Report

Nottingham City Council | Housing Services

WHOLE HOUSE RETROFIT PROJECT LED BY NOTTINGHAM CITY COUNCIL

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1. Project Summary

The Whole House Retrofit (WHR) project was delivered by Nottingham City Homes (NCH), via agreement with Nottingham City Council (NCC), and Energiesprong UK (ESUK). Nottingham City Homes has since been absorbed back into the council and this department of the council is now known as Nottingham City Council Housing Services (NCCHS). The project applied to the Department for Energy Security and Net Zero's (formerly Department for Business, Energy and Industrial Strategy) Whole House Retrofit competition in May 2019 and the project was awarded up to £3,529,759.52 grant funding in February 2020. The purpose of this report is to summarise the activities undertaken to deliver project outcomes whilst providing insight on the lessons learnt. Further information on programme delivery and outcomes can be found in the Whole House Retrofit and Social Housing Decarbonisation Fund Demonstrator: joint outcome and economic evaluation report [1]

The Whole House Retrofit project (WHR 106) comprised two workstreams, Destination Zero 1 (DZ1) (originally 96 properties) and ES Clifton (originally 72 properties).

Destination Zero 1 set out to test an approach of sequential retrofit, optimising retrofit integration within the existing asset management plan.

ES Clifton was intended as a deep retrofit, following the Energiesprong[2] model and attempting to achieve a net zero solution in one step. This workstream did not progress past the feasibility stage, largely owing to the predicted out-turn costs being circa 20% more than budgeted, including those for future phases (that assumed a reduction in costs), and an overall programme of works that was not feasible to deliver within the time constraints of the project. Therefore, the Council Housing Energy Efficiency Board took the decision to withdraw the ES Clifton stream of the programme.

Both workstreams were delivered by NCH as part of their management agreement with NCC. The project was initiated prior to the adoption of PAS 2035:2019[3] and as such was not resourced to achieve this. PAS 2035:19 required prescriptive roles and processes to the retrofit process i.e., the appointment of a Retrofit Co-ordinator, provision of an options evaluation and medium-term Retrofit Improvement Plan.

Parts of the project were delivered via both energy company obligation (ECO3) and WHR grant funding. The ECO3 scheme provided grants to fund energy efficiency upgrades to homes that reduce emissions, electricity, and energy bills. This allowed elements of the works to be funded via ECO3[4] and necessitated compliance with PAS 2035 and conversely PAS 2030[5] for the energy efficiency measure being funded. This was applicable to the external wall insulation element of the DZ1 workstream.

[1] https://www.gov.uk/government/publications/whole-house-retrofit-and-social-housing-decarbonisation-fund-demonstrator-joint-process-evaluation

[2] Energiesprong was created by the government of the Netherlands in 2010 to retrofit existing buildings for higher energy efficiency standards, becoming zero-energy buildings through retrofitting. The Energiesprong Model typically involves snapping a prefabricated shell of panels to the exterior of a building to improve its thermal efficiency considered a deep retrofit, smart heating, and ventilation and cooling installations.

[3] See: https://www.trustmark.org.uk/tradespeople/pas-2035

[4] For ECO3 scheme performance outcomes see: https://www.ofgem.gov.uk/publications/energy-company-obligation-eco3-final-determination-report

[5] See: https://www.trustmark.org.uk/tradespeople/how-to-become-pas-mcs-certified

The WHR competition end use energy demand target for each retrofitted dwelling was 30 kWh/m2, however, the Department stated if this was not technically and functionally practicable, evidence to this effect must be demonstrated and an overall performance of no worse than 50 kWh/m2 was to be achieved. The project aimed to achieve an overall performance of 50kWh/m2/yr for DZ1 (and 40kWh/m2/yr for the cancelled ES Clifton phase) using a fabric first approach and sharing learnings on what was practicable.

Destination Zero's key principles were to deliver:

- Process improvements aimed at scaling up delivery, including off-site processes and manufacture.
- 2050 ready i.e., homes retrofitted to have minimal energy use and net carbon emissions over the year because they are highly insulated, have low water demand and are fitted with or directly connected to renewable energy systems.
- 'No regrets' i.e., actions which are cost-effective now, consistent with a range of future climate scenarios and don't involve hard trade-offs with other policy objectives.
- Asset Management aligned.

NCHHS were striving for a solution that could be delivered either in one go – or incrementally. With the aim to make incremental measures work for the council instead of against – as they did at the time. i.e., retrofit works that fit in with the normal asset management approach and replacement cycles for social housing providers. Working with an existing supply chain to further develop in-house capability and optimise local jobs and use what was in the project's control to drive process efficiencies.

Project objectives

- Reduction in fuel poverty and improvement in tenant comfort and ability to pay rent.
- Development of a cost-effective model to deliver carbon neutral homes and better understand risks, enabling the learning to be embedded into the Housing Revenue Account (HRA) 30-year business plan.
- Develop an understanding of where insourcing opportunities exist, incorporate delivery team's learnings from the project and apply to methods of achieving energy performance targets across all stock.
- An opportunity to work with Government to inform the future strategy of retrofit projects, to evidence cost reduction through the project and to show how this would continue beyond the project.
- Monitoring results to provide evidence that proposed solutions work.
- Insourcing approach to delivering whole house retrofit, which is the practice of upskilling the authorities' own resources to create a delivery programme in house.
- Show cost reduction from DZ1 through improved processes.
- Secure maximum funding to support improvement to NCH/NCC's assets insourcing approach to delivery.
- To achieve the thermal demand target of 50 kWh/m2/yr and improve energy performance certificates (EPCs) from bands D and below to EPC band C or higher.

Before - Mapperley

After - Mapperley

Before - Bakersfield

After - Bakersfield

Figure 1 – Photos of the properties before and after the retrofit works

Working to the notion that every lesson learned is invaluable, irrespective of whether the outcome was positive or not, then the project has made several achievements.

