order to identify and improve retrofit products. It would also enable needs to be identified which could then be used to develop briefs and specifications for products.

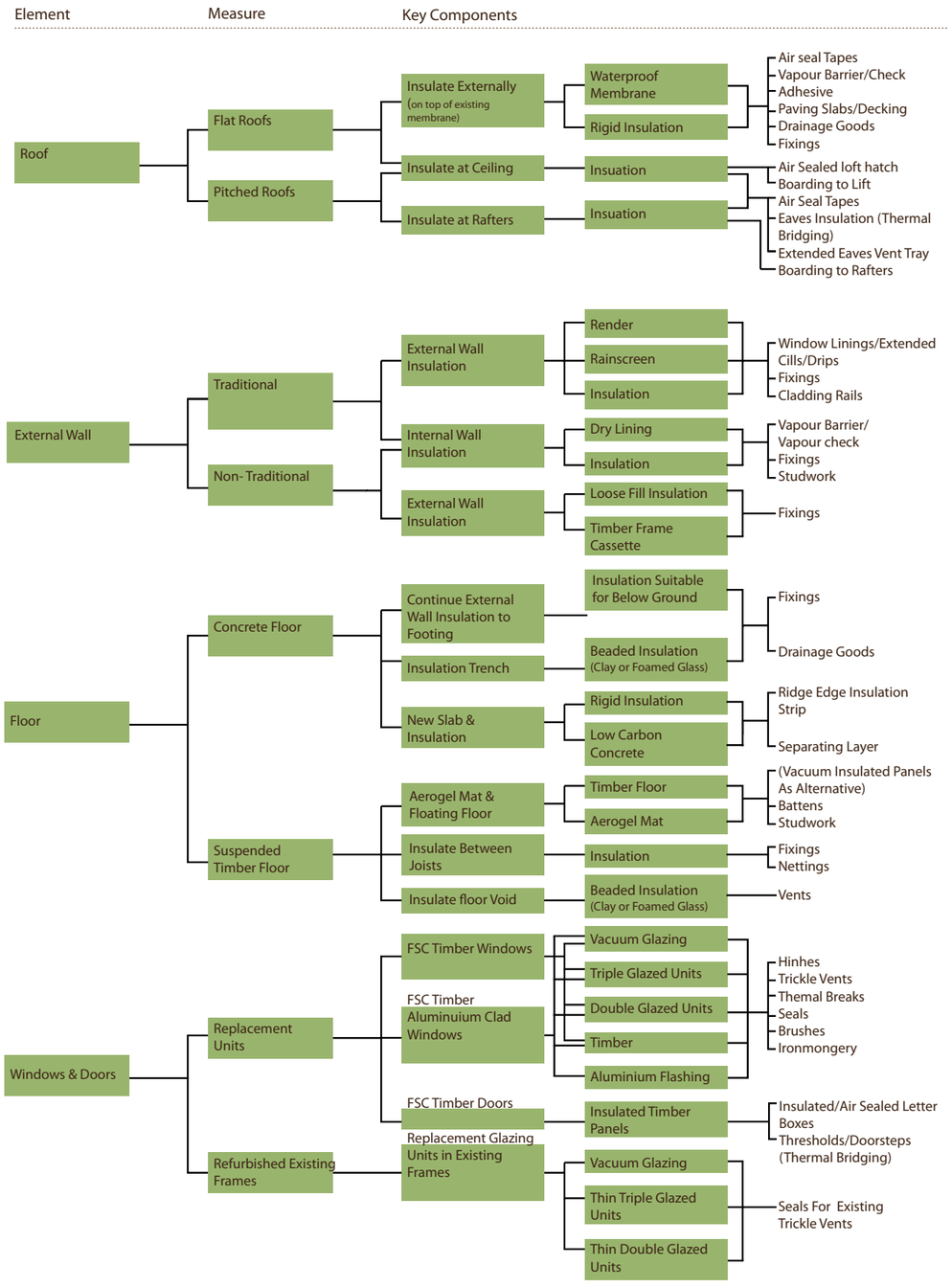
As discussed in Chapters 3 and 4 this process could be directly linked to intelligence captured through a GM front-end to the NEED database linked through to best practice portals such as that being developed by the BRE's National Centre for Refurbishment[44].

