Department for Energy Security & Net Zero

Green Homes Grant Local Authority Delivery Scheme Phases 1 & 2

Evaluation Technical Annexes

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Figures & Tables

Annex 1: Evaluation Question Matrix

The Evaluation Question Matrix (EQM) outlines the approach to answering each of the evaluation questions (EQs). Our data collection tools incorporated all these elements so as to provide a complete answer to each evaluation question. The EQM includes:

- **The lines of enquiry**, which specify the details to be assessed for each questions, providing a direction for the primary and secondary research.
- **The hypotheses to test**, which hare formulated based on the lines of enquiry, setting up expectations and theoretical outcomes to be validated or invalidated. These outline how the Scheme processes would work, in theory, if they were working well.
- **Risks and assumption**, which provide foresight on potential challenges and their implications they could have on this evaluation.

- Developing the EQM aids in pinpointing the specific data required to answer each evaluation question, and this way steers the design of data collection tools. By identifying the lines of enquiry, hypotheses to test, and risks/assumptions, we tailored primary research methods like participant interviews and surveys to probe into specific lines of inquiry and developed secondary research methods to gather pre-existing data relevant to the hypotheses under test.

Table 1. Evaluation question matrix

EQ	Lines of enquiry	Hypotheses to test	Risks/assumptions
Overarching question: 1) What factors influence the ability of Scheme Leads to deliver installations under the Scheme?	• This question is an overarching question for other EQs related to delivery mechanism.		

EQ	Lines of enquiry	Hypotheses to test	Risks/assumptions
New sub-question added: How effectively are Scheme Leads (LAs and Hubs) able to submit applications and partake in the Scheme?	• Analysis of factors in the Scheme that facilitate or hinder LAs/Hubs participation (e.g., adequacy of timings to submit requests to participate, how easy/difficult it is to meet BEIS requirements or provide information needed, etc.) • Analysis of other external factors that may affect their participation (e.g., resources being shifted to dealing with COVID-19)	• LAs have the resources needed to submit applications • LAs have previous experience and partners to allow them to deliver the Scheme • Despite tight timescales to deliver installations, LAs are able to put realistic work plans in place LAs have delivery mechanisms in place that they can use to deliver GHG-LAD	• Some LAs may not have the resources needed to submit applications • Some LAs may lack knowledge/experience to deliver the Scheme
2) How effectively are Scheme Leads (LAs and Hubs) able to procure delivery providers and what commercial models are adopted in the Phase 2?	• Analysis of delivery models adopted by LAs and Hubs • Differences observed among delivery models, advantages and disadvantages of the models (e.g., type and number of households	• LAs are able to find and engage / persuade the right low-income households • LAs identify a package of measures that suit the households • LAs engage suppliers to partake in the Scheme	• Some delivery models may not work as expected

EQ	Lines of enquiry	Hypotheses to test	Risks/assumptions
	reached, whether or not landlords are targeted) • Analysis of internal factors (at LAs / Hubs) that may affect their capacity to deliver the Scheme (e.g., staff capacity, skills, relationships with installers and landlords…)		
3) How effectively can eligible homes be identified for participation in the Scheme?	• Mechanisms used by LAs/Hubs to identify homes • Types of homes / homeowners that are easier/harder to identify • Barriers experienced by LAs/Hubs to identify homes (both internal to the LA/Hubs and related to the GHG-LAD Scheme)	• LAs identify the mechanisms to select households in their applications, and these work well in practice • EPC rating is an effective mechanism to select fuel poor households	• Private landlords/agencies do not facilitate to LAs information on property characteristics/housing stock/energy efficiency market • Income threshold for LAD set at £30K to ensure LAs are able to identify enough homes, but may not be targeted/low enough to identify households in fuel poverty

EQ	Lines of enquiry	Hypotheses to test	Risks/assumptions
4) What role is COVID-19 having on delivery of the Scheme?	• Analysis of the extent to which COVID-19 is affecting (positively or negatively) LAs/Hubs capacity to deliver, e.g., is there increased demand given recession? Is COVID-19 affecting LAs human resources to deliver the Scheme?	• Risks related to COVID have been identified and mitigated to the extent it is possible (e.g., extending delivery period, creating exceptions for installations to take place during lockdown, publishing guidelines to conduct installations safely) • Economic recession increases households' willingness to partake in the Scheme (e.g., it helps make energy bills affordable) • Installers have adequate COVID measures/guidelines to conduct installations safely	• Covid could impact supply chains and the costs/access to materials. • Covid also may influence as there is a risk now in contractors going into people's households. • LAs may not have capacity to manage the Scheme due to COVID-related issues
5) What barriers to delivery exist?	• Analysis of other potential barriers not covered within previous questions • Not all LAs have submitted a bid in Phase 1. Role of Net Zero Hubs: engage at local	• All potential barriers/risks were identified at the outset and mitigation measures were put in place • Programme delivery managers have a risk matrix	• The fact that the Scheme is running during the winter period may be a barrier for take-up

EQ	Lines of enquiry	Hypotheses to test	Risks/assumptions
	level and collaborate with LAs. BEIS keen to understand why some areas might not submit applications.	that is updated regularly, and actions taken as and when appropriate • Barriers identified by the evaluation (e.g., in early findings report) are addressed during delivery • Barriers related to Brexit have been identified and acted upon • Regional disparities do not happen with LAD	• Negative press about other insulation programmes may affect participation • Brexit could impact supply chains and the costs/access to materials. • Regional disparities if certain LAs/Hubs do not partake in the Scheme
6) To what extent are the homeowners and landlords engaged by the project willing to undertake installations (including with heat pumps)?	• Analysis of the customer journey, i.e., who engages with homeowners, through what means, how are they informed about the project, etc. • Profiles of homeowners who engage with the Scheme • Adequacy of economic incentives for homeowners	• Landlords see the value of contributing to the cost of installations • Households interested in undertaking the measures that are eligible within the Scheme	- From previous Schemes, this depends on measure, e.g., new heat central system (easy for households to accept), wall insulation (changes characteristics of the property, households don't understand the benefits of it).

EQ	Lines of enquiry	Hypotheses to test	Risks/assumptions
	• Existence of previous positive/negative experience with similar Schemes (e.g., ECO) • Adequacy of procedures to claim the benefit • Degree of take up of the Scheme for homeowners vs landlords • Extent to which eligible installations match homeowners' needs • Extent to which GHG-LAD helps landlords meet existing energy standards • Experience of working with LAs (e.g., provision of practical support, confidence in funding) • Non-participant households (*only if fieldwork with this group is conducted*): a) the factors which deterred non		

EQ	Lines of enquiry	Hypotheses to test	Risks/assumptions
	participants from undertaking an installation (in what contexts) b) what other actions they might be taking to reduce energy use / save money / heat their homes - i.e., the 'counterfactual' ** might need to consider whether we'd need to gather re-contact information for a future impact evaluation too**		
7) Is the project delivering a positive experience for consumers and landlords, and how is this influenced by the Scheme design?	• Overall experience of the project; >> customer satisfaction / basic process evaluation • Factors influencing their overall experience of the project >> theory-based process evaluation	• The process for households is easy to follow (BEIS pays LAs upfront and LAs manages Scheme, reducing admin burden for households) • Households are satisfied with the installations (process of installation and final quality)	• Previous installations conducted during winter period caused damage and posed health risks e.g., trapping in damp • Installations may be too intrusive / time consuming, and households may not perceive the benefit

EQ	Lines of enquiry	Hypotheses to test	Risks/assumptions
	• Perceived wider benefits (on health and finances - energy consumption and bills) >> outcomes analysis / benefits measurement • Perceived quality of the installations (potential overlap with EQ 11)	• Households report wider benefits (e.g., health and finance) • Households advocate for advanced EE installations, generating positive word of mouth and helping to normalise this type of work	• Households may not understand the new measures or be able to use them efficiently (e.g., smart technologies) • Households may perceive they did not have sufficient decision-making power in the type of measures installed, or when they were installed
8) What types of energy efficiency installations are being delivered through the Scheme and to what extent does this align with the Scheme objectives?	• What kind of installations homeowners have undertaken >> coverage mapping (installations by region - to be triangulated with the MI). • The factors influencing homeowners' decisions about what type of installation to install in what contexts • Who decides which installations are undertaken	• Risk of installations and measures skewing towards one type is mitigated by assessments of the LA applications, which set out the measures they are targeting • LAs know the measures that are most needed in their area, and this is correctly reflected in the applications	• There may be lower take-up of installations that are disruptive, such as: installations that involve scaffolding (especially in high rises), solid wall, under-floor insulation • Mismatch between types of installations needed/demanded and types of installations identified by LAs • Households may be advised to install the measures that

EQ	Lines of enquiry	Hypotheses to test	Risks/assumptions
	(LA, installer, landlord, households) • Split of types of installations (e.g., whether there is balance or concentration towards one type of installations)		the installer can provide, instead of the measures that would best improve the home's energy efficiency
9) What energy, carbon and bills savings are being delivered by the Scheme and how is the Scheme design influencing this?	• Extent to which the retrofitting measures are delivering (a) energy and bills savings, or (b) more energy for the same money (i.e., are people just consuming less, or as they have more income, they are consuming more energy?) • Benchmarking across LAs, regions and delivery models, to explore energy savings • Estimates of energy, fuel cost and CO2 savings per household and by type of installation	• Scheme has a positive impact on how the government is perceived • Installations deliver positive impact on people: reduced energy bills / warmer homes	• Risk that consumers do not know how to use new installations efficiently and energy use does not decrease

EQ	Lines of enquiry	Hypotheses to test	Risks/assumptions
10) Does the energy efficiency and low carbon heating installer market have the capacity/willingness to participate in this energy efficiency project, including compliance with PAS2035 process? What barriers to participation exist?	• Analysis of economic barriers (e.g., investment needed to be PAS2035 certified) • Analysis of skills barriers (e.g., is there enough offer in the labour market?) • Behavioural barriers (e.g., previous experience with other Schemes, lack of trust on the Scheme or its duration/take up by homeowners • Geographical barriers (e.g., mismatch between where installations are needed and where installers are located) • Adequacy of incentives provided to installers (e.g., number of other Schemes requiring PAS2035)	**Capability** • Installers understand the requirement of PAS2035 and what it means to be compliant • Installers are able to scale up operations and conduct installations quickly enough • There are PAS2035 accredited installers across all LAs **Opportunity** • There is enough demand under this and other Schemes requiring PAS2035 to incentivise installers **Motivation** • Installers (staff) are willing to be upskilled in PAS2035 • Confidence that PAS2035 will provide new knowledge / improve installations conducted	**Capability** • Training to installers to comply with PAS2035 not available, or at a very high cost • PAS2035 perceived as too onerous **Opportunity** • Installers can obtain higher margin from other operations outside GHG-LAD and resources are shifted away **Motivation** • Low confidence that PAS2035 will continue being required by future similar Schemes

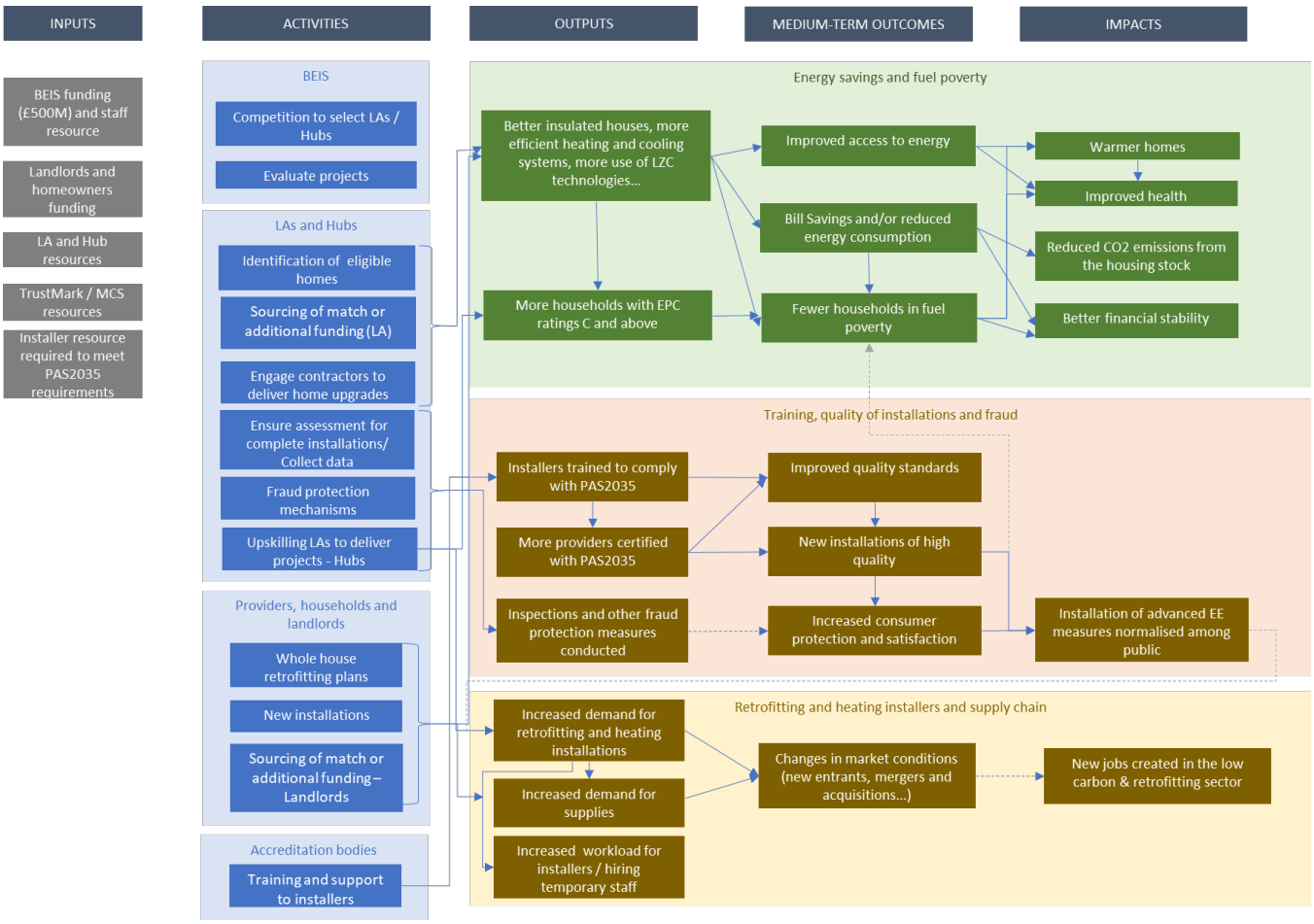
EQ	Lines of enquiry	Hypotheses to test	Risks/assumptions
11) What influence has the requirement for PAS2035 accreditation had on the delivery of installations?	• Influence of PAS2035 on the quality of installations • Influence of PAS2035 on the types of installations conducted (i.e., are the installations conducted the ones that provide best outcomes for homeowners?) • Shortage of installers, influence of PAS2035 on the support provided to local businesses (e.g., are SMEs participating, or are there only large companies?)	• Installations are of good quality • TrustMark carry out audits appropriately and identifies any issues of non-compliance with standards etc. • (Most) Installers are TrustMark accredited in Phase 1 and have PAS2030 • All installers are TrustMark accredited in Phase 2 and have PAS2035 • GHG-LAD contributes to uptake among installers of PAS2035	• PAS2035 only required in Phase 2. Quality of installations in Phase 1a and 1b may be diminished • Installations are not assessed once completed and this might put at risk compliance with quality standards • TrustMark accredited installers may use subcontractors who are not accredited / do not comply with minimum quality standards
12) How is the Scheme creating and supporting jobs in the energy efficiency and low carbon heat sector? Are these jobs new market entrants or existing installers reskilling or certifying to the required standard?			

EQ	Lines of enquiry	Hypotheses to test	Risks/assumptions
12.1 Among installers	• Extent to which the Scheme creates and maintains upskilled jobs • The number of jobs created and supported through the GHG-LAD Scheme • Whether installers are new market entrants or existing installers	• Installation firms hire new staff to scale up operations • New firms are created in response to increase in demand • It is the combination of Schemes (LAD, vouchers, etc.) that drives demand and influences the labour market • GHG-LAD is additional because if focuses on low-income households (households would not undertake installations without the incentive) • Without government support, the demand would drop due to economic recession	• Installers not willing to participate in the Scheme due to short timeframe, impossibility to delivery jobs in the delivery timeframe, high costs involved in getting themselves accredited, installers already too busy. • Installers do not participate in other Schemes of the stimulus package and GHG-LAD alone is not enough to scale up the market
12.2 Among their supply chain	Characteristics of the supply chain market: • Labour intense vs capital intense • Location (UK or overseas)	• The increase in demand for installations leads to an increase in demand for supplies	• Supply chain mostly located overseas • Disruptions in supply chain due to Brexit

EQ	Lines of enquiry	Hypotheses to test	Risks/assumptions
	• Size of the sector (FTE, GVA, etc.)	• The supply chain increases production to deal with increased demand • New jobs are created among the supply chain	• Jobs are not created because the sector is primarily capital intensive
13) To what extent has the Government's commitment to funding of energy efficiency improvements created confidence across the supplier market?	• Views of installers and their supply chain on the Scheme, and how it fits within a package of Schemes (GHG package and beyond) • Extent to which installers and supply chain consider there is consistency in the Schemes / packages of support available	• GHG-LAD is perceived to be one among multiple Schemes to improve insulation / access to low carbon energy • GHG-LAD complements other Schemes while avoiding overlap • The support from the government is sustained over time through GHG-LAD and other Schemes	• GHG-LAD is perceived as one temporary, isolated Scheme • GHG-LAD does not signal a long-term commitment to finance low carbon and retrofitting measures • Previous experience of shifts in policies (e.g., changes in ECO) disincentivise suppliers from partaking in the Scheme / creating jobs
14) What cost is being incurred for installing energy efficiency measures in homes and where are those costs being incurred?	• Analysis of direct costs (i.e., of installation) by stakeholder type (Landlord, LA, homeowner, HA, tenant) • Analysis of indirect costs, including the costs of	• Cost of installations is in line with costs in previous Schemes • Costs per stakeholder are in line with budget	• If demand increases only in short term, it may push prices up instead of pushing offer (quantity of installers) up

EQ	Lines of enquiry	Hypotheses to test	Risks/assumptions
	installations being of poor quality or incomplete. • Analysis of differences in costs per delivery model	• There are no indirect costs • Costs supported by LAs do not differ substantially	
15) To what extent is fraud and non-compliance effectively managed within the Scheme?	• Analysis of processes put in place by BEIS and LAs to deal with fraud	• BEIS has put in place a strategy to prevent fraud • LAs have put systems in place to prevent fraud • There is no evidence that fraud has taken place	• Households might request funding from more than one Scheme for the same installations • LA level - LAs misappropriating funds from the Scheme • Supply chain level – supply chains increase prices to get money from LA • Homeowner level- bribes to receive lower EPC rating to get the installation

Annex 2: LAD Evaluation Theory of Change



The final Theory of Change developed for LAD Phases 1&2 as an output of this evaluation.

Annex 3: Methodological Approach

The evaluation has followed a mixed-methods approach, underpinned by the Theory of Change developed during the scoping Phase of the evaluation (see section "LAD Theory of Change in the main evaluation report"). The terms of reference for the LAD evaluation included a series of evaluation questions that were refined and further developed into an Evaluation Question Matrix (EQM), available in Annex 2. The EQM included, for each question, lines of enquiry, hypotheses, risks, assumptions and data collection methods to be used in each Phase of the evaluation to answer the question.

The evaluation was divided into two main strands:

- A Process Evaluation to assess the delivery of the LAD Scheme, including the reach of the Scheme, the scale and nature of the measures installed, as well as the barriers and enabling factors influencing the delivery of the Scheme.
- An Outcomes Evaluation to assess the experience of consumers and landlords of partaking in the Scheme, the energy, carbon and bills savings achieved, and the effect of the Scheme on the installer market and their supply chain.

Each evaluation strand has used different approaches, which are explained in turn in the ensuing sub-sections.

3.1 Process Evaluation

The process evaluation focused on assessing the lines of enquiry that were set out in the EQM. As explained above, the EQM also included hypotheses outlining how the Scheme processes would work, in theory, if they were working well, as well as risks and assumptions. Our data collection tools incorporated all these elements so as to provide a complete answer to each evaluation question.

The process evaluation covered the following themes:

- Delivery mechanism (EQs 1-5): These were questions covering the experience of LAs managing the Scheme, and barriers experienced. The objective was to extract lessons learned from the different models adopted by LAs in terms of what works and why and identify any aspects in the design of the Scheme that might be facilitating or hindering delivery. To answer these questions, we developed a portfolio analysis identifying the different models adopted in Phases 1 and 2, and used the data collection tools to probe on aspects that were working well and less well, and why.
- The experience of households (EQ 6): This evaluation assessed the experience of households from a "consumer" point of view. To address this question, we analysed the customer journey from identification of eligible households through to completion of the installation. This question was assessed via consultations with LAs and households.

- Type of energy efficiency installations delivered (EQ 7): This question assessed whether the installations delivered were in line with expectations. We conducted a descriptive analysis of the monitoring information on installations conducted and compared it with the objectives set at the outset by BEIS and with the expectations of LAs. Where deviations were observed, we analysed the reasons for this.
- Installers' willingness and capacity to participate in the Scheme (EQ 10): To answer this question, we used the first part of the COM-B method. The COM-B model for behaviour change cites capability (C), opportunity (O), and motivation (M) as three key factors capable of changing behaviour (B). Capability refers to an individual's psychological and physical ability to participate in an activity. Opportunity refers to external factors that make a behaviour possible, and motivation refers to the conscious and unconscious cognitive processes that direct and inspire behaviour. Our EQM incorporated hypotheses, risks, and assumptions for each of the first three components (COM). These aspects were in turn incorporated in our data collection tools (installers' survey questionnaire and interview topic guides for installers and industry associations).
- Costs of LAD (EQs 14 and 15): The evaluation question matrix also included questions around the costs incurred for installing energy efficiency measures in homes, and on whether fraud and non-compliance was effectively managed within the Scheme. To assess the costs incurred, we considered: (a) the costs of the Scheme itself, based on monitoring information, and (b) any additional costs incurred by LAs, installers and households. For (a), we used monitoring information, and (b), we used the surveys and interviews with LAs and installers to find out whether any additional costs were incurred, and if so, to quantify them. In relation to fraud and non-compliance, the EQM included some risks on how fraud could be committed, and these were checked during the evaluation to the extent this was possible. The evaluation also assessed the systems put in place by BEIS and LAs to prevent fraud and non-compliance.