Key Achievements

- Retrofit of 50 homes of EPC Band F to D, achieved a minimum EPC Band of C.
- Continuity of work during the COVID-19 pandemic.
- Maintenance of project delivery whilst encountering some challenging issues i.e., the liquidation of Mauer UK who were the original external wall insulation contractor.
- Developed an in-house team with excellent knowledge of the various challenges faced by retrofit including the experience of how to foresee risks and manage these appropriately.
- Development of a cost model per archetype which can be used to inform future budgets and bids.

- Development of a concept for the ES Clifton workstream. If afforded more time the project could have reduced the capital costs for these properties and achieved financial feasibility for the first delivery stage.

2. Property selection, retrofit measures, and energy demand reduction

2.1 Property Selection

96 properties under the DZ1 workstream and 72 properties under the ES Clifton workstream were identified as suitable for a whole house retrofit. 65 of these 168 properties were shortlisted under the DZ1 Scheme. From that shortlist, tenants of 50 properties under the DZ1 workstream agreed for works to be carried out, retrofitted and commissioned (see Annex 2 for further details).

2.2 Property Deselection

Reasons that homes have been deselected for retrofit included tenant refusals, cost of remedial work, and planning permission.

Reason for deselection	Details
Right To Buy	• Reduction of 5 properties that were purchased under the Right To Buy scheme[6] post identification within the original bid application.
Cost challenges	• The £4.49m cost limit for ES Clifton could not be met, this resulted in a reduction of 76 properties. • The costs under DZ1 increased due to scope increases (increase of costs due to national shortage/uplift of building materials and resource plus additional costs due to unforeseen works) and other challenges such as Covid-19 pandemic and the liquidation of Mauer UK. These issues reduced the final number of properties from 96 to 50 (-45).

Further deselection reasons noted over the course of the project included refusals by tenants due to issues such as bolt-on unauthorised adaptation to the property and vulnerable persons concerned at scale of works and disruption involved.

2.3 How measures installed differed from original plans

The Mauer UK external wall insulation (EWI) system was installed to four properties and subsequently removed from three due to concerns over quality, specifically the condensation risk within the horizontal quilt insulation layer.

These have been replaced with the product designed with the novated contractor Surefire Management Services Ltd (SMS), which is an innovative offsite EWI system that replicates the existing brick façade. One property remains with the Mauer system installed as the customer has refused works to remove it due to not wanting any further disruption.

[6] For further information on Right To Buy see: https://www.gov.uk/right-to-buy-buying-your-council-home

Three properties were unable to be treated with the Q-bot underfloor insulation system due to issues over access (unsuitable for robot) and excessive levels of damp. These floors were insulated using more traditional means, i.e., removal of floorboards, and installation of rigid insulation from above, sealing all perimeters.

A heating and ventilation pod[7] was originally intended to be installed to 20 properties. This measure was however limited to one property, predominantly due to poor system performance and projected costs being £38K (as opposed to £20k quoted originally). The installed pod did not perform as anticipated and the tenant found that their energy bills had increased significantly. Therefore, due to these issues not being possible to rectify within a reasonable timeframe, the pod was removed, replaced with a boiler and the tenant was satisfied.

Generally, the original project budget was found to be inadequate. This was contributed to by the issues described above, alongside under-budgeting in the first instance. This was the councils first project of this kind and significant unforeseen repair and enabling works were required. In response, the project developed an Excel template for pre-works scoping surveys, to be carried out by NCCHS/SBS surveyors, to capture property layout and condition.

The only means to mitigate the cost pressures described above was to reduce the original number of properties.

2.4 Changes to the energy use targets

The original 50kWh/m2 target was reduced for several properties following more detailed modelling and is likely to be between 70kWh/m2 and 80kWh/m2 for these homes.

Where under floor insulation has not been possible to install due to access issues and damp, this affected the level of airtightness achieved.

Whilst the target remained the same, expectation had to be managed about what would finally be realised. As the basis of the DZ1 workstream was sequential delivery there remain options to make further improvements to achieve the original target. These measures should be delivered as part of the wider asset management strategy.

Performance metric	**Method of calculation (planned or used)**		
	Pre- retrofit (baseline)	**Target**	**Post- retrofit (actual)**
EPC	Existing lodged EPCs, range from: EPC D– F (application)	EPC band C	Post EPR reports
SAP rating	Existing lodged EPCs	Range from: 69 and above	Post EPR report
Energy use (kWh/m2/annum)	Energy modelling calculations based on archetype data, from: 120kWh/m2/yr	Range from: 50kWh/m2/yr - 63.4 kW/m2/yr	Energy modelling using monitoring data and meter readings

[7] The pod system was a pilot grid-connected energy pod incorporating heat pump, ventilation, battery storage and controls with AI learning. Taking an incremental approach, the whole house methodology was designed so that the system could be installed later when a gas boiler requires replacement.

2.5 Methodologies for measuring (pre- and post-retrofit) performance of retrofitted properties

The fuel bills were not monitored due to the uncertainty with energy prices over the final stretch of the project, meaning the bills would not provide accurate readings. Also, efforts to obtain this information from the tenants requires significant resource and have proven to be unsuccessful in the past.

3. Cost reduction

3.1 Baseline per property cost of whole house retrofit works.

Actual Baseline cost per property

Property type 1 (End of terrace)

Cost category	Baseline cost per property (£)
Preliminaries	£8,000
PAS Suite (Assess', Design, Co-ord')	£10,000 (per archetype)
Roofing Works (enabling and insulation)	£2,500
Enabling Works to EWI	£3,000
EWI	£25,000
Windows	£6,000
Extract Ventilation (2Nr)	£1,000
Total	**£55,500**

Property type 2 (Mid terrace)

Cost category	Baseline cost per property (£)
Preliminaries	£8,000
PAS Suite (Assess', Design, Co-ord')	£10,000 (per archetype)
Roofing Works (enabling and insulation)	£500
Enabling Works to EWI	£3,000
EWI	£18,000
Windows	£6,000
Extract Ventilation (2Nr)	£1,000
Total	**£46,500**

All figures above are exclusive of VAT but include direct labour costs.

