Programme Area: Smart Systems and Heat

Project: WP1 Building Retrofits

Title: Approach to Domestic Retrofit

Abstract:

Through its Optimising Thermal Efficiency of Existing Housing Project, the ETI developed a theoretical delivery mechanism for retrofitting the UK domestic housing stock at a sufficiently high rate to impact climate change targets, this was described as “the ETI Approach”. This document describes the methodology for implementing the ETI Approach on a house by house basis, considering (i) the consumer, (ii) the solutions implemented (iii) the delivery mechanism itself and (iv) the potential business opportunities. The ETI Approach was subsequently subjected to testing, evaluation and improvement via the ETI’s Domestic Retrofit Demonstration Project.

Context:

The aim of the project is to validate the cost, time and energy effectiveness of domestic retrofit across different house types, using an approach that could be employed to improve the energy efficiency of the vast majority of the existing 26 million homes in the UK which will still be in existence by 2050. The novel, mass-scale retrofit approach being tested was first developed in a deskbased ETI project (“Optimising Thermal Efficiency of Existing Housing”) completed in 2012, as part of the ETI Buildings programme. The 20-month long, £475,000 project will retrofit five types of domestic property, identified and prioritised in the earlier ETI project.

energy technologies institute

Smart Systems and Heat
Approach to Domestic Retrofit









Executive Summary

Continuing the work undertaken as part of the ETI's Optimising Thermal Efficiency of Existing Housing project, this report proposes improved approaches to the retrofit process which address current shortcomings in technical performance and consumer perceptions.

Overall, the aim is to implement a retrofit approach which has whole house packages as standard, delivered by professional small teams efficiently and in the shortest programme without compromising quality.

Key Elements

The report has been divided into the following four sections, each of which details the outcomes of the Optimising Thermal Efficiency of Existing Housing project while offering insight to aid the practical application of these desktop research findings.

The Consumer

Extensive customer engagement has led to an improved understanding of consumer thoughts and attitudes regarding retrofit. The central lesson has been the importance of trust throughout the process, as personal experience, or those of friends and family, has tarnished consumer faith in the building industry as a result of unreliable contractors and builders.

For rapid growth, retrofit needs to be consumer focussed, while ensuring the delivery of a quality service. An essential element is a single point of contact between the retrofit team and the consumer, which not only fosters a positive relationship, but also makes customers more tolerant of any issues and more likely to recommend retrofit.
Lastly, consumers tend to be driven by the potential for cash savings associated with retrofit, and not CO_2 savings. Environmental concerns tend to be secondary to the tangible and direct benefits like lower bills and warmer homes.

The Solutions

The current piecemeal nature of retrofit should be replaced by a whole house approach, which helps to maximise energy savings over the long term, while reducing cost and disruption for the consumer. Whole house packages, tailored to the nine dominant house types in the UK, were developed as part of the Optimising Thermal Efficiency of Existing Housing project and are outlined this report. Each package typically includes external or internal wall insulation, loft and ground floor edge insulation, improved airtightness, heating system and control upgrades, depending on the age and construction of the home.

Two levels of intervention have been developed for each house type (titled **RetroFix** and **RetroPlus**), both of which will achieve significant energy and CO_2 savings, while also offering different options based on consumer preference, cost and the level of disruption.

The potential for savings in delivered energy consumption ranged between 25-40% for RetroFix and 40-60% for RetroPlus. For primary energy, consumption

was reduced to between 300-170 kWh/m^2/annum for RetroFix and 220-140 kWh/m^2/annum for RetroPlus. Comfort conditions and air tightness were improved across all dwelling/household types.

The Delivery

Changes to the retrofit delivery process offer the greatest potential financial savings for both the retrofit teams and the consumer. Previous ETI research has reviewed current processes and identified areas of waste which contribute significantly to higher project costs through excess material and unproductive labour. By eliminating these wastes and streamlining the process, the research team has set a target cost of £10,000, to be carried out in less than ten days per property.

The most important changes to the process involve the introduction of the 'poly-competent' team, where all required skills for retrofit are in a team of four installers who are dedicated to each individual house project. Rather than using expert tradespeople, the model is based on a team trained and accredited to deliver the core retrofit tasks to a high standard. The team-leader, at least, will have the required expertise to certify the regulatory requirements of the works and will act as the single point of contact for the consumer, but in general the team is only trained to the level required to complete retrofit tasks.

Another area to reduce retrofit cost and time is related to the standardisation of processes. With greater integration between the installer and the supplier, and the use of pre-cut materials, there is significant opportunity to eliminate 'non-value-adding activity' from the entire process to create the best value result for the householder. In this way, repeatable tasks in assembly, logistics and construction can be optimised to reduce labour content by between 30% and 60%. In the desk based research a conservative 40% figure for overall reduction in costs was expected.

Business Opportunities

A new approach to retrofit means there are new business opportunities for a variety of organisations and companies in different market segments. The Business Opportunities section considers options for creating scalable and targeted offerings to match market needs. Four potential options are considered, with retrofit being delivered by a contractor, retailer, national specialist or independent four-person team, Other important considerations for the whole house retrofit include material supply and logistics, through-life maintenance and available funding.

Introduction

The Energy Technologies Institute has prepared this report using the outputs from the Optimising Thermal Efficiency of Existing Housing project which developed solutions for the retrofit of the UK's housing stock.

The Optimising Thermal Efficiency of Existing Housing project was a two year, Energy Technologies Institute (ETI) funded project, undertaken by a multi-disciplinary team to help plan for the energy efficient retrofit of the UK housing stock. The project endeavored to understand a range of issues related to mass retrofit, including the best combination of measures and their impact on energy consumption, fuel prices and carbon emissions, as well as the best way to deliver retrofit cost effectively while appealing to the householder.

The focus on retrofit has gained prominence following the introduction and growth of legislation related to reducing carbon emissions in the UK's building stock. The 2011 Carbon Plan states that "by 2050, all buildings will need to have an emissions footprint close to zero." In addition, the UK is legally committed to an 80% greenhouse gas emissions reduction target for 2050, with five year carbon budgets in the interim.

Improvements to the thermal performance of the UK's buildings are pertinent not only to meet future carbon emission targets, but also to improve health and comfort, reduce fuel poverty, improve energy security and help smooth peaks of heating demand. The Optimising Thermal Efficiency of Existing Housing project concentrated on developing the tools, processes and technologies required to achieve these goals and improve the fabric of our existing housing stock.

In its present form, retrofit is considered too expensive for the majority of the UK population. One of the key findings from the work conducted on customer engagement is that across all segments, money is still the primary focus of customers in relation to retrofit (from upfront cost to potential savings achieved) followed closely by personal comfort (mainly temperature but also other factors such as air quality, noise and security). A capital cost limit of £10,000 emerged from discussions across all segments as a threshold beyond which works solely focused on retrofit would be deemed as too expensive.

As a result, the project developed a detailed methodology for delivering mass retrofit efficiently and with reduced costs, including tailored retrofit packages for the nine dominant UK house types and an innovative approach to retrofit delivery.

A key aspect of this approach to retrofit is having all the required skills within a team of four installers. Rather than using wholly expert tradespeople, who may be over-qualified for retrofit, the model is based on a team trained and accredited to deliver the core retrofit tasks to a high standard.

The team-leader, at least, will have the required expertise to certify the regulatory requirements of the works, but in general the team is only trained to the level required to complete retrofit tasks. To distinguish this capability from a team with the additional depth of multiple skills the term 'poly-competent team' has been coined.

With regard to the retrofit measures to be implemented with this delivery approach, two levels of intervention have been developed. This allows for packaged work (rather than individual measures) while also offering different options based on customer preference, cost and the level of disruption.

The package called **RetroFix**, is designed to tackle the most significant thermal losses in our existing housing stock. **RetroPlus** packages include all of the solutions in the RetroFix packages plus further thermal improvements to floors, replacement doors and windows and more innovative heating systems where appropriate.

Expected Savings

Using these tailored retrofit programmes and streamlined supply chain approach, the ETI housing stock energy model quantified that household fuel spend was on average reduced by 49% for the RetroFix and 60% for RetroPlus packages, compared to similar non-retrofitted properties. CO_2 emissions were reduced, on average, by 33% and 45%, respectively (although the pre-1919 detached house archetype showed modelled savings of around 54% for RetroFix and 66% for RetroPlus).

The potential for savings in delivered energy consumption ranged between 25-40% for RetroFix and 40-60% for RetroPlus. For primary energy, consumption was reduced to between 300-170 kWh/m^2/annum for RetroFix and 220-140 kWh/m^2/annum for RetroPlus. Heat losses were reduced across all dwelling/household types.

Aim of this Report

Following this extensive research and preparation, the next step in the process is to implement this approach in UK homes. This report details the proposed methodology for delivering mass retrofit efficiently, including example day programmes for the on-site installation work. The aim is for the methodology and packages outlined in this report to provide a suggested process which could enable mass retrofit across the UK.

The Customer

Retrofit has the potential to deliver huge benefits to customers. However, many of these benefits are not fully understood or trusted.

Retrofit practitioners with a clear understanding of customers' needs are better equipped to deliver a successful experience that leaves the customer satisfied and likely to recommend retrofit to other customers.

As part of ETI's Optimising Thermal Efficiency of Existing Housing project, a number of customer engagement activities were carried out to better understand the customer experience of retrofit.