Towards the end of the delivery of the LAD Scheme, it became apparent that the Scheme was delivering fewer installations than originally anticipated, and BEIS expressed a need to get insights into why this was the case. To answer to this need, the evaluation team developed a framework, inspired by Process Tracing, to provide an assessment of which factors, and in what measure, were influencing under-delivery. The framework, available in Annex 9 , covered the following barriers to delivery, which were in turn aligned with the evaluation questions:

- Aspects of the design of the LAD that might be hindering delivery.
- Aspects related to LAs' capacity and ability to deliver the Scheme;
- Potential barriers experienced by installers to participate and deliver measures under the Scheme.
- Barriers or issues related to the PAS2035 and TrustMark requirements for installers.
- Issues related to the supply chain, such as the availability of materials.
- Potential lack of engagement or barriers experienced by households, including landlords.

To identify potential barriers, we relied on the Theory of Change (including the risks and assumptions identified there), the evidence collected in early stages of the evaluation, and results from other evaluations of the GHG package which could also apply to LAD. We then mapped all the barriers identified against data collection sources and refined our data collection tools to incorporate all these elements. We also mapped the barriers against the EQ they related to in order to facilitate analysis and reporting.

3.2 Outcomes evaluation: Experience for consumers and landlords

The evaluation has assessed whether the LAD Scheme has delivered a positive experience for consumers and landlords, and how this was influenced by the Scheme design (EQ 7). To assess this question, we analysed the households' consumer journey, from becoming aware of the LAD Scheme through to submitting an application and receiving the installation(s). The survey questionnaire and the interview topic guide included questions to help us assess this aspect.

3.3 Outcomes evaluation: Energy efficiency

The LAD Scheme aims to:

- Raise the energy efficiency of low energy performance homes (i.e., those with energy performance certificate (EPC) ratings of D, E, F or G).
- Tackle fuel poverty by reducing energy bills and making homes more energy efficient for low-income households.
- Delivering cost effective carbon savings to carbon budgets and progress towards the UK's target for net zero by 2050.

3.3.1 BRE Analysis

In order to quantify the extent to which the Scheme achieved these aims, BRE modelled the energy, carbon and financial savings associated with the improvements installed as part of the Scheme.

To quantify the direct effects of the GHG installations, BRE controlled for the effects of other changes to the dwelling that were not a result of the funded improvement. It was especially important to focus the analysis on the impact of the Scheme itself without allowing other factors, which cannot be influenced by the Scheme, to obscure the results.

To perform a true RdSAP (EPC) calculation of a dwelling's energy efficiency, a lot of detailed information regarding the physical characteristics of the dwelling and any energy efficiency

measures is required. An EPC assessment normally requires a building survey by a trained EPC assessor. It was, however, not possible to acquire this level of information for all dwellings being improved as part of LAD and GHG Voucher Schemes. There was limited information available regarding some of the physical characteristics of dwellings. In addition, EPC data was initially only available for either before or after the installations (not both) for the vast majority of cases. For these reasons BRE used their 'Simple SAP' stock model to produce SAP ratings for each dwelling before and after the improvements.

The 'Simple SAP' model consists of two separate models: the BRESMI model and the Baseline model. The BRESMI model allows for an RdSAP calculation to be performed with much fewer inputs than would be normally required, by utilising in-built imputation procedures. The Baseline model applies statistical modelled distributions to infer building characteristics, where key inputs are unknown. This modelling approach was employed for both the GHG-Vouchers and LAD Schemes to ensure a dwelling energy efficiency and fuel poverty status could be calculated for as many of the participating households as possible.

The BRESMI model was used to generate the following data for each of the dwellings before and after the improvement installations:

- Initial modelled SAP score and EPC band rating
- Annual energy consumption
- Annual carbon emissions
- Annual energy bills

This enabled BRE to model the expected energy, carbon and bill savings associated with the improvement measures installed as part of the Scheme.

A detailed description of BRE's modelling methodology can be found in Annex 10.

3.3.2 DESNZ Analysis

Subsequently to BRE completing this analysis, the scheme data on LA-reported EPCs pre and post-installation improved substantially, making it possible to obtain actual EPC data that had been verified against the EPC register in this analysis. DESNZ conducted an updated EPC outcomes analysis in February 2024 and these findings are used in the main report.

Further detail on how DESNZ's ran an updated EPC outcomes analysis using verified EPC data can be found in Annex 16.

3.4 Outcomes Evaluation: Fuel poverty

One of the key aims of the Green Homes Grant (GHG) Schemes was to reach households who are fuel poor, who may be struggling to afford to adequately heat their homes, either because they have low incomes, energy inefficient homes, or a combination of the two. The

LAD Scheme aimed to help take low-income families out of fuel poverty by improving the energy efficiency of their homes and reducing their energy bills.

3.4.1 Defining Fuel Poverty

The current definition of Fuel Poverty being used in England is the Low Income, Low Energy Efficiency (LILEE) metric. Under this definition, households are fuel poor if:

- They have a Fuel Poverty Energy Efficiency Rating (FPEER) [1] of band D or below and.
- The household income after housing costs and fuel costs falls below a set income threshold (defined as 60% of the national after-housing-cost (AHC) equivalised income).

When assessing all households for their fuel poverty status (using the LILEE definition), they are divided into one of four quadrants, namely:

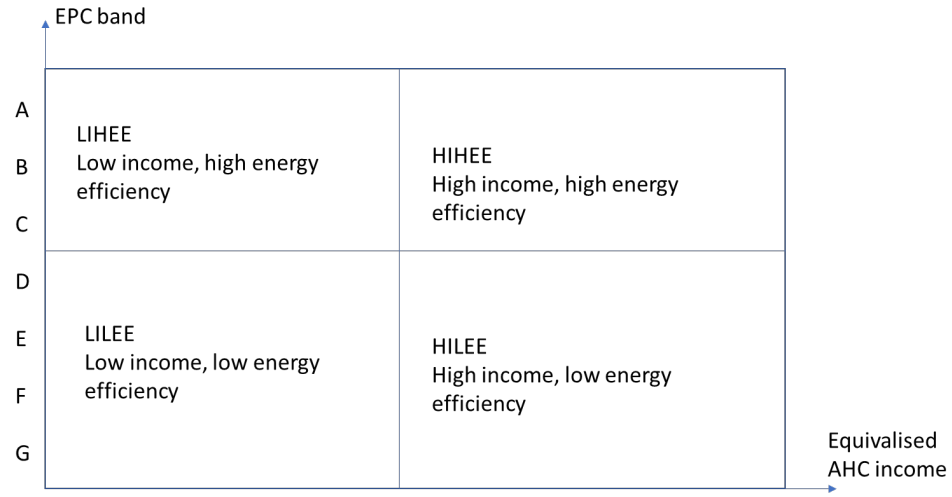
- The LILEE quadrant - households with low income and low energy efficiency. Households where the income is below the threshold and where the Fuel Poverty Energy Efficiency (FPEER)[2] rating of their home is band D or below (these indicate households in fuel poverty).
- The LIHEE quadrant - households with low income but living in a home with high energy efficiency. Households where the income is below the threshold but where the FPEER rating of their home is band C or above (although these households have low income, they are not deemed to be in fuel poverty by this measure because of their home's high energy efficiency).
- The HILEE quadrant - households with higher income and living in a home with low energy efficiency. Households where the income is above the threshold but where the FPEER rating of their home is band D or below (although these homes have low energy efficiency, households are not deemed to be in fuel poverty because of their higher income).
- The HIHEE quadrant - households with higher income and living in a home with high energy efficiency. Households where the income is above the threshold and where the FPEER rating of their home is band C or above (these households are in the most favourable category and are not considered to be in fuel poverty as their homes have high energy efficiency and they have high income).

[1] The FPEER methodology is based on the Government's Standard Assessment Procedure (SAP) for assessing the energy performance of domestic properties while taking into account the impact of policy interventions (e.g., Warm Homes Discount) that directly affect household energy costs. Like SAP, the methodology gives an energy efficiency rating from 0 (lowest) to 100 (highest). This rating can be translated into an energy efficiency 'Band' from G (lowest) to A (highest), rather like the SAP rating being used to generate an overall energy efficiency Band (again from G to A) for Energy Performance Certificates (EPCs). As a general rule, the EPC band will be a good proxy for the FPEER band.

2 The fuel poverty energy efficiency rating (FPEER), is based on SAP, but accounts for the impact of policies which discount households' energy bills (e.g. the Warm Home Discount). For example, if a household has a band D Energy Performance Certificate (EPC) and they get a rebate deducted from their energy bill due to receipt of the Warm Home Discount, this could move them into an FPEER band C.

The quadrants associated with the LILEE method are shown below, together with their associated EPC bands and equivalised AHC income levels.

Figure 1. LILEE method associated quadrants



3.4.2 Developing a Fuel Poverty proxy method

For a standard fuel poverty assessment (upon which the national fuel poverty statistics are based) a huge amount of detailed information is collected regarding both the household and their income (via the EHS householder survey[3]) and about the energy efficiency of the dwelling they live in (via a building survey). For the GHG evaluation projects it was not possible to collect this level of detailed information for each participating household and therefore BRE[4] developed a proxy fuel poverty modelling method to identify those participating households who were likely to be fuel poor prior to and after the installation of dwelling improvement measures through the Schemes.

In order to identify fuel poor households, BRE developed a proxy indicator comprising two components: (i) the income of the household (collected via a householder survey) and (ii) the energy efficiency rating of the dwelling (modelled using data collected through the LAD Scheme and EPC data, where available). The scheme mandated that pre and post-installation EPC certification was carried out on all properties, so the original intent was to use the data on this directly in this proxy, but poor scheme data quality required an increased reliance on modelling.

If a household fell below both the income threshold (defined as 60% of the AHC equivalised income[5]) and the modelled energy efficiency threshold (defined as EPC band D or below), then they were flagged as likely to be fuel poor.

[3] English Housing survey: https://www.gov.uk/government/collections/english-housing-survey
[4] "Building Research Establishment (BRE) are a built environment research organisation. BRE deliver the national housing surveys for the England, Scotland, Wales and Northern Ireland Governments and produce national Fuel Poverty statistics for England, Wales and Northern Island. For the GHG LAD project, BRE modelled the Fuel Poverty status of participating households and the energy, carbon and bill savings achieved by the scheme."
[5] AHC means 'income after housing costs.' Housing costs include mortgage and/or rent on the property. Equivalisation is an adjustment to take into account variations in the size and composition of the household.

For Phase 1 of the fuel poverty analysis, BRE modelled the Fuel Poverty status of households who successfully applied for the Scheme to assess the extent to which the Scheme had been successful in reaching fuel poor households.

For Phase 2 of the fuel poverty analysis, BRE analysed how many households would be expected to be taken out of fuel poverty as a direct result of the energy efficiency improvement installations funded by the LAD Scheme, to assess whether the Scheme had been successful in taking households out of fuel poverty.

In order to isolate the effects of the LAD installation measures, other factors which influence a household's fuel poverty status such as changes in household composition, household income, fuel prices and any other changes to the dwelling were held constant for the Phase 2 analysis.

As with the Energy Efficiency analysis, the scheme data on LA-reported EPCs pre and post-installation improved substantially after BRE's initial Fuel Poverty proxy analysis had been completed. This made it possible to generate a Fuel Poverty proxy using both after housing cost incomes, derived from the householder survey data, and actual EPC ratings, extracted from the EPC register, for a sample of properties. DESNZ conducted an updated Fuel Poverty proxy analysis in February 2024 and these findings are the versions used in the main report.

A detailed description of BRE's Fuel Poverty proxy modelling methodology can be found in Annex 10.

Further detail on how DESNZ's ran an updated Fuel Poverty proxy analysis on this sample using verified EPC data can be found in Annex **16**.

3.5 Outcomes evaluation: Market outcomes

Several evaluation questions covered market outcomes: EQ 11 (the influence of PAS2035 in the delivery of installations), EQ 12 (the extent to which the Scheme is creating and supporting jobs) and EQ 13 (the extent to which the Scheme has created confidence across the market).

These questions explore long-term outcomes and there are multiple external factors that may influence results. To better understand the role of LAD in achieving results, we used a Contribution Analysis (CA) approach. This is further explained in Annex 8 in this technical report.

Annex 4: Qualitative data collection methods

Qualitative data collection methods used in this evaluation include in-depth, one-hour interviews, as well as short 30-minute interviews and workshops. Qualitative research was carried out in three Phases:

- The first Phase was conducted between December 2020 and March 2021, a few months after the start of the LAD Scheme. The purpose of this initial research was to gather evidence to inform the evaluation design, and provide an initial indication of experiences, progress and barriers to delivery among some of the key audiences involved in the Scheme; LAs, installers and beneficiary households.
- The second Phase of qualitative research was conducted between October and November 2021, approximately a year after the LAD Scheme started, and a few months after the start of Phase 2 of the LAD Scheme. This Phase of research enabled researchers to gather experiences and insights after the Scheme had been in place for a year. Installers interviewed were able to reflect on a longer period of involvement in the Scheme.
- The third Phase of qualitative research was conducted between August 2022 and March 2023, approximately around the time that Phase 2 of the Scheme as concluding. This concluding Phase of qualitative research included interviews with Local Authorities, Installers, Installation industry organisations, and BEIS and enabled them to reflect on their experience of the Scheme across all Phases and how changes to the Scheme had affected delivery of the Schemes intended aims over time. This research also targeted landlords (including social housing providers) to improve understanding of their experiences of the Scheme[6].

Table 2 below summarises all the methods used by audience and evaluation stage. These are further described in the ensuing sub-sections. The sample size for interviews with BEIS and interviews with other audiences were proposed by BEIS. These sample sizes were sufficient to interview a range of relevant stakeholders within BEIS, and a range of industry organisations that were interested in the scheme through representing their organisation members.

[6] Private landlords did not engage with the Scheme to the extent expected. While this Phase of research broadly aimed to understand their experience across the Scheme (from application to post-installation), it was a secondary intention to understand any specific enablers or barriers to Scheme participation experienced by participating private landlords.

Table 2. Summary of qualitative research conducted by audience and evaluation stage

Audience	Scoping and Early Insights Phase 1a (Oct 20 – Mar 21)	Early Insights Phases 1 and 2 (Oct – Nov 21)	Final Research Phases 1 and 2 (Aug 22 – Mar 23)
Local Authorities	11 interviews	-	10 interviews
Net Zero Hubs	-	5 interviews	-
Households	8 interviews with homeowners and tenants	-	7 interviews with landlords
Installers	6 interviews	12 interviews	7 interviews
BEIS	Theory of Change workshop	-	2 workshop group interviews with 6 participants each
Other audiences	1 interview with TrustMark	-	3 interviews with installation industry representation organisations

4.1 Local Authorities and Hubs

A total of 26 in-depth interviews were conducted with individuals working in Local Authorities and Net Zero Hubs (hereafter 'Hubs') who held responsibility for LAD Scheme delivery. Each of the interviews lasted for up to 1 hour and were conducted either via telephone or Microsoft Teams. The sample was designed to include different audiences involved in the Scheme and those who had participated in different Phases to explore experiences from a range of viewpoints.

4.1.1 Scoping and Early Insights Research from December 2020 – March 2021

During the scoping research Phase, 11 Local Authorities were interviewed between December 2020 and March 2021. These LAs were sampled opportunistically and purposively. Where possible LAs were selected according to specific sampling criteria to ensure a range of experiences were captured, and in some instances were selected because they were at a

more advanced stage of implementing LAD than other authorities involved in the Scheme. In a small number of instances, sample was limited and LAs were selected on convenience. A sample size of 11 was sufficient to capture a breadth of experience from participating LAs and be broadly representative of the experience of LAs.

To inform the Early Insights Report submitted in December 2021, five interviews were conducted with Hubs, between October and November 2021. One interview was conducted with each of the Hubs to understand the way LAD was being delivered across each region. Each interview lasted for up to 1 hour and were conducted via telephone or Microsoft Teams.

4.1.2 Final Research from October 2022 – March 2023

The second round of qualitative research with Local Authorities involved conducting 10 interviews between February and March 2023. Due to issues with the sample[7], these LAs were sampled from the recontact information provided in the survey. To ensure that we captured a range of experiences regarding Phase 2 rollout, we aimed to hear from Local Authorities operating within each of the Hubs, the sampling breakdown is outlined in the Table 3 below. A sample size of 10 was sufficient to capture a breadth of experience from participating LAs and be broadly representative of the experience of LAs.

Table 3. Breakdown of LA Phase 2 interviews, by Hub

Hub	No. Interviews achieved
Midlands	3
North East	2
North West	2
South East	2
South West	1
Total	**10**

[7] Details of participating LAs were unavailable for this Phase of the research, meaning Ipsos relied on Hubs to recruit LAs for interviews. More information is available in the limitations annex.

4.2 Households (including landlords)

4.2.1 Scoping and Early Insights Research from December 2020 – March 2021

Interviews were completed with eight households participating in LAD. At the time of research, only a small proportion of the households involved in LAD had sufficient permissions and data for Ipsos[8] to approach for interview, and as such participants were selected according to convenience sampling. This limited Ipsos to achieving a final sample size of eight. Interviews were conducted in February and March 2021. Seven out of eight households interviewed had had LAD installations completed at their property at the time of interview. Households were in five different LAs, in a mix of rural and urban settings, and covered a range of installation types.

4.2.2 Final Research from October 2022 – March 2023

Interviews were conducted with seven landlords that had energy efficiency measures installed in their properties through the LAD Scheme. The interviews were conducted over the phone and lasted 45-60 minutes. Respondents received an incentive of £40 for their participation, either as a bank transfer or as a donation to a charity of their choice. Landlords that completed the household survey gave their consent for Ipsos to recontact them for further research about the LAD Scheme, meaning participants were selected according to convenience sampling. In total, 70 landlords gave consent to be recontacted for the final qualitative research. As there was a relatively small amount of sample available, hard quotas were not applied during recruitment to avoid sample exhaustion. The limited amount of sample available for recruitment constrained the sample size that could be achieved. From a target sample size of 10, which was sufficient to cover a range of landlord experiences of the scheme, 7 interviews were achieved. Some soft recruitment criteria were used to ensure a good mix of landlords was recruited, including:

- A mix of social landlords/housing associations and private landlords
- A different Local Authority area of the UK for each interview
- A range of different measures installed

Interviews were conducted in February and March 2023. Four of the seven were private landlords, who owned a small portfolio of properties and had measures installed through the LAD Scheme in a small number of properties (one or two). Three of the seven respondents were housing associations (mix of social and private rented properties) responsible for hundreds or thousands of properties and had measures installed in tens or hundreds of properties within their portfolio. Landlords were in seven different LAs, in mix of rural and urban setting, and covered a range of installation types.

[8] Ipsos UK are a research agency that led the design and delivery of the evaluation.

4.3 Installers

4.3.1 Scoping and Early Insights Research from December 2020 – March 2021

Interviews were completed with six installers participating in LAD. At the time of research, only a small proportion of the installers involved in LAD had sufficient permissions and data for Ipsos to approach for interview, and as such participants were selected according to convenience sampling. This limited Ipsos to achieving a final sample size of six, compared with the original target of twenty. Interviews were conducted in February and March 2021. Five out of six installers had carried out LAD installations at the time of interview, and most were participating in GHG-Vouchers as well as LAD.

4.3.2 Early Insights Research in October and November 2021

Twelve interviews were conducted with installers in October and November 2021. Three of these had been interviewed during the previous round of research in Spring 2021 and were re-contacted to understand if and how experiences had changed as the Scheme had progressed. The final sample size achieved was limited by the number of installer contacts who had opted in to further research. Although 3 installers were interviewed previously, Ipsos achieved interviews with 15 installers from Phase 1, which is only 5 fewer than the original target sample size of 20. This was sufficient enough to capture a range of views from participating installers on the scheme. Most installers were small or medium-sized although one larger installer with national coverage was also interviewed. Installers were spread across the North, South and Midlands, with a small number working across more than one broad region of the country. All installers had been involved in Phase 1A or Phase 1B delivery (in some cases, across both Phases), with ten having started installations by the time of interview.[9]

4.3.3 Final Research in October 2022 – March 2023

Interviews were conducted with seven installation companies that had participated in the LAD Scheme. The interviews were conducted over the phone and lasted 45-60 minutes. Respondents received an incentive of £40 for their participation, either as a bank transfer or as a donation to a charity of their choice. Installers that completed the survey gave their consent for Ipsos to recontact them for further research about the LAD Scheme, meaning participants were selected according to convenience sampling. In total, 36 installers gave consent to be recontacted by Ipsos for an interview. Due to the limited amount of sample available, no hard quotas were set for recruitment and installers were booked based on those who responded to our request to be interviews. From a target sample size of 10, Ipsos were able to achieve a sample size of 6. This was sufficient to capture a broad range of installer experiences at Phase 2. Interviews were conducted in February and March 2023. The installers interviewed were

[9] One installer had not yet completed any installations, while another had been completing installations but was not sure which fell under GHG-Vouchers or LAD.

responsible for installing a range of different energy efficiency measures and worked across multiple Local Authorities, in a mix of rural and urban settings.

4.4 Installation industry trade organisations & certification bodies

4.4.1 Early Insights Research in October and November 2021

Ipsos conducted an interview with a representative from TrustMark to explore impacts on the installer industry as a whole and the role of TrustMark in the Scheme.

4.4.2 Final Research in October 2022 – March 2023

Ipsos spoke with three installation industry and certification bodies during March 2023. Contact details for these organisations were provided to Ipsos by BEIS, meaning these respondents were convenience sampled. The sample size was determined by the number of contacts provided by BIES, who felt the organisations interviewed provided sufficient coverage of industry and trade organisation perspectives of the Scheme. The interviews lasted for 60 minutes and were conducted through Microsoft Teams. These trade organisations represent large numbers of installers that participated in the LAD Scheme and provided support to them throughout the delivery of each Phase of the LAD Scheme.

4.5 BEIS Stakeholders

4.5.1 Final Research in October 2022 – March 2023

Ipsos also spoke with six stakeholders within BEIS who were responsible for different elements of the LAD Schemes design and delivery. Their roles covered Scheme design, Scheme management, Scheme delivery and Scheme data collection. BEIS selected these stakeholders to speak with Ipsos because of their knowledge of the LAD Scheme. Interviews lasted 60 minutes and were conducted online through Microsoft Teams in February and March 2023.