3.2 Steps taken to achieve cost reductions

The original cost reduction plan at the outset, extracted from competition funding application, is as follows:

Energiesprong:
Deliver a cost reduction of 13% within the project. NCCHS to work with ESUK. Their 'raison d'etre' is to work with Housing Providers to create a large-scale market with consistent demand and to help Solution Providers innovate to meet this demand and in doing so reduce costs. NCCHS will also build in a cost reduction to procurement and contracting to ensure the whole delivery team is focused on cost reduction targets from the outset. This will hard wire the delivery of a cost reduction into the project.

Destination Zero:
The nature of the work programme makes the setting of the baseline and final cost somewhat challenging. NCCHS anticipate delivering a cost saving of at least c.12% within the project. However, if the design costs are included within the calculation this figure would be c.44%. It is worth noting that this is already a lower cost way of achieving similar standards than the Energiesprong approach but does not include the performance guarantee for 30 years.

Planned cost reduction areas / activities:

- For Energiesprong - split phases with cost reduction built into contract.
- For DZ1 - phased work delivery, using different approaches to compare costs (including increasing the off-site proportion of work). Opportunity to use learning from early phases to inform later phases.
- Manufacturing process review (both work streams).
- Installation cost review.
- Procurement and delivery review.
- Integrating delivery by (Direct Labour Organisation) DLO (lower cost than a Main Contractor)
- Integrating measures with asset management processes (marginalising cost and creating larger scale).
- Digital workflow development. Smart data feed in, smart data processing, smart use of data long term.
- Integrating IT solutions with asset management.
- Off-site manufacture of EWI panels at scale, set up with Mauer.

Outcomes
The project did not achieve the planned cost reduction; however, it was successful in managing the costs and timelines to reach the set budget and performance targets. To achieve these, numerous changes were made via project change requests over the lifetime of the project.

- The original principal contractor Mauer went into liquidation; upfront costs were paid for the materials which were not then able to be claimed.
- Mauer experienced quality issues for their new offsite EWI system. Four of these systems were installed and three had to be replaced.
- Reduction of 45 properties on the Destination Zero work stream to meet the timeline and budget targets.
- The prototype phase of ES Clifton received a substantial increase to its original budget. The NCCHS team re-negotiated with the contractor over a period to proceed with the prototype phase, however, due to other projects that are much larger and achievable within the timeframe allowed, it was decided to withdraw the ES Clifton project and focus on these projects.
- The bid indicated 20 heating and ventilation pods would be installed at c£20k each, this was reduced to one. This pod subsequently had to be removed and replaced due to poor performance, adding more costs.
- Material costs increased.
- Labour shortages also contributed to increased cost (with retrofit being a niche requirement).

The main means to reduce overall costs was to reduce the number of properties. The more options that were investigated (e.g., off-site roofs via the Manufacturing Technology Centre for the mansard roof properties) the more the embryonic nature of the retrofit supply chain became apparent, and with it the increased risk of cost rises. NCCHS did however take steps to achieve cost savings to remain on track by:

- Grouping properties in certain areas to simplify site set up and supply chain logistics.
- Grouping of archetypes.
- Setting up a rolling programme of works to ensure all works that can be completed in advance are identified and planned, this being remedial works, survey works, design work and tenant liaison.
- Hosting regular cost and quality meetings with the principal contractor and other subcontractors.
- Exploring designs to find one that is of both good quality and value for money.
- Taking all lessons learnt and applying them to the next phase of projects to realise cost reductions.

3.3 Achieved cost reduction for whole house retrofits per property within the project lifetime

No cost savings were realised on this project in the truest sense, owing to the reduction in overall scope to maintain costs in line with the budget available. However, many valuable lessons have been learned and applied on later schemes to eliminate, reduce, and control cost risks.

Based on initial bid documents the initial baseline of costs was:

Cost category	Baseline cost per property (£)	Baseline cost per property (exc. heating and ventilation pod) (£)
Cost reduction (MTC), Design package, Health & wellbeing, and Monitoring & evaluation	**£4,364**	**£4,364**
Enabling works	£500	£500
Loft insulation	£3,000	£3,000
Enabling Works to EWI	**£2,690**	**£2,690**
EWI	**£13,917**	**£13,917**
Windows & doors	**£4,000**	**£4,000**
Airtightness	£1,000	£1,000
PV (£4,250 for 35 properties)	£1,549	£1,549
Q-Bot	£2,358	£2,358
M&E – heating and ventilation POD (20 properties)	£17,000	0
TOTAL	**£50,378**	**£33,378**

The major cost increases from this table demonstrating cost at bid to the table provided under section 3.1 actual costs are highlighted; this also demonstrates that the works that were intended to be included originally.

3.4 Remedial/enabling works

The actual cost of remedial/enabling works were between £1,600 and £3,000, depending on archetype, compared to estimated costs of £500 per property for enabling works on DZ1 at inception; this impacted the project financially.

A significant factor in determining the costs was the extent of works above windows where it was found that lintels were not installed, or that existing ones were defective. Investigations also evidenced that some windows were missing adequate structural support to the external wall elements. In addition, whilst most of the properties were of solid wall construction, some had lower plinth details which had a thin cavity with no wall ties. These features had to be installed before EWI could be applied.

3.5 Suggested costs reduction beyond lifetime of the project

This project's experience suggests the following generic routes to achieving cost reductions:

1. Procure works under one single delivery partner.
2. Group properties together geographically so that delivery logistics are simplified.
3. Group archetypes together (after first piloting each).
4. Use local design resource so that issues can be responded to promptly.
5. Survey beyond the scope of the standard PAS 2035 requirement.
6. Strike the right balance with residents – keep them informed but don't raise expectations; This means that the project does not over-commit to residents at an early stage before works have been market-tested. This then allows reductions in scope and specifications to be made, if necessary, without disappointing residents.
7. Scope out private owners early on.