With better foresight of potential future demand for retrofit products early investment in startup companies, diversification by existing companies and suitable inward investment could create competitive advantages for Greater Manchester. The product quality board outlined in Section 7.2.2 could play a key role here, providing independent oversight of product needs. Partners such as the University of Salford have already been incubating and supporting new startup companies who are seeking to enter the retrofit market. The Universities also have a track record in testing and verifying the performance of new products.

[43] See reference 18

[44] See reference 28

Figure 7.1
Identifying the retrofit supply chain opportunities



Experience and progress made by GM stakeholders

- A low carbon goods and services database has been created by K-Matrix in support of the LCEA. This database is a resource that has significant potential to identify opportunities for diversification across Greater Manchester.
- Envirolink have run a series of Green Deal events and briefings for local industry in conjunction with the North West Centre for Construction Innovation. They have also been working with the Energy Saving Trust to help develop the supply chain in support of the Basic Measures programme.
- Envirolink have been developing 'sustainable procurement framework' ITT's in conjunction with social landlords in Greater Manchester. These are designed to introduce criteria aimed at supporting local supply chain and skills development.
- The new Local Enterprise Partnership (LEP) is working with the Greater Manchester Chamber of Commerce to develop a Low Carbon Investment Framework to support growth of the sector.
- A solar PV 'special interest group' is being established which will function as a business club to develop the value of the supply chain. It will also allow products to be tested using the University Salford's Energy Hub.
- A bid is being led by Siemens to establish a Technology and Innovation Centre (TIC) in Greater Manchester. The Centre could be aligned with the LCEA built environment objectives.
- Working alongside Trafford College, Oldham College Business Centre is establishing a Renewable Technology Centre in conjunction with local installation companies who will support new spin-out enterprises.

8 –
Building up the skills and capacity

Take-up of the Green Deal will create significant demand for a range of skills, from design and installation to marketing and customer care. Greater Manchester's workforce will require support to upskill in order to benefit from these opportunities, to improve access for the unemployed and to provide a consistent quality of service.

Action Plan

1. Identify opportunities within the existing programmes for sustained or short term work placement, apprenticeships and skills development – by linking supply chain partners and local learning providers. Set up KPIs to monitor and benchmark performance against other capital programmes.

2. Work with local learning providers to ensure the 'fabric first' approach to housing retrofit in Greater Manchester is built into their curriculum, alongside the emerging focus on green technologies.

Key Messages

— Greater Manchester already has a significant construction sector. A growing retrofit sector would create significant potential to for safeguarding and expanding employment in this sector.

— Delivering whole house retrofit will require a broad range of upskilling which, to some extent, will be governed by the Green Deal Code of Practice.

— The skills required will encompass the whole process of delivering retrofit improvements - from the surveying and assessment of properties to design, installation, customer care and ongoing maintenance.

— In order to create a level playing field across GM, accredited skills will need to be required for certain retrofit works. These will be supported in the future by the proposed Green Deal Code of Practice and Quality Mark.

— Decent Homes programmes have embedded a range of these new skill sets in some sectors of the construction industry – including, for example, higher standards of customer care and liaison.

— These programmes have also demonstrated how through careful procurement local upskilling and apprenticeships can be supported.