Annex 5: Quantitative data collection methods

Ipsos conducted surveys of three audiences: households, installers, and LAs. All the surveys were conducted in the last phase of the evaluation once the measures had been installed or were near completion. It is important to note that although some surveys (installers and households) were run across two waves, the waves reached out to different participants, and they were not longitudinal. The purpose of having two waves was merely to gather data at different points in time to inform the delivery of the Scheme. The table below provides a summary of the methods used.

Table 4. Summary of the quantitative data collection methods

Audience	Survey mode	Sampling method	Fieldwork dates	Response achieved	Representativeness of the sample
Households	Push to Web[10]	Quotas	Wave 1: 2nd September – 24th October 2022 Wave 2: 3rd January – 6th February 2023	2,938 responses across both waves (24% response rate)	Data was weighted to be representative of the population
LAs	Online	All LAs invited (102 LAs from Phase 1 and five Hubs, who distributed it to LAs in Phase 2)	3rd January – 13th February 2023	58 responses from 57 LAs	Not representative
Installers	Wave 1: Online Wave 2: Telephone	All installers for which we had contact details. Wave 1: 81 installers Wave 2: 132 installers[11]	Wave 1: 4th October 2022 – 31st October 2022 Wave 2: 24th January - 11th February 2023	Wave 1: 6 (7% response rate) Wave 2: 40 (30% response rate)	Not representative

[10] Participants were contacted by post, and they were invited to participate in the survey online.
[11] A pre-identification exercise was conducted to increase the number of installers for which we had contact details.

5.1 Household survey

Ipsos ran two waves of a survey of households. Each wave aimed to recruit a different sample of households (it was not a longitudinal analysis) and both waves used the same questionnaire. The objective was to obtain 3,000 responses across both waves.

The survey was a push to web survey (P2W). Participants were contacted by post, and they were invited to participate in the survey online.

In September 2022, Ipsos ran the first wave of a survey of households who had participated in the Local Authority Delivery (LAD) Scheme and had an installation completed.

The first wave ran between 2nd September – 24th October 2022. Participants were sent three further reminders on 22nd September 4th October and 14th October. Ipsos contacted 4,029 households and received responses from 776, a response rate of 19%. Wave 2 of the survey ran between 3rd January – 6th February 2023 with a reminder sent on 25th January. Out of 8,217 households contacted for wave 2, a response rate of 26% yielded 2,195 completed responses. After cleaning the data, the total number of combined completes was 2,938 (a response rate of 24% across both waves).

Participants in the first wave were selected to quotas based on region, the profile of property type and tenure and the type and number of measures they received, based on July 2022 monitoring Scheme data. The second wave was selected based on final monitoring data of the Scheme as of November 2022. Quotas were set based on the type of measures that the households received, their region[12], their property type, and property tenure. Achieving a representative sample of types of measures was prioritised over all other quotas during both surveys of households. As the type of measure installed affects household experience and outcomes, it was important to ensure that type of measure was used as a quota for the survey to prevent over-representation of certain measures.

Please note that percentages may not add up to 100% either due to the way in which questions were asked (such as multi-code or including a do not know / prefer not to say option) or rounding. Survey data was weighted to the available scheme data, unless otherwise stated.

5.1.1 Weighting and Significance Testing

After the second wave of the survey, the sample was combined and weighted. Weighting was based on type of measure, region, property type and property tenure, with more detail on the weighting for each outlined below. Overall, the final weighting efficiency was 50%. Although this is usually seen as a low level of weighting efficiency (80% and above is usually considered good), the interviewed sample in the survey was quite different to the overall sample, making it difficult to effectively weight without distorting the data to a large degree.

[12] Regions used: North East, North West, Yorkshire and the Humber, East Midlands, West Midlands, East of England, London, South East, and South West.

5.1.2 Measures

The following section and tables explain how survey data for measures was weighted against Scheme measures data.[13]

Table 5. Weighting changes for measure type

	Original weighting instructions	% figures from scheme data (Nov22)	Suggested new weighting (same as % in scheme data)
Buildings wall insulation: Cavity Wall Insulation, External Solid Wall Insulation, Internal Solid Wall Insulation	19%	24.0%	24.02
Building's roof and floor insulation: Loft Insulation, Pitched Roof Insulation, Flat Roof Insulation, Room in Roof Insulation, Solid Floor Insulation, Suspended Floor Insulation	17%	20.9%	20.92
Park Home insulation: Park Home Insulation	6%	7.3%	7.33
Low carbon heat: Air Source Heat Pump, Ground Source Heat Pump, Hybrid Heat Pump, Biomass Boiler, Solar Thermal, Electric Storage Heating, District Heating	7%	9.1%	9.06
Solar PV: Solar PV	37%	47.6%	47.56
Windows, doors, heating controls and lighting: Double or Triple Glazing, Draught Proofing, Energy Efficient Windows and Doors, Secondary Glazing, Heating Controls, Hot Water Tank Insulation, Hot Water Tank Thermostat, Energy Efficient Lighting	13%	13.8%	13.18

[13] The original weighting instructions for the Households survey assumed beneficiaries were receiving one single measure, however this was not the case. This meant Ipsos had to apply new weights based on Scheme data rather than using the original weights suggested.

None / missing		0.1%	
Total	**99%**	**123%**	**122.71**

The quotas were well designed, and Ipsos survey results aligned with the scheme data. Type of measure was used as the principal criterion to base quotas on, and it was decided that Ipsos would try to achieve completes as close as possible to those listed for other criteria. This had an impact on how representative the survey was for region and property tenure (see below). There was also a good match between the measures that respondents said they had installed, and the measures allocated to them in the Scheme data. We had 92-100% accuracy in the Scheme data for all measures.

The only discrepancy was that some survey respondents claimed to have received more measures than the ones allocated to them in the scheme data. This was particularly the case for buildings wall insulation and roof and floor insulation. It may be because LAs packaged LAD with other sources of funding, and survey respondents were unable to differentiate which measures they had received through LAD vs other schemes.

Therefore, Ipsos used Scheme data as the most reliable data for weighting (there were some cases where Scheme data could not be matched to survey data due to issues with the Link Variable. Survey data for these cases was used instead).

Table 6. Measure Type weighting solution agreed with BEIS

Estimates based on a random probability sample of 1000 Households	% figures from scheme data (Nov22)	Unweighted % from survey sample	Scheme data for survey respondents (%)	% cases where information in survey and scheme data match
Buildings wall insulation: Cavity Wall Insulation, External Solid Wall Insulation, Internal Solid Wall Insulation	24.0%	33%*	23.6%	99.0%

Building's roof and floor insulation: Loft Insulation, Pitched Roof Insulation, Flat Roof Insulation, Room in Roof Insulation, Solid Floor Insulation, Suspended Floor Insulation	20.9%	31%*	23.8%	97.5%
Park Home insulation: Park Home Insulation	7.3%	8%	7.5%	99.1%
Low carbon heat: Air Source Heat Pump, Ground Source Heat Pump, Hybrid Heat Pump, Biomass Boiler, Solar Thermal, Electric Storage Heating, District Heating	9.1%	10%	8.8%	94.3%
Solar PV: Solar PV	47.6%	45%	42.8%	99.8%
Windows, doors, heating controls and lighting: Double or Triple Glazing, Draught Proofing, Energy Efficient Windows and Doors, Secondary Glazing, Heating Controls, Hot Water Tank Insulation, Hot Water Tank Thermostat, Energy Efficient Lighting	13.8%	23%	17.2%	92.6%
None / missing	0.1%		2.4%	

*denotes where unweighted survey data differed by a large degree compared with Scheme data

5.1.3 Region

Our sample had over-representation of beneficiaries from the North West, and under-representation of beneficiaries from the South East and South West. This translated into survey results that also over/under represented these regions. This did not represent major issues for weighting. Region was weighted to the Scheme data for region.

Table 7. Region weighting for households survey

Estimates based on a random probability sample of 1000 Households	% figures from scheme data (Nov22)	% figures from W1&2 survey sample (main + reserve)	Unweighted % from survey
E12000001 (North East)	9%	7%	7%
E12000002 (North West)	18%*	29%*	28%*
E12000003 (Yorkshire and the Humber)	9%	14%	14%
E12000004 (East Midlands)	10%	12%	12%
E12000005 (West Midlands)	5%	6%	6%
E12000006 (East of England)	8%	7%	8%
E12000007 (London)	8%	11%	10%
E12000008 (South East)	16%*	6%*	7%*
E12000009 (South West)	19%*	7%*	8%*

*denotes where unweighted survey data differed by a large degree compared with Scheme data

5.1.4 Property type

The proportions for property type in the scheme data and the survey responses aligned very well, presenting no issues in terms of weighting.

However, survey responses and scheme data only matched in 70% of the cases. The scheme data had 8% of cases with information missing. Instead, we used the survey responses as the most reliable source of information.

5.1.5 Property tenure

In the sample and survey results, Councils/Housing Associations were under-represented, and owner-occupied were over-represented.

Table 8. Property Tenure

Estimates based on a random probability sample of 1000 Households	% figures from scheme data (Nov22)	% figures from W1&2 survey sample (main + reserve)	Unweighted % from survey
Owner-occupied	72%*	89%*	93%*
Council/Housing Association	25%*	9%*	4%*
Privately rented (inc. landlords)	2%	1%	2%
Unknown (scheme) / none of these (survey)	1%	1%	1%

*denotes where survey data differs to a large degree compared with Scheme data.

Comparing survey results to scheme data, **93%** of cases matched. When recruiting landlords for qualitative interviews, Ipsos found survey data was more accurate at indicating whether the respondent was a landlord than the Scheme data. On this basis, Ipsos suggested using survey data for weighting property tenure. Only 132 responses were received from households living in council/housing association type of tenure (4% of survey responses vs. 25% of the population). These cases could not be weighted up to 25% as this would have negatively affect weights for other variables and overall survey efficiency. Weighting for these cases had a maximum cap of 5 applied (no minimum weight cap was applied), which meant analysis on significant differences between types of tenure was not possible.

5.1.6 Significance testing

Total household data was significance tested against sub-groups at the 95% confidence level. Two tailed T-tests were used to test correlations between sub-groups and the total population. Significance testing was only conducted on sub-groups with base sizes of 30 or over.

5.2 Survey of installers

In October 2022, Ipsos ran the first wave of a survey of installers who had participated in the Local Authority Delivery (LAD) Scheme and completed all the installations they had been

scheduled to deliver. Due to challenges with the quality of sample available[14], only 6 out of 81 installers contacted responded to the survey, leading Ipsos and BEIS to change the survey approach. After conducting a pre-identification exercise in January 2023 to improve sample quality, Ipsos ran a new survey in January and February 2023 which achieved 40 survey completes from 132 installers contacted. Due to the low sample achieved, findings from the survey of installers are not representative of all installers who participated in the LAD Scheme. While Ipsos completed the data collection and analysis to a high standard, the data should be taken as only indicated of the views of a small number of participating installers. Due to rounding some of the figures may add to more than 100%.

Table 9. Response rate for survey of installers vs total population

Total number of unique installation businesses participating in LAD 1/2	Wave 1 Survey Contacted / Responded	Wave 2 Survey Contacted / Responded	Total unique installation businesses Contacted / Responded
At least 274 in scheme data at time of analysis.	81 / 6	132 / 40	148 / 45

5.3 Survey of Local Authorities (LAs)

The survey with LAs ran between 3rd January – 13th February 2023. BEIS provided a total of 102 unique contact details for LAs who had participated in Phase 1a and Phase 1b. For Phase 2, individual contact details were provided for each of the five Hubs who were then asked to forward an open survey link to LAs who participated in Phase 2 under their Hub. All Hubs confirmed with BEIS that they had issued invites to the LAs participating in Phase 2, and they were instructed to issue two more reminders. Despite this, Ipsos does not have visibility over how many Phase 2 LAs were contacted to take part in the survey, nor how many reminders were sent. However, BEIS have provided information about the number of LAs participating in each Hub:

Table 10. Number of Local Authorities participating in each Hub region

Midlands	South East	South West	North East & Yorkshire	North West
56	142	38	20	39

[14] Information on whether installers had consented to be contacted for research as part of the evaluation of the Scheme was not consistently reported by LAs participating in the Scheme. Explicit consent was required under the terms of the privacy noticed used to collect this scheme data. From a database of 268, information was missing for 209 installers (78% of the sample). Only 37 installers had explicitly consented to be contacted about research by Ipsos, while 21 had declined to be contacted for research. Ipsos used generic, publicly available contact details for installers (from their own websites) that consented to be contacted but had provided no/partial contact details.

LAs for which we had contact details received three reminder emails plus one further email notifying them that the survey closure had been extended by one week. Hubs received two reminder emails plus one further email notifying them of the extension. In total, Ipsos sent invitations to 102 LAs and five Hubs and received a total of 58 responses. Results from this survey should therefore not be read as representative of all LAs who participated in the LAD Scheme. In the main report, where we have reported on results from Phase 2 of the Scheme, it is where the base size was sufficiently large to do so. Otherwise, results are discussed for Phase 1 & 2.

Table 11. Responses to the Local Authority survey by Scheme Phase

	Phase 1	Phase 2	Total
Total number of participating LAs	233	303	309
Number of LA survey responses	46	42	58 (corresponding to 57 individual LAs)

There were two responses from the same LA. This is likely because different staff members were responsible for delivering different Phases of the Scheme and as instructed, answered the survey separately. Therefore, the 58 responses correspond to 57 LAs.

Annex 6: Desk research and analysis of monitoring information

Throughout the evaluation, we have reviewed a number of documents that can be categorised as follows:

- Documents provided by BEIS in relation to LAD and the Green Economic Stimulus package (e.g., the Business and Economic Case, the Counter Fraud Plan, etc.).
- Evaluations from other similar programmes and Schemes.
- Literature in relation to the installer industry and the labour market in the sector.
- Monitoring information, including:
    a) Data on applications made by LAs to participate in LAD.
    b) Database provided by BEIS on the measures installed by LA and household.
    c) Database from TrustMark on measures installed by installer.

The data was reviewed, and we produced a series of analytical products, mainly: a portfolio analysis, and analysis of data on measures installed.

6.1 Portfolio analysis

The portfolio analysis is a database that pulls together information on the delivery models adopted by LAs to deliver LAD in Phases 1a and 1b. Combined with information gathered in interviews and the survey, it has helped us to assess key factors that underpin or hinder delivery of the Scheme. We conducted a similar analysis for Phase 2 at the Hub level, based primarily on information provided by Hubs interviewed in 2021.

The analysis relied on primary and secondary information, mainly:

- Interviews with Hubs and LAs in Phase 2
- Responses of Hubs to the Hub Extension Survey
- External documentation review (including LA funding bid documents describing their proposed delivery models, Official Statistics reports, and other published datasets).

The evaluation team conducted portfolio analyses of phases 1a and 1b, delivered by Local Authorities. We developed these in Excel, using information from the proposals for funding. As there were five different delivery schemes in Phase 2 (as opposed to one scheme per participating LA), we developed mini-case studies for each Hubs bringing both qualitative and quantitative information of the design and performance of the delivery mechanisms. We developed the portfolio analysis for phase 2 in a narrative format, instead of an Excel-based format.

The portfolio analysis contained descriptive information of the delivery mechanisms used by Hubs, as well as data to inform EQs 1 to 5. The content we analysed included:

1. Context of the hub:
    a. Housing stock and household income – estimated number of properties per EPC rating (source: EPC statistics[15]), gas and electricity consumption (source: National Energy Efficiency Data-Framework), and household income (source: ONS).
    b. Brief description of the LAs included and whether LAs participated in phase 1 of GHG-LAD.
2. Delivery model (source: Hub Extension Survey, interviews with Hubs and interviews with LAs):
    a. Brief description of delivery model, including procurement model
    b. Governance of the delivery model
3. Process mapping, including (but not limited to):
    a. methods of identifying households
    b. promotion of the scheme
    c. methods of engaging installers
    d. quality assurance.
4. Objectives set at the outset (e.g. number and type of installations)
5. Barriers to delivery, including, but not limited to:
    a. COVID-19
    b. Capacity and skills in the labour market
    c. Supply chain
6. Coordination with previous phases of GHG-LAD and other schemes

[15] We will use RdSAP or, alternatively, public statistics on EPC certificates (https://www.gov.uk/government/statistical-data-sets/live-tables-on-energy-performance-of-buildings-certificates#epcs-for-all-domestic-properties-existing-and-new-dwellings)

6.2 Analysis of measures installed

The monitoring data provided on measures installed was analysed to provide an assessment of the progress made by the Scheme, compared to the objectives set at the outset. The databases provided were the following:

- Scheme data: The Scheme data was formed by monitoring information reported by LAs and/or Hubs and collected centrally by BEIS. It consisted of three spreadsheets:
    a) “Non rejected applications”: This spreadsheet included details of the households participating in the Scheme and on the status of their application. It also included information, inter alia, on the characteristics of the dwelling and the type of tenure.
    b) “Installed measures”: This spreadsheet included details on the measures installed, such as type of measure, and where they were installed (property, LA, etc.).
    c) “Installer details”: This is the spreadsheet that the evaluation team used to build the sample of installers.
- TrustMark data: TrustMark provided data of the installations conducted under Phases 1 and 2 of LAD. It included information on the dwelling and type of tenure, the measures installed and the standard under which they were installed.

The evaluation team matched both datasets (although not all records could be matched due to data being incomplete) and we also matched the data from the household survey with the Scheme data in order to weight the results to be representative of the total population of households benefited by the Scheme.

Annex 7: Limitations of the evaluation

The evaluation was subject to some limitations in the methodology used and the information available which need to be recognised, as they affect the strength of evidence of this report. The single largest factor affecting this evaluation's findings is the quality and coverage of the scheme's mandatory monitoring data, which directly affected every instance of data collection and every analysis. Because this quality improved substantially for property EPCs during the scheme's closure, this also necessitated DESNZ conducting limited updated analysis in February 2024 to existing modelling by BRE on the scheme's energy efficiency and fuel poverty outcomes. Specific limitations are provided below.

7.1 Limitations in the secondary data

The secondary data available to conduct the evaluation presented significant limitations which have affected the overall quality and robustness of the evaluation. The following main limitations were identified:

- Lack of consistency on how information was collected and reported by LAs: The 'Scheme data' compiled data provided by LAs. However, the way information was collected was inconsistent and there were many data gaps in the database. For instance, many LAs did not include information on costs.
- Databases were cleaned by BEIS before sharing with the evaluation team, but there was some initial confusion over the presence of cleaned and non-cleaned versions of specific variables. Despite this cleaning the databases still presented internal inconsistencies, for instance, in the terminology used (not consistent for the measures installed, for the name of LAs, etc.). This meant that different analysis teams had to make their own interpretation of the data (e.g. interpret that EWI stands for External Wall Insulation), potentially affecting consistency.
- Lack of consistency across different databases: As explained in the section above, we received two databases: The 'Scheme data,' with three spreadsheets containing monitoring information on LAD, and 'TrustMark data.' We aimed to match the cases across the different spreadsheets and databases, however this was not possible for a large portion of the cases: There were problems with the variable used to match cases, there were inconsistencies across databases on the measures installed, and data in the 'Scheme data' was largely incomplete. In addition to this, the total number of measures installed did not match across databases.

The evaluation team had therefore to work with data that was incomplete and that was not fully reliable, resulting in both a partial picture of scheme delivery and a restricted ability to target data collection from all stakeholder populations as planned. Ipsos feels that the strength of evidence (and the associated conclusions) for every question in this evaluation has been weakened by poor data quality by:

1. Provision of insufficient secondary data, or non-provision of relevant secondary data, to inform the planned analysis
2. Incomplete Scheme data, to inform the planned analysis and sampling activity[16]
3. Limited accuracy of planned sampling activity, with insufficient coverage of target populations compared with what was planned in the Scheme specification
4. Restricted response rates of all primary data collection other than the household survey, through poor quality contact data and/or missing contact consent data

7.2 Limitations in the quantitative data collection methods

Quantitative research was conducted with a wide range of audiences involved with or participating in the LAD Scheme. Although efforts were made to ensure surveys were representative and inclusive for large numbers of the target audiences, there were some challenges to quantitative data collection.

Survey of installers: The survey achieved 40 responses from installation businesses that participated in the Scheme. As per the Scheme data used for the research, at least 274 installation business had participated in the Scheme, meaning survey results are not fully representative of the experience of all installers who participated in LAD. Ipsos typically recommend a base size of 50 for robust data analysis, as a small sample size leaves room for outliers to disproportionately affect results, and does not guarantee all demographics are well represented. The small total sample size also precluded Ipsos from weighting the data, although population characteristics for installers are not known making weighting for installers almost impossible even a large sample size was achieved. Although the results from the installer survey should be interpreted with caution, any data included in the main evaluation report can be considered sufficiently robust for the purposes of evaluating the Scheme.

Survey of LAs: Difficulties sharing surveys with participating LAs resulted in low response rates, with Ipsos only receiving 58 survey responses. While this is slightly above the previously stated recommended base size of 50, a sample size of 58 cannot be said to be fully representative of participating LAs around the UK[17]. For example, there was a relatively uneven distribution of responses, with over half of responses (53%) coming from LAs in the West Midlands, compared to 11% from those in the North. As with the installers survey, the small sample size of participating Local Authorities means it is not appropriate to weight the survey data. Care should be taken when making inferences from the data collected for LAs, particularly on anything specific to Phase 2 where survey distribution was conducted via the Hubs. However, findings in the main evaluation report can be considered sufficiently robust for the purposes of evaluating the Scheme.

[16] Scheme pre and post-installation EPC data did improve, but only at the point of scheme closure well after Ipsos and BRE's analysis had been completed.
[17] 233 LA's participated in Phase 1 & 303 participated in Phase 2.

Survey of households: The survey of households received 2,938 responses. We can confidently say the weighted dataset is broadly representative of participating households[18], and we conducted significance testing on the whole population and sub-group descriptive analyses using this dataset. However, there were some sub-groups where response rates were small (below 30), for which we could not conduct significance testing. Analysis of these sub-groups was therefore not included in evaluation findings. The table below shows which sub-groups (as used as cross-breaks in household survey data tables) were affected:

Table 12. Sub-groups with low base sizes

Break	Base size (unweighted)
Tenure – private tenant	24
Tenure – live in property rent free but do not own	9
Tenure – private landlord	18
Payment method – included in rent	11
Payment method – payment when purchased / delivered	18
Payment method – other	10
Payment method (rental) – paid by tenant	18
Payment method (rental) – heating inc. in rent, electricity paid by tenant	0
Payment method – all bills included in rent	0
Measure type – ground source heat pump	3
Measure type – biomass boiler	4
Measure type – solar thermal hot water	22
Measure type – draught proofing	28
Measure type – secondary glazing	19
Measure type – hot water tank thermostat	20
Measure type – district heating	2

[18] 38290 household received measures through GHG LAD, meaning our survey sample of 2938 represents just under 8% (7.6%) of all beneficiary households. Such a large sample size for this survey means we can confidently say the sample is broadly representative (while acknowledging some of the sample skews outlined in section 5.1).