Specific points relating the above are:

1. This project had two main contractors, which meant a reduction in overheads (even more where elements have been shared such as scaffolding). This however meant greater Project management (PM) and Quality surveyor (QS) resource had to be deployed.
2. Properties side-by-side bring immediate cost reduction benefits when compared to undertaking works in isolated pockets.
3. The best experience has been taking the learning from the WHR 106 (DZ1) project and applying it to the Social Housing Decarbonisation Funding Demonstrator (SHDFD)– Destination Zero 2 (DZ2). This results in fewer construction site queries which means that works can progress as planned and use the resources allocated efficiently. A proactive approach with the project's resources means better management of comms, reporting, etc.
4. The ability to respond promptly to design and site-based queries is paramount.
5. Picking up 'abnormal's', *e.g., subtle differences between archetypes,* at procurement stage means that they can be assessed and addressed at design level prior to works starting, thus saving time on site; and
6. A good strike rate in terms of access to properties when planned – this can be the biggest hurdle to delivery at scale by deadlines.

4. Road map to mass deployment

4.1 Housing archetypes selected for retrofit works

In addition to the points covered above in section 3.5, the property archetypes in this project are all pre-1919 solid wall homes that had received room-in-roof conversions in the 1980's (approx.)

4.2 Lessons learnt in replicating a whole house approach for these archetypes

- Don't under-estimate the extent (and cost) of the accumulation of uncompleted maintenance work and enabling works (see comments above in section 3.4).
- Engage with the Planning Authority early as statutory approvals are 12 weeks for planning and a further 8 weeks for full plans approval through building control.
- Brick-slips provide a better appearance than brick effect render (this comes at a cost; both have been tried, predominantly driven by a Planning requirement).
- 200mm of External wall Insulation (EWI) can exacerbate the usual issues and interfaces with existing building elements, i.e., extensive works in extending gulley positions, and other external services, reduction in access widths to existing pathways.
- Historic (and relatively recent) window replacement programmes can cause issues when installing EWI, particularly around reducing thermal bridges and achieving airtightness targets.
- Air permeability (and therefore the scope to reduce) can vary greatly between properties, even of the same archetype. This was predominantly related to the quality of window installation, service penetrations, and existing defects such as gaps in mortar joints.

The key observed challenges in scaling up a whole house retrofit approach were:

- **A dedicated supply chain who understands that it isn't 'business as usual'**
  Nottingham City Council Housing Services have participated in six funding streams to date on whole house retrofit (four administered by the Department for Energy Security and Net Zero). Within this timeframe it was observed by the project that numerous suppliers were increasing their pricing from these schemes from their own learning processes and a supplier going into administration. Whilst trying to source alternative suppliers it became evident that there was a limited pool of suppliers who specialise in this area, and those who do were at full capacity. This limits the scaling up potential of whole house retrofit whilst these key resources remain scarce.

- **Specialised Project Teams**
  Managing these types of projects is much more complex with several different risks that wouldn't ordinarily be thought of in other projects (i.e. unintended consequences related to damp, mould and ventilation). The required specialised knowledge is limited throughout the industry. In Nottingham the retrofit project staff are on temporary contracts only aligned to the funding contracts and upon the end of these projects this valuable knowledge and experience is typically lost.

- **Innovation challenges**
  Like with all innovation projects and technology, NCCHS have found that piloting new technologies (particularly Mechanical and Electrical (M&E) Systems) can be challenging in several ways.
  - Tenant capabilities and understanding on using the new technologies.
  - Technologies not working as they should such as the heating and ventilation pod.
  - Tenants adapting to "low heat" in some cases. These tenants have had systems installed that provide a lower heat then they are used to, which they are unable to amend.

  The third point does not apply to WHR but are examples to challenges NCCHS have faced on other projects and may apply to the air source heat pump retrofits.

- **An appreciation of the 'backlog' repairs that need to be dealt with in advance of retrofit (time and money)**
  When the works commenced NCCHS found a backlog of repairs that were required on properties, that impacted both the time and costs of the project and caused completion date delays. These included repairs to defective or absent window and door lintels and replacement wall ties.

- **Budget availability vs costs**
  The cost plan provided at the time of bid and contract award have changed significantly due to several factors:
  - Material cost increases
  - Labour cost increases
  - The cost of M&E works
  - Contractors unable to provide the work for the original budget due to risk of unforeseen costs that they are unable to pass on, therefore leading to a loss.

4.3 Barriers to mass deployment

NCCHS faced several barriers during project inception; before the project began the principal contractor that was proposed in the bid for these works went into administration. As a result of this a lengthy novation process to a new contractor took place. However, to maintain the budget with the new contractor the potential for further works was offered (SHDFD).

During this time the Coronavirus restrictions were also temperamental, specifically impacting the most vulnerable tenants in these properties. This impacted face-to-face survey works and tenant engagement. As a work around, outdoor engagement events were held during this time, which had good traction and started the process.

Additionally, imposed artificial timescales and deadlines could lead to incorrect decisions, whereas a little more time afforded could produce tangible benefits. A need to 'spend' by a certain date focusses the mind into areas that are best left open to enable informed decisions to be made and then deployed at scale.

Lastly, access to properties at the time of surveys, and the ability to enter properties to identify issues (and solutions) prior to any mass roll-out commencing. Without the ability to identify issues and rectify them through the correct teams this will cause delays to work being rolled out. Work will stop to correct issues.

5. Lessons learnt during retrofit works

5.1 Lessons learnt throughout the whole house retrofit process

5.1.1 Planning and property selection

Securing planning permission in advance of securing a Partner Contractor can be difficult as awareness of any 'system specifics' is limited, which might materially affect the planning submission and may lead to a need to request amendments after approval. An example being any previous brick features that need to be retained in some form, how this is achieved and with what material.