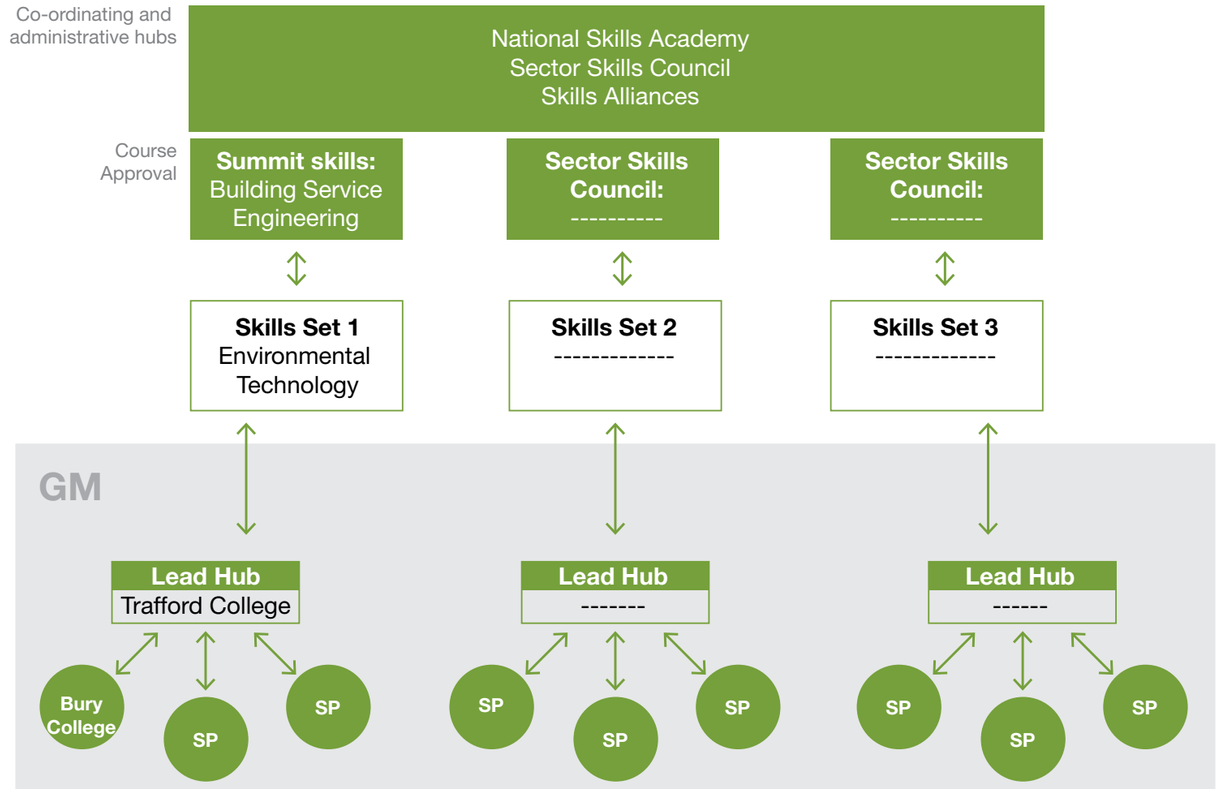
— This experience will need to form the starting point for a broader upskilling across Greater Manchester and its potential retrofit installer and supplier base.

— In order to support the broader range of skills it will be necessary to engage with Sector Skills Councils, National Skills Academies and Colleges in Greater Manchester to ensure a co-ordinated approach to skills training.

— A gap has been identified by stakeholders for training in site co-ordination and to ensure there is a diversified skills set capable of responding to the challenges of whole house retrofit.

— Upskilling may also extend to manufacturers and distributors who may have the potential to expand and diversify but may need to develop new business and manufacturing skills.

Figure 8.1
Model for the co-ordinated development of new courses to deliver retrofit skills



8.1 Addressing deficiencies in construction skills

Greater Manchester already has a significant construction sector which encompasses existing property renovation and low carbon new-build construction in response to Part L of the Building Regulations. There is also considerable experience of aspects of low carbon retrofit from Decent Homes programmes in the social housing sector. A growing retrofit sector would therefore create significant potential to both safeguard and expand employment in this sector.

A deficiency of certain construction skills that will be required in the private sector housing market has already been identified by stakeholders in Greater Manchester. These range from more advanced skills such as the installing of PV's and external wall insulation to plasterers and scaffolders. This is particularly evident from anecdotal evidence of trying to find good quality trades people with these skills.

One issue with finding trades people with these skills is that those with higher qualifications are often more expensive. When contractors are outsourcing work they have to keep costs down which can be to the detriment of quality. At the moment a suitably skilled workforce might also have to be brought in from further afield – although there are areas such as boiler servicing and installation where there is already a strong GM presence.

In order to create a level playing field and encourage more competitive rates accredited skills will need to be required for certain retrofit works. This will be supported in the future by the proposed Green Deal Code of Practice and Quality Mark, but there will be scope for a co-ordinated approach to be taken across Greater Manchester – as demonstrated by the Toasty basic measures programme.

B4Box Construction

8.2 Addressing the breadth of skills required

Drawing upon the lessons from contractors engaged in Decent Homes programmes it is important to recognise the full range of skills that will be required for cross tenure home retrofit. The whole process will need to be considered - from the surveying and assessment of properties to design, installation, customer care and ongoing maintenance.