7.3 Limitations in the qualitative data collection methods

Overall, the evaluation consulted with a broad range of audiences, and the resources available to conduct qualitative research were utilised in the most cost-effective way. However, given the length of the evaluation, with several data collection periods, and the broad range of stakeholders involved in LAD, some groups could not be consulted:

- The initial evaluation plan included interviews with **eligible households who decided not to participate in LAD** in order to understand their reasons not to do so. In the end, however, this group was not consulted to allow us to dedicate resources to interview other audiences who had not been included initially in the plan, but which we realised later were needed (e.g., industry associations). Interviewing this audience would have helped us to better understand the reasons why some households refused to participate or did not apply to LAD.
- The number of interviews conducted with installers had to be reduced to allow us to shift some resources towards the quantitative survey. This has limited to some extent the range of views gathered; however, in the opinion of the evaluation team, this has not had a major impact on the strength of evidence. We found that views provided by installers largely converged, and these interviews were complemented with interviews with industry organisations, who were able to provide wider views across the industry.
- The evaluation did not include any interviews with companies managing the LAD on behalf of LAs ('delivery agents')I. Instead, only LAs and Hubs were consulted. Managing companies might have provided a different view of the Scheme and the delivery models adopted. This information would have been beneficial for triangulation with information provided by LAs and installers (the latter were critical of the role of managing companies).
- The scope of one evaluation question included not only installers, but also their supply chain. However, consultations with the wider supply chain (for example, manufacturers of components and parts, retrofit assessors and co-ordinators, transportation companies, scaffolding companies etc.,) were not foreseen in the evaluation. This limited the ability of the evaluation team to apply this wide scope to this specific evaluation question (EQ 12). See the limitations in the evaluation approach for more information on this issue.

7.4 Limitations of the energy and fuel poverty outcomes approach

Pre- and post-installation EPC data was not available for many homes at the time of BRE's evaluation analysis. The scheme data did not include the planned post-installation EPCs, and only began to include this after all BRE analysis had been completed. Pre and post-installation EPCs were available via the TrustMark lodgement data, but were only populated for 14% of records. It was therefore necessary for BRE to model the energy efficiency of the homes and

BEIS agreed with BRE to model the energy efficiency of homes based on the limited data available from other sources and imputed values using statistical modelling techniques. This imputation process used data from the English Housing Survey, Experian, ONS and other data to determine the likely distribution of building characteristics, given a specific dwelling archetype and geographical location. DESNZ subsequently carried out an update to this analysis using verified pre and post-installation EPCs taken directly from the EPC register, which reduced some of the limitations around assumptions in the modelling, at the expense of being applied to smaller overall base sizes.

7.4.1 Modelled EPC method

The original modelling method used allowed for an RdSAP calculation to be performed with much fewer inputs than would be normally required, by utilising in-built imputation procedures. This ensured that the SAP score, EPC band, annual energy demand, carbon emissions and energy bills could be calculated for the vast majority of homes. However, the limitations of this simplified model meant that it was not possible to model the impacts of heat pumps, storage heaters, underfloor insulation, doors and draughtproofing as there were no corresponding model inputs for these measure types.

Overall, these limitations meant that for some homes the impacts of the measures installed were underestimated by the model, as the impact of some measures could not be modelled. However, BRE were able to model the impact of the measures installed in the vast majority of homes and overall, 82% of the measures installed were modelled. The overall reported savings are likely to slightly underestimate the actual savings achieved.

In addition, limited information was available regarding what energy performance measures were present prior the installations and exactly what was installed as part of the scheme. For example, how much loft insulation was already present prior to the scheme, how much insulation was actually installed, and what materials were used. Based on the data available at the time and the categories available in the simplified model, BRE made assumptions regarding what was already present in the home and what was installed. These assumptions were based on the data available about the dwelling prior to the installations and were underpinned by EHS data on existing energy measures within the social housing stock. The discrepancy between the modelled findings and the published statistics suggests these assumptions may have been conservative for some measures. It is possible that these assumptions may have resulted in an overestimation the energy efficiency of the homes before the installations and/or underestimation of the impact of some measures.

A more detailed description of the technical limitations of the energy and fuel poverty modelling approach can be found in section Annex 10.1.2 ‘Methodological assumptions and limitations’ and Annex 11 ‘Limitations of the BRESMI modelling method’.

As noted in Annex 11, BRESMI models the energy ‘demand’ of the home i.e., how much energy is required to heat, light and power the home. For this reason, the installation of PV panels is modelled as having no effect on the energy ‘demand’ of the home, even though it

would affect the amount of energy the homes would draw from the grid. This subtle difference needs to be considered when assessing the energy savings associated with the measures. Although the installation of PV does not influence the energy demand figures, the model does account for the impact of PV on carbon emissions, fuel bills, SAP score and therefore the installation of PV panels does also influence the change in EPC band and fuel poverty status figures.

7.4.2 Verified EPC method

DESNZ used pre and post-installation EPCs that had been verified through the EPC register in the revised energy efficiency and fuel poverty outcomes analysis, which served to remove the limitations associated with modelled EPCs described above. However, because only around half of all properties receiving measures under the scheme have these verified EPCs at the time of writing, this serves to cut the available base size for both outcomes analyses in half, increasing the risk of skew on non-observable characteristic in the findings. They have no evidence to suggest the existence of skew in observable characteristics, and are therefore treating these findings as the most accurate available.

7.5 Limitations of the evaluation approach

Overall, the evaluation followed a robust approach for both the process and the outcomes evaluation. The Theory of Change and the evaluation frameworks developed helped to collect and assess the information transparently, and to present the strength of evidence. However, we need to highlight two limitations of specific aspects of LAD that could not be fully assessed, or where the strength of evidence was limited:

- To answer EQ 11 (the extent to which installations were conducted according to PAS/MCS standards), we relied to some extent on data that would be provided by TrustMark on the activity conducted by retrofit assessors/coordinators, and on the monitoring and audits conducted. However, this information was not available for the evaluation. Instead, we had to rely on the consultations with industry (interviews and survey) to assess this question. The question could be answered, but the lack of secondary data has weakened the strength of evidence.
- EQ 12 asked about economic benefits of the Scheme for the industry. While we could assess the economic benefits for installers through the contribution analysis framework, this was not possible for their supply chain. The contribution analysis framework to assess economic impacts on the supply chain relied only on secondary data, and the

evaluation team could not find sufficient data to be able to assess this specific hypothesis.[19]

More broadly, we would like to note that the evaluation does not provide a quantitative assessment of the economic impacts of the LAD Scheme on jobs; this was not an objective. The contribution analysis provides, instead, a qualitative assessment of the extent to which LAD contributed to create and support jobs in the industry.

Finally, It was not within the scope of the evaluation to develop a full cross-scheme analysis of deadweight (i.e. the extent to which the programme spend was additional, or consumers would have installed measures anyway). However, the likelihood of households installing measures or LAs running similar initiatives, without the Scheme, is assessed through the qualitative research.

[19] Hypothesis 2: The increase in demand for installations translates into an increase in demand for supply. Suppliers in the UK are able to maintain their staff and/or recruit new staff due to the increase in demand.

Annex 8: Contribution analysis framework

Contribution Analysis was initially developed as a way of assessing the performance of a programme or a policy where the direct establishment of a counterfactual is either not feasible or impractical. Mayne (2008, p. 1) defines if as follows – Contribution analysis explores attribution through assessing the contribution a programme is making to observed results[20]. Contribution analysis is a theory-based approach to evaluation, which hinges on the development of a programme Theory of Change explaining how the activities funded lead on to expected outputs, outcomes, and impacts. This provides an overall framework developing a credible 'performance story' that links the evidence available to underlying intervention logic.

For each EQ (11, 12 and 13), we defined one or more overarching hypothesis to test. Each overarching hypothesis has the following types of test (as per the steps in the CA analysis):

- Theory of Change test: It checks whether the output/outcome has been achieved (i.e., whether the programme is working as expected).
- Contribution pathway: If the Theory of Change holds true, then this test assesses whether it was due to LAD (or the contribution of LAD to achieving the output/outcome).
- Alternative pathway: Explores the extent to which other potential pathways to results played a role in achieving the outputs/outcomes.

The tests were phrased as evidence that we would expect to see to confirm the theory of change, the contribution pathway, or the alternative pathway. We also categorised each test according to their relationship with the overarching hypothesis, as follows:

- Plausible – Passing the test is a necessary condition to confirm the hypothesis (i.e., it makes it plausible), but it is not sufficient. Not passing this test almost unequivocally suggests that the hypothesis can be rejected. This is normally the case for tests on the theory of change linkages.
- Probable – The evidence suggests that it is probable that the hypothesis can be confirmed. Not passing this test does not reject the hypothesis but weakens it.
- Strong – The evidence strongly suggests that the hypothesis is true. Not passing this test does not reject the hypothesis but may weaken it.
- Weakens contribution – This evidence would confirm alternative pathways towards achieving the outcome, hence weakening the hypothesis.

Each test has been assessed via one or more sources of information and categorised according to its strength. We applied two strength of evidence frameworks: First, we used a framework to assess ex-ante the likely strength of evidence, based on the source of

[20] Mayne, J. (2008) Contribution Analysis: An approach to exploring cause and effect. Brief 16, Institutional Learning and Change (ILAC) Initiative.

information the test was building upon.[21] We then applied, ex-post, a second framework that provides a final assessment on the strength of evidence. This second step was needed for several reasons: (i) In some tests, we had to change the source of evidence (for instance, if certain interviews were not conducted in the end, or certain information was missing in the monitoring databases); (ii) Some sources needed to be caveated (for instance, the survey of installers is not representative, and therefore its strength of evidence is lower than initially anticipated). Notwithstanding, the ex-ante score fed into the ex-post score. Below we provide a summary of the frameworks used ex-ante and ex-post.

Ex-ante strength of evidence framework:

- Authoritative source – This is a piece of evidence which has already passed a thorough test under the responsibility of credible authorities in so far as the point at issue is not in dispute among differing authorities. An example would be the IEA's World Energy Outlook 2018 or the IPCC's report on 1.5 degrees.
- Signature – When X causes Y it may operate so as to leave a signature (a trace, a fingerprint) that is unequivocally indicated. An example would be if a think tank claimed its research had helped improve forest management plans in Ghana, and the unique formula from the think tank was evident in the Forest Management Plans developed and implemented by Ghanaian government.
- Convergent triangulated sources – These are independent from one another in so far as they stem from stakeholders having different vested interests. Pieces of evidence originating from such sources are mutually reinforcing as far as they converge. However, it is important to note that the strength of evidence categorised here will vary dependent on: (a) the stakeholders consulted have different vested interests and (b) any potential bias within their responses being assessed and considered / caveated in the analysis.
- Volume of voice – The stakeholders consulted do not have different vested interests, but they all (or a majority) hold similar views in relation to a certain issue. The strength of evidence will be dependent on the volume of people consulted, the representativeness of the sample, and the extent to which their opinion matters to confirm or reject the hypothesis (e.g., the evidence will be strong if the hypothesis assesses public's opinion and the method is a survey of a representative sample of the population, but it will be weak if the hypothesis to be tested requires scientific knowledge and the respondents are the general public).
- Consistent chronology – This is never a sufficient argument for confirming a contribution claim, but it may be used for refuting an assumed contribution. An example would be a think tank claiming to have contributed to the development of a global standard in forest stewardship, when in reality, the think tank was set up after the standard.

[21] The framework has been adapted from Delahais and Toulemonde (2017) by adding the category "volume of voice".

Ex-post strength of evidence framework:

- Strong – Evidence comprises multiple data sources (good triangulation), which are of decent quality. Where fewer data sources exist, the supporting evidence is more factual (e.g., quantitative data from secondary sources, or objective reporting from desk review of activities undertaken) than subjective (e.g., qualitative sources).
- Medium-strong: Evidence comprises multiple data sources (good triangulation) of lesser quality, or the finding is supported by fewer data sources (limited triangulation) of decent quality but that are more perception-based than factual (e.g., only qualitative data).
- Medium-weak: Evidence comprises few data sources (limited triangulation) and is perception-based (e.g., only qualitative data) or based on data sources that are viewed as being of lesser quality (e.g., quantitative data that is estimated, or qualitative data where there are concerns regarding informant bias).
- Weak: Evidence comprises very limited evidence (single source, or a limited number of informants or documents within the source) or incomplete or unreliable evidence.
- The overarching hypotheses and tests were reviewed and adapted as new evidence became available (mainly, after the delivery of the Early Insights Reports). The changes undertaken were minimal, indicating that we had undertaken a robust scoping Phase. The CA framework is available in Annex 8.

Contribution analysis tables

Sections 8.1 to 8.3 below show how the contribution analysis was completed.

All evidence from these tables was used in addressing the corresponding evaluation questions in the main report, alongside a report of the strength of the weight of evidence where this was less than strong.

8.1 EQ11. What influence has the requirement for PAS 2035 certification had on the delivery of installations?

Hypothesis: By requiring installers to be PAS 2035 certified, GHG-LAD maximises the chances that the quality of installations is good. PAS 2035 adds an assessment process before measures are installed to determine which measures are the most adequate for the dwelling. This helps households to decide which measures to install. The monitoring processes after an installation takes place ensure that any quality issues are identified and addressed on a timely manner.

Table 13. EQ11 Contribution analysis

Step CA Analysis	Test	Source	Method to assess the test	Type of causal claim	Assessment	Rationale	Weight of evidence
ToC Test	Installations under LAD are conducted under PAS 2030 or MCS specifications	TrustMark data, installers survey, consultations with installers	Authoritative source	Plausible	True	There is strong evidence that installations in Phase 1 were conducted by installers who are TrustMark accredited. There are over fourteen and a half thousand TrustMark accredited installations from Phase 1. This is supported by qualitative feedback given by installers and installation industry organisations, who also said installations were complete to PAS2030 /MCS standards and accredited by TrustMark. There is also quantitative data from installers who participated in the Scheme that indicates a majority were PAS 2030/MCS certified and registered with TrustMark. However, there are thousands of measures that have been installed through the Scheme that have not been registered with TrustMark, suggesting not all installations have been correctly registered.	Medium-strong. Data provided by TrustMark showing over fourteen and a half thousand installations accredited by TrustMark. However, the TrustMark data does not cover all the measures installed, meaning the data is either incomplete, or that some of the measures were not registered with TrustMark. The installers survey is not representative, so the weight of evidence is medium. 95% of installers survey were registered with TrustMark before or during the Scheme, with around three quarters of installers surveyed saying they were PAS 2030:2017 certified (73%) or PAS 2030:2019 certified (78%) before or during the Scheme, while a further two thirds (65%) were PAS2035:2019 certified before or during the Scheme.
ToC Test	Installations in Phase 2 are conducted by	TrustMark data, installers survey,	Authoritative source	Plausible	True	There is strong evidence that installations in Phase 2 were conducted by installers who are TrustMark accredited. There are nearly sixteen	There is strong evidence that installations in Phase 2 were conducted by installers who are TrustMark accredited.

Step CA Analysis	Test	Source	Method to assess the test	Type of causal claim	Assessment	Rationale	Weight of evidence
	installers who are TrustMark accredited and compliant with PAS 2035	consultations with installers				thousand TrustMark accredited installations from Phase 2. This is supported by qualitative feedback given by installers and installation industry organisations, who also said installations were complete to PAS2035 /MCS standards and accredited by TrustMark. There is also quantitative data from installers who participated in the Scheme that indicates a majority were PAS 2035 compliant/MCS certified and registered with TrustMark. However, there are thousands of measures that have been installed through the Scheme that have not been registered with TrustMark, suggesting not all installations have been correctly registered.	There are nearly sixteen thousand TrustMark accredited installations from Phase 2. This is supported by qualitative feedback given by installers and installation industry organisations, who also said installations were complete to PAS2035 /MCS standards and accredited by TrustMark. There is also quantitative data from installers who participated in the Scheme that indicates a majority were PAS 2035 compliant /MCS certified and registered with TrustMark. However, there are thousands of measures that have been installed through the Scheme that have not been registered with TrustMark, suggesting not all installations have been correctly registered.
ToC Test	Installations in Phase 2 are conducted by installers who are TrustMark accredited and are PAS 2035 compliant	TrustMark data, installers survey, consultations with installers	Authoritative source	Plausible	True	There is strong evidence that installations in Phase 2 were conducted by installers who are TrustMark accredited. There are nearly sixteen thousand TrustMark accredited installations from Phase 2. This is supported by qualitative feedback given by installers and installation industry organisations, who also said installations were complete to PAS2035 /MCS standards and accredited by TrustMark. There is also quantitative data from installers who participated in the Scheme that indicates a majority were PAS 2035 compliant/MCS certified and registered with TrustMark. However, there are thousands of measures that have been installed through the Scheme that have not been registered with TrustMark,	Medium-strong. Data provided by TrustMark showing nearly sixteen thousand installations accredited by TrustMark. However, the TrustMark data does not cover all the measures installed, meaning the data is either incomplete, or that some of the measures were not registered with TrustMark. The installers survey is not representative, so the weight of evidence is medium. 95% of installers survey were registered with TrustMark before or during the Scheme, with around three quarters of installers surveyed saying they were PAS 2030:2017 certified (73%) or PAS 2030:2019 certified (78%) before or during the Scheme, while a further two thirds (65%) were PAS2035:2019 compliant before or during the Scheme.

Step CA Analysis	Test	Source	Method to assess the test	Type of causal claim	Assessment	Rationale	Weight of evidence
						suggesting not all installations have been correctly registered.	
ToC Test	Retrofit assessor/coordinator/advisor provides assessment/advice on the measures to be installed that are the most effective or offer the best value for money	N/A	Signature	Probable	Not enough data to assess	Information on the activity performed by retrofit coordinators, assessors or advisors was not available.	
ToC Test	Homeowners receive information from retrofit assessor/coordinator/advisor on the recommended measure(s) to install	Consultations with households (survey and interviews)	Volume of voice	Probable	Partially true	There is evidence from qualitative and quantitative research with beneficiary households that they had mostly positive experiences of speaking to assessors about installations and the benefits of measures proposed. Around three quarters of respondents (72%) are satisfied with the suitability of the measure installed. However, some households were not satisfied with the measure recommended & and were not given enough information by the retrofit assessors about next steps.	Medium-Strong. Surveys with 2,938 beneficiary households after LAD 1 & Lad 2. Sample quotas were set to be representative across measures, household type, region, and property tenure. Qualitative interviews with 8 beneficiary households after LAD 1.
ToC Test	Installations are monitored by retrofit coordinators/evaluators	N/A	Signature	Probable	Not enough data to assess	Information on monitoring activity was not available	
ToC Test	Inspections and other fraud	N/A	Signature	Probable	Not enough	Information on monitoring activity was not available	

Step CA Analysis	Test	Source	Method to assess the test	Type of causal claim	Assessment	Rationale	Weight of evidence
	protection measures are conducted				data to assess		
ToC Test	Findings of monitoring and audit are shared, and poor performers identified. Corrective action is taken if needed.	N/A	Signature	Probable	Not enough data to assess	Information on monitoring activity was not available	
Contribution Pathway	Without GHG-LAD, installers would have not become learning PAS2035 standards, or would have done it later	Consultations with installers	Consistent chronology and volume of voice		Partially true	Installers indicated that the Scheme did not encourage the adoption of PAS2035 standards due to the short lifespan of the Scheme. Installation companies reported they were reluctant to invest in training for staff when they did not know how long the Scheme would last. Gaining this accreditation takes time, longer than the LAD Scheme was active, so installers did not have time to become accredited to participate in LAD. If PAS2035 becomes the standard for government work, installers will invest in making sure their workforce are trained in PAS2035 standards. Government needed to give companies more advance warning and support to gain accreditations before Scheme began. Supported by quantitative data: only 10% of installers began process of gaining PAS2035 compliance. LAD in isolation was not directly responsible for large numbers of installers gaining accreditation, but overall installers invest in requirements because of government Schemes.	Medium-strong. Consistent qualitative feedback from installers and industry organisations. Quantitative data from installers. Limitation is small sample size.

Step CA Analysis	Test	Source	Method to assess the test	Type of causal claim	Assessment	Rationale	Weight of evidence
Contribution Pathway	Without the recommendation, homeowners would have installed different measures or would have been less certain about what measures to install	Consultations with households (survey and interviews)	Volume of voice	Strong	Partially true	It is not clear that homeowners intended to install other measures and changed their minds when advised by assessors. However, their advice and information provided by retrofit assessors (when provided) did make homeowners more certain about what measures to install.	Medium-Strong. Surveys with 2,938 beneficiary households after LAD 1 & Lad 2. Sample quotas were set to be representative across measures, household type, region, and property tenure. Qualitative interviews with 8 beneficiary households after LAD 1.
Contribution Pathway	Monitoring measures incentivise installers to apply high quality standards, preventing low quality of installations	Consultations with installers	Volume of voice	Probable	Partially true	Installers like the PAS2035 standards and TrustMark Scheme as it keeps the quality of installations high + increases consumer confidence. Quality of work was felt to be very high (although sometimes unnecessarily following certain standards). Retrofit assessor quality was criticised as they were felt to lack knowledge and penalised installers for unnecessary things. E.g., assessors following standards for loft insulation to the letter when not necessary & ignoring installer expertise.	Strong. Consistent and reiterated feedback from installers and industry representatives, who made it clear these standards must be maintained in future Schemes.
Contribution Pathway	Issues detected through monitoring are addressed/solved	N/A	Consistent chronology and volume of voice	Strong	Not enough data to assess		
Alternative Pathway	Installers believe having TrustMark/PAS2035 does	Consultations with installers	Volume of voice	Weakens contribution	False	Installers like the PAS2035 standards and TrustMark Scheme as it keeps the quality of installations high + increases consumer confidence. Quality of work was felt to be very	Strong. Consistent and reiterated feedback from installers and industry representatives, who made it clear these standards must be maintained in future Schemes.