Through talking to people across the country, in groups and individually in their homes, ETI developed a richer understanding of the needs of different customer segments, strengthening their ability to propose a better model for retrofit. As such, the designs and processes described in this report have been structured around their understanding of customers and tested directly with research participants.

This chapter highlights some of the learning that can be applied by retrofit practitioners who want to understand the best way to identify potential customers, what some of their motivations might be, how to engage with them and how to deliver an excellent service at each stage of their retrofit journey.

The key elements of the retrofit process, as identified by the customer, are outlined in the following section.

Key Lessons

Cash and Comfort, not Carbon and Climate Change

Tangible and direct benefits like lower bills and warmer homes generally motivate customers more than environmental concerns.

Build Lasting Trust

Customers need to trust the message, the technology and the delivery agents. Build positive relationships with early adopters to encourage positive recommendations to other customers.

Customer Service Matters

A positive relationship built on excellent customer service at each stage, and a consistent, single point of contact throughout, makes customers more tolerant of any issues and more likely to recommend retrofit, and particular retrofit teams, to friends and family.

Right First Time

Many customers who live in homes with low levels of insulation may be under the impression that their home is already retrofitted. Future problems can be avoided by recommending a whole house retrofit system.

Keep it Simple

When describing retrofit, avoid technical language and focus on the key benefits for the customer such as warmth and lower running costs for the long term.


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The benefits of retrofit can be enjoyed by all. However, certain customer groups may be easier to attract than others. Focusing on key customer groups can help gain traction in a retrofit market still in its infancy.

Young Families

Who are they?
Couples with infants and toddlers, often first time buyers with disposable income and fresh concerns for the wellbeing of their household.

Why will they accept retrofit?
The introduction of a child into the family can provide a powerful point at which consumers consider the comfort and health provided by their home, triggering a desire to improve the internal environment through retrofit.

Added Value Opportunities
Generally tech-savvy, this group will be more interested in smart control technologies as part of a retrofit solution.

Empty Nesters

Who are they?
Approaching, or at the point of retirement, couples with children who have left home, looking to downsize and prepare for retirement.

Why will they accept retrofit?
Retirement presents a trigger to customers to invest in their homes, where they may now be spending an increased proportion of their time. Downsizing also presents an opportunity to unlock capital to invest in retrofitting a smaller home that provides a warmer and more comfortable environment, with lower running costs.

Added Value Opportunities
A service that can link seamlessly with moving home could allow these groups to have works done to a new home before moving in.

Established Retired

Who are they?
Retired singles and couples spending most of their time in the home.

Why will they accept retrofit?
These customers will typically spend the majority of their time in their home. Therefore making it a warm, comfortable and healthy place is a priority.

Added Value Opportunities
Retrofit packages that are designed with catering for old-age living in mind are key, such as intelligent control systems with a simple interface or other packages that are “fit-and-forget”.

Customer Retrofit Journey

Pre-Sale

Simple, accessible information available on demand, provided by a trustworthy source.

Survey

Technically robust survey presented in a simple format by a professional with excellent customer service.

Sale

Clearly defined costs, timescales, impacts on the customer delivered without pressure.

Touchpoints

- Hear about retrofit
- Initial research
- Contact retrofit provider
- Basic survey
- Review results
- Detailed options
- Review specification
- Agree approach
- Sign contract and place deposit

Key Stakeholders

Pre-Sale	Survey	Sale
·Advertisers/Marketing teams ·Lead generators ·Community groups ·Friends and family ·Local Authorities	·Polycompetent retrofit team ·Surveyors ·Energy assessors ·Local Building Control (and potentially) planners	·Polycompetent retrofit team ·Finance providers ·Independent advisors ·Friends and family (to discuss options)

Key Considerations

Pre-Sale	Survey	Sale
·Advice and information available from a variety of sources ·Clear and relevant benefits presented in simple language ·Open but positive messaging about the costs and installation impacts ·Retrofit process explained, step-by-step	·Basic survey for free to give a sense of options available ·Detailed survey, to be paid for, providing detail on options, plans, timescales and costs ·All information should be clear, simple and jargon-free ·Deliver excellent customer service from the surveyor and team leader for installation	·Customer should be given time and space to make a decision ·Finance options and any contract documentation should be clear and explained if necessary ·Any deposit system must be fair and safely underwritten

Installation

Ideal solution installed by a poly-competent team with excellent customer service, in the shortest time, with minimal disruption.

Through Life

Fit-and-forget technology that is simple to use, easy to maintain and easy to dispose of.

Preparation as necessary

Start work

Materials arrive just in time

Measures commissioned

Final decoration

Handover

Daily use

Maintenance options

Upgrade and enhancement

·Polycompetent retrofit team
·Manufacturer
·Supplier
·Logistics provider
·Local Authority

·Polycompetent retrofit team
·Third party maintenance companies
·Manufacturer

·Any preparation (e.g. clearing space) should be explained well in advance

·Installation should take as short a time as possible

·Maximum team size of four people led by familiar single point of contact

·Delivered with resident in-situ. Installers deliver excellent customer service

· Works completed with exemplary levels of health and safety, both for customer and team

·Handover documentation and user guidance should be simple and explained, face-to-face by team leader

·All installed systems and products covered by warranty from the manufacturer; potential for specialist insurance in future

·Both service contract and ad-hoc maintenance options should be offered and explained by single point of contact team leader

·Home operation should require low interaction with energy system controls

·Disposal/replacement should be easy and parts able to be recycled

The Solutions

In order to replace the current piecemeal nature of the UK retrofit industry, whole house solutions were developed to achieve significant energy consumption and carbon emission reductions in relation to space heating and hot water while also considering capital cost, currently available technologies, aesthetic concerns, disruption and customer values.

33%

Average energy savings (kWh/dwelling/annum) for Retrofix packages

50%

Average energy savings (kWh/dwelling/annum) for Retroplus packages

The first change to the current approach to retrofit relates to the survey of the property. The traditional approach to residential retrofit leads to multiple persons conducting surveys to gather often the same or similar information, ultimately frustrating the customer and wasting valuable resource. The survey process has been reimagined to address these deficiencies and improve customer acceptance.

The survey process is divided into two stages, with the stage one survey forming a crucial part of the overall customer engagement process. This first, shorter survey will follow the initial contact with the homeowner, and will act as a screening process to avoid a more lengthy survey of homes that ultimately cannot be retrofitted economically. Such cases may include insurmountable risks and constraints or where the customer is unwilling or unable to pay the associated cost of retrofit. During this Stage 1 survey, the customer will provide information related to ther lifestyle, in addition to the data on the locality and house type which will be gathered by the retrofit team in advance.

At the end of this meeting, the customer will be presented with a proposal of options for an affordable solution to reduce their energy consumption, subject to a detailed stage two survey.

On agreement from the customer to proceed, a stage two survey will be undertaken led by the polycompetent team leader, who will be the single point of contact throughout the process to provide continuity and build trust with the customer. Previous research suggests that the survey might take between 3 and 8 person hours, with the average householder tolerance being a maximum of four hours, although this will depend on the house type and the level of intervention. In properties which require more than four person hours to survey, a second team member will assist to keep within the desired four hour window. The aims of this process are to assess and establish possible risks, accurately measure the house and quantify materials for the retrofit, understand possible constraints such as access, approvals, health and safety or vulnerability, familiarise the Team Leader with the installation and introduce the customer to their main point of contact during the retrofit.

Figure 1 on the following page is a summary of the key items that would be required for a comprehensive pre-retrofit survey (both Stage 1 and Stage 2).

Proposed Packages

Based on the dominant house types in the UK, tailored retrofit solutions were developed while considering construction type, unique features and potential obstacles, such as likely technical limitations or conservation constraints.

Two levels of intervention have been developed which allow for packaged work (rather than individual measures) while also offering different options based on customer preference, cost and the level of disruption.

The package called **RetroFix**, is designed to tackle the most significant thermal losses in their existing housing stock. The package for each house type typically includes external or internal wall insulation, loft and ground floor edges insulation, improved airtightness, heating