In order to provide new forms of training active dialogue is required with learning providers. The Sector Skills Councils are responsible for identifying needs and creating new sets of qualifications, including Training Quality Standards, which are in turn set according to National Occupational Standards. These qualifications can then be provided through local hubs of the National Skills Academy such as Trafford College and by affiliated training providers that may then wish to specialise – as demonstrated by Oldham College's new Renewable Technology Centre[45].

Summit Skills have already established a National Skills Academy for environmental technologies[46], but in order to support the broad range of skills associated with low carbon home retrofit it will be necessary to work with GM Colleges in order to engage with other Sector Skills Councils. A number are already developing related qualifications under the Green Deal Skills Alliance[47]. In addition to Summit Skills other potential Sector Skills Council partners are likely to include[48]:

- Asset Skills: Whose coverage includes housing, property and planning. They are looking at energy assessment;
- Construction Skills: Who are developing NVQ and City & Guilds qualifications in building treatments to support the Green Deal.
- ProSkills: Whose coverage focuses on the process and manufacturing sector. Relevant areas could include building and timber products.
- SEMTA: Whose coverage focuses on science, engineering and manufacturing technologies. Relevant sectors could include electronics, metal goods and mechanical equipment manufacturing.

[45] Oldham College Business Centre, Groundtherm supporting Oldham College, 19th January 2011, www.oldhambusinesscentre.co.uk

[46] National Skills Academy (2011) Environmental technologies, www.nsaet.org.org.uk/environmental_technologies

[47] Summit skills, Green Deal code, www.summitskills.org.uk, June 2011

[49] UK Commission for Employment and Skills (2011) List of Sector Skills Councils, www.ukces.org.uk/ourwork/sector-skills-councils

B4Box Construction

B4Box Construction

The role of skills development in manufacturing was highlighted in the Chapter 7 of this Strategy and will need to be a parallel area of focus in order to support supply chain development.

The LCEA programme is promoting the need to provide training services near to where there is a potential workforce. However, in seeking to do this the preferred route would be if each college became a specialist in a certain area rather than all providing the same, or similar courses, as there may not be sufficient future demand in one area for significant overlap.

8.3 Multiple skills sets and retrofit career progression

A gap has been identified by stakeholders for training to support career progression. For example, to allow construction workers to progress into site management roles – which are particularly important given the need to co-ordinate many different skilled trades on site. This would generally only be accessible through a University qualification,. There is the scope to develop and pilot a modular series of qualifications from NVQ through to degree level. These might also be extended to cover design skills, such as the architecture of retrofit and services design.

A gap and need has also been identified to ensure there are diversified skills sets to respond to the challenges of whole house retrofit,. The types of courses on offer need to also focus on acquiring several different skills sets – which could extend to include assessments and customer care - which would in turn make the local employment market more resilient. This could be addressed at an early stage through the GM apprenticeship strategy, which targets funding at the 16-19, 19-25 and 25+ age groups up to NVQ level 4.