Brick-slips are more aesthetically appealing than brick effect render, however, this comes at a cost. As a rule, the Local Planning Authority (LPA) are not keen on brick effect render.

Property selection is usually guided by historic EPC data. For this project the team were keen to tackle some of the more complex (low EPC rated) archetypes as these can generate a lot of learning and challenges.

A 'toolkit' of measures gleaned from previous learning and replicable across archetypes is being developed, together with a detailed cost analysis and benefits realisation schedule. By combining these with Asset Management plans, and investments and optimised strategy for retrofit at scale can be developed, with a high degree of certainty over its deliverability in terms of cost, timescale, and benefits.

This may mean that energy efficiency measures are rolled out more sequentially as opposed to a 'big bang', however, in doing so the strategy will ensure efficiency in capital cost, timescale and minimise customer disruption. It will also target the 'quicker' wins where pay-back is better. This also feeds back into the Asset Management plans mentioned earlier.

5.1.2 Property surveying and suitability assessments (including built form, party walls, etc.)

Initial access arrangements can be challenging. The project has learned to capture as much data in a single visit as possible. The Assessor and Designer attended addresses jointly. This exercise needs to be seen as part of the process of consulting and updating the customers in order that they understand and remain on the journey.

Digital scanning to capture elevation data has been successfully trialled. This enabled accurate and speedy deployment of survey data, which enabled design work to progress during the COVID pandemic.

Early air-permeability tests generated an understanding of how modelling was going to work out i.e. results from air-permeability testing gave an insight into the likely modelling results.

Several historic backlog repairs have been highlighted. In some instances, these relate to fire safety improvements. However, as the application for Building Regulations Approval does not propose any works under Part B, Building Control cannot enforce any improvements. This does however pose a moral argument, whereby surveyors are aware of deficiencies related to fire safety and are duty bound to report these. This can add to the burden of the Landlord's limited resources. It is however necessary to disaggregate the backlog and compliance repairs from the retrofit energy improvements to determine true costs and timelines of the project.

5.1.3 Design and sequencing of works (including ensuring works adhered to PAS 2035 standards)

It is important to have 'stop-gaps' in the design and modelling process to challenge, propose new ideas and consider alternate approaches, deferments, etc. However, sometimes timescales don't permit this to happen as thoroughly as desired.

Sequencing is key to efficient delivery in terms of both time and cost resources. For example, a roofing programme co-ordinated with EWI works such that there will be very small gap between the delivery of different elements and maximised opportunity to share scaffolds.

5.1.4 Procurement process and supply chain capacity and capability

The market is saturated at present, and deadlines do slip. Elements such as the brick slips look great, but the supply chain is not well experienced in their application, and probably a little reluctant to use them as they are time-consuming. This further exacerbates delivery pressures when you have deadlines by when to spend and complete works.

Procuring through a hub, in this case Efficiency East Midlands, or via a Framework has enabled a quicker route to market.

5.1.5 Remedial/enabling works

The extent of remedial works and enabling works surprised NCCHS on the WHR 106 retrofit programme, which prepared the council for the Social Housing Decarbonisation Fund Demonstrator (SHDFD) programme. Procuring these works in advance is an option if time permits. In this case these are scoped and included in the remit of the main delivery partner.

A reasonable budget for enabling and remedial works should be included at bid stage, and as part of any initial cost planning exercise.

The time impact of these works should also not be under-estimated, a reasonable allowance would be two weeks to undertake any remedial works, assuming that these are identified at the assessment stage and therefore procured in advance.

5.1.6 Execution of retrofit works

The inadequacy of supply chains in terms of capacity and capability should not be under-estimated. There appears to be a huge assumption that PAS 2035 and PAS 2030 ensure that the quality of works carried out is high. The project did not find this to be the case.

Several suppliers appear to have pitched themselves to the retrofit market without fully understanding the requirements, commitments, and challenges. This has resulted in an increased burden on the Client's Quality Assurance (QA) monitoring staff, with pressure and frustration also being felt by occupants. The process needs to be a lot more seamless and occupant engagement increased, particularly providing regular updates on progress.

5.2 What would be done differently if the project was repeated

The project would and has done the following things differently throughout:

- A reliance on SMEs should be reviewed prior to commencement to fully establish their capacity and capability.
- Carry out detailed survey of condition irrespective of the risk path.
- Appoint a locally based Retrofit Designer to quicken the design process and have prompt access to someone in the case of any design adaptions.
- Retain the PAS 2035 roles under the Client – greater transparency, probity, and prompt access to findings.
- Employ greater cost control and management from the outset.
- Engage experienced resource to establish cost plans and budgets at bid stage and prior to procurement.

5.3 Process innovations within the project

- Use of the Mauer external insulation product – the Mauer EWI System intended to insulate external walls, which helps to reduce heat loss in cold weather and heat gain in warm weather. The project's experience was that this was not the solution the project was sold, and as such ended up being removed from the majority of homes.
- Use of the heating and ventilation pod proved to be problematic – installed system was found to be inadequate in terms of performance and led to higher utility bills for this resident post-retrofit. The system was a pilot energy pod incorporating heat pump, ventilation, battery storage and controls with AI learning. The pod was initially viewed as attractive as it was quoted at a competitive price and could be included as input at the whole house retrofit design stage and installed a later date when a gas boiler required replacement.
- Q-bot under floor insulation – a cost-effective solution when the conditions are suitable. Early survey and remediation work, together with greater deployment (economies of scale) would benefit this approach.
- In the initial stages of the project the decision was made to use a pilot property to test out the systems prior to rolling them out to the rest of the selected properties. This enabled the project to identify that both the Mauer system and heating and ventilation pod was not as anticipated and required rectifying.

Figure 2 – Pilot property – fitted at the start with Mauer EWI system, mechanical ventilation, heating and ventilation pod, PV.

5.4 Residents engaged throughout the retrofit process

Residents have been engaged from early inception via leaflets, information and booklets and face to face engagement. The project team initially conducted an outdoor engagement event which took place in July 2020. Following the event tenants were always kept engaged and informed by the dedicated Project Liaison Officer (PLO). Some examples of these materials are in Annex 1.