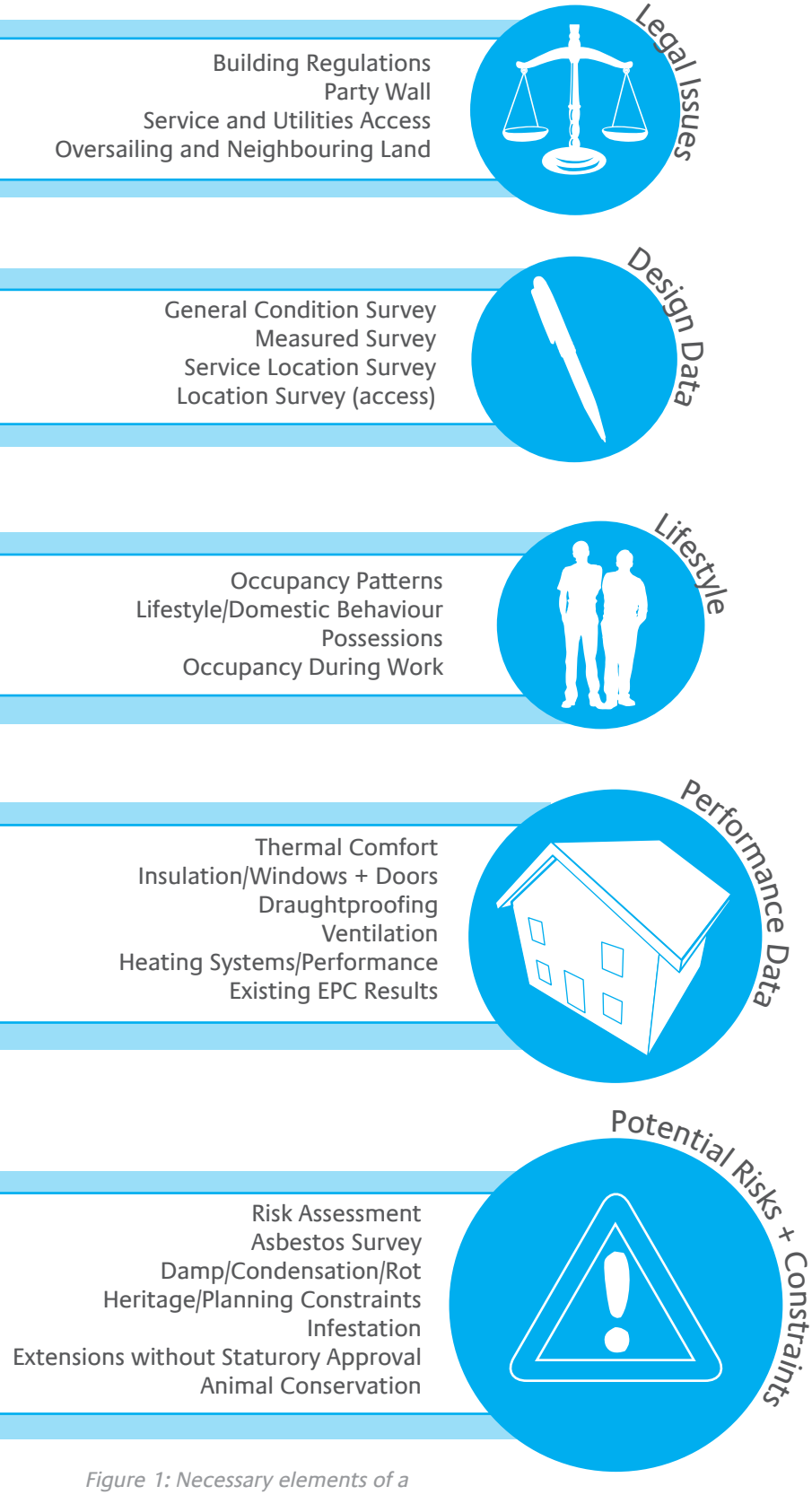


Figure 1: Necessary elements of a thorough retrofit survey.

system and control upgrades, depending on the age and construction of the home.

RetroPlus packages include all of the solutions in the RetroFix packages plus further thermal improvements to floors, replacement doors and windows and more innovative heating systems where appropriate.

What does each package include?

Each package began with the following list of basic solutions, which were then customised based on the unique features of each house - architectural features, wall construction, party walls, and configuration. Diagrams of these measures for both RetroFix and RetroPlus are outlined on the following page in Figure 2.

The **RetroFix Packages** were designed around the following strategy:

- Wall Insulation: Typically EWI and CWI (if applicable) with a target U-value of 0.15-0.20 W/m^{2}K for existing cavity walls. For solid walls, the approach is tailored to the house type.

- Loft Insulation: Typically top up to 300mm of insulation to a U-value of 0.15 W/m^{2}K

- External Floor Edge Insulation: to reduce thermal bridging between the newly insulated wall and the floor

- Airtightness of 7 m^3/(m^2.hr) @ 50Pa for Post-1945 properties, 8 m^3/(m^2.hr) @ 50Pa for Pre-1945 Properties

RetroFix Package Elements

WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS
EWI 0.20W/m²K	Loft insultation 0.15W/m²K	Ground floor edge insulation	Draught stripping	Airtightness 7m³/m².hr	Single room heat recovery	A-rated boiler
Removable reveals	Insulated loft hatch					HW jacket
CWI 0.15 W/m²K						TRVs, zoned heat controls

RetroPlus Package Elements

WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS
EWI 0.20W/m²K	Loft insultation 0.15W/m²K	Ground floor edge insulation	Draught stripping	Airtightness 5m³/m².hr	Single room heat recovery	HW jacket
CWI 0.15 W/m²K	Insulated loft hatch	Solid floor insulatiion 0.30 W/m²K	Insulated secure door 1.5 W/m²K			TRVs, zoned heat controls
		Floor insulatiion 0.15 W/m²K	Triple glazing 0.80W/m²K			Modulating boiler

Figure 2. Key elements of Retrofit and RetroPlus packages

· Draughtstripping of existing doors and windows along with removable reveals around windows, allowing for ease of window replacement in the future.

· Boiler replacement to 90% efficiency A-rated boiler for older boilers close to the end of their lives, with a 80mm jacket for HW tank

· Heat recovery extract fans for bathrooms and kitchens

· TRVs and zoned heating controls

For **RetroPlus Packages**, these additional components are then included:

· Floor Insulation: For suspended floors, we would propose lifting and insulating between the joists to achieve a target U-value of 0.15 W/m^{2}K. For the properties that may have solid floors, the target U-value is 0.3 W/m^{2}K due to the challenge of sourcing an appropriate insulation solution.

· Replacement windows: Replace existing windows with thermally broken triple-glazed windows with a U-value of 0.80 W/m^{2}K. Windows will need to be moved outwards so that it coincides with the EWI depth, to minimise thermal bridges.

· Replacement doors: Replace existing external doors with insulated security doors and, create a draught lobby where feasible and aesthetically acceptable.

· Airtightness of 5 m^3/(m$_2$.hr) @50Pa for Post-1945 properties, 5 m^3/(m^2.hr) @ 50Pa for Pre-1945 properties, 3 m^3/(m^2.hr) @50Pa only when in conjunction with MVHR for ventilation.

· Modulating boiler: Ensures that boilers have a flexible range of capacities to enable them to adjust to reduced hot water and heating requirements that may result from future improvements to the thermal efficiency of the property and changes in occupancy. Forward compatibility with solar thermal systems is also recommended so that the transition to solar hot water can be made more easily in the future.

Detailed solutions for each house type can be found in the Appendices.

Risks

With both sets of packages, installers and retrofit teams should be wary of the particular risks associated with retrofit. The most important have been outlined below as important elements to take into consideration (see Table 1).

Risk Category	Specific Risk
Aesthetic	Loss of architectural character
	Streetscape degradation
Usability	Oversailing of EWI
	Loss of internal space
	Previous substandard work
	Trees
	Access
	Future work/phasing
Statutory	Non-compliance with Building Regs
	Party Wall Act
	Planning constraints and Heritage issues
Environmental	Condensation, Mould and Rot
	Summer Overheating
	Loss of daylight/sunlight
	Thermal bridging
	Existing damp/rot
Financial	Property devaluation

Table 1: Specific risks to consider prior to undertaking and during the retrofit process.

Predicted Savings

The housing stock energy model used in the Optimising Thermal Efficiency of Existing Housing project quantified the effect of energy efficiency improvements and savings that could be delivered through the retrofit of groups of the UK housing stock for RetroFix and RetroPlus. The retrofit scenarios were assessed at both a 2012 and a 2030 projected base position. The results also include a margin of reduction in achieved savings (from underperformance or comfort take), recognising that maximum improvements are rarely achieved. Details of the results can be found in Table 2.

The potential savings that can be made from the application of retrofit to the whole housing stock were modelled according to available stock data. For the 2012 scenario, household fuel spend was on average reduced by 49% for the RetroFix and 60% for RetroPlus packages, compared to the baseline. CO_2 emissions were reduced by 33% and 45%, respectively.