Experience and progress made by GM stakeholders

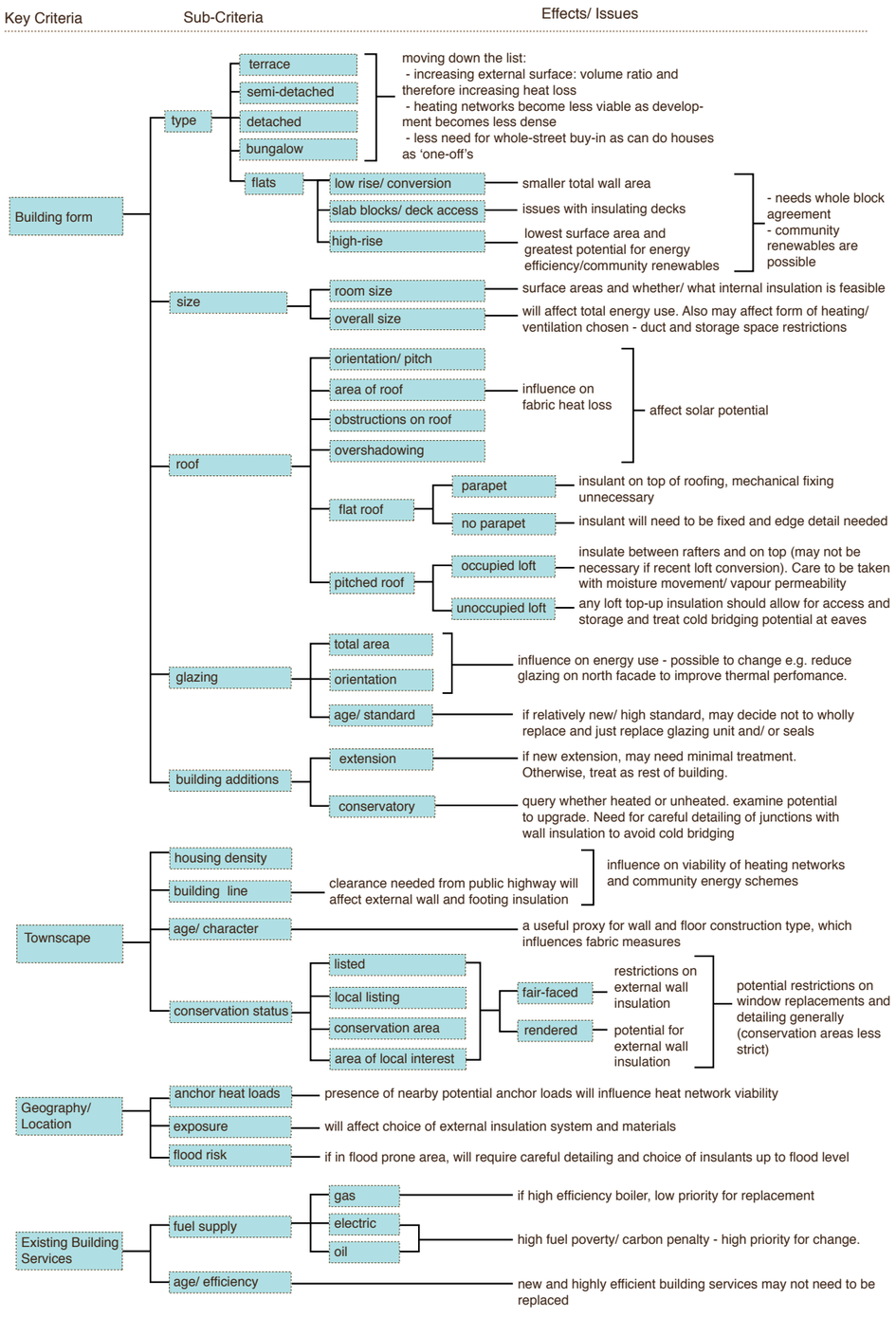
- Trafford College is a local hub for the National Skills Academy and has been leading on the new set of qualifications around environmental technologies developed by Summit Skills.
- Working alongside Trafford College, Oldham College will establish a Renewable Technology Centre in conjunction with local installation companies, such as Groundtherm in Tameside, to support training programmes.
- Skills Solutions are modelling the number of apprenticeships that could be created through future retrofit programmes in order to meet targets and support the scale of demand.
- Work Package 4 of the LCEA programme has begun work to design and pilot a modular degree in retrofit site management.
- J21 were established as a Local Labour in Construction initiative by Oldham and Rochdale Councils to help local people and businesses access contracts and employment arising from regeneration and investment in the area. It acts as an intermediary, arranging appropriate training and accreditation.
- Procure Plus are delivering a solar PV investment programme with social landlord partners, including Stockport Homes and Trafford Housing Trust. This includes a commitment to local training.
- B4Box is a Salford-based building contractor that aims to maximise the local benefits of their work. They commit to training a minimum of 6 apprentices for every £1m of contract value. Around 80% of their workforce were previously on out-of-work benefits.
- The Carbon Co-operative has been established in Manchester as a social enterprise to support households in reducing their carbon emissions. It will manage domestic retrofit installations for its members.