Contractor liaison with residents was considered poor due to tenant complaints. This had a negative effect on delivery and increased the burden on council staff (responding to complaints).

The best technique was the simplest technique, to simply keep talking to the residents in person and on the phone to update them on project progress.

6. Post-retrofit benefits and performance

6.1 Unintended consequences around retrofit works

The performance of the heating and ventilation pod and resulting increased utility bills is an unintended consequence. The tenant's bills increased up to and above £500pm in some instances. This understandably caused upset and anxiety for the tenant. The short-term solution was that pod manufacturers were paying these bills whilst they investigated the issue. The pod was eventually removed and replaced by a traditional boiler.

Most customers have confirmed a positive impact on their thermal comfort. However, given the rise in energy costs the extent of bill savings has not been as great as anticipated.

6.2 Variance between the predicted energy use and actual energy use in retrofitted homes

Please refer to the energy performance report for further details (see Annex 2).

6.3 Post retrofit performance monitoring

In addition to the simple PAS 2035 post-works evaluation process the project is also seeking to install monitoring equipment (Carnego Systems) in up to 20 properties. This will provide long-term (next 3 years) performance monitoring data. This element is being managed by Energiesprong UK.

6.4 Advice and training for residents post retrofit

Advice and training were provided to the property with the heating and ventilation pod installed, which required very little resident input.

Otherwise, an EWI system guide was provided to tenants, as was a leaflet on the ventilation.

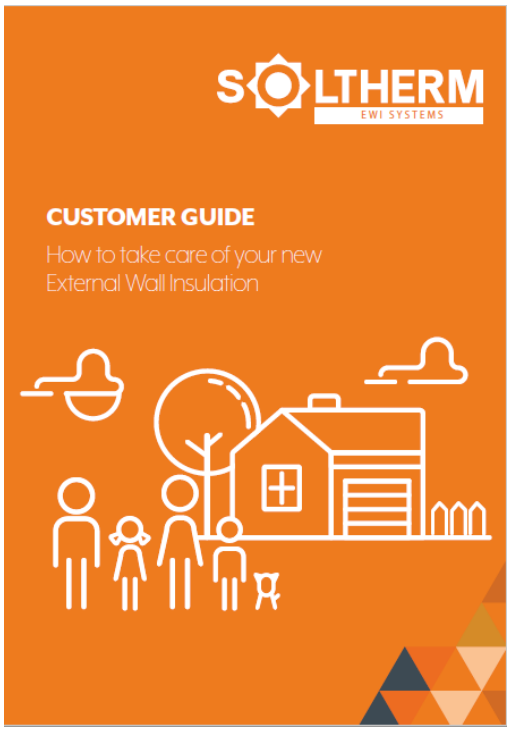

Figure 3 – Leaflets provided to residents post retrofit

7. Employment

7.1 Potential new businesses or roles that have been created as a result of the project

The Main Contractor, SMS, was able to attract several local people to take up employment with them. This has then moved on to other similar projects being undertaken by Nottingham City Council.

Annex 1 – Example of resident Liaison Material

Whole House Retrofit
Information for residents

Nottingham City Homes

Whole House Retrofit will improve your home, making it warm and comfortable. It will also help Nottingham be carbon neutral by 2028.

The Whole House retrofit project includes the following works, although not all of them will be done to every property. There is more information about them over the page.

- New lintels, if necessary
- External wall insulation
- Under floor insulation
- Below damp proof course insulation
- Roof insulation
- Removing small windows in under stairs and kitchen cupboards
- Loft insulation
- Roof replacement, if necessary
- New extractor fans
- Panels on the roof that can generate electricity from light (Solar PV panels)
- New heating systems.

We will deliver the works as seamlessly as possible to minimise disruption, and we'll notify you two weeks in advance before we start any of the works.

We will have to carry out some surveys so we can put together a programme of works for each house. Details of the programme of works are enclosed. It looks a lot, but we'll plan them out with as little disruption to you possible. We may need to take some measurements and photographs for our records, and we'll ask you to provide energy bills for the previous year, but please rest assured all information is held in accordance with NCH's strict GPDR protocol.

Loft insulation

All homes will have additional loft insulation installed to the loft space. It'll be spray foam insulation, which stops draughts and reduces heat loss. It is certified as non-combustible. If you're having a new roof as part of this project, the loft insulation will be done at the same time.

Time the works will take: One day, if you're not having a new roof – you'll need to stay downstairs while the work is done.

Preparation works and time needed: We'll need to install a small section of supporting timber to the roof structure, so you'll need to empty the loft.

Roof replacement

If we need to replace your roof, it will take between five and seven working days and we'll need to put scaffolding up. We'll co-ordinated it with installing your solar panels and loft insulation.

Time the works will take: Five to seven days.

Preparation works and time needed: We'll confirm when we survey your property but we will need the loft to be empty. We can help with this if you need us to.

New extractor fans

We'll be replacing your extractor fans in your kitchen and bathroom with something called Heat Recovery and Mechanical Ventilation units (MVHRs). They'll make sure that your home has enough fresh air to prevent mould growth, but they'll pre-heat the fresh air, which will reduce energy costs.

MVHRs are very energy efficient and will be installed through the existing extractor fans you have already. If you don't have extractor fans, we'll look at where and how we can solve the issue.

Time the works will take: One day.

Preparation works and time needed: You'll need to clear a space around the fan so we can get in to do the work.

Panels on the roof that can generate electricity from light (Solar PV panels)

Some homes will have solar panels installed. They'll provide electricity from the sun, which will you'll be able to use in your home. Solar panels work best when they are facing south, or to a slightly lesser extent, east or west. We're selecting the homes that will get solar panels based on the direction they face and the space available.

Time the works will take: Two to three days.

Preparation works and time needed: We'll confirm when we survey your property.