Step CA Analysis	Test	Source	Method to assess the test	Type of causal claim	Assessment	Rationale	Weight of evidence
	not impact on quality					high (although sometimes unnecessarily following certain standards).	
Alternative Pathway	Installations conducted without PAS2035 are of the same quality (or better) than installations conducted with PAS2035	Consultations with installers	Convergent triangulated sources	Weakens contribution	False	Installers were clear in their support for PAS 2035 and the impact on quality of installations. They frequently mentioned how they had driven cowboys out of the industry and increased consumer confidence. Consumer satisfaction with quality of measures in stalled high.	Strong. Consistent feedback from installers.

8.2 EQ12.: how is the Scheme creating and supporting jobs in the energy efficiency and low carbon heat sector? Are these jobs new market entrants or existing installers reskilling or certifying to the required standard?

Hypothesis 1: LAD increases the demand for EE and low carbon installations. To cope with the increase in demand, installers upscale their capacity by recruiting more staff. The increase in demand also leads to the creation of new companies in the installer market and low carbon heat sector. Those companies who furloughed staff during COVID, were able to bring their staff back to work thanks to the increase in demand produced by LAD.

Table 14. EQ12 Hypothesis 1 Contribution analysis

Step CA Analysis	Test	Source	Method to assess the test	Type of causal claim	Assessment	Rationale	Weight of evidence
ToC Test	The turnover and number of jobs in the energy efficiency and low carbon sector increases across the UK	Secondary data (Business Register and Employment Survey)	Authoritative source, consistent chronology	Plausible	True	BRES stats show industry grew in all parts of the sector in 2020-2021 (during COVID). No data available yet for 2022.	Strong. An authoritative source - Business Register and Employment survey shows an increase in sector wide employment (in Low carbon and renewable energy sector)
ToC Test	If number of jobs does not increase, there are other external factors that might explain it (e.g., COVID, economic crisis)	Market analysis, consultations with industry	Convergent triangulated sources, consistent chronology	Plausible	False	Number of jobs did not decrease overall.	Strong. An authoritative source - Business Register and Employment survey shows an increase in sector wide employment (in Low carbon and renewable energy sector). Evidence from survey of installers & interviews with installers.
ToC Test	Turnover of firms participating in LAD increases	Survey of installers, consultations with industry	(Depends on source)	Plausible	True	Installers interviewed and surveyed reported their turnover had increased as a result of participating in LAD. This was supported by industry organisation feedback about the impact of the Scheme on installer turnover.	Strong. A combination of consistent and clear qualitative feedback from industry organisations and installers, and from a quantitative survey with installers.
ToC Test	Installers participating in LAD recruit new employees to cope with demand	Consultations with installers (quantitative survey, interviews) and consultations with	Volume of voice	Plausible	Partially True	Installers surveyed reported creating some new jobs as a result of the LAD Scheme. However, qualitative feedback from installers and industry suggests these jobs were not 'sticky' and new hires were not always retained longer term.	Medium-weak. There is evidence of job retention and job creation in the short term. A relatively small number of installers responded to the survey, so results may not be fully representative of installer experiences. Consistent feedback was received from installers and industry representatives confirming that there was some job creation but not lots.

Step CA Analysis	Test	Source	Method to assess the test	Type of causal claim	Assessment	Rationale	Weight of evidence
		industry (interviews)					
ToC Test	New firms are created in response to increase in demand	Consultations with installers (interviews and survey) and consultations with industry (interviews)	Volume of voice	Plausible	False	Evidence available for this evaluation suggests that no new firms were created in response to increased demand.	Medium-weak. The survey may not have captured new firms given the low response rate. Installers & industry organisations did not know of any new firms created through the LAD Scheme
Contribution Pathway	LAD drives an increase in demand (measures are installed that would not have happened otherwise)	Consultations with industry (e.g., they report an increase in demand), survey of households (they would not have conducted the installations without the Scheme/funding)	Convergent triangulated sources	Probable/strong	Partially True	LAD did drive increased demand for duration of Scheme. This was new demand, which would otherwise not have existed without the Scheme. However, issues with Scheme design prevented installers being able to fully meet demand.	Strong consistent feedback from survey of households. Consistent feedback from installers about the Scheme increasing demand after COVID (which had suppressed demand).
Contribution Pathway	The total funding delivered through LAD represents a significant	Consultations with industry (share of LAD related work in their turnover)	Volume of Voice	Strong	Partially True	Installers and industry organisations report that at the time, LAD was a significant source of income for many businesses. Almost half of installers surveyed said LAD was 25%+ of their annual turnover in 2021 + 2022.	Medium-strong. Consistent and converging evidence from qualitative and quantitative research with installers.

Step CA Analysis	Test	Source	Method to assess the test	Type of causal claim	Assessment	Rationale	Weight of evidence
	share of the market						
Contribution Pathway	The length and scale of LAD was sufficient for installers to upscale their capacity	Consultations with industry & installers	Volume of voice	Probable	Partially True	Installers scaled up during LAD 1, but subsequent extensions to the Scheme made scaling up difficult.	Medium-strong. Clear and consistent qualitative feedback from installers and industry organisations interviewed about the impact of timings & extensions on ability to scale up work.
Alternative Pathway	It is other public spending programmes (e.g., SHDF, GHG Vouchers) that drive demand for installations	Consultations with industry	Volume of voice	Weakens contribution	Partially True	LAD was run in parallel with other Schemes that also drove demand for installations in the sector. Installers consistently confirmed LAD was just one of a few Schemes they were involved with.	Medium-strong. Clear and consistent qualitative feedback from installers and industry organisations about the effects of other Schemes on demand.
Alternative Pathway	Demand is increasing among households, and this is unrelated to LAD	Consultations with industry and installers	Volume of voice	Weakens contribution	Partially True	Installers and industry organisations feel demand for retrofit measures will continue to increase outside of Schemes. Cost of measures is prohibitive to many, so Schemes like LAD are also important for increasing demand.	Medium-strong. Installers and industry organisations were able to discuss household demand from their perspective and consistently believe that consumer demand will increase.

Hypothesis 3: LAD Contributes to reskill and certify installers to the required standard (PAS 2030 / PAS 2035 / MCS)

Table 15. EQ12 Hypothesis 3 Contribution Analysis

Step CA Analysis	Test	Source	Method to assess the test	Type of causal claim	Assessment	Rationale	Weight of evidence
ToC Test	Installers participating in LAD report that their staff have been upskilled on PAS2035	Consultations with industry	Volume of voice	Plausible	True	Most installers were already PAS2035 compliant before LAD. Those who were not, became compliant during LAD and all reported having trained their staff.	Medium weak - due to a low survey response rate from installers.
Contribution Pathway	Installers register on PAS2035 after it was announced as a requirement to participate in LAD, in order to participate in the Scheme	Consultations with industry	Consistent chronology	Plausible	Partially true	The majority were registered in TrustMark and were compliant with PAS2035 before LAD. Only a minority started the process specifically for LAD.	Medium weak - due to a low survey response rate from installers.
Contribution Pathway	Installers report that they upskilled their staff on PAS2035 in order to ensure quality standards are met	Consultations with industry	Volume of voice	Probable	Partially true	The survey did not investigate on reasons to upskill staff; however, installers overall believed PAS2035 increased quality	Medium weak - due to a low survey response rate from installers.
Alternative Pathway	It is other Schemes/requirements that influence installers to upskill their staff	Consultations with industry	Volume of voice	Weakens contribution	True	Most installers working on the LAD Scheme had previously learned PAS2035 standards for another Scheme. Schemes that require PAS2035 like ECO are influencing uptake.	Medium-strong (although survey response rate was low, the majority provided the same response). Consistent feedback was provided by installers about becoming PAS 2035 compliant prior to LAD.

8.3 EQ13. To what extent has the Government's commitment to funding of energy efficiency improvements created confidence across the supplier market?

Hypothesis: GHG package creates confidence across the supplier market that demand for installations will continue to increase. Demand will be led by new government Schemes, as well as private installations.

Table 16. EQ13 Contribution analysis

Step CA Analysis	Test	Source	Method to assess the test	Type of causal claim	Assessment	Rationale	Weight of evidence
ToC Test	Installers are confident the retrofit and low carbon market will grow in the near future	Consultations with installers	Volume of voice	Plausible	True	The Net Zero targets and the need to decarbonise the economy provide assurance to the industry that the market will grow.	Strong, unanimous qualitative feedback from installers and industry organisations
Contribution Pathway	Installers have positive experience of participating in GHG-LAD	Consultations with installers (interviews and survey) & consultations with industry	Volume of voice	Probable	Partially true	68% of installers participating in the survey were satisfied with their participation in LAD, and it was reported that it helped to keep businesses afloat. However, installers and industry organisations identified several shortcomings in the design of LAD.	Strong, unanimous qualitative feedback from installers and industry organisations.
Contribution Pathway	Installers believe the government will continue to support this type of measures	Consultations with installers	Volume of voice	Strong	Partially true	Installers know the government is committed to funding similar Schemes in future, based on past experience of Schemes being launched. However, they are less confident that future Schemes will be well designed.	Strong, unanimous qualitative feedback from installers and industry organisations.
ToC Test	Installers believe the public is becoming more aware of the need to install EE and	Consultations with installers	Volume of voice	Plausible	True	Installers believe public awareness of the need to install measures is increasing.	Strong, unanimous qualitative feedback from installers and industry organisations.

	low carbon measures in domestic buildings						
Alternative Pathway	Installers believe LAD supported installations that would have happened regardless	Consultations with installers	Volume of voice	Weakens contribution	False (note that passing this test would weaken the hypothesis)	Installers are aware that LAD was addressed to lower income households. However, some mentioned GHG-Vouchers as an example of a Scheme that stopped private measures.	Strong, unanimous qualitative feedback from installers and industry organisations.

Annex 9: Process evaluation framework – barriers to delivery

Towards the end of the evaluation, it became apparent that fewer installations were being delivered than expected, and BEIS required the evaluation to address what could have led to this. For this purpose, the evaluation team developed a framework to understand whether any processes were hindering delivery.

The table below shows the tests per theme and the sources of information used to assess them. These hypotheses were developed in the last year of the project, and they arose in the course of data collection in the early stages of the evaluation, as well as from desk research.

The sources of information include the household, LAs, and installer surveys, the two phases of qualitative research, as well as other desk research carried out by the evaluation team. For the surveys, we identified which questions would help test this hypothesis, and for the qualitative interviews we marked whether a relevant question or probe was included in the discussions. Finally, for the desk research, we marked the activities that could help us gather evidence for the hypothesis.

The analysis involved assessing the evidence above against each of the ToC hypotheses using the following criteria:

- Incidence (how frequent was the barrier?) – no evidence, low, medium, high (unsure)
- Relevance (how much did it influence under-delivery of installations) – no evidence, low, medium, high (unsure)
- Weight of evidence (how strong is our evidence?) – no evidence, low, medium, high (unsure)

The results from the analysis are set out in Section 5.4 of the main report. The analysis is set out in a slightly different order to the hypotheses below as follows:

- Scheme timeframes
- Scheme contracts
- Scheme design features
- Capacity within the supply chain
- External factors (e.g., the impact of COVID-19 and weather conditions).

Table 17. Process evaluation framework

	Source					
Theory of no change hypotheses (barriers to delivery)	**HH Survey**	**LA survey**	**Inst survey**	**Qual Phase 1**	**Qual Phase 2**	**Desk research**
Design aspects						
The maximum cap of £10,000 per household is insufficient, and as a result certain measures that are more expensive are not conducted. No alternative measures are installed instead.		C7			Yes	
The EPC band limit, combined with the maximum earnings of £30,000 per household, reduces significantly the number of eligible households to participate in LAD					Yes	
The specific measures offered under LAD are not attractive to households, who would prefer installing other EE measures not offered by LAD (e.g., replacing windows)				Yes		
The timeframe of the LAD Scheme may not have been long enough to allow for		D6; D8			Yes	

	Source					
Theory of no change hypotheses (barriers to delivery)	**HH Survey**	**LA survey**	**Inst survey**	**Qual Phase 1**	**Qual Phase 2**	**Desk research**
the installation of some measures that people wanted but which take longer to install						
There were unanticipated challenges for which LAs did not have sufficient time to react which impacted on their capacity to complete installations					Yes	
The procurement of installers and delivery partners was blocked, the procurement activities were not clear, resulting in LAs deciding against going ahead with installations		C7			Yes	
LAs						
There was insufficient time to engage households					Yes	
LAs had insufficient time and/or resources to request changes for the measures installed under LAD or the types of households/buildings targeted					Yes	

	Source					
Theory of no change hypotheses (barriers to delivery)	**HH Survey**	**LA survey**	**Inst survey**	**Qual Phase 1**	**Qual Phase 2**	**Desk research**
LAs did not apply to participate in LAD						Portfolio analysis
LAs who contracted delivery partners find that their delivery partners are not delivering LAD effectively					Yes	
Delivering LAD takes more resources than what LAs were allocated to by BEIS		G2			Yes	
LAs/delivery partners find it difficult to identify and engage eligible households		E2; E3; E4; F2			Yes	
LAs find it difficult to find enough good quality installers for all or some of the measures		C4			Yes	
Application process for Phase 1A of the Scheme was challenging (timeframes, word counts, lack of support)	E1	B2, B3		Yes		
LAs have limited time to engage with new suppliers		B3; C5; C6		Yes	Yes	

	Source					
Theory of no change hypotheses (barriers to delivery)	**HH Survey**	**LA survey**	**Inst survey**	**Qual Phase 1**	**Qual Phase 2**	**Desk research**
LAs struggle to identify and engage landlords in their LAD-funded Schemes		E2; E3; E4; F2		Yes	Yes	
Delays with subcontractor contracts - insufficient time for subcontracting resulting in LAs deciding against installations		C7; F2		Yes	Yes	
Impact of COVID on LA resources leading to less capacity to run the Scheme	F2	F2		Yes	Yes	
Monitoring data requirements in the application process are complex and significant, can have an impact on smaller LAs and put off LAs from applying		B3		Yes		
Challenges when working with Local Energy Hubs (e.g. difficult coordination/communication with Hubs leading to delays to Phase 2 delivery and delays in decision making due to project		C9; C10			Yes	

	Source					
Theory of no change hypotheses (barriers to delivery)	**HH Survey**	**LA survey**	**Inst survey**	**Qual Phase 1**	**Qual Phase 2**	**Desk research**
management structure)						
Installers						
Installers do not have capacity to deliver installations for both GHG LAD and Vouchers	E3	C7; F2		Yes	Yes	
Some measures offered initially to households by LAD cannot be offered due to property characteristics. This leads to the household not receiving an installation or getting an alternative measure installed				Yes		
Installers are unable to install the measures requested by households (e.g., during property checks) due to property characteristics/being outside of the scope of the Scheme				Yes		
Concerns around payment - some installers were expecting money				Yes	Yes	

	Source					
Theory of no change hypotheses (barriers to delivery)	**HH Survey**	**LA survey**	**Inst survey**	**Qual Phase 1**	**Qual Phase 2**	**Desk research**
upfront and therefore they delay the installation or do not install the measure at all						
Monitoring data commitments can put off new installers with no prior experience of working with similar Schemes				Yes	Yes	
Weather conditions/seasonality impacting ability to conduct installations		F2		Yes	Yes	
Lack of confidence in the Scheme/lack of long-term visibility leading to low willingness to employ new installers and train staff				Yes	Yes	
Delays when working with LAs - delays receiving customer details and collecting paperwork, leading to delays in installations or impossibility to install measures as paperwork is incomplete	E1			Yes	Yes	
Impact of COVID on installers availability	F2			Yes	Yes	

	Source					
Theory of no change hypotheses (barriers to delivery)	**HH Survey**	**LA survey**	**Inst survey**	**Qual Phase 1**	**Qual Phase 2**	**Desk research**
(some going back to other countries, if they were not from the UK)						
Resource issues due to COVID (illness)	F2			Yes	Yes	
Increase of wages of installation staff mean that installer companies (employers) are unable to employ more installers to carry out installations and have to therefore deliver less installations				Yes		
Cost of participating in the Scheme too high e.g., to get accreditation, upgrade infrastructure, hire additional staff. Installers do not partake in LAD as a result, decreasing capacity to implement LAD.			C1 (first wave)		Yes	
Installers are new to the market or new to particular measures and lack confidence					Yes	

	Source					
Theory of no change hypotheses (barriers to delivery)	**HH Survey**	**LA survey**	**Inst survey**	**Qual Phase 1**	**Qual Phase 2**	**Desk research**
to get involved in Scheme						
Installers do not know how to get involved in Scheme, particularly if no experience of working with LAs before					Yes	
PAS 2035/TrustMark						
Tight timeframes and Phased approach for LAD may have impacted installers' willingness to gain accreditation				Yes	Yes	
Installers unsure of whether they have to be TrustMark to take part in the Scheme				Yes	Yes	
Investments required to set up PAS 2035 are too high compared to the expected benefits of getting it. Installers decide not to get the certification, which decreases the pool of suitable installers for LAD.			C8, C9 (first wave)	Yes	Yes	
Some installers did not register for PAS2035 as they did not see the value of it			C10 (first wave)		Yes	

	Source					
Theory of no change hypotheses (barriers to delivery)	**HH Survey**	**LA survey**	**Inst survey**	**Qual Phase 1**	**Qual Phase 2**	**Desk research**
(e.g., Impact of the certification on the quality of installations), reducing the pool of suitable installers for LAD						
Supply chain / availability of materials						
Waiting times for materials and labour committed to other Schemes mean there is less capacity to carry out installations under GHG LAD		F2		Yes		
Lack of manufacturing capacity due to COVID means there is less capacity for installations	F2			Yes	Yes	
COVID and Brexit leading to changes on the labour market, means less capacity for installations	F2	F2		Yes	Yes	
Material delivery delays due to Brexit and COVID, means there are not enough materials to carry out installations	F2	F2		Yes		
Material price increases,		F2		Yes	Yes	

	Source					
Theory of no change hypotheses (barriers to delivery)	**HH Survey**	**LA survey**	**Inst survey**	**Qual Phase 1**	**Qual Phase 2**	**Desk research**
discouraging stakeholders (HH, LAs) to go for installations						
The market is still very new, and its supply chain still immature - resulting in not enough installers/materials to carry out installations					Yes	
Households						
Coverage of LAD on private rented housing may be limited	D4					
Challenges engaging households, leading to fewer households engaged in the Scheme and fewer EE measures installed	C5; F1	F2		Yes		
Impact of COVID on household engagement (e.g., changes in engagement techniques; households uncomfortable) leading to impossibility to raise awareness of the	D4; F1; F2	F2		Yes		

	Source					
Theory of no change hypotheses (barriers to delivery)	**HH Survey**	**LA survey**	**Inst survey**	**Qual Phase 1**	**Qual Phase 2**	**Desk research**
Scheme, generate trust among households, and carry out eligibility checks, leading to less measures installed						
Tight timeframes leading to low credibility and trust (due to less comms/engagement activities with households), leading to less people accepting measures	C5			Yes		
Lack of trust in LAs among some vulnerable groups meant they were unwilling to install EE measures	C5			Yes		
Vulnerable people being targeted by the Schemes may already be in crisis and difficult to engage as heating their homes may be low on their list of priorities	I1			Yes		
Mistrust between tenants and landlords is driving some	C5				Yes	

	Source					
Theory of no change hypotheses (barriers to delivery)	**HH Survey**	**LA survey**	**Inst survey**	**Qual Phase 1**	**Qual Phase 2**	**Desk research**
tenants to refuse to participate						
Retrofit would have negatively affected elements of their home set up to address accessibility needs	C5; E5; F3					
Disruptions caused by installations may put households off (especially elderly people)	C5; F3			Yes		
Running similarly named Schemes at the same time can cause confusion among households and some may miss out on benefitting from installations	D4			Yes		
Households unsure about the benefits of the measure offered or suitability of it	C5; E4; E5			Yes		
Misunderstandings about the measures that can be installed - Household expecting to receive a certain measure installed but installers being unable to carry out the installation due to				Yes		

	Source					
Theory of no change hypotheses (barriers to delivery)	**HH Survey**	**LA survey**	**Inst survey**	**Qual Phase 1**	**Qual Phase 2**	**Desk research**
property characteristics or measure outside of the scope of the Scheme						
Concerns about compliance with park home contracts leading to park home households being sceptical about getting an installation done	E5; F1			Yes		
Lack of awareness of the Scheme mean households do not trust the Scheme and do not accept installations	D4; E5			Yes		
Lack of awareness of energy efficiency mean households do not see the need to have EE measures installed and therefore do not accept installations	C5; E5; F1			Yes		
Bureaucracy and checks making recruitment difficult, leading to less households engaged and less EE measures installed	C5; D4; E1; E4; E5			Yes		

	Source					
Theory of no change hypotheses (barriers to delivery)	**HH Survey**	**LA survey**	**Inst survey**	**Qual Phase 1**	**Qual Phase 2**	**Desk research**
Landlords						
LAs struggle to identify and engage landlords		D2		Yes	Yes	
Unable to make top-up payments / not economical for them to do so					Yes	
Concerns about disruption to tenants					Yes	
Measures made available to them would not bring property up to minimum EPC standards for renting and would require extra work					Yes	

Annex 10: Detailed methodology for the modelled fuel poverty analysis

This method was used to calculate fuel poverty status for households pre and post-installation in June 2023, as scheme data was not available at the time. After the analysis was conducted scheme data was updated and DESNZ decided to rerun the analysis using EPCs verified from the EPC register as this was felt to be more reliable than using modelled data. Please see Annex 16 for the updated method used.

One of the aims of the Green Homes Grant Schemes was to reach households who may be struggling to afford to adequately heat their homes, either because they have low incomes, energy inefficient homes, or a combination of the two (fuel poor households).

The LAD Scheme aimed to help take low-income families out of fuel poverty by reducing energy bills and improving the energy efficiency of their home. The objectives of the LAD and GHG-Vouchers Schemes were similar, although LAD focused specifically on the least efficient housing and on households most at risk of fuel poverty.

To measure scheme outcomes for targeting fuel poor households and moving them out of fuel poverty, BRE developed the following method to model these. This was then built on by subsequent DESNZ analysis using the household income status derived from householder survey data, combined with verified pre and post-installation EPC data, to produce the final findings for these outcomes. This subsequent analysis is explained in more detail in Annex 16.

Verified EPC data from the EPC register was used to derive the fuel poverty figures included in the final report. Modelled EPCs were also used for estimating the energy, carbon and financial savings associated with individual and combinations of GHG improvement measures and to estimate the fuel poverty status of household survey cases for the purposes of comparing the responses of fuel poor and non-fuel poor households.