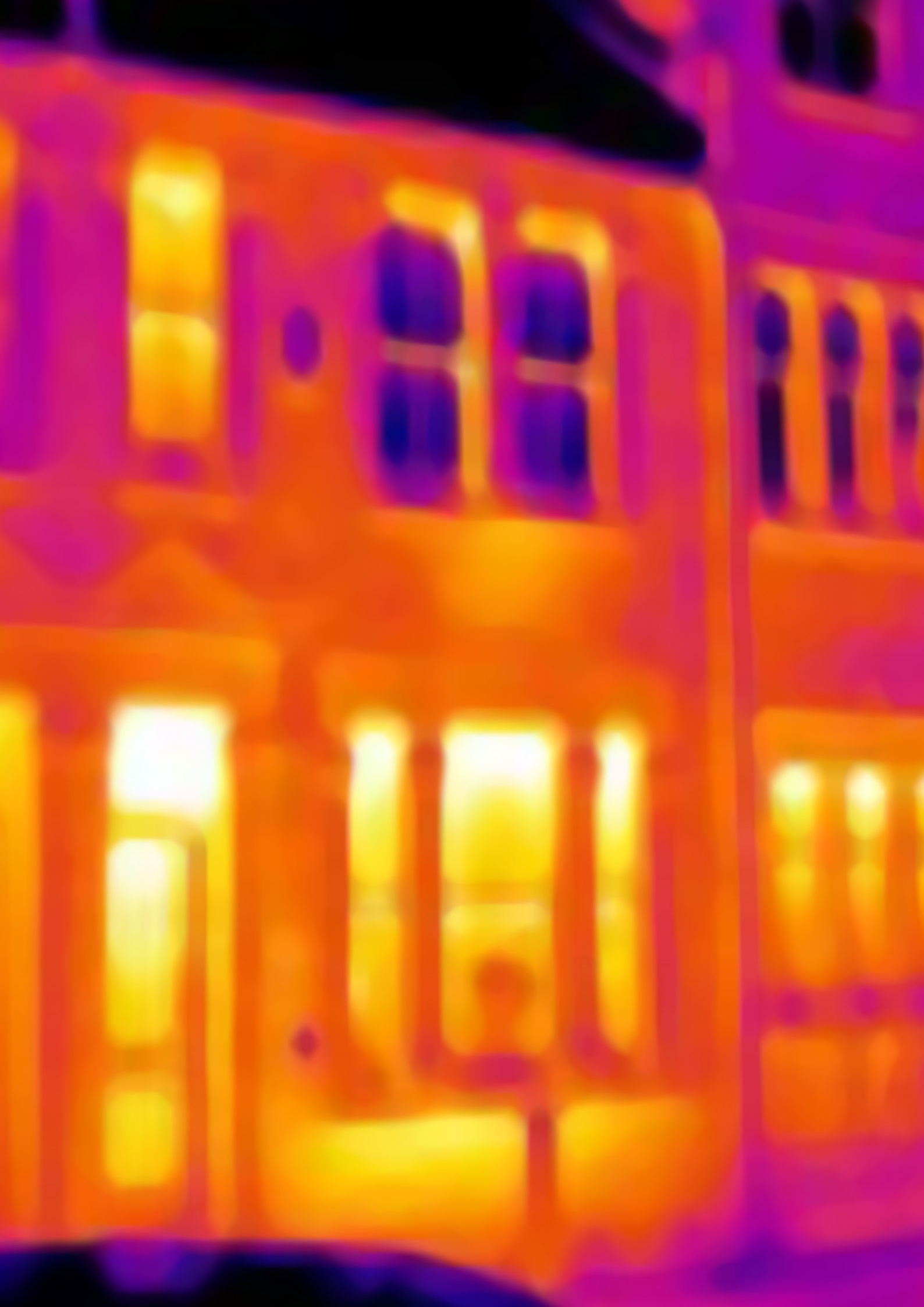
The potential for savings in delivered energy consumption ranged between 25-40% for RetroFix and 40-60% for RetroPlus. For primary energy, consumption was reduced to between 300-170 kWh/m^2/annum for RetroFix and 220-140 kWh/m^2/annum for RetroPlus. Heat losses were reduced across all dwelling/household types.

In 2030, the reduction in fuel spend was less than 2012 (39% and 49%) due to assumed higher outdoor ambient temperatures but the percentage CO_2 emission savings are comparatively higher due to reduced fuel carbon intensity factors.

The range of savings demonstrated broken down by dwelling and typical resident type, suggest that the potential CO_2 savings are typically between 20-35% for RetroFix and 30-50% for RetroPlus (although the pre-1919 detached house showed savings of around 54% for RetroFix and 66% for RetroPlus).

	2012			2030		
	As is	RetroFix	RetroPlus	As is	RetroFix	RetroPlus
Delivered energy (kWh/annum/ property)	19,700	13,200 (-33%)	9,790 (-50%)	18,000	12,200 (-32%)	9,270 (-49%)
Fuel cost (£/annum/ property)	2,180	1,110 (-49%)	880 (-60%)	2,180	1,340 (-39%)	1,110 (-49%)
CO2 emissions (kg/annum/ property)	5,010	3,380 (-33%)	2,770 (-86%)	3,610	2,320 (-36%)	1,730 (-52%)

Table 2. Modeling results of predicted average CO_2, heat energy and fuel cost savings for 2012 and 2030. All data is per annum and per property.



The Delivery

The ETI customer research has shown that retrofit is currently unappealing to the mass market because it is seen as disruptive, risky (both in terms of finished quality and programme), has unproven benefits, and is over-priced.

To overcome these obstacles, retrofit delivery solutions need to be carefully designed with a robust standard approach with clear targets against all these criteria.

10

10 days or less installation programme

£10,000

£10,000 target cost for whole house solutions

Quality

Right first time quality with demonstrable energy savings.

Lean Principles

The suggested approach is to use lean principles to identify and eliminate all 'non-value-adding activity' from the entire process to create the best value result for the householder.

Previous ETI research has reviewed current processes and identified significant areas of waste as seen in Figure 3 on the following page. These wastes contribute significantly to higher project costs through excess material and unproductive labour.

The key elements of lean principles include:

- Define value in the eyes of the customer
- Map the value chain for every step from factory to completed retrofit
- Create flow so tasks and materials move without obstruction
- Establish pull where work and materials arrive just when needed
- Seek perfection to improve the process with every iteration.

Engagement: Detailed Survey

As described previously, the survey process has significant potential to be streamlined to reduce time, costs and also to save time on downstream processes. Key information to collect during the detailed survey include dimensions and access issues, both of which will have a significant impact on the costing of the retrofit.

With the ease of sharing photographs and other information, commercial teams can provide crucial information about the property, occupants and special requirements at an early stage. This enables greater attention to detail in the planning stage which will reduce the likelihood of delay during installation.

Examples of such information include photographs showing potential access problems, pre-existing conditions (such as cracks or damage) and details of known defects to be made good as part of the retrofit.

Early customer engagment will also allow for ease of process, by agreeing on a location for overnight material storage, as well as details such as pets, children and school times, around which installers need to work. It also provides an opportunity for customers to identify (and contractors to photograph) possessions or elements of the property which must be protected.

A common template and format for this data capture, ideally on a handheld device software format, will allow for seamless exchange of critical information. It will also provide the basis of an accurate 'job library' for preparation, installation, future maintenance and upgrade tasks.

There are significant advantages of the detailed survey being carried out by a member of the installation team, including:

- Early familiarity with the property and plans.
- An opportunity to build rapport with the householder and discuss / alleviate any concerns.

Material Inventory

Damaged material from multiple handling or 'shrinkage'. Significant leftovers at the end of a job.

Waiting

Delays from previous trades not completing in time for the next. Imbalanced schedule where tradesman wait for colleague to finish task.

Transport

Multiple material deliveries of low value, or trips to the builders' merchant to collect.

Over-processing

Multiple surveys from different trades for different tasks.

Defects

From unclear plans / communication, poor-workmanship or inadequate tools for the job.

Motion

Hard work for tradesmen to fetch material as a result of poor planning or inadequate material handling equipment. Adds to the safety risk.

Over-production

Excess material use – too much render mixed, etc.

Figure 3: 7 areas of waste in the current retrofit supply chain

- Greater ownership of the solution and survey

- Team responsibility for delivering a quality project, on-time and within cost.

Retrofit Standardisation

The use of 'retrofit kits' would significantly reduce material handling time on-site. By preparing a 'Bill of Materials' (BoM) for each task, the surveyors' ordering process is greatly simplified and the supplier can prepare a pack with all the material to compete the job. This approach is currently successfully employed in the installation of so-called 'flat-pack kitchens.'

For example, the surveyor may order an EWI kit for a property based on laser-measured survey data (to give wall area and position of windows/doors, etc.) as well as two additional kits for drainpipe relocation, and an additional EWI fixing pack for 10 m^2 based on poor quality brickwork.

The supplier, or the installer's supplier (builders' merchant or Retrofit Hub), will have a system to calculate quantities of materials. as well as a material optimisation programme to cut to the solid insulation to size and support frame to length. Appropriately sized materials should be barcoded to identify location on the property and sequenced on the pallet in installation order.

In this case, the installer is ordering just 3 separate items rather than a complex list of components. With standard kits the time to order is minimised and the supplier can co-ordinate a relatively high-value delivery to site, avoiding costly additional deliveries. In addition there is minimal cutting to size on

site reducing waste and dust for the householder.

This requires high levels of integration between installer and supplier, through the co-development of processes. By refining the BoM for each task material waste can be reduced, making the cost to the customer more attractive without penalising installer or supplier margins. A visual representation of such a supply chain is outlined below in Figure 4.

Site Set-up

Site welfare is a challenge for installers, as small businesses may rely on their van for breaks and the householder for welfare facilities (such as toilets). Larger organisations avoid this with hired welfare units, which are relatively costly and may be problematic on small sites. Creative solutions within a retrofit van, or using temporary shelters and external drainage access may be possible.

A clear and clutter free site is ideal and also, safest, for the householder. As such, installers and suppliers will need to organise any new material while also removing items to be recycled. Where space and householders permit, a lockable trailer on the driveway with all materials will optimise delivery cost. Where space is a problem daily deliveries may be required and logistics optimisation may be needed for the supplier to service multiple sites, or for the team to collect en-route to site.

Installation

Installation labour is the largest single opportunity for innovation and saving both time and cost (other potential savings are outlined in Figure 5). There are a few key underpinning principles for installation teams to optimise their time.

Polycompetence

The installation team are to be appropriately skilled to complete all the tasks of a retrofit. The term poly-competence is used to make clear that the individuals are trained and capable to do the tasks required, but not multi-skilled to the extent that each individual is a fully qualified electrician/plumber/etc. This ensures that the team is neither over-qualified and too costly, nor under-qualified and incapable of completing the task.

The poly-competent team is responsible for ensuring the whole house measures operate as a system. Without hand-offs between trades, there is no room for ambiguity of the causes of error. The team have ownership of the final result and shared responsibility for delivering exactly what the householder requires.