New heating systems

If your boiler is due for replacement, we're hoping to be able to offer a new heat pump system. We're prioritising properties that have old boilers and hot water tanks.

Time the works will take: We'll confirm when we survey your property.

Preparation works and time needed: We'll confirm when we survey your property.

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Details of works

Lintels

We need to check (and replace if necessary) the lintels above your windows before we install the external wall insulation, to make sure we won't have any problems in future years. You'll need to remove any items on the window ledge and keep windows closed during any works. Most lintels can be installed in one day.

Time the works will take: One day.

Preparation works and time needed: We may need to extend the length of boiler flues and waste pipes, which will take around half a day.

External wall insulation

The external wall insulation is likely to have a brick finish. It's installed using temporary scaffolding which is removed at the end of each day – although if you need fixed scaffolding because you're having roofing works, we'll try to coordinate works for the same time.

Time the works will take: We'll confirm when we survey your property.

Preparation works and time needed: We may need to remove fences (we'll put them back afterwards) and cut back hedges. We may also need to remove and temporarily secure Sky dishes and repoint brickwork. We'll confirm the time this will take when we survey your property.

Under floor insulation

We'll install under floor insulation under the timber floors of your home. In most homes, this is the lounge and the hallway. The insulation is sprayed under the floor using robots which are controlled from outside with X-box controllers.

During the installation, you'll need to be outside or upstairs. We'll also open windows and doors, although the team will include one person in a van outside and one person going in and out of the house during the works, so the property will be secure

More information about Qbot is on our website at www.nottinghamcityhomes.org.uk/whr.

Time the works will take: No longer than a day per floor, but you'll need to be outside or upstairs.

Preparation works and time needed: We'll need to move some furniture and roll back carpets. If you have laminate floor, we'll discuss it with you.

Below damp proof course insulation

This insulation is done to the ground around your home. Sometimes we have to excavate the ground around parts of your house to achieve the required depth. This will make sure that you don't lose heat through the concrete floor in your kitchen, and will reduce the risk of damp and condensation.

Time the works will take: Three days.

Preparation works and time needed: An hour at most, to remove any hanging baskets / plants / furniture within two metres of the external wall.

Removing small windows in under stairs cupboards and pantries

Some homes have windows under the stairs, or in the pantry. We're going to block these windows up and cover them with insulation to help achieve the best energy efficiency for your home. We will make good the internal plaster.

Time the works will take: Half a day.

Preparation works and time needed: An hour at most, to remove any hanging baskets / plants / furniture within two metres of the external wall.

Nottingham City Council | Housing Services

Comfort Plan

When the work is completed, you'll move onto a Comfort Plan for your heating. It'll help you stay warm and comfortable at a reduced cost. So that we can work out how much money you'll save, we'll ask you to share your energy bills for the last year with us. High users will see the biggest savings, while low users will save less but be warmer once the works are completed.

Timeframes

The project is starting now (April 2021), and we expect to complete most of the works by July. However this may be affected by coronavirus restrictions and lockdowns, as they can impact on the availability of materials as well as our ability to deliver works on site. The entire installation process should take less than 15 working days, although we will need to carry out some preparation works in advance.

FAQs

How much will I save on my energy bills?
This depends on how you use your energy, but it could be up to £200. See insert for more details.

Do I have to have the works done?
We're keen to deliver the works while we have funding and supply chains in place. In the past, people who have refused the works regret it later when they see how great their neighbours' homes look, and ask if they can have the works after all – and we have to explain that it's no longer possible. If you have concerns about having the works done, please let us know so we can understand your concerns and see how we can help.

Will I have to change my energy supplier?
No, but if you need help switching to a lower tariff, we can support you with this.

What happens if I'm shielding?
If you're shielding at any point, you must let us know, and you must not let any of our staff enter your home unless we've carried out a specific risk assessment and agreed it with you.

Will work be completed this year?
All work will be completed by April 2022, but we're hoping to get everything done earlier than that.

Are you going to fix things like damp and mould?
Yes, and the new measures should eliminate these issues altogether, provided the new ventilation is used correctly.

Will you compensate for any damage to laminate flooring?
We'll discuss this with you - however, we can't complete any of the works without insulating wooden floors and rectifying any damp or structural issues, so laminate flooring will need to come up.

Do you have to cover over the under-stairs cupboard window?
Yes, heat is lost through this and we can't meet the energy performance targets (and reduce your bills) without blocking doing so.

Our team

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Department for Business, Energy & Industrial Strategy | CONSTRUCTIVE THINKING | FOCUS | q-bot | SMS | Nottingham City Homes | Nottingham City Council