The fuel poverty status of householder survey respondents was modelled rather than based on verified EPCs for two reasons: Primarily because verified EPC data was not available at the time of the analysis. However, in addition, the sample size was much greater using the modelled EPC data rather than the verified EPC data. Of the 2,230 households for whom the after-housing cost income was provided, BRE were able to model the fuel poverty status of 2,005 (90%), compared with 1,055 (47%) using the verified EPC data.

10.1 Phase 1 – Pre-installation fuel poverty status

To help to understand whether the Scheme has been successful in reaching fuel poor households, for Phase 1 of the Fuel Poverty analysis BRE modelled the proxy Fuel Poverty status of households who successfully applied for the Scheme.[22]

BRE combined data collected through LAD Scheme and EPC data (where available) with their proprietary SAP stock model, in order to estimate the likelihood of a household being in fuel poverty prior to the installation of dwelling improvement measures through the Scheme. More information on how the LAD data was modelled is given below. A full list of the data sources used for model inputs is also included below.

10.1.1 Methodology

The current definition of Fuel Poverty being used in England is the Low Income, Low Energy Efficiency (LILEE) metric. Under this definition, households are fuel poor if:

1. They have a Fuel Poverty Energy Efficiency Rating (FPEER)[23] of band D or below;
2. The household income after housing costs and fuel costs falls below a set income threshold (defined as 60% of the national after-housing-cost (AHC) equivalised income).

The proxy fuel poverty indicator comprises of two components: (i) the income of the household and (ii) the energy efficiency rating of the dwelling. If a household falls below both the income threshold (defined as 60% of the AHC equivalised income[24]) and the modelled energy efficiency threshold (defined as EPC band D or below), then they are flagged as likely to be fuel poor. The energy efficiency threshold of band D or below has been chosen to align with the LILEE fuel poverty definition, whilst still providing a good proxy of whether a household has high fuel bills, as defined under the Low Income, High Cost (LIHC[25]) fuel poverty definition.

10.1.1.1 Derivation of Income

The householder survey collected income information which was used to calculate the household's equivalised AHC income. This measure was only considered for applicants who

[22] For Phase 2 of the fuel poverty analysis, BRE modelled the direct effects of the GHG-VOUCHERS installation measures on the fuel poverty status of households in order to quantify how many households would be expected to be taken out of fuel poverty as a direct result of the energy measures funded by GHG-VOUCHERS. The Phase 2 modelling approach and findings are covered later in this report.
[23] The FPEER methodology is based on the Government's Standard Assessment Procedure (SAP) for assessing the energy performance of domestic properties while taking into account the impact of policy interventions (e.g., Warm Homes Discount) that directly affect household energy costs. Like SAP, the methodology gives an energy efficiency rating from 0 (lowest) to 100 (highest). This rating can be translated into an energy efficiency 'Band' from G (lowest) to A (highest), rather like the SAP rating being used to generate an overall energy efficiency Band (again from G to A) for Energy Performance Certificates (EPCs). As a general rule, the EPC band will be a good proxy for the FPEER band.
[24] AHC means 'income after housing costs.' Housing costs include mortgage and/or rent on the property. Equivalisation is an adjustment to take into account variations in the size and composition of the household.
[25] The Low-Income High Costs (LIHC) indicator is a measure of fuel poverty in which a household is considered to be fuel poor if: (a) They have required fuel costs that are above average (the national median level); and (b) Were they to spend that amount, they would be left with a residual income below the official poverty line. The LIHC definition is a relative indicator as it compares households to the national median fuel costs and income – thereby reflecting contemporary trends.

were responding to the survey in relation to an application for a property in which they lived. This resulted in a total of 2,971 participants being asked about AHC income.

Respondents who had applied for measures for the property in which they lived were asked to estimate the amount of money they have left after accounting for housing costs. They were asked whether their household income after housing costs was above or below a threshold which was based on the number of children (aged 13 or younger) and adults (aged 14 and over) in the household. The threshold[26] was calculated as follows, based on 2018 household incomes:

Income threshold = 13,927[27] x (0.58 + (0.42 x (number of adults in household – 1)) + (0.2 x number of children in household))

The calculation was embedded in the survey script and fed in the appropriate income threshold into the relevant question. The question asked:

[If household owns property with mortgage/Once your household has paid your mortgage] [If household part rents/part owns property (shared ownership)/Once your household has paid your mortgage and the rental on your property] [If household rents property (private or social rent)/Once your household has paid your rent] [All others/Once your household has paid any housing costs], would you say the money you have left each month is more than <threshold >, or less than this?

741 (25%) of all respondents to the applicant surveys did not provide an AHC income. Overall, this resulted in AHC income being available for 2,230 households.

10.1.1.2 Derivation of Modelled Energy Efficiency Rating

BRE modelled dwelling Energy Efficiency Rating for each of the households surveyed (prior to and following any installations through the Scheme), following the RdSAP[28] methodology. This is the same method used in the creation of EPCs. The modelling has allowed for an SAP rating to be calculated which can then be converted into an EPC band, between A and G, for each dwelling in the sample, even for dwellings where EPC data was not available. Within the SAP band ratings, A represents very low fuel cost (high energy efficiency), and G represents very high fuel costs (low energy efficiency). Dwellings with a modelled EPC band of D or below will be classed to have a 'low energy efficiency,' and occupants living in these dwellings were flagged as likely to be fuel poor if their income also fell below the income threshold. Since the rating here was based on RdSAP rather than a true Fuel Poverty Energy Efficiency Rating (FPEER) rating, it did not take into account the impact of policy interventions (e.g., Warm Homes Discounts), potentially leading to a small number of households being classed as fuel poor that would not have been if such policy interventions were able to be taken into account in the calculations.

[26] Fuel poverty uses equivalised income with factors consistent with the Department for Work and Pension poverty analysis. This reflects that a large household will need a larger income to service the same level of costs.
[27] 60% of the AHC Income in the 2018 dataset.
[28] A Reduced data version of a standard SAP calculation, Reduced data SAP (RdSAP).

To perform a true RdSAP (EPC) calculation, a lot of detailed information regarding the physical characteristics of the dwelling and energy efficiency measures is required. It was not possible to acquire this level of information for all dwellings being improved as part of LAD Scheme. Pre and post improvement EPC data was not available for all dwellings and there was limited information available regarding the physical characteristics of some dwellings. BRE have therefore used their 'Simple SAP' stock model to produce SAP ratings.

The 'Simple SAP' stock model consists of two separate models: the BRESMI model and the Baseline model. The BRESMI model allows for an RdSAP calculation to be performed with much fewer inputs than would be normally required, by utilising in-built imputation procedures. The Baseline model applies statistical modelled distributions to infer building characteristics, where key inputs are unknown. This modelling approach was employed for both the GHG-Vouchers and LAD Schemes to ensure a dwelling energy efficiency and fuel poverty status could be calculated for as many of the participating households as possible.

Despite the various sources of input data, some of the critical data inputs were not available for households where no EPC data was available. Where data was missing, BRE's model (the Baseline model) imputed the values using statistical modelling techniques (see Imputation methodology section below for more details). This imputation process uses data from the English Housing Survey, Experian, ONS and other data to determine the likely distribution of building characteristics, given a specific dwelling archetype and geographical location. The scale of this imputation is discussed in the 'assumptions and limitations' section.

After all the required data inputs were collated or imputed for each household in the sample, an RdSAP calculation was performed to determine the dwelling's modelled EPC band.

Of the 2,230 households for whom the AHC income was assessed (i.e., excluding those not providing a valid answer to the AHC income questions), there were only 225 properties for which it was not possible to model an SAP score. The lack of matching came about because it was not possible to match the Unique Property Reference Number (UPRN) for some properties and it was not possible to model some of the dwellings. This left a total sample of 2,005 households for which there was a valid after housing cost income figure and SAP rating.

10.1.1.3 Determining the Fuel Poverty status

The information collected from the householder survey on income was combined with the modelled EPC rating to create the proxy Fuel Poverty status. If a household had an equivalised AHC income of below the income threshold, and a modelled EPC band of D or below, then the household was classified as likely to be in fuel poverty.

As noted above, this is only a proxy fuel poverty status, which has been developed to represent the LILEE fuel poverty definition,[29] currently in use in England. Differences in the data collection process, the model used to calculate an EPC band, and the method of

[29] Due to the correlation between the energy efficiency of a dwelling and the associated cost for heating the property, this proxy indicator can also be used to represent the Fuel Poverty status under the previously used LIHC (Low-income, High Cost) definition.

combining income and energy efficiency metrics, means that the actual fuel poverty status of each household (were it to be calculated using the official LILEE method) may differ slightly. However, despite the slight differences, EPCs are a very good proxy for FPEER ratings.

Of the 2,230 households for whom the AHC income was provided, the fuel poverty status of 2,005 households could be calculated.

10.1.2 Methodological assumptions and limitations of the evidence

10.1.2.1 Imputation methodology

Up-to-date pre and post installation EPC data was not available for the majority of the LAD dwellings at the time of analysis. It was therefore necessary for BRE to model the energy efficiency of the dwellings using the BRESMI model described in the section 'Derivation of Energy Efficiency Rating' above. Where data was not available for certain dwelling characteristics, these needed to be imputed using baseline data which was based on population distributions. Where EPC data was available, these data were used as inputs into the BRESMI model (see Table 18).

10.2 Phase 2 – Post-installation fuel poverty status

10.2.1 Methodology

The statutory fuel poverty target, set in December 2014, has a clear focus on improving energy efficiency to mitigate fuel poverty where it exists. The target is to ensure "that as many fuel poor homes as is reasonably practicable achieve a minimum energy efficiency rating of Band C, by 2030"[30]. Improving the energy efficiency of dwellings was a key objective of both GHG Schemes.

The main aim of the Phase 2 analysis was to quantify the direct effects of the GHG installations on the energy efficiency of the dwellings and the fuel poverty status of households. Specifically, the analysis looked at how many households would be expected to be taken out of fuel poverty as a direct result of the energy efficiency improvement installations funded by the LAD Scheme (this analysis was also conducted for the GHG-Vouchers Scheme).

In order to isolate the effects of the GHG installation measures, other factors which influence a household's fuel poverty status such as changes in household composition, household income, fuel prices and any other changes to the dwelling were held constant for the purpose of the analysis. This approach was taken because the purpose of this analysis was to evaluate the direct influence of the LAD Scheme on fuel poverty status. Given the significant changes to the price of energy and the impacts of the pandemic over the period of this evaluation, it was especially important to focus the analysis on the impact of the Scheme itself without allowing other factors, which cannot be influenced by the Scheme, to obscure the results.

[30] Terms of reference - Committee on Fuel Poverty - GOV.UK (www.gov.uk)

The same BRESMI modelling methodology employed in Phase 1 to estimate the energy efficiency of the dwelling pre-installation was used to calculate the energy efficiency of each dwelling post-installation in Phase 2. The change in Fuel Poverty status was calculated for the same 2,005 cases that were modelled in Phase 1.

As set out in the 'Derivation of Energy Efficiency Rating' section above, to perform a true RdSAP (EPC) calculation, a lot of detailed information regarding the physical characteristics of the dwelling and energy efficiency measures is required. It was not feasible to acquire this level of information for all of the dwellings being improved as part of LAD Scheme and BRE have therefore used their 'Simple SAP' stock model (BRESMI) to produce SAP ratings. The BRESMI model allows for an RdSAP calculation to be performed with much fewer inputs than would be normally required, by utilising in-built imputation procedures.

The SAP ratings modelled by BRESMI were used to determine, for each household, whether it was in fuel poverty before the GHG-LAD installation and after. The analysis focused on the 2,005 households for which a fuel poverty status had been calculated at the pre-installation stage.

When assessing which households are in fuel poverty (using the LILEE definition), the households are divided into four quadrants, namely:

The LILEE quadrant - households with low income and low energy efficiency. Households where the income is below the threshold and where the Fuel Poverty Energy Efficiency (FPEER)[31] rating of their home is band D or below (these indicate households in fuel poverty).

The LIHEE quadrant - households with low income but living in a home with high energy efficiency. Households where the income is below the threshold but where the FPEER rating of their home is band C or above (although these households have low income, they are not deemed to be in fuel poverty by this measure because of their home's high energy efficiency).

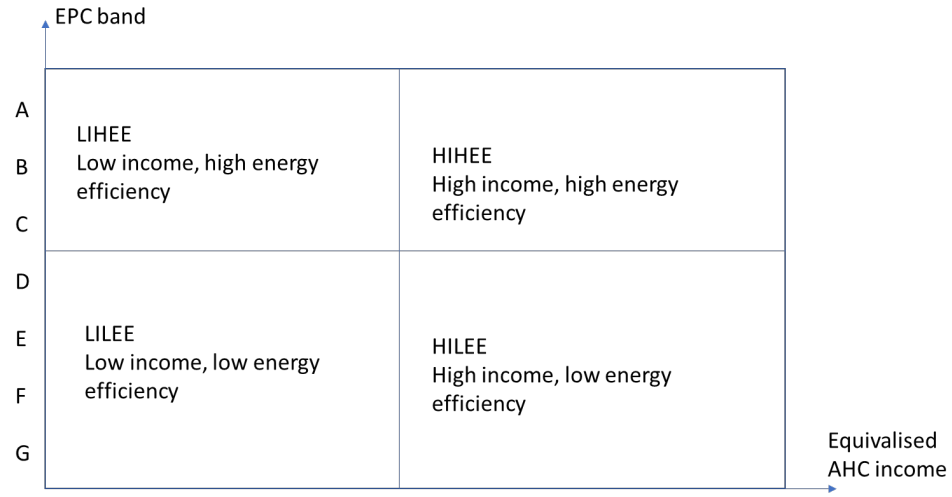
The HILEE quadrant - households with higher income and living in a home with low energy efficiency. Households where the income is above the threshold but where the FPEER rating of their home is band D or below (although these homes have low energy efficiency, households are not deemed to be in fuel poverty because of their higher income).

The HIHEE quadrant - households with higher income and living in a home with high energy efficiency. Households where the income is above the threshold and where the FPEER rating of their home is band C or above (these households are in the most favourable category and are not considered to be in fuel poverty as their homes have high energy efficiency and they have high income).

31 The fuel poverty energy efficiency rating (FPEER), is based on SAP, but accounts for the impact of policies which discount households' energy bills (e.g. the Warm Home Discount). For example, if a household has a band D Energy Performance Certificate (EPC) and they get a rebate deducted from their energy bill due to receipt of the Warm Home Discount, this could move them into an FPEER band C.

The quadrants associated with the LILEE method are shown below, together with their associated EPC bands and equivalised AHC income levels.

Figure 2. LILEE method associated quadrants



10.2.2 Limitations of the BRESMI modelling method

As noted above, one of the main benefits of the BRESMI model is that it requires far less detailed inputs for each dwelling characteristic than would be made using a full EPC survey. This enables BRE to model the energy efficiency of far more cases using limited information. As EPC data was not available for all dwellings before and after the improvements, therefore it was necessary to use the BRESMI modelling method.

Within BRESMI there are a limited number of pre-existing categories for each dwelling characteristic. These pre-existing categories ensures that less detailed input data is required. However, the Scheme measures installed did not always match the input categories available within BRESMI. This necessitated us applying a 'best fit' between the available Scheme data and the BRESMI categories when it came to recording the Scheme measures installed for the purposes of modelling the impact of the Scheme installations. In some cases, it was not possible to model the impacts of particular GHG measures as there were no corresponding BRESMI model inputs for these measure types.

In addition, it was not possible to model the energy savings when like-for-like measures were installed, for example, if old inefficient electric storage heaters were replaced with new storage heaters. As the relative efficiency of the old and new heating systems were not known it was not possible to quantify the savings these measures would achieve.

For these reasons it was not possible to model the impact of changes to the heating systems including heat pumps, biomass boilers, and storage heaters. It was also not possible to assess the impacts of energy efficient lighting, insulated doors, draughtproofing, underfloor insulation, on the energy efficiency of the building using BRESMI.

Overall, these limitations mean that for some dwellings the impacts of the measures installed will be underestimated by the model, as the impact of some measures cannot be modelled.

However, BRE were able to model the impact of the measures made for the vast majority of cases.

In addition, limited information was available regarding what energy performance measures were present prior the installations and exactly was installed as part of the scheme. For example, how much loft insulation was already present prior to the scheme, how much insulation was actually installed, and what materials were used. Based on the data available at the time and the categories available in the simplified model, BRE made assumptions regarding what was already present in the home and what was installed. These assumptions were based on the data available about the dwelling prior to the installations and were underpinned by EHS data on existing energy measures within the social housing stock. The discrepancy between the modelled findings and the published statistics suggests these assumptions may have been conservative for some measures. It is possible that these assumptions may have overestimated the energy efficiency of the homes before the installations and/or underestimated the impact of some measures.

As noted in 6.5 (Limitations of the energy and fuel poverty modelling approach), although the installation of PV does not influence the modelled energy demand figures, the model does take into account the impact of PV on the homes SAP score and therefore the installation of PV panels does also influence the change in fuel poverty status figures.

Table 18 below shows the number of each type of measure installed within the sample of cases being examined.

Table 18. Number of each type of measure installed

Type of Scheme measure	Number of households receiving measure	Could Scheme measure be modelled?
Roof insulation	460 [1]	yes
Wall insulation	540 [2] [3]	yes
Double or secondary glazing	101	yes
Heating controls	176	yes
Hot water tank insulation	6 [4]	yes
Solar thermal	7	yes
Photovoltaic installations	932	yes

Air source heat pumps	125	no
Hybrid heat pumps	38	no
Storage heaters	17	no
Underfloor insulation	54	no
Energy efficient doors	118	no
Draughtproofing	1	no

[1] for 9 cases, 2 roofs were insulated, so 469 measures in total. [2] for 12 cases, 2 walls were insulated and for 1 case 3 walls were insulated, so 554 measures in total. [3] park home insulation was assumed to have the same energy impact as cavity wall insulation or solid wall insulation. [4] hot water tank jackets were assumed rather than spray foam. 2,245 measures could be modelled out of 2,731 measures.

Of the 2,731 measures installed BRE were only unable to model of 486 measures, meaning the impacts of 82% of the installation measures could be modelled.

For a few installation measures, the BRESMI input categories did not exactly match the measures made so some had to be adapted, for example, whenever roof insulation was installed through the Scheme, the final level of insulation was assumed to be the equivalent of 250 mm of mineral wool or higher, as this was the highest level of insulation that could be inputted into the BRESMI model. Secondary glazing was assumed to have the same impact as replacement double glazing. Where hot water tank insulation was installed, it was assumed to be equivalent to a hot water tank jacket. Where double or secondary glazing was installed, it was assumed to apply to every window.

For this reason, i.e., because of the inexact matches between the format of the BRESMI input and the measures data, and because of some of the assumptions about the final level of insulation etc. installed, the saving reported should be treated as estimated changes in SAP ratings.

10.2.3 Fuel prices

When modelling the changes to the SAP rating of the dwelling and the fuel poverty status of the households, two sets of fuel prices were used, the standard fuel prices taken from Table 12 of SAP 2012 and updated 2021 fuel prices (see Table 19 in Annex 11).

The fuel poverty status calculated for the breakdowns of the household survey responses were based on the standard SAP 2012 fuel prices. The fuel prices used for the energy, carbon and

bill saving modelling were based on 2021 average fuel price figures. 2021 fuel prices were used for this analysis as these were the latest figures available at the time of analysis and most closely matched the time period in which the measures were installed. Thereby enabling us to quantify the impact of the measures at the time they were installed. Table 19 in Annex 11 shows the fuel prices used and sources for the fuel price data.

10.3 Data Sources used for model inputs

The table below shows the inputs required for the BRE BRESMI model to calculate an EPC rating for a particular dwelling, alongside the datasets and their priority used to inform the input values, if a dataset is not in a given row for a variable, this usually means information on that variable was missing in that dataset. For the evaluation of the LAD Scheme, data from the following sources were available to use as part of the modelling process:

- Data collected by LAD administrators ('Scheme data')
- TrustMark
- Energy Performance Certificates
- Applicant Surveys

Where there were differences in the data collected through the above sources, the data from some datasets were prioritised over others, based on perceived accuracy of the data collection method and when the data was collected. Generally, EPC data (where available) was considered the most trustworthy. However, for some variables, the hierarchy changed, based on reviewing the data available from the data sources for each of the key modelling inputs. For example, for household tenure it was felt that the householder's self-reported tenure (collected via the householder survey) was likely to be the most up-to-date and reliable source.

Where no data were available from any of the above sources, values were imputed using BRE's imputation model. This imputation process uses data from the English Housing Survey and other external data sources to determine the likely distribution of energy efficiency measures and building features, based on key characteristics of the property and geographical location.

Table 19. EPC modelling input data sources for LAD Scheme analysis

Model Input Variable	Primary Data Source	Secondary Data Source	Tertiary Data Source
Tenure	Applicant Survey	Scheme / TrustMark	
Dwelling Type	EPC	Applicant Surveys	
Dwelling Level	EPC		

Model Input Variable	Primary Data Source	Secondary Data Source	Tertiary Data Source
Dwelling Age	EPC	Scheme / TrustMark	Applicant Surveys
Number of Storeys	Scheme / TrustMark	EPC	Applicant Surveys
Number of rooms	EPC	Scheme / TrustMark	
Loft Insulation	Scheme / TrustMark	EPC	Householder Surveys
Wall Type	EPC	Scheme / TrustMark	Householder Surveys
Wall Insulation	Scheme / TrustMark	EPC	Householder Surveys
Double Glazing	Scheme / TrustMark	EPC	Householder Surveys
Main Heating System	Scheme / TrustMark	EPC	Householder Surveys
Type of Boiler	Scheme / TrustMark	EPC	Householder Surveys
Main Heating Fuel	EPC	Scheme / TrustMark	Householder Surveys
Main Heating Controls	Scheme / TrustMark	EPC	Householder Surveys
Water Heating	Scheme / TrustMark	EPC	Householder Surveys
Hot water tank insulation	Scheme / TrustMark	EPC	Householder Surveys
Solar hot water panels	Householder Surveys	EPC	
Photovoltaic Solar panels	Householder Surveys	EPC	
Floor area	EPC	Scheme / TrustMark	

Annex 16: Detailed updated DESNZ EPC Outcome and Fuel Poverty Proxy Methodology

After BRE completed the EPC modelling in Annex 11 and Fuel Poverty proxy modelling in Annex 10, the volume and quality of pre-and post-installation LA-reported EPC data for the scheme, and the corresponding number of registrations to the EPC register, substantially improved.