Appendix

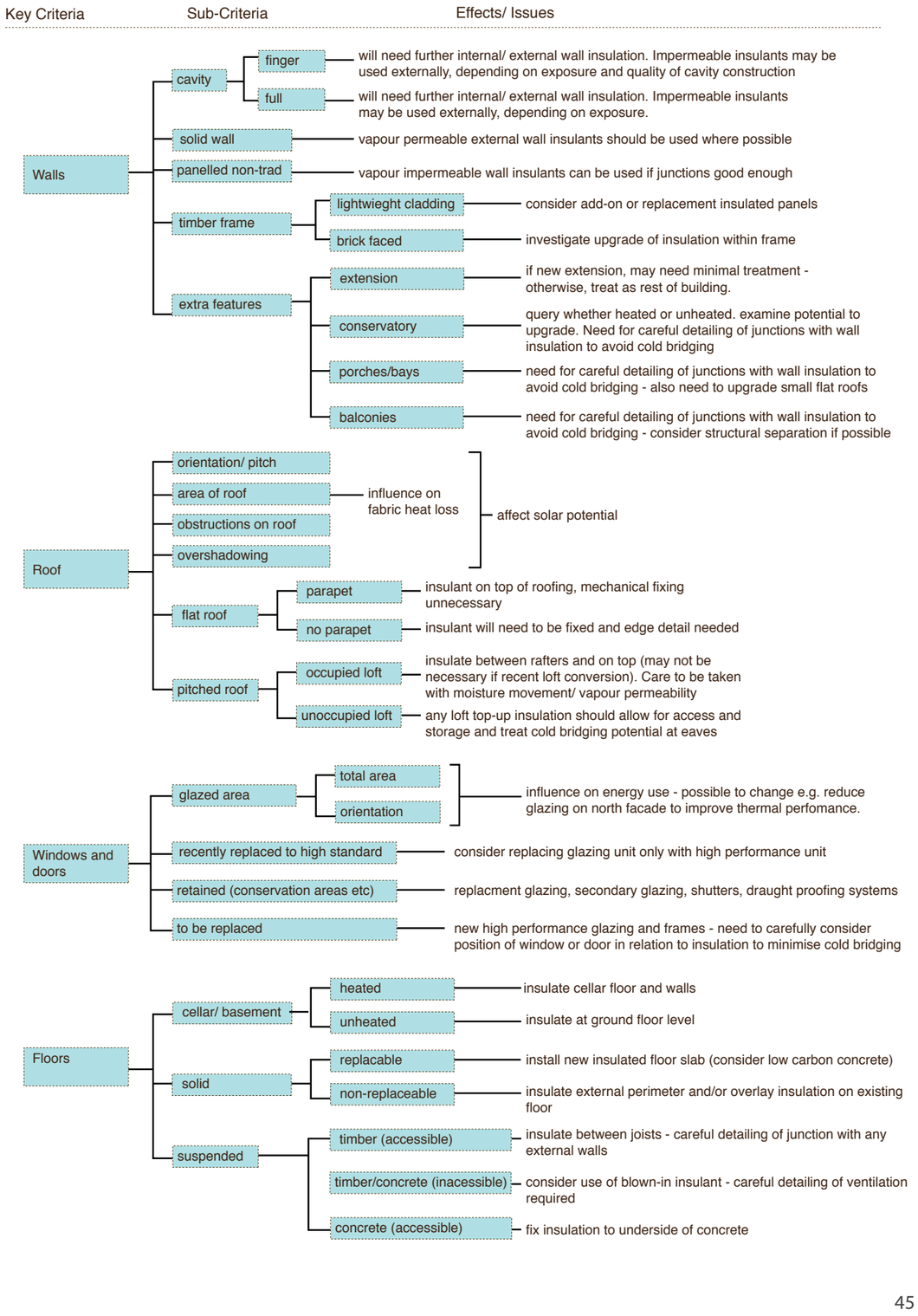
Appendix 1 –

Retrofit Decision Matrix

Decision Matrix



Decision Matrix - Fabric Element Detail



Appendix 2 –

Archetype Case Studies

	NOTES	VALUE	NOTES	VALUE	NOTES	VALUE
archetype	pre-1945 terrace	1897	pre-1945 semi-detached house	1918-1939	1945-64 semi-detached house	1938
landlord/tenure	Accord HA		Wolverhampton Homes		South Shropshire HA	
description	*Built between 1900 and 1910, typically two bedroom. Construction is traditional masonry with solid walls. Floors are suspended timber with air brick ventilation.*	floor area 110m^2	*Part of an estate of semi-detached housing built during the inter-war period. 4 & 5 bedroom, they are traditional masonry construction with, for the most part, rendered external walls. Floors are concrete screed on a slab.*	floor area 226m^2	*The 2 bed properties are of standard masonry construction with a cavity wall of between 50 and 60mm. Floors are concrete screed on a raised slab. No gas connection.*	floor area 76m^2
improvements to date	Dry lining, re-roofing (including loft insulation) gas central heating. uPVC double glazing (without coating or gas fill) and doors, top-up loft insulation to 150mm in total	1985 2004	*Double glazed uPVC windows (without coating or gas fill) and cavity insulation.* *Condensing boiler and radiators.*	1999 2004	*uPVC double glazing (without coating or gas fill)* *Kitchen replacement* *Solid fuel heating system (coal and wood) with electric immersion backup* *Loft insulation (100mm)* *Cavity insulation (50-60mm) and top-up loft insulation (200mm)* *Electrical testing*	1992 1996 1997 1999 2005 2007
scheduled improvements	Kitchens, 2011/12 (subject to budget)		Re-roofing, 2010 Kitchens, bathrooms and electric rewiring, 2011/12		External door replacement, 2011/12 Bathroom replacement, 2015/16	