From a programme perspective the flexibility of the team allows the optimum labour productivity. There are many tasks which require two people part of the time, but only one at others (for example, a boiler installation will require 2 people to lift it, but only one person to install). With careful programming the second individual is able to

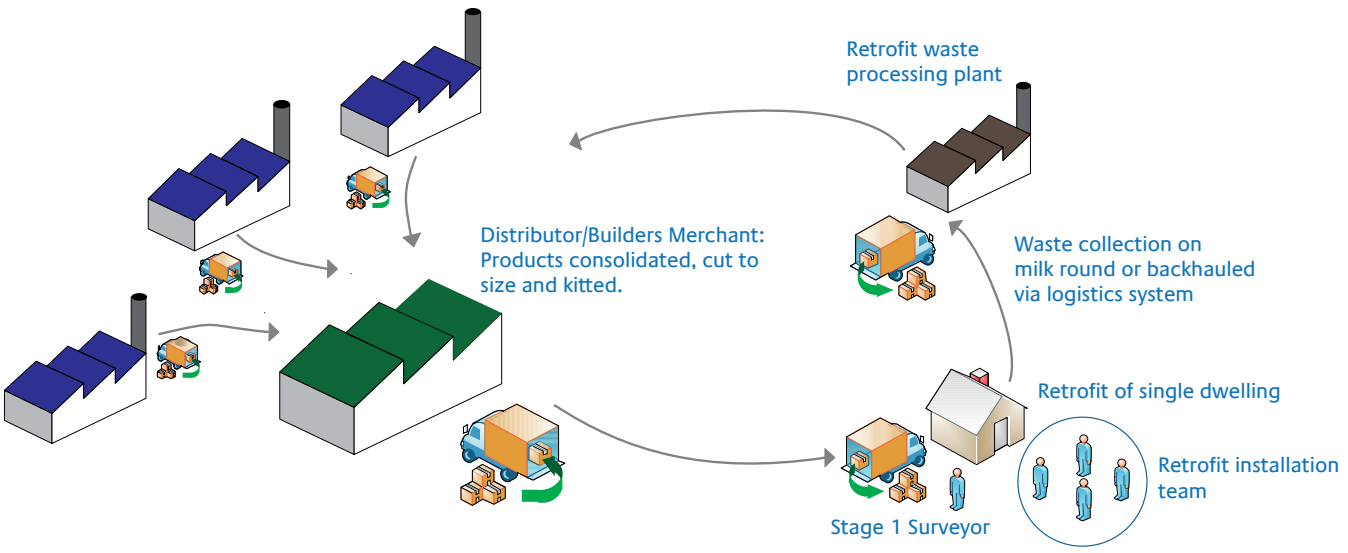


Figure 4: Proposed lean retrofit supply chain. This least waste supply chain design is the end goal once demand is established at a sufficient level to justify such investment.

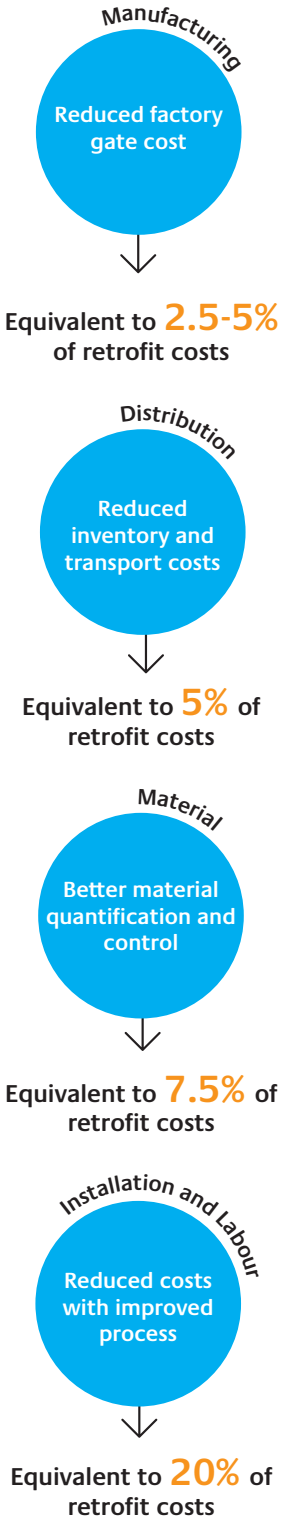


Figure 5: Projected process improvements and associated savings

shift onto another task when not required for the critical path activity. Other activities, such as render coat drying or flushing radiators, require waiting time and by programming other tasks into this period the programme is reduced and productivity increased.

Standard Work Approaches

The (anecdotal) builders' response to the concept of a 'standard' task, is that every home is different and cannot be standardised. While this may be the case, the large majority of activity is the same, with adjustments for property dimensions and additional features (such as bay windows or chimney breast). By building expertise in a specific local house-type, an installation team can improve their process as they complete more retrofits. They should also be encouraged to document the optimum process as they learn, benchmarking best-practise with other teams. In this way, repeatable tasks in assembly, logistics and construction can be optimised to reduce labour content by between 30% and 60%. In the desk based research a conservative 40% figure for overall reduction in costs was expected for retrofit.

To respond to unexpected events, the retrofit plan needs to identify critical path tasks and be flexible enough to shift other tasks around to keep the programme on track. Again, documentation of disruption should be documented so that they can inform future work and establish mechanisms for avoiding future delays.

Process review

As discussed in the sections above there should be a continual drive to improve the installation process through collection of data on causes of delay. Problems with achieving the required quality of install, latent defects which were not identified at the time of survey and opportunities for product, process or tool innovation which would save time or improve quality.

Teams which play a part in identifying process improvements should be recognised for their efforts to encourage on-going innovation to achieve the lowest delivered cost.

Business Opportunities

If retrofit is to be viable at scale, there need to be business models which are profitable and scalable as the market grows.

A model which is predicated on national coverage from the outset will be very high risk, as it is dependant on the market responding rapidly to recover the investment of a large scale solution.

To overcome this level of risk, smaller business models have been identified and explored which allow organisations to test the market at a local level.

Supply chain elements

To enable the business models to operate effectively the following elements are required.

Marketing and Lead Generation

Attracting potential customers will likely involve targeting a a specific demographic. Specifically, those with above average income who are approaching retirement age have been identified as a high potential target market for early adopters. A recognised and established brand supporting this work will help this process.

Engagement and Solution Development

Once interest has been generated the householder needs to understand what the implications are for them: How much saving? How long will it take? What is the benefit? Is work guaranteed and how much will it cost? Initially much of this could be carried out with a website and an online configuration tool. However, customers will want to contact a knowledgeable inidivudal, either over the phone or in person, to discuss their specific needs.

These individuals need to be seen as credibly knowledgeable and trustworthy enough to not mis-sell. For example, retail brands have recently backed away from energy as a result of the toxicity of such mis-selling but for a quality and service offering customer brands may invest.

Survey & Install

As outlined previously, there are many reasons for survey and install to both be carried out by members of the 4-person poly-competent team. This is one of the key findings of previous research.

Material Supply & Logistics

There is excess capacity in existing construction material supply and, as such, it appears uneccesary to create new networks. However, the concept of configure-to-order (at a builders' merchant or logistics depot) and deliver to a property is likely to be a new approach, and may require a change of depot culture.

Through Life Maintenance

To continue the theme of 'ownership' of the customer journey, it would be sensible for the installation team to be able to offer service contract, upgrade or replacement as part of the retrofit offer. This may require additional skills, but would meet the customer preference for local tradesmen.

Funding

Sources of finance are a major hurdle in an untested market. For example, a new retrofit business model will likely been seen as high risk, leading to high interest on loans or require high levels of equity. However, if retrofit can be shown as a value enhancing proposition, there will be no shortage of investment options, ranging from Green Deal and ECO finance to mortgages or bank loans. On the other hand, if the

delivery organisation is able to invest their own money – and gets their specification right to deliver to target cost – they will be able to make a greater return than if they had borrowed money.

Business Models

Contractor

Today the success of a main contractor model is based on economies of scale, where the lead organisation sub-contracts to specialist trade companies and adds value through this co-ordination role. With the small-team ethos being a single house sale and 4-person delivery team, the model is unlikely to fit with the main contractor, unless a new business unit is created.

Retailer

The retail model refers to known home improvement brands who have the expertise in delivering single house projects cost effectively and have an existing client base in the target market. They also have material buying power as well as a national depot network to act as an office base and provide facilities for preparing material kits. A challenge seen by these organisations is developing the capabilities for whole house retrofit in a single team. The sector is also trying to overcome a reputation for hard selling and quality issues.

National Specialist

Specialist refurbishment and retrofit companies have built their reputations on the refurbishment of the rental sector. Although based on multiple property contracts, this model is better suited to service single properties. Some companies have, or are aiming to add, a direct sale mechanism to owners. National specialists have worked hard to develop a reputation for quality, but may find it difficult to drive down costs to the required level while retaining quality.