This enabled DESNZ to produce a sample of households that had these EPCs verified against the EPC register, and commission a piece of internal analysis using these to build on BRE's analyses and generate revised figures for the following scheme outcomes:

- The proportion of households which received installations which were low Energy Efficiency (EPC Band D or below)
- Changes to household SAP scores and EPC ratings as a result of the installation.
- The average SAP scores and EPC ratings of properties before and after installation.
- The proportion of households likely to be in Fuel Poverty before installation.
- The proportion of households moved directly out of likely Fuel Poverty as a result of the installation.

This analysis was conducted by Hugo Massiot (DESNZ Economic Advisor, Fuel Poverty Analysis team) and was quality assured by Aydin Sandalli (DESNZ Fuel Poverty Analyst, Fuel Poverty Analysis team).

The following sections detail the methods used to iterate on BRE's existing methods to generate each finding.

16.1. Generating verified household EPCs from the EPC register

The DESNZ Official Statistics teams used both property UPRNs and addresses from the LA-reported scheme data to match and extract the following property-level data from the EPC register[32] to November 2022, and append it to the scheme data:

- **EPC register SAP score – Pre-installation.** Defined as the most recent EPC score in the register (if any) within the past 5 years, dated before the LA-reported date of installation completion.

[32] https://epc.opendatacommunities.org/

- **EPC register SAP score – Post-installation.** Defined as the most recent EPC score in the register, dated on or after the LA-reported date of installation completion. Cannot exist without a valid Pre-installation SAP score.

They also provided EPC band conversions from these SAP scores. Any properties in the scheme data that did not have both pre-installation and post-installation SAP scores available from the register were eliminated. This left a functional sample of **21,644 properties** with verified EPC scores.

16.2. Low Energy Efficiency targeting, and Changes to household EPC ratings as a result of the installation

DESNZ used descriptive statistics of these revised EPCs and SAP score to generate outcome measures for:

- The proportion of households which received installations which were low Energy Efficiency (EPC Band D or below)
- Changes to household SAP scores and EPC ratings as a result of the installation.
- The average SAP scores and EPC ratings of properties before and after installation.

Table 20. *EPC register Matrix for all properties with verified EPCs*

		Post-installation		
		High EE	**Low EE**	**Total**
Pre-installation	**High EE**	1,070	0	**1,070**
	Low EE	10,705	9,869	**20,574**
	Total	**11,775**	**9,869**	**21,644**

Low EE hit rate	95%
Share of low EE to High EE	**52%**

As with BRE's analysis, the EPC data for this sample (n=21,644) was then combined with household income data to revise the Fuel Poverty proxy modelling analysis.

16.3. Fuel Poverty Proxy – creating the sample

DESNZ took the evaluation's household survey data that contained BRE's original 'low income' flag from their Fuel Poverty proxy analysis (n=2,005 households) and appended the verified

pre and post-installation EPCs where known. 950 of these households did not have verified EPCs, reducing the functional sample size for this analysis from 2,055 to 1,055.

Table 21*: Verified EPC Matrix for LAD Fuel Poverty proxy sample with income data (n=2,005)*

End / Start	High EE	Low EE	No EPC matched	Total
High EE	27	0	0	**27**
Low EE	529	499	0	**1,028**
No EPC matched	0	0	950	**950**
Total	**556**	**499**	**950**	**2,005**

Low EE hit rate	97%
Share of low EE to High EE	**51%**

We obtained a proportion of low EE homes upgraded to C High EE of 51% for this sample, noting that:

- This is very similar to the overall EPC outcome findings in the previous section (52%), indicating this sample is less likely to be skewed despite reducing in size from 21,644 to 1,055.
- This is lower than the comparable proportion in the Official Statistics (58%), which are derived purely from the LA-reported EPCs without being verified against the EPC register.

We obtained a Low Energy Efficiency 'hit rate' of 97% for this sample, noting that:

- This is again similar to the hit rate in the previous section (95%), indicating this sample is less likely to be skewed, although may very slightly overstate the targeting outcome for Fuel Poor homes.
- This is slightly lower than the comparable proportion in the Official Statistics (100%).

16.4. Fuel Poverty Proxy – measuring fuel poverty status

We generated an updated version of BRE's fuel poverty flag for the new sample (n=1,055), based on identical definitions under LILEE, after some quality assurance in section 16.5 below. The results of this analysis are below in Table 22.

Table 22*: Fuel poverty matrix of sample with verified EPCs (n=1,055)*

End / Start	Non-FP	FP	Total
Non-FP	232	0	**232**
FP	425	398	**823**
Total	**657**	**398**	**1,055**

Fuel poverty hit rate	**78%**
Fuel poverty reduction	**52%**

The low EE hit rate is 97% in this reduced sample (n=1,055), compared with 95% for the larger more representative sample for the EPC outcomes analysis (n=21,644). Properties at EPC Band C+ pre-installation cannot be in fuel poverty, so to control for this difference we scaled the overall fuel poverty hit rate outcome proportionately down from 78% to **76%**

Table 23*: Summary of key EPC and Fuel Poverty outcomes from revised DESNZ analysis*

	Low EE hit rate	Fuel poverty hit rate	Low EE upgraded to High EE	FP reduction %
Register-verified EPCs (Fuel Poverty proxy sub-sample)	97%	78%	51%	52%
Register-verified EPCs (Overall sample)	95%	76%		

This analysis has an identical fuel poverty targeting 'hit rate' (76%) to the BRE-modelled results. We expected this similarity to the BRE modelled findings - the hit rate is mostly driven by income (as almost all household are Low Energy Efficiency before installations), and both estimates use the same evaluation household survey income data.

The findings differ much more substantially on the proportion of households moved directly out of fuel poverty reduction (52% compared with 19% for the BRE modelling). This is driven specifically by the divergence in post-installation EPCs – the verified SAP scores from the EPC register have a much greater proportion of properties at EPC Band C or higher post-installation that those generated by BRE's model.

Following a methods review between DESNZ and BRE, we agreed the main reason for this divergence is that the BRE model is fairly conservative on the impact of insulation measures, and excludes low carbon heating measures entirely. We are unable to further test the accuracy of the SAP scores awarded to treated properties through the EPC registration process, so must take these as the most accurate measure of Energy Performance available.

16.5. Fuel Poverty Proxy – Quality Assuring the Low Income flag

As described in earlier sections, the evaluation survey household income data includes a simple monthly income threshold and a yes/no response on whether the household is earning below this threshold. To verify BRE's original calculations for the low income flag, used as the basis for this revised fuel poverty proxy analysis, we re-calculated the income threshold for all 2,389 households with income data, and classified each as low income or high income.

Each threshold was calculated by applying the same formula BRE used for Equivalised Income threshold:

Income threshold = 13,927[2] x (0.58 + (0.42 x (number of adults in household – 1)) + (0.2 x number of children in household))

We used the mid-point of the gross income band reported by each household, inflated it to 2023 prices, and subtracted income tax, national insurance, average housing cost for the household size[33] and average fuel cost for the household size[34].

From this analysis we found that 78% of households for which data is available are classified as having a low income After Housing Costs, versus 81% from BRE's original calculations. This was sufficiently similar for us to use the BRE low income flag in the revised analysis.

Table 24*: Income classification of households – QA results*

	Calculated threshold and net income (All household survey data with incomes)		BRE low-income flag (BRE fuel poverty proxy sample)	
High Income	525	22%	385	19%
Low Income	1,864	78%	1,620	81%
Total	2,389		2,005	

The small gap can be explained by several factors:

- If some households inaccurately responded to the survey question "Is your income higher than £x", this may have led to BRE slightly over-estimating the share of low-income households, and therefore the fuel poverty hit rate.
- Our adjustments made for housing costs and energy costs are rough approximations. We may have underestimated these costs for certain households.

[33] Estimated from ONS rental market statistics
[34] Modelled for LAD-eligible households internally using the National Buildings Model (2023)

As the findings are very similar, we concluded that BRE's method for calculating the fuel poverty threshold could not explain the divergence between their original modelled fuel poverty outcomes, and those produced from DESNZ's updated analysis.

Appendix 1: Pre and Post-installation EPC Matrix - All EPCs verified with Register

End / Start	A	B	C	D	E	F	G	Unknown
A	125	0	0	0	0	0	0	0
B	2	153	0	0	0	0	0	0
C	19	53	718	0	0	0	0	0
D	186	1,406	4,739	3,037	0	0	0	0
E	64	674	2,821	3,983	887	0	0	0
F	14	145	517	699	485	283	0	0
G	0	29	110	187	128	104	76	0
Unknown	0	0	0	0	0	0	0	12,580

Appendix 2: Pre and Post-installation EPC Matrix - Fuel Poverty Proxy sub-sample

End / Start	A	B	C	D	E	F	G	Unknown
A	0	0	0	0	0	0	0	0
B	0	2	0	0	0	0	0	0
C	1	0	24	0	0	0	0	0
D	4	71	228	133	0	0	0	0
E	5	34	144	199	46	0	0	0
F	1	11	28	51	28	10	0	0
G	0	1	2	15	11	6	0	0
Unknown	0	0	0	0	0	0	0	950

Appendix 3: Pre-installation Fuel poverty quadrant - Fuel Poverty Proxy sub-sample

	Low Cost	High costs	Total
High income	2	205	207
Low income	25	823	848
Total	27	1028	1055

	Low Cost	High costs
High income	0.2%	19.4%
Low income	2.4%	78.0%

Appendix 4: Post-installation Fuel poverty quadrant - Fuel Poverty Proxy sub-sample

	Low Cost	High costs	Total
High income	106	101	207
Low income	450	398	848
Total	556	499	1055

	Low Cost	High costs
High income	10.0%	9.6%
Low income	42.7%	37.7%

Annex 11: Energy, carbon, and financial savings – modelling methodology

The LAD Scheme aims to:

- Raise the energy efficiency of low energy performance homes (i.e., those with energy performance certificate (EPC) ratings of D, E, F or G).
- Tackle fuel poverty by reducing energy bills and making homes more energy efficient for low-income households
- Delivering cost effective carbon savings to carbon budgets and progress towards the UK's target for net zero by 2050.

In order to quantify the extent to which the Scheme achieved these aims BRE modelled the energy, carbon and financial savings associated with the improvements installed as part of the Scheme. To quantify the direct effects of the GHG measures and only the Scheme measures, BRE controlled for any other changes to the dwelling that were not a result of the funded improvement. It was especially important to focus the analysis on the impact of the Scheme itself without allowing other factors, which cannot be influenced by the Scheme, to obscure the results.

The same BRESMI modelling methodology employed to estimate the energy efficiency of the dwelling pre-installation was used to calculate the energy efficiency of each dwelling post-installations.

As set out in the 'Derivation of Energy Efficiency Rating' section above, to perform a true RdSAP (EPC) calculation, a lot of detailed information regarding the physical characteristics of the dwelling and energy efficiency measures is required. It was not possible to acquire this level of information for all dwellings being improved as part of LAD and GHG Voucher Schemes. There was limited information available regarding the physical characteristics of some dwellings and BRE have therefore used their 'Simple SAP' stock model to produce SAP ratings for each dwelling before and after the improvements. The 'Simple SAP' stock model consists of two separate models: the BRESMI model and the Baseline model. The BRESMI model allows for an RdSAP calculation to be performed with much fewer inputs than would be normally required, by utilising in-built imputation procedures.

To generate an SAP score, EPC rating, and annual consumption figures for the dwellings after the installations, the BRESMI model was updated for each dwelling to account for all the measures installed. Once all the dwelling characteristics were amended and updated to include the measures installed, the dataset was fed through the BRESMI tool for a second time. This enabled BRE to generate a post-installation SAP rating, EPC band, and estimate of the annual energy and carbon consumption for each dwelling before and after the installations.

Several months after the BRESMI modelling was completed, the volume and quality of LA-reported pre and post-installation data substantially increased, as did the number of registrations to the EPC register. This enabled DESNZ to produce a larger sample of properties with EPCs that we had verified as matching with records on the EPC register, and to conduct updated analysis on changes to property EPCs for this evaluation. This analysis replaced the BRESMI modelling in those instances. The main report describes where findings are taken from the DESNZ analysis, and when they are taken from BRESMI modelling. For more detail on the DESNZ analysis's methodology, please see Annex **16**.

11.1 Limitations of the BRESMI modelling method

See 10.2.2.

11.2 Sample

The energy, carbon and financial savings were calculated for the same sample used for the fuel poverty analysis. The analysis focused on the 2005 households for which a fuel poverty status had been modelled at the pre-installation stage. It was necessary to focus on this sample as household survey data was used as inputs for the energy efficiency modelling. Focussing on these cases also ensured that a complete and comprehensive dataset was available for this core sample of households including;

- Household composition, tenure, and income
- Dwelling characteristics of the property they live in
- Improvement measures installed
- Modelled energy efficiency rating (SAP and EPC) of the dwelling before and after the installations.
- Household fuel poverty status before and after the improvements
- Modelled energy savings resulting from the GHG improvement(s) made
- Modelled carbon savings resulting from the GHG improvement(s) made
- Modelled financial savings resulting from the GHG improvement(s) made
- Householder feedback on the Scheme and perceptions of the impacts it has had.

11.3 Annual energy consumption and carbon emissions modelling method

To estimate the annual energy consumption savings (kWh/yr) and carbon emissions savings (kgCO2e/yr) resulting from the packages of measures installed, BRE modelled the annual

energy consumption and carbon emissions of each dwelling twice, once before and once after the improvements were made.

First, a series of calculations are carried out to find the energy demand of the dwelling for each of the uses specified, for example space heating, water heating and lighting, based on the dwelling characteristics. As the fuel type used to meet each of these requirements can be different, each energy demand is then multiplied by the appropriate primary energy factor for the fuel being used to meet it. Summing the primary energy figures associated with each purpose then gives the total primary energy demand of the dwelling. Further detail on the method and the primary energy factors can be found in the following briefing note – Derivation and use of Primary Energy factors in SAP[35].

11.4 Energy bill saving modelling method

To estimate the annual energy bill savings (£/yr) resulting directly from the packages of measures installed, BRE modelled the annual energy bills for each dwelling before and after the improvements were made using the BRESMI model.

Assumed fuel prices assumptions.

The fuel prices used for the bill saving modelling were based on 2021 average fuel price figures. 2021 fuel prices were used as these were the latest figures available at the time of analysis and most closely matched the time period in which the measures were installed thereby enabling us to quantify the impact of the measures at the time they were installed.

Table 19 below shows the fuel prices used and sources for the fuel price data.

Table 25. 2021 fuel prices used for the bill saving modelling

	2021 price per kWh or 2021 annual standing charge	Sources
Standard electricity unit prices	£0.1890	QEP 2.2.4 averaged over the methods of payment, UK average
Standard electricity standing charges	£88.57	QEP 2.2.4 averaged over the methods of payment, UK average

[35] https://bregroup.com/wp-content/uploads/2019/10/Briefing-note-on-derivation-of-PE-factors-V1.3-01-10-2019.pdf

Economy 7-unit prices, on peak	£0.2205	QEP 2.2.4 averaged over the methods of payment, UK average
Economy 7-unit prices, off peak	£0.1110	QEP 2.2.4 averaged over the methods of payment, UK average
Economy 7 standing charges	£92.15	QEP 2.2.4 averaged over the methods of payment, UK average
Gas unit costs	£0.0342	QEP 2.2.4 averaged over the methods of payment, GB average
Gas standing charges	£99.00	QEP 2.2.4 averaged over the methods of payment, GB average
Heating oil	£513.69 per 1000 litres £0.0499 per kWh	Unpublished prices provided by BEIS, UK averages [a]
Bulk LPG unit prices	£0.4946 per litre £0.0676 per kWh	Sutherland Tables for October 2021, using Quarterly Energy Prices 2020 Annual Domestic Bills Estimates Supplement for calorific value [d]
Bulk LPG standing charges	£67.08	Sutherland Tables
Bottled gas	£0.1318 per kWh	Sutherland Tables
House coal	£21.243 per 50 kg £0.0578 per kWh	Unpublished prices provided by BEIS, UK average [b]
Smokeless fuel	£24.308 per 50 kg £0.0587 per kWh	Unpublished prices provided by BEIS [c]
Anthracite	Same as for smokeless	Use same prices as for smokeless fuel
Biomass	Same as for wood	Use same prices as for wood

Wood	£0.052	SAP 2012 price adjusted using Consumer Price Index

[a] to convert from price per 1000 litres to price per kWh, the price is multiplied by 1246, divided by 1000, divided by 46.19849 GJ/tonne and then, to convert from price/GJ to price/kWh, is multiplied by 0.0036.

[b] to convert from price per 50 kg to price per kWh, the price is multiplied by 20, then divided by 26.46058 GJ/tonne and then, to convert from price/GJ to price/kWh, is multiplied by 0.0036. 26.46058 is the calorific value of the fuel.

[c] to convert from price per 50 kg to price per kWh, the price is multiplied by 20, then divided by 29.8 GJ/tonne and then, to convert from price/GJ to price/kWh, is multiplied by 0.0036. 29.8 is the calorific value of the fuel.

[d] the price is the average over the six Sutherland Tables regions of South West and Wales, Midlands, South East England, North England, Northern Ireland, and Scotland.

Annex 12: Household survey profile

The following section outlines a profile of the household survey sample, as context for the analysis of this population in the main report.

12.1 Profile of households surveyed

Age distribution: The majority of respondents in participating households are likely to be older than younger. Just 6% of respondents were aged 16-34, compared to 48% being aged 35-64 and 45% being aged 65+.

Regions: Respondents are more concentrated in the South West (18%), South East (17%) and the North West (19%) than other parts of the country.

Work status: Of the chief income earner in the household, around half (44%) are retired, with a quarter (25%) being in full-time employment. 15% are employed part-time and one-in-ten 10% are not working.

Household income: Three quarters of respondents (73%) are earning under the LAD eligibility threshold of £30,000 per year, which includes 40% who are earning less than £16,000 per year. 6% claimed to be earning over the eligibility threshold in our survey.[36] When housing costs are taken into account, more than three-in-five (60%) are from low-income households.

Payment methods: Most (81%) of those who had an installation in the property they reside in pay their energy bills by direct debit. Just one-in-ten (10%) are on a pre-payment meter (rising to 22% among 16–34-year-olds).

Additional support: More than half (58%) of respondents who had an installation in the property they occupy receive help with their energy bills. Just over half (51%) are on means tested benefits and more than two-in-five (44%) have someone in their household who is living with a long-standing illness, disability, or infirmity.

Occupancy: Nearly half (47%) of respondents live in households with two to three occupants, although more than a third (37%) are from single occupant households. Reflecting the general age profile of respondents, most (84%), do not have children living with them whilst 7% have children under five and 13% have children between the age of five and thirteen. Almost half of respondents (48%) have at least one person over the age of 65 living in their household.

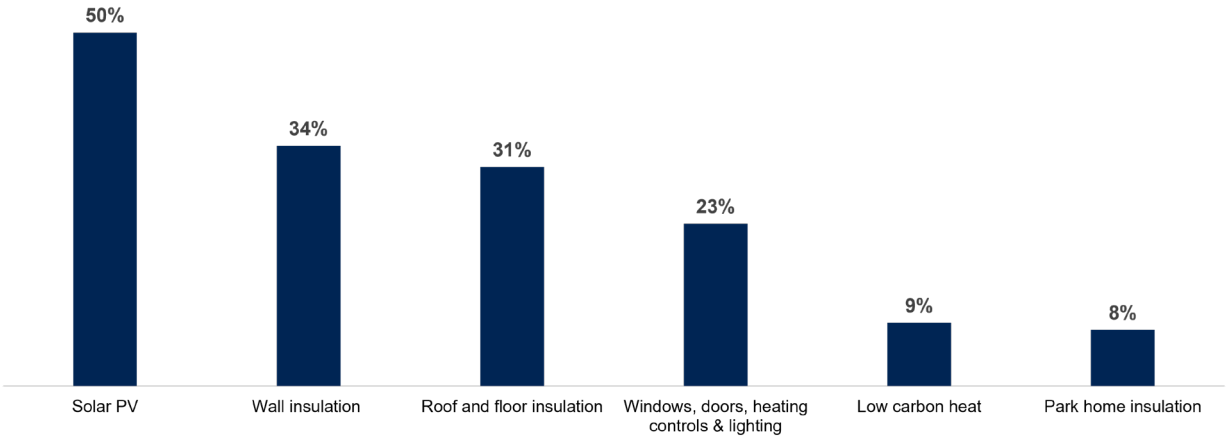
Tenure: Almost four-in-five (78%) are owner occupiers, one-in-five (20%) are social tenants and 1% are private tenants. Regarding the type of properties respondents either own or live in:

[36] This may be due to respondents answering the question incorrectly, or because they have seen an uplift in their income since the completion of their installation.

- Two thirds (63%) live in a house of which a quarter (26%) are semi-detached; 18% are mid-terrace; 9% are end-terrace and 8% are detached. 9% of properties were a park home, 20% a bungalow and 8% a flat or maisonette.
- One-in-five (22%) of respondents' properties do not have an EPC rating recorded in the Scheme data. Four-in-ten (41%) of properties are rated D and more than a quarter (29%) are rated E. F and G only represent 7% of the sample surveyed.
- Over half (54%) of respondents' properties were built before 1967, which is around the time that the first set of national buildings standards were introduced (1965).

Measures installed: In terms of measures received under the LAD Scheme:[37] Solar photovoltaic (PV) was the most common measure with half of all respondents (50%) having had this installed. A third (34%) had wall insulation (17% received external wall insulation, 7% internal solid wall insulation, and 14% cavity wall insulation). A similar proportion (31%) had roof & floor insulation installed (driven mainly by loft insulation – 24%), and a quarter (23%) had some form of secondary measure installed (windows, doors, heating controls and lighting).

Figure 3. Measures received under the LAD Scheme



A2. Our records show that the property listed below had the following energy efficient or heating home improvement(s) installed under the LAD Scheme, or an associated scheme delivered by your local authority. Is this correct? A4. Has the property had any other energy efficient or heating home improvements installed under the LAD Scheme in the last 18 months?
Base: Participating households with a LAD Scheme installation completed (2938)

12.2 Property before applying to the LAD Scheme

Before having a measure installed under the LAD Scheme, using some form of central heating was the most prevalent way of heating their property. This was most commonly by using a combi gas boiler (37%). 70% were also using some other type of heater, most commonly electric plug-in room heaters (31%) or mains gas fires (24%).