windows	Replacement of existing glazing units with high performance double glazing units in existing frames	1.2 W/m^{2}K	Replacement of existing frames and glazing units with high performance triple glazing	0.7 W/m^{2}K	Replacement of existing glazing units with high performance double glazing units in existing frames	1.2 W/m^{2}K
doors	Solid timber panel insulated doors	1.2 W/m^{2}K	Solid timber panel insulated doors	1.2 W/m^{2}K	Solid timber panel insulated doors	1.2 W/m^{2}K
floor	Insertion of insulation bats (200mm) between rafters of suspended timber floor	0.2 W/m^{2}K	Installation of insulated timber flooring (10mm insulation, 25mm overall) over existing concrete ground floor	0.4 W/m^{2}K	Blown fill beneath raised slab	0.2 W/m^{2}K
walls front	30mm Aerogel internal insulation	0.5 W/m^{2}K	150mm rendered external wood fibre insulation	0.2 W/m^{2}K	Cavity fill	0.65 W/m^{2}K
walls rear/side	150mm rendered external wood fibre insulation	0.2 W/m^{2}K				
roof	Top-up existing insulation to 400mm	0.1 W/m^{2}K	Top-up existing insulation to 400mm	0.1 W/m^{2}K	Top-up existing insulation to 400mm	0.1 W/m^{2}K
ventilation	Passive stack ventilation		Mechanical Ventilation / Heat Recovery		Passive stack ventilation	
space heating	Communal biomass, gas backup, & thermal store	4,006 kWh/A	Solar hot water + storage topped up by condensing boiler	3,503 kWh/A	Biomass stove c/w back boiler, solar thermal & thermal store	4,599 kWh/A
hot water	spray taps / flow restrictors solar thermal tubes	1,389 kWh/A	spray taps / flow restrictors solar thermal tubes	1,218 kWh/A	spray taps / flow restrictors solar thermal	1,768 kWh/A
electricity	A+ appliances, low energy lighting throughout	2,058 kWh/A	A+ appliances, low energy lighting throughout	2,769 kWh/A	Low energy lighting throughout	2,058 kWh/A
cost to reach 80% CRT		**£25,718**		**£32,171.00**		**£18,582**
cost /m^2		**£234/m^2**		**£142/m^2**		**£245/m^2**