Franchise

A local independent company backed by a national branded franchise could potentially be attractive to customers. The franchisor would be able to create the scale and buying power, as well as potentially providing the training, distribution and back-office support. On the part of the franchisee, they will be responsible for meeting brand quality standards and using the appropriate material channels. This could be a successful model for growing revenues for

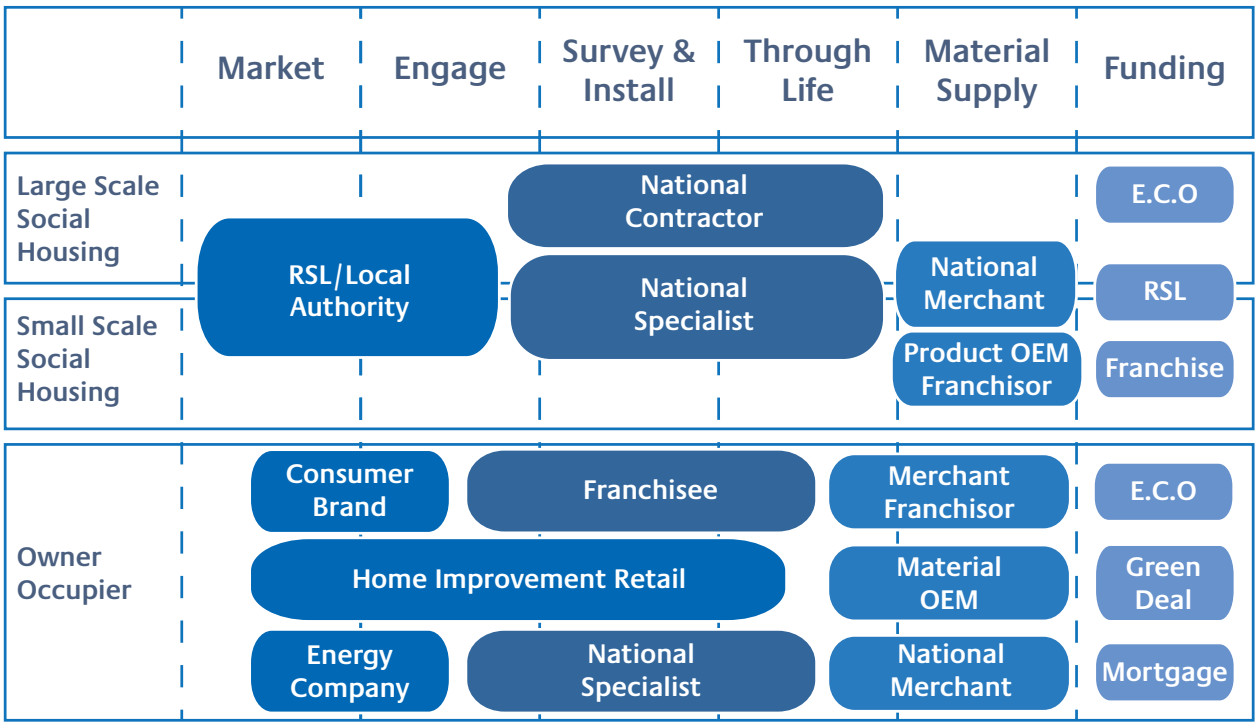


Table 3: Business opportunities for different stages of Retrofit for various customers

builders' merchants, insulation/ heating manufacturers or a consortium using a customer brand linked to a material distributor. Quality assurance and contract liability would be key for this set-up.

Independent Four Person Team

For a fully independent team, the main challenge will be the time necessary to develop a reputation for quality and service. A successful existing business aiming to specialise in retrofit may achieve quicker growth, but without the support of a larger organisation will likely be slower. With smaller scale comes reduced buying power and more cash-flow risk.

Summary

With an untested market, investors prefer a model which does not depend on large scale investment in the early stages until demand is generated and there is confidence in a return. To achieve this, it may be advantageous to create a minimum viable unit, which can be scaled as rapidly as demand dictates.

Each of the above models has merits in particular market segments. New models come with some risk, but the franchise & retail models could best take advantage of existing networks of depots to act as the retrofit configuration points. This approach leverages existing assets of distribution or retail companies and could be tested geographically with minimal risk. The viable options by customer groups are shown graphically in Table 3.

Sketching a Plan for Retrofit

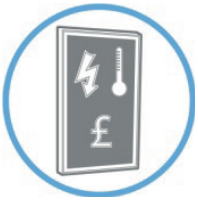
Appendices

Whole House Packages

IWI front only
EWI 0.20W/m²K

Floor
insulatiion
0.15 W/m²K

Party
walls/floors



Energy monitor

The following whole house packages were developed for each specific house type.

The following tables contain the suggested measures and U-values for both RetroFix and RetroPlus packages.

Light green circles signify that the measure belongs to the RetroFix Packages, while dark green circles signify that the measure belongs to the RetroPlus packages.

Typically RetroPlus packages take the RetroFix elements as a starting point and then further improve thermal efficiency using floor insulation, replacement doors and windows, better airtightness and more innovative heating systems.

However, there are 4 instances where this is not the case:

Floors: If a RetroPlus package is undertaken and floor insulation is going to be installed, floor edge insulation does not need to be installed as well, since the floor joist insulation should be adequate

Windows: If a RetroPlus package is undertaken and windows are to be replaced, removable reveals should not be installed.

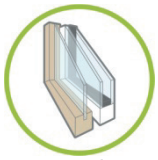
Airtighness: The light green airtightness figure is the target for RetroFix packages, while the dark green figure is the target for RetroPlus packages.

Boilers: If a RetroPlus package is undertaken, the existing boiler is replaced with a modulating boiler, not an A-rated boiler.

Orange circles denote unique features that have a high probability of occurrence for that particular housetype, which could potentially increase the complexity and cost of the retrofit, or require special attention to thermal bridging features.

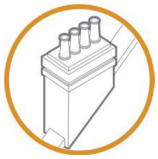
Blue circles denote “Added Value” features which are not necessarily thermal efficiency related but have been added as part of the RetroPlus packages in order to respond to the requirements different customer groups.

RetroFix: Pre-1919 Mid-terrace and Converted Flat

WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS
 IWI front only EWI 0.20W/m²K	 Loft insultation 0.15W/m²K	 Ground floor edge insulation	 Secondary glazing 2.0W/m²K	 Airtightness 6m³/m².hr	 Single room heat recovery	 A-rated boiler
 Removable reveals	 Insulated loft hatch	 Upper floor edge insulation	 Draught stripping			 HW jacket
						 TRVs, zoned heat controls

UNIQUE FEATURES

 Extension- EWI

 Chimney- fill and insulate

 Decorative features

 Bay window- upgrade

 Recessed door- insulate

 Party walls/floors

RetroPlus: Pre-1919 Mid-terrace and Converted Flat

WALLS

IWI front only
EWI 0.20W/m²K

ROOF

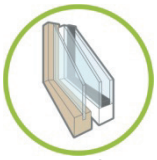
Loft insultation
0.15W/m²K

Insulated
loft hatch

FLOOR

Floor
insulatiion
0.15 W/m²K

DOORS/ WINDOWS



Secondary
glazing
2.0W/m²K

Draught
stripping

Insulated
secure door
1.5 W/m²K

AIRTIGHTNESS

Airtightness
6m³/m².hr

VENTILATION

Single room
heat recovery

HEATING/ CONTROLS

HW jacket

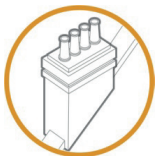
TRVs, zoned
heat controls

Modulating
boiler

Consider
heat pump

UNIQUE FEATURES

Extension-
EWI



Chimney- fill
and insulate

Decorative
features

Bay window-
upgrade

Recessed door-
insulate

Party
walls/floors

ADDED VALUE

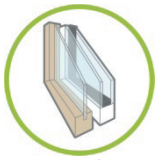
Storage deck

New kitchen

New bathroom

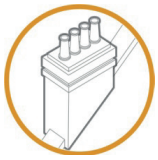
Energy monitor

RetroFix: Pre-1919 Detached

WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS
 IWI 0.25W/m²K	 Loft insultation 0.15W/m²K	 Ground floor edge insulation	 Secondary glazing 2.0W/m²K	 Airtightness 8m³/m².hr	 Single room heat recovery	 A-rated boiler
 Removable reveals	 Insulated loft hatch	 Upper floor edge insulation	 Draught stripping			 HW jacket
						 TRVs, zoned heat controls

UNIQUE FEATURES

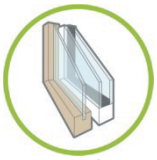
 Extension- EWI

 Chimney- fill and insulate

 Bay window- upgrade

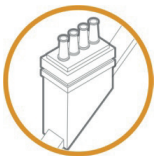
 Recessed door- insulate

RetroPlus: Pre-1919 Detached

WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS
 IWI 0.25W/m²K	 Loft insultation 0.15W/m²K	 Floor insulatiion 0.15 W/m²K	 Secondary glazing 2.0W/m²K	 Airtightness 6m³/m².hr	 Single room heat recovery	 HW jacket
 Removable reveals	 Insulated loft hatch	 Solid floor insulatiion 0.30 W/m²K	 Draught stripping			 TRVs, zoned heat controls
			 Insulated secure door 1.5 W/m²K			 Modulating boiler
						 Consider heat pump

UNIQUE FEATURES

 Extension- EWI

 Chimney- fill and insulate

 Decorative features

 Bay window- upgrade

 Recessed door- insulate

ADDED VALUE

 Storage deck

 Energy monitor

 LED lighting

 PV

RetroFix: 1919-1944 Semi-detached

WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS

EWI
0.20W/m²K

Loft insultation
0.15W/m²K

Ground floor
edge insulation

Draught
stripping

Airtightness
8m³/m².hr

Single room
heat recovery

A-rated
boiler

CWI
0.15 W/m²K

Insulated
loft hatch

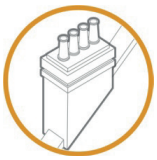
HW jacket

Removable
reveals

TRVs, zoned
heat controls

UNIQUE FEATURES

Extension-
EWI



Chimney- fill
and insulate

Decorative
features

Bay window-
upgrade

Recessed door-
insulate

Party wall

RetroPlus: 1919-1944 Semi-detached

WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS

EWI
0.20W/m²K

Loft insultation
0.15W/m²K

Floor
insulatiion
0.15 W/m²K

Draught
stripping

Airtightness
5m³/m².hr

Single room
heat recovery

HW jacket

CWI
0.15 W/m²K

Insulated
loft hatch

Solid floor
insulatiion
0.30 W/m²K

Insulated
secure door
1.5 W/m²K

TRVs, zoned
heat controls

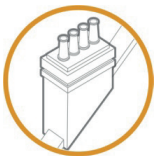
Triple glazing
0.80W/m²K

Modulating
boiler

Consider
heat pump

UNIQUE FEATURES

Extension-
EWI



Chimney- fill
and insulate

Decorative
features

Bay window-
upgrade

Recessed door-
insulate

Party wall

ADDED VALUE

Storage deck

New kitchen

New bathroom

Energy monitor

Underfloor
heating

Solar thermal
hot water

RetroFix: 1945-1964 Semi-detached

WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS


EWI
0.20W/m²K


Loft insultation
0.15W/m²K


Ground floor
edge insulation


Draught
stripping

Airtightness
7m³/m².hr


Single room
heat recovery


A-rated
boiler


CWI
0.15 W/m²K

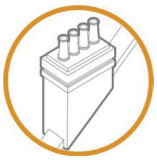

Insulated
loft hatch

HW jacket


Removable
reveals


TRVs, zoned
heat controls

UNIQUE FEATURES


Chimney- fill
and insulate


Recessed door-
insulate


Party wall

RetroPlus: 1945-1964 Semi-detached

WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS

EWI
0.20W/m²K

Loft insultation
0.15W/m²K

Floor
insulatiion
0.15 W/m²K

Draught
stripping

Airtightness
5m³/m².hr

Single room
heat recovery

HW jacket

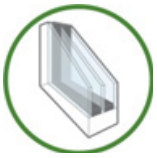
CWI
0.15 W/m²K

Insulated
loft hatch

Solid floor
insulatiion
0.30 W/m²K

Insulated
secure door
1.5 W/m²K

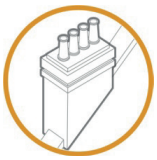
TRVs, zoned
heat controls



Triple glazing
0.80W/m²K

Modulating
boiler

UNIQUE FEATURES



Chimney- fill
and insulate

Recessed door-
insulate

Party wall

ADDED VALUE

Storage deck

New kitchen

New bathroom

Energy monitor

Underfloor
heating

Solar thermal
hot water

RetroFix: 1965-1980 Detached

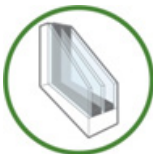
WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS
 EWI 0.20W/m²K	 Loft insultation 0.15W/m²K	 Ground floor edge insulation	 Draught stripping	 Airtightness 8m³/m².hr	 Single room heat recovery	 A-rated boiler
 CWI 0.15W/m²K	 Insulated loft hatch					 HW jacket
 Removable reveals						 TRVs, zoned heat controls

UNIQUE FEATURES

 Extension- EWI

 Garage wall/s & soffit

RetroPlus: 1965-1980 Detached

WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS
 EWI 0.20W/m²K	 Loft insultation 0.15W/m²K	 Solid floor insulatiion 0.30 W/m²K	 Draught stripping	 Airtightness 3m³/m².hr	 Single room heat recovery	 HW jacket
 CWI 0.15W/m²K	 Insulated loft hatch	 Insulated secure door 1.5 W/m²K				 TRVs, zoned heat controls
		 Triple glazing 0.80W/m²K				 Modulating boiler

UNIQUE FEATURES


Extension- EWI


Garage wall/s & soffit

ADDED VALUE


Storage deck


New kitchen


New bathroom

Energy monitor

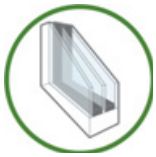

Solar thermal hot water


LED lighting

RetroFix: 1965-1980 Bungalow

WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS
 EWI 0.20W/m²K	 Loft insultation 0.15W/m²K	 Ground floor edge insulation	 Draught stripping	 Airtightness 7m³/m².hr	 Single room heat recovery	 A-rated boiler
 CWI 0.15W/m²K	 Insulated loft hatch					 HW jacket
 Removable reveals						 TRVs, zoned heat controls

RetroPlus: 1965-1980 Bungalow

WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS
 EWI 0.20W/m²K	 Loft insultation 0.15W/m²K	 Solid floor insulatiion 0.30W/m²K	 Draught stripping	 Airtightness 5m³/m².hr	 Single room heat recovery	 HW jacket
 CWI 0.15W/m²K	 Insulated loft hatch		 Insulated secure door 1.5W/m²K			 TRVs, zoned heat controls
			 Triple glazing 0.80W/m²K			 Modulating boiler

ADDED VALUE

 Storage deck

 New kitchen

 New bathroom

 Energy monitor

 A-rated appliances

RetroFix: 1965-1980 Low Rise Purpose Built Flat

WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS
 EWI 0.20W/m²K	 Loft insultation 0.15W/m²K	 Ground floor edge insulation	 Draught stripping	 Airtightness 7m³/m2.hr	 Single room heat recovery	 A-rated boiler
 CWI 0.15W/m²K	 Insulated loft hatch					 HW jacket
 Removable reveals						 TRVs, zoned heat controls

UNIQUE FEATURES


Party wall

RetroPlus: 1965-1980 Low Rise Purpose Built Flat

WALLS

EWI
0.20W/m²K

CWI
0.15W/m²K

ROOF

Loft insultation
0.15W/m²K

Insulated
loft hatch

FLOOR

Solid floor
insulatiion
0.30 W/m2K

DOORS/ WINDOWS

Draught
stripping

Insulated
secure door
1.5 W/m2K

Triple glazing
0.80W/m²K

AIRTIGHTNESS

Airtightness
5m³/m².hr

VENTILATION

Single room
heat recovery

HEATING/ CONTROLS

HW jacket

TRVs, zoned
heat controls

Modulating
boiler

UNIQUE FEATURES

Party wall

ADDED VALUE

Storage deck

New kitchen

New bathroom

Energy monitor

RetroFix: Post-1980 Detached

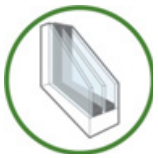
WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS
 EWI 0.20W/m²K	 Loft insultation 0.15W/m²K	 Ground floor edge insulation	 Draught stripping	 Airtightness 7m³/m².hr	 Single room heat recovery	 TRVs, zoned heat controls
 CWI 0.15W/m²K	 Insulated loft hatch					
 Removable reveals						

UNIQUE FEATURES

 Extension- EWI

 Garage wall/s & soffit

RetroPlus: Post-1980 Detached

WALLS	ROOF	FLOOR	DOORS/ WINDOWS	AIRTIGHTNESS	VENTILATION	HEATING/ CONTROLS
 EWI 0.20W/m²K	 Loft insultation 0.15W/m²K	 Solid floor insulatiion 0.30W/m²K	 Draught stripping	 Airtightness 6m3/m².hr	 Single room heat recovery	 TRVs, zoned heat controls
 CWI 0.15W/m²K	 Insulated loft hatch		 Insulated secure door 1.5W/m²K			 Modulating boiler
			 Triple glazing 0.80W/m²K			 Consider heat pump

UNIQUE FEATURES

 Extension- EWI

 Garage wall/s & soffit

ADDED VALUE

 Storage deck

 New kitchen

 New bathroom

 Energy monitor

 Underfloor heating

 LED lighting

 PV

Day Programmes

	Labourer	Trade Specialist #1	Trade Specialist #2	Team Leader
	Experience: 0-2 years *Qualifications:* CSCS card	*Experience:* 2-10 years *Qualifications:* NVQ, registered with industry body such as JIB, system training as applicable	*Experience:* 2-10 years *Qualifications:* NVQ, registered with industry body such as JIB, system training as applicable	*Experience:* 10+ years *Qualifications:* NVQ, Heating Engineer
Operative Skills	access equipment	access equipment	working at height	decommission/install gas equipment
	painting finish	TRVs	access equipment	supervision
	radiator fitting	electrical basics	TRVs	electrical certification
	electric preparation	EWI	electrical basics	signing off building regulations
	insulation HW tanks	kitchen units	EWI	customer handover
	loft insulation draught proofing	plumbing	kitchen units	
		carpentering	plumbing	
		tiling	carpentering	
			tiling	

note: all visual and physical surveys undertaken prior to start on site

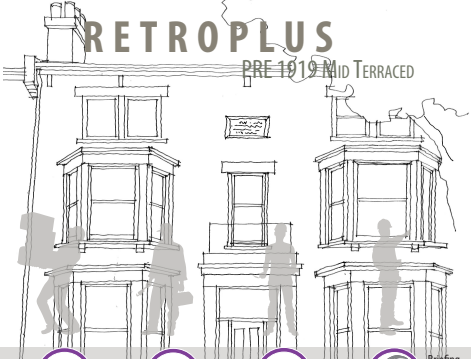
Pre-1919 Mid-terrace RetroFix and RetroPlus

RETROFIX

PRE 1919 MID TERRACED

RETROPLUS

PRE 1919 MID TERRACED



1

Briefing
Site prep.