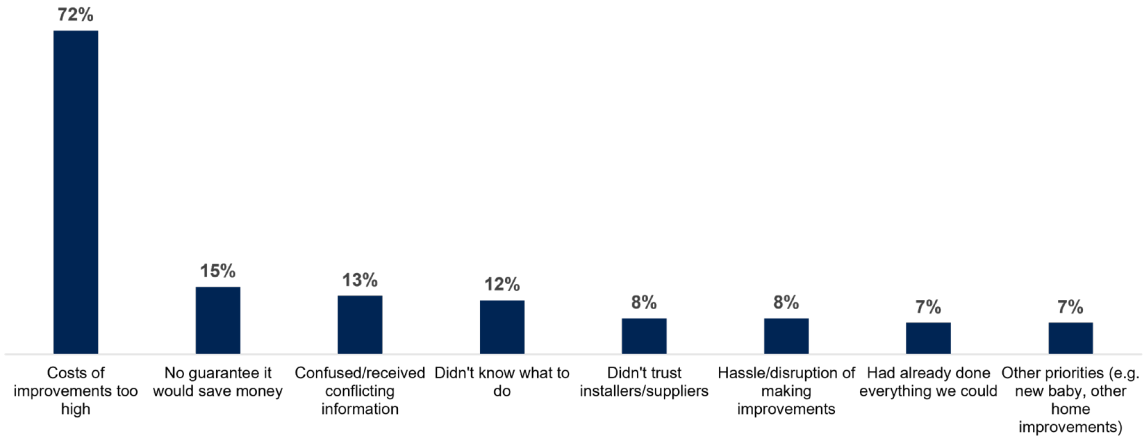
Most respondents already had some form of energy efficient, or home heating improvement installed at the property before the LAD Scheme. The most widely adopted measure prior to

[37] Percentages will not add up to 100% as respondents may have received more than one measure.

the Scheme was double or triple glazing (80%). Two thirds (63%) also had some form of loft insulation (which in terms of thickness was most commonly between 10cm and 30cm) while a third (34%) had previously installed cavity wall insulation. Low carbon measures were least common; just 2% claim to have had an air source heat pump or solar thermal hot water and 1% ground source heat pump. Out of the measures presented to the respondents, it is also these three measures that people are the least likely to have heard of/know anything about.

Cost was the most common barrier stopping respondents from making improvements to their properties in the past, given as a reason by three quarters (72%) of respondents. Some (15%) were sceptical over cost savings of the measures, whereas for others lack knowledge was also seen as a barrier, whether it be because they had received conflicting information (13%) or were unsure on the next steps to take (12%).

Figure 4: Factors that prevented respondents from making improvements in the past



C5. What, if anything, has prevented you from making energy efficient or heating improvements to in the past?
Base: Participating households with a LAD Scheme installation completed (2938). NB: Responses under 5% not shown.

Annex 13: Local Authorities survey profile

The following section outlines a profile of the Local Authority sample, as context for the analysis of this population in the main report.

13.1 Profile of Local Authorities surveyed

Almost eight in ten respondents (79%) had participated in Phase 1 (either Phase 1a or Phase 1b), 72% had participated in Phase 2 and just over half (52%) had participated in both Phase 1 and Phase 2.

Respondents were more concentrated in the Midlands (53%), with fewer responses from the South (28%) and the North (11%).

Most respondents were allocated to the Midlands Hub (48%), followed by the South East (26%), then allocated to any other hub.

The majority of respondents were in areas categorised as predominantly urban (64%), compared with those in predominantly rural areas (26%) or areas categorised as urban with significant rural (10%).

Survey respondents were most likely to have worked at LAs which installed building wall insulation (78%), building roof and floor insulation (71%), loft insulation (67%), external solid wall insulation (59%) and cavity wall insulation (55%), as part of the LAD Scheme.

The vast majority (91%) of respondents to the LA survey had been involved in other Schemes, compared to just 7% who were not.

The Scheme that survey respondents were most likely to be involved with was the Energy Company Obligation (ECO/CERO/HHCRO) with 66% of participants having been involved in this Scheme.

This was followed by the Social Housing Decarbonisation Fund (59%), the Affordable Warmth Scheme (38%) and other localised grants or programmes (38%).

13.2 The LAD application stage

Of those surveyed, 48% had been involved in the application process for LAD funding in Phase 1 and 38% had been involved in Phase 2.

13.2.1 Delivery models

Overall, the vast majority (88%) of respondents said that their LA delivered LAD as a stand-alone project, rather than as part of an existing energy efficiency plan (14%). This was more common for those who took part in Phase 2 than it was for those who took part in Phase 1 – 85% of those who took part in Phase 1 said they delivered LAD as a standalone project, compared to 100% of those in who took part in Phase 2.

Over half (55%) of survey respondents said that their LA engaged installers to manage the Scheme, as well as or apart from, delivering installations, and over a quarter (26%) said that they engaged a social housing provider.

22% of respondents to the survey said that they also worked with another local council or combined authority to deliver the LAD Scheme as part of a consortia.

22% said that they also engaged an energy efficiency/services company to deliver the LAD Scheme, and the same proportion said that they engaged a managing agent.

One in five (21%) said that they worked with a foundation or charity and 19% said that they engaged a utility company.

13.3 Scheme Delivery

13.3.1 Types of homes targeted

The most common types of homes targeted by LAs across both Phases were houses, with 88% of respondents saying they targeted semi-detached houses, 86% targeting mid-terrace houses and 84% targeting end-terrace houses.

72% of respondents said that their LA targeted bungalows for the Scheme, and 59% said their LA targeted detached houses.

A third (33%) of respondents said their LAs targeted flats and one in five (19%) said that they targeted park homes for works.

In terms of home ownership, three-quarters (74%) of respondents said their LA targeted owner-occupiers for LAD Scheme improvements.

When it came to renters, over half (53%) of respondents said that their LA targeted those who rent their home from the council or LA, just under half (48%) said they targeted private renters and a quarter (26%) said they targeted those who rent their home from a housing association/housing cooperative or charitable trust.

Just under two in five (38%) respondents said that they targeted private landlords, while 22% said they targeted social landlords.

Most of the respondents said that their LA targeted homes with mains gas (83%) and electricity (83%). Two in five (41%) respondents said that their LA targeted properties with home heating oil, and solid fuels, 28% of respondents said the LAD Scheme in their area targeted properties that used liquified petroleum gas.

13.3.2 Types of measures installed

When asked what measures were planned and delivered by LAs in Phase 1, the majority (59%) installed loft insulation, half (50%) installed solid wall insulation (external), 46% installed solar PV and 43% installed cavity wall insulation.

In Phase 2, the majority (62%) installed solar PV. A similar proportion (60%) installed loft insulation, 45% installed solid wall insulation (external) and 45% installed cavity wall insulation.

13.3.3 Identification of eligible homes

88% of respondents said their LA identified households for the LAD Scheme were using EPC data.

Income data was used to identify eligible households by just over half (52%) of respondents, followed by specific targeted measures – 38% of respondents targeted areas or households that had been involved in previous Schemes, and 34% targeted specific housing associations.

Referrals were also used to identify eligible households – a third (34%) said they identified households through referrals from installers, and 31% said they identified households through referrals from charities or the Citizens Advice Bureau.

Data from other sources was also used to identify eligible households - one in five (21%) used data from other Schemes (such as ECO) for this and a similar proportion (19%) used data provided by a subcontractor, such as a communications partner or managing agent.

13.3.4 Additional costs incurred

When asked about costs incurred for managing the Scheme that were not covered by initial funding allocated from BEIS for administration, over half of respondents (57%) said that they had incurred costs that were not covered. This breaks down into 31% who said that they incurred minor costs that were not covered, and 26% who said that they incurred significant costs that were not covered.

Of those that incurred any uncovered costs, 45% said that these costs came to less than £25,000. Please see the breakdown of these costs in the table below:

Table 26. Unrecovered costs incurred by Local Authorities through the LAD Scheme

Spending	Percentage
Less than £24,999	45%
£25,000 - £49,999	12%
£50,000 - £99,999	15%
£100,000 - £199,999	6%
£200,000 - £499,999	12%
£500,000 - £999,999	3%

Annex 14. Installers survey analysis

The following section outlines a profile of the installers survey sample, as context for the analysis of this population in the main report.

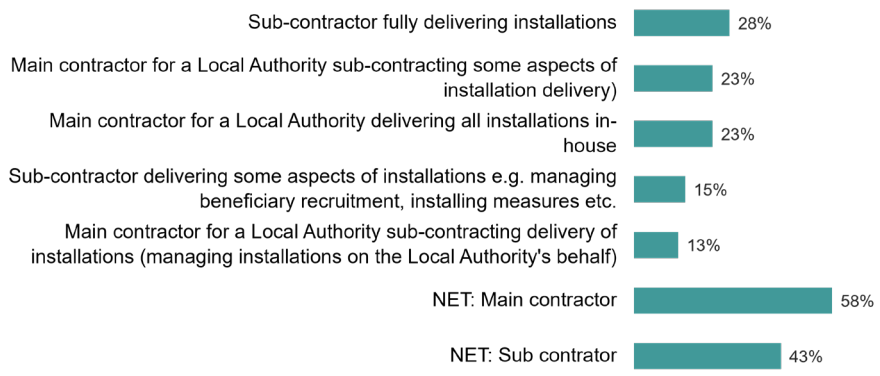
14.1 Participation in the LAD Scheme

As figure 5 shows, the installers surveyed participated in the LAD Scheme under more than one delivery model:

Almost six-in-ten (58%) were working as a main contractor for a LA in some capacity, through fully delivering installations in house (23%), working as a main contractor who subcontracted out certain aspects of installation delivery (23%) or a main contractor sub-contracting delivery of installations but managing installations on the LAs behalf (13%).

Around four-in-ten (43%) were acting as subcontractors, either though subcontracting but fully delivering installations (28%) or as a subcontractor delivering some aspects of installations such as managing beneficiary recruitment, installing measures etc. (15%).

Figure 56. How contractors were involved in the Scheme



Base: C2 In which of the following ways was your company involved in the LAD Scheme? N=40

Almost all (90%) installers surveyed took some specific action to be able to participate in the LAD Scheme and the average number of actions was four. These fell into three categories:

Accreditations: seven-in-ten (70%) gained further accreditations, and more than half became compliant with updated guidance e.g., PAS 2035 (55%) and/or registered with TrustMark (55%). Accreditation and compliance was the main action taken by companies to participate in the LAD Scheme.

Staff: More than half (55%) hired new staff to either deliver the installations or to assist with administration and management (53%). Four-in-ten installers surveyed (43%) trained existing staff to install new measures.

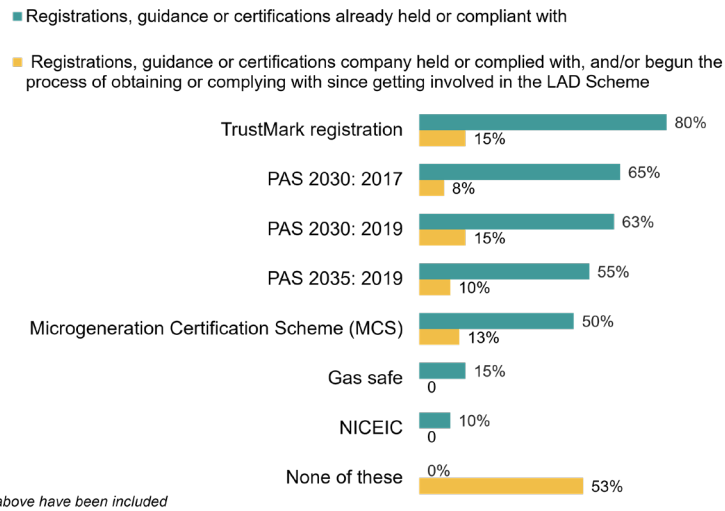
Investment: just less than half of installers surveyed (48%) were investing in new infrastructure and more than a third (38%) in new equipment such as machinery.

Before becoming involved in the LAD Scheme, as illustrated in figure 6, four-in-five installers (80%) were already TrustMark registered, and two thirds were PAS 2030: 2017 compliant (65%) and/or PAS 2030: 2019 compliant (63%). More than half (55%) were already accredited to PAS 2035: 2019 and a similar proportion (50%) to the Microgeneration Certification Scheme (MCS).

A number of other accreditation Schemes were also cited among 'Other.' These included Gas Safe (15%) and NICEIC (10%).

Since becoming involved in the LAD Scheme a further 15% had or were in the process of obtaining their TrustMark registration and the same proportion (15%) their PAS 2030:2019 certification. A further 10% have begun the process of obtaining PAS2035: 2019 certification since becoming involved with the Scheme.

Figure 67. Registrations, guidance, or certifications that installers were already compliant with prior to the LAD Scheme or had begun the process of becoming compliant with during the Scheme



Note: only codes with 10% or above have been included

Base: C4 Which, if any, of the following registrations, guidance or certifications did your company hold or was compliant with before getting involved in the LAD Scheme? *N=40*

Base: C5 And which, if any, of the following registrations, guidance or certifications has your company held or complied with, and/or begun the process of obtaining or complying with since getting involved in the LAD Scheme ? N=40

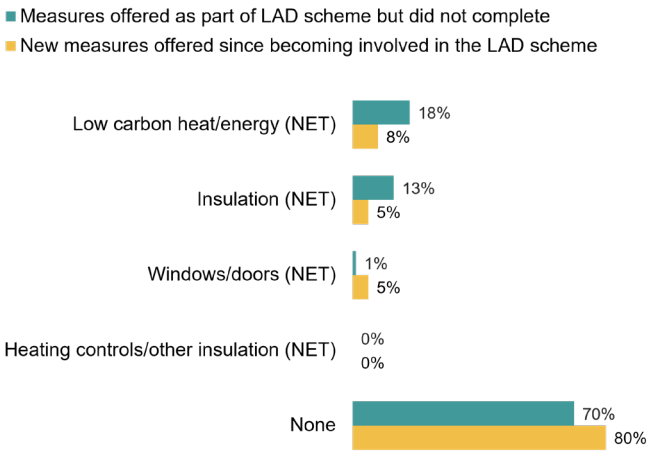
Around half (48%) of those interviewed were satisfied (very/fairly) with the process of becoming compliant with the PAS 2035 guidance, with 11% saying they were very satisfied and 37% saying they were fairly satisfied. Almost a third (29%) found the experience to neither satisfying nor dissatisfying. Fewer installers were dissatisfied with the process of compliance, with 14% saying they were fairly dissatisfied. No installers surveyed claimed to be very dissatisfied with becoming compliant with the PAS 2035 guidance.

14.2 GHG LAD Delivery

As highlighted by Figure 7, the majority of installers surveyed (70%) stated that they completed at least one installation of all the different types of measures their company offered. The measures that were most often offered and for which installers said they did not complete any installation were Solar PV (13%), different types of insulation measures (13% across all insulation measures), and Air source heat pumps (8%).

Almost one in ten installers started to offer insulation installations since becoming involved in the LAD Scheme, while a further 5% offering low carbon heat/energy measures, or windows/doors. Eight-in-ten (80%) of installers did not offer any new measures for installation through their participation in the LAD Scheme.

Figure 7. Measures offered as part of the LAD Scheme



*Base: D1: Please could you tell me which insulation, low carbon heating or other measures your company **offered as part of the LAD Scheme but did not then complete any installations of?** Base: D3b: Did you start to offer any new measures **since becoming involved** in the LAD Scheme? N=40*

14.3 Company staffing levels

All installers who participated in the survey categorised themselves as an existing company that was already in operation before the LAD Scheme. There were no companies interviewed that were specifically started to deliver the LAD Scheme or new branches/subsidiaries of existing companies set up to deliver the LAD Scheme.

When probed on business size, Figure 8 shows that the largest proportion of installers interviewed came from medium sized businesses (between 10 and 49 employees) and this has remained the case from 2019 before the LAD Scheme was introduced through to 2022. When it comes to the number of staff specifically involved in delivering measures in medium sized businesses (between 10 and 49 employees) and in large business (between 50 and 249+ employees), the proportion involved shows a directional increase post-covid and after establishment of the Scheme, with the largest number of staff specifically working on LAD

Scheme in 2022. Please note, due to the low number of completes this directional increase is not statistically reliable and as such should be taken as a purely indicative shift.

Figure 8. Size of businesses involved in the LAD Scheme between 2019 and 2022, and number of staff involved in the delivery of measures through the LAD Scheme between 2020 and 2022

Number of staff employed between 2019 and 2022

%	2019	2020	2021	2022
	N=34	*N=33*	*N=35*	*N=38*
NET: Under 10	32	33	26	18
NET: 10 to 49	53	48	57	63
NET: 50 to 249	15	18	17	18

Number of staff involved in the delivery of measures provided through the LAD scheme between 2020 and 2022

%	2020	2021	2022
	N=35	*N=37*	*N=40*
NET: Under 10	69	57	45
NET: 10 to 49	31	41	50
NET: 50 to 249	0	2	5

Base: D5c: How many staff were there in your company in total between 2019 and 2022?
Base: D5D How many staff were involved in the delivery of the measures you provided through the LAD scheme?

Most installers either grew their number of employees to some degree or managed to maintain their existing staffing levels. Almost no installers lost staff between 2020 and 2022. Only 3% said they had lost installation staff, while other staff levels in other roles either remained the same or increased.

Since 2020, almost two thirds of businesses hired more installation staff (61%) or administration and management staff (60%), while just over half (53%) hired new estimation/quotation staff. Most businesses added between one to nine new staff in these roles, although almost one in ten (8%) hired between 10-19 new installation staff, and 5% added between 10-19 new administration and management staff. Figure 9 also shows that only slightly over a third (39%) hired new staff in quality assurance roles since 2020.

Figure 9. Number of new staff hired by installation businesses since 2020

%	Estimation/quotation staff	Installation staff	Quality assurance staff e.g. retrofit assessors	Administration and management staff	Other staff
	N=38	*N=38*	*N=38*	*N=38*	*N=38*
Less than 0 (lost staff)	0	3	0	0	0
0	47	37	61	39	87
NET: 1-9	50	53	39	55	11
NET: 10-19	3	8	0	5	2

Base: *D6 How many new staff did your company hire since 2020 in…?*

Figure 10 shows that across the previous four years, company turnover remains comparable, with the largest proportion outside of those who 'don't know' citing a company turnover of between £500,000 and £5 million.

Figure 10. Company turnover between 2019 and 2022

%	2019	2020	2021	2022
	N=40	*N=40*	*N=40*	*N=40*
NET: £100,000 to less than £500,000	8	8	5	3
NET: £500,000 to less than £5million	35	35	40	40
NET: £5million to less than £10million	0	5	8	8
NET: £10million to less than £50million	8	8	8	8
Don't know/prefer not to state	51	43	41	43

Base: D8A What was your company's turnover in... ?

As can be seen in Figure 11 the percentage of turnover that can be attributed to LAD shows a directional increase between 2021/22 compared to 2020 when LAD had only recently been launched. One quarter (25%) of installers surveyed cited that in 2022 the LAD Scheme contributed to up to a quarter of turnover with around one-in-five (18%) believing this to be between 25% and 49% and a similar proportion (20%) to be between 50% and 74%.

Figure 1111. Percentage of business turnover attributed to LAD

%	2020	2021	2022
	N=40	*N=40*	*N=40*
NET: 0% of turnover	33	8	8
NET: 1% - 24%	25	28	25
NET: 25% - 49%	3	18	18
NET: 50% - 74%	8	15	20
NET: 75% - 99%	3	5	8
NET: 100% of turnover	0	3	0
Don't know/prefer not to state	30	25	22

Base: D8B What percentage of your company's turnover was due to installing measures under the LAD scheme in…?

Of installers surveyed, around two thirds (63%) believed that their company turnover would have been lower if they had not participated in the LAD Scheme, with more than a quarter (28%) of installers believing their turnover would have been significantly lower without the Scheme. Less than one-in-ten (8%) believed turnover would have been higher (slightly or significantly) had they not participated in the Scheme.

Linking to revenue, more than half of installers interviewed (53%) agreed that being involved in the LAD Scheme had enabled their company to employ more staff with a third (33%) agreeing strongly. A quarter however (23%) strongly disagreed that this was the case. Levels of

agreement on whether the LAD Scheme had enabled my company to continue operating were also divided. Whilst two-in-five (43%) strongly or slightly agreed with this, the same proportion disagreed.

Annex 15. Distribution charts – SAP, annual energy, carbon, and bills savings

The distribution of SAP ratings, annual energy demand, carbon emissions and fuel bills (based on 2021 prices) are shown below for the 'before' and 'after' measure installations.

Figure 1212. Distribution of SAP ratings before the Scheme

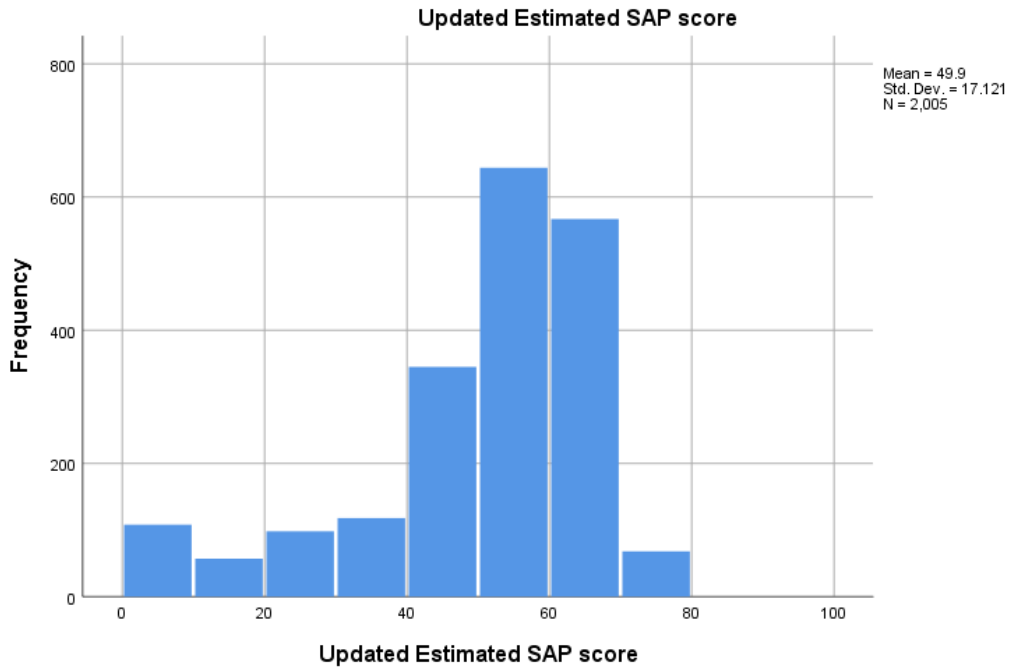


Figure 1313. Distribution of SAP ratings after the Scheme