archetype case studies





NOTES	VALUE	NOTES	VALUE	NOTES	VALUE	NOTES	VALUE	NOTES	VALUE
Post 1945 low rise flats	1966-71	Semi-detached (non-traditional)	1945-55	Medium rise flats (non-trad)		Medium rise flats	1970's	High Rise flats	1960's
Wolverhampton Homes		Sandwell homes		Wolverhampton homes		Accord HA		Sandwell Homes	
Mactrad' timber frame system. The flats have shallow pitched roofs and external walls clad with brick and timber tiles, with a thin layer of mineral fibre insulation. The floors are concrete screed on a slab. Electric heating systems throughout.	floor area 40m^2	*Smiths' system, prefabricated concrete external walls with a brick slip facing. 3 bedrooms. Problems with movement due poor panel fitting and corrosion of steel reinforcing. Very poor airtightness and prone to water penetration.*	floor area 82m^2	*Clusters of 12 two bedroom flats built with the Wimpey 'no fines' system of solid external and load bearing walls of in-situ concrete. Roofs are flat asphalt. Problems with condensation.*	floor area 70m^2	*1 & 2 bedroom flats, incl. sheltered units. Concrete frame, cavity masonry external & party walls. Concrete floors. Pitched roofs with a void filled with 50-100mm insulation. Heating - gas, electric or communal gas.*	floor area 84m^2	*Service core provides extract from bathrooms & kitchens. Concrete frame with cavity brick skin. Problems with cavity fill & driven rain penetration. Electric storage heaters & immersion.*	floor area 75m^2
Double glazed uPVC windows (without coating or gas fill	1999	*Gas central heating, circa 1980's uPVC windows and loft insulation (100mm)*	1980's 1995	*uPVC windows Gas boiler and wet space heating system Kitchens, bathrooms and rewiring*	2001 2007 2008	*uPVC double glazing (no coating or gas fill), cavity insulation (50- 60mm) and kitchens. Electrical rewiring.*	1998 2009	*uPVC windows and cavity fill insulation (50-60mm) Roof insulation (200mm)*	1995 2009
Re-roofing, 2010 Kitchens, bathrooms and electric rewiring, 2011/12		Replacement bathrooms and kitchens, 2011/12 External insulation and improved roof insulation, 2011/12		None		Sheltered housing boiler and ancillaries, unspecified timing		Upgrading of electric heating systems, 2011/12	
Replacement of existing frames and glazing units with high performance triple glazing	0.7 W/m^{2}K	Replacement of existing frames and glazing units with high performance triple glazing	0.7 W/m^{2}K	Replacement of existing frames and glazing units with high performance triple glazing	0.7 W/m^{2}K	Replacement of existing frames and glazing units with high performance triple glazing	0.7 W/m^{2}K	Replacement of existing frames and glazing units with high performance triple glazing	0.7 W/m^{2}K
Solid timber panel insulated doors	1.2 W/m^{2}K	Solid timber panel insulated doors	1.2 W/m^{2}K	Solid timber panel insulated doors	1.2 W/m^{2}K	Solid timber panel insulated doors	1.2 W/m^{2}K	Solid timber panel insulated doors	1.2 W/m^{2}K
		Installation of insulated timber flooring (10mm insulation, 25mm overall) over existing concrete ground floor	0.4 W/m^{2}K	Installation of insulated timber flooring (10mm insulation, 25mm overall) over existing concrete ground floor	0.4 W/m^{2}K				
cladding replaced with off-site 180mm insulated panels to be filled with cellulose insulation	0.18 W/m^{2}K	150mm rendered external wood fibre insulation	0.2 W/m^{2}K	150mm rendered external wood fibre insulation	0.23 W/m^{2}K	100mm rendered external insulation	0.2 W/m^{2}K	100mm rainscreen and rockwool external insulation	0.22 W/m^{2}K
150mm rendered external wood fibre insulation	0.19 W/m^{2}K								
Loft insulation to 400mm	0.1 W/m^{2}K	Loft insulation to 400mm	0.1 W/m^{2}K	200mm EPS external insulation.	0.15 W/m^{2}K				
Passive stack ventilation		Mechanical Ventilation / Heat Recovery		Passive stack ventilation		Passive stack ventilation		Communal MVHR	
communal solar hot water & thermal store c/w gas top-up wet system	2,143 kWh/A	Solar hot water + storage topped up by condensing boiler	1,672 kWh/A	communal solar hot water & thermal store c/w gas top-up wet system	2,406 kWh/A	biomass fuelled district heating and hot water	647 kWh/A	Communal solar thermal and gas fired system with heater elements on MVHR air inlet	476 kWh/A
spray taps / flow restrictors solar thermal	1,098 kWh/A	spray taps / flow restrictors solar thermal tubes	944 kWh/A	spray taps / flow restrictors solar thermal	887 kWh/A	spray taps / flow restrictors	2,846 kWh/A	spray taps / flow restrictors + solar thermal/gas heat exchanger	2,074 kWh/A
A+ appliances, low energy lighting throughout	1,030 kWh/A	A+ appliances, low energy lighting throughout	2,281 kWh/A	Low energy lighting throughout	1,109 kWh/A	A+ appliances, low energy lighting throughout	1,109 kWh/A	A+ appliances, low energy lighting throughout	1,311 kWh/A
	£24,474		**£32,237**		**£22,602**		**£21,352**		**£16,371**
	£583/m^2		**£393/m^2**		**£314/m^2**		**£254/m^2**		**£218/m^2**

Appendix 3 –

Retrofit Work Flow Diagram