Briefing
Asbestos
control

Digging/
backfilling
trench

Install
GFI

Unload
access
equipment

Internal
Floor
edge

Drainage
and
plumbing

Break

Remove
external
electrics

Scheduling
wash-up

2

Create
access
platforms

Extend
eaves and
flues

Break

Remove
external
pipes

Prepare
bay
windows

Extend
cills

Extend
flues and
drainage
routes

Install
EWI

Break

Party wall
insulation

Heating
system
upgrades

Removable
reveals

Bay
window

Break

Install single
room HR

Reconnect
services

Waste
disposal

Scheduling
wash-up

4

Render
base coat

Loft
Insulation
top-up

Break

Waste
disposal

Scheduling
wash-up

5

NON WORK DAY

6

NON WORK DAY

7

8

Render
top
coat

Secondary
double
glazing

Break

PROPERTY
SURVEY or
OCCUPANT
BRIEFING
(OTHER SITES)

Waste
disposal

9

IWI

Airtightness
draught-
stripping

Rainwater
goods,
cables,
flues

Refit
drainage
and
plumbing

External
electrics

Airtightness
draught-
stripping

Insulate
chimney
stack

Floor
Insulation
prep.

Break

Disman-
tle access
equip-
ment

Scheduling
wash-up

Cleanup

10

Rainwater
goods,
cables,
flues

Refit
drainage
and
plumbing

External
electrics

Decoration
party wall,
internal
reveals

Insulate
chimney
stack

Floor
Insulation

Break

Disman-
tle access
equip-
ment

Quality
checks
pre-hand-
over

IWI

Cleanup

Handover

Scheduling
wash-up

11

Floor
Insulation

Decoration
party wall,
internal
reveals

Break

IWI

Scheduling
wash-up

12

Floor
Insulation

Decoration
party wall,
internal
reveals

Break

Quality
checks
pre-hand-
over

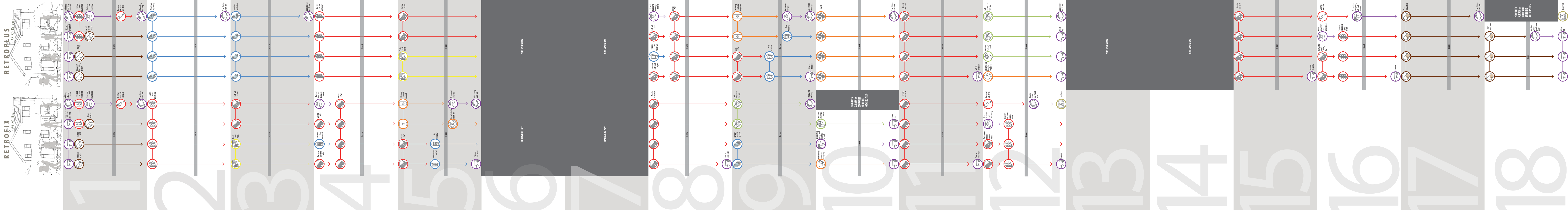
Cleanup

Handover

1919-1944 Semi-detached RetroFix and RetroPlus

RETROFIX
1919-1944 Semi Detached
RETROPLUS
1919-1944 Semi Detached
1
Briefing Site prep.
Briefing Asbestos control
Digging trench
Install GFI
Unload access equipment
Filling trench
Drainage and plumbing
Break
Remove external electrics
Scheduling wash-up
2
Create access platforms
Doors/Windows replacing
Break
Extend eaves
Scheduling wash-up
3
Remove external pipes
Prepare bay windows
Extend cills
Extend flues and drainage routes
MVHR
Install EWI
Break
Scheduling wash-up
4
Party wall insulation
Heating system upgrades
Create access platforms
Removable reveals
Bay window
Break
Install single room HR
Reconnect services
Extend eaves
Waste disposal
Scheduling wash-up
5
Render base coat
Remove external pipes
Prepare bay windows
Extend cills
Extend flues and drainage routes
Install EWI
Break
Waste disposal
Scheduling wash-up
6
NON WORK DAY
NON WORK DAY
7
NON WORK DAY
NON WORK DAY
8
Render top coat
Render base coat
Break
Waste disposal
Scheduling wash-up
9
Loft Insulation top-up
Insulate chimney stack
Decoration party wall, internal reveals
PROPERTY SURVEY or OCCUPANT BRIEFING (OTHER SITES)
Party wall insulation
Heating system upgrades
Break
Airtightness draught-stripping
Bay window
Reconnect services
Waste disposal
Scheduling wash-up
10
Rainwater goods, cables, flues
Refit drainage and plumbing
External electrics
Floor Insulation
Dismantle access equipment
Making good
Break
Quality checks pre-hand-over
Cleanup
Handover
Scheduling wash-up
11
Floor Insulation
Break
Scheduling wash-up
12
Render top coat
Break
Waste disposal
Scheduling wash-up
13
NON WORK DAY
14
NON WORK DAY
15
Loft Insulation top-up
Insulate chimney stack
Decoration party wall, internal reveals
PROPERTY SURVEY or OCCUPANT BRIEFING (OTHER SITES)
Break
Airtightness draught-stripping
16
Rainwater goods, cables, flues
Refit drainage and plumbing
External electrics
Dismantle access equipment
Making good
Break
Quality checks pre-hand-over
Cleanup
Handover

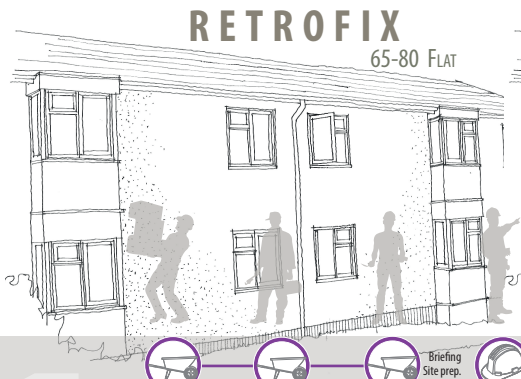
1965-1980 Detached RetroFix and RetroPlus


RETROPLUS
RETROFIX

1965-1980 Flat RetroFix and RetroPlus

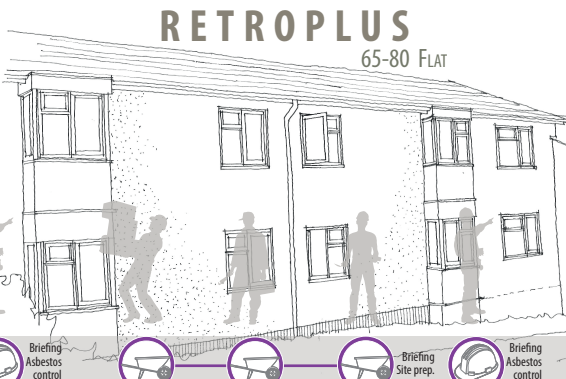
RETROFIX

65-80 Flat



RETROPLUS

65-80 Flat



1

Briefing
Site prep.
Briefing
Asbestos
control
Digging
trench
Install
GFI
Unload
access
equipment
Filling
trench
Drainage
and
plumbing
Break
Remove
external
electrics
Scheduling
wash-up

Briefing
Site prep.
Briefing
Asbestos
control
Party wall
insulation
Unload
access
equipment
New
Front
door
Drainage
and
plumbing
Break
Remove
external
electrics
Scheduling
wash-up

2

Create
access
platforms
Extend
eaves and
flues
Break
Remove
external
pipes
Airtightness
draught-
stripping
Extend
cills
Extend
flues and
drainage
routes
Waste
disposal

Windows
replacing
Break
Scheduling
wash-up

3

Install
EWI
Break
Loft
insulation
top-up
Waste
disposal

PROPERTY SURVEY or OCCUPANT BRIEFING (OTHER SITES)

Create
access
platforms
Extend
eaves and
flues
Break
Remove
external
pipes
Airtightness
draught-
stripping
Extend
cills
Extend
flues and
drainage
routes
Waste
disposal

4

Removable
reveals
Heating
system
upgrades
Install single
room HR
Reconnect
services
Break
Render
coat
Waste
disposal
Scheduling
wash-up

Install
EWI
Break
Loft
insulation
top-up
Waste
disposal

PROPERTY SURVEY or OCCUPANT BRIEFING (OTHER SITES)

5

Rainwater
goods,
cables,
flues
Refit
drainage
and
plumbing
External
electrics
Dismant-
tle access
equip-
ment
Decora-
tion
party
wall,
internal
reveals
Making
good
Break
Quality
checks
pre-hand-
over
Cleanup
Handover

Removable
reveals
Heating
system
upgrades
Install single
room HR
Reconnect
services
Break
Render
coat
Waste
disposal
Scheduling
wash-up

6

NON WORK DAY

NON WORK DAY

7

NON WORK DAY

NON WORK DAY

8

Floor
Insulation
Break
Scheduling
wash-up

9

Floor
Insulation
Break
Scheduling
wash-up

10

Rainwater
goods,
cables,
flues
Refit
drainage
and
plumbing
External
electrics
Dismant-
tle access
equip-
ment
Decora-
tion
party
wall,
internal
reveals
Making
good
Break
Quality
checks
pre-hand-
over
Cleanup
Handover