Annex 2 – Property Information

Summary				Milestones					Homes				Jobs				
Project ID Number	Name of lead Local Authority	Project/Phase Name	Estimated Project/Phase Completion Date	Project Team Appointment	Design	Procurement Complete	Installation Start Date	Installation End Date	# Homes Identified	# Homes Shortlisted	# Homes Agreed	# Homes Retrofitted	# Local Authority/ Consortium Employees (FTE)	# Local Authority/ Consortium Employees (FTE) of which apprentices	# Contractor Employees (FTE)	# Contractor Employees of which apprentices	# Supply Chain Employees
WHR 106	Nottingham City Council	Destination Zero	28th February 2023	Mar-20	May-21	May-20	Jun-20	Feb-23	96	72	66	51					
		Energiesprong Clifton	Workstream did not progress	Mar-20	N/A	N/A	N/A	N/A	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Basic Information		Basic Information	Basic Information	Basic Information	Basic Information	Basic Information	Basic Information	Basic Information	Pre-Retrofit	Pre-Retrofit	Pre-Retrofit	Pre-Retrofit
Property ID	Area	Property Type	Tenure Type	Number of Bedrooms	Property Age	Property Floor Space (m2)	Property Number of Floors	Smart Meter Installed?	On or off gas grid property	Rate Condition	Previous Heating System Type	EPC Rating	Energy Efficiency Rating (SAP)
1	Bakersfield	House mid-terrace	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	D	66
2	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	53
3	Bakersfield	House mid-terrace	Social Rented	2	1930-1949	88	2		On-gas grid	3	Gas boiler	D	62
4	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	48
5	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	D	56
6	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	53
7	Mapperley	House - semi-detached	Social Rented	2	1930-1949	64	2		On-gas grid	3	Gas boiler	D	57
8	Mapperley	House - semi-detached	Social Rented	2	1930-1949	92	2		On-gas grid	3	Gas boiler	E	52
9	Mapperley	House - semi-detached	Social Rented	2	1930-1949	89	2		On-gas grid	3	Gas boiler	E	41
10	Mapperley	House - semi-detached	Social Rented	2	1930-1949	92	2		On-gas grid	3	Gas boiler	E	53
11	Mapperley	House - semi-detached	Social Rented	2	1930-1949	89	2		On-gas grid	3	Gas boiler	E	47
12	Mapperley	House - semi-detached	Social Rented	2	1930-1949	99	2		On-gas grid	3	Gas boiler	D	67
13	Mapperley	House - semi-detached	Social Rented	2	1930-1949	89	2		On-gas grid	3	Gas boiler	E	48
14	Mapperley	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	52
15	Mapperley	House - semi-detached	Social Rented	2	1930-1949	92	2		On-gas grid	3	Gas boiler	E	53
16	Mapperley	House - semi-detached	Social Rented	2	1930-1949	89	2		On-gas grid	3	Gas boiler	E	54
18	Mapperley	House - semi-detached	Social Rented	2	1930-1949	89	2		On-gas grid	3	Gas boiler	E	53
17	Mapperley	House - semi-detached	Social Rented	2	1930-1949	89	2		On-gas grid	3	Gas boiler	E	53
19	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	49
20	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	D	58
21	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	54
22	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	50
23	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		Off-gas grid	3	Gas boiler	D	64
24	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	D	55
25	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	F	37
26	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	47
27	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	D	58
28	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	78	2		On-gas grid	3	Gas boiler	E	42
28	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	43
30	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	78	2		On-gas grid	3	Gas boiler	E	40
31	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	78	2		On-gas grid	3	Gas boiler	E	52
32	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	43
33	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	49
34	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	53
35	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	52
36	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	D	57
37	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	54
38	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	78	2		On-gas grid	3	Gas boiler	F	38
39	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	78	2		On-gas grid	3	Gas boiler	E	42
40	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	47
41	Mapperley Park	House - semi-detached	Social Rented	2	1930-1949	92	2		On-gas grid	3	Gas boiler	E	46
42	Mapperley Park	House - semi-detached	Social Rented	2	1930-1949	87	2		On-gas grid	3	Gas boiler	E	50
43	Mapperley Park	House - semi-detached	Social Rented	2	1930-1949	98	2		On-gas grid	3	Gas boiler	E	54
44	Mapperley Park	House - semi-detached	Social Rented	2	1930-1949	98	2		On-gas grid	3	Gas boiler	E	54
45	Mapperley Park	House - semi-detached	Social Rented	2	1930-1949	98	2		On-gas grid	3	Gas boiler	D	59
46	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	54
47	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	53
48	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	48
49	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	48
50	Bakersfield	House - semi-detached	Social Rented	2	1930-1949	67	2		On-gas grid	3	Gas boiler	E	53

Pre-Retrofit	Pre-Retrofit	Pre-Retrofit	Post-Retrofit	Post-Retrofit	Post-Retrofit	Post-Retrofit	Post-Retrofit	Post-Retrofit	Post-Retrofit	Methodology	Methodology	Costs	Costs
Heat Transfer Coefficient	Space Heating Requirement	Annual Heating Costs (£)	Rate Condition	Heating System Type	EPC Rating	Energy Efficiency Rating (SAP)	Heat Transfer Coefficient	Space Heating Requirement	Annual Cost Saving (£)	Method used for space heating requirement savings	Method used for cost savings	Baseline per property cost (£)	Actual per property cost (£)
	238		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	348		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	251		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	404		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	320		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	336		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	321		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	346		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	422		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	318		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	363		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	245		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	361		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	351		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	316		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	336		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	344		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	315		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	367		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	286		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	338		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	357		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	277		4	ASHP (Ventive)	B					RdSAP	RdSAP	£20,000	£50,000
	356		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	515		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	399		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	303		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	410		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	431		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	423		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	339		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	475		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	364		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	349		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	354		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	310		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	285		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	471		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	403		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	391		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	351		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	324		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	303		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	300		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	264		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	342		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	346		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	369		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	369		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000
	334		4	Gas boiler	C					RdSAP	RdSAP	£20,000	£50,000

Basic Info	Basic Info	Basic Info	Basic Info				Basic Info	Basic Info	Basic Info	Field is only required if the measure installed is an insulation measure
Property ID	Trustmark Certificate	UMR	Measure Type	Measure Type	Measure Type	Measure Type	Installation Date	Handover Date	Sub-Installer Name	Insulation Top-up
1			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
2			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
3			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
4			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
5			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
6			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
7			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
8			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
9			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
10			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
11			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
12			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
13			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
14			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
15			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
16			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
17			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
18			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
19			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
20			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
21			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
22			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
23			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
24			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
25			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
26			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
27			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
28			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
28			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
30			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
31			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
32			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
33			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
34			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
35			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
36			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
37			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
38			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
39			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
40			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
41			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
42			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
43			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
44			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
45			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
46			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
47			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
48			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
49			External Solid Wall insulation	Loft Insulation	Under-floor insulation: Suspended Floor	Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up
50			External Solid Wall insulation	Loft Insulation		Draught proofing/air tightness	01/06/2021	28/02/2023		Top-up

Property ID	Tenant Dropout	Reason for tenant dropout	Reason for tenant dropout - Other reason	Contact Consent
1	YES	Doesn't want retrofit		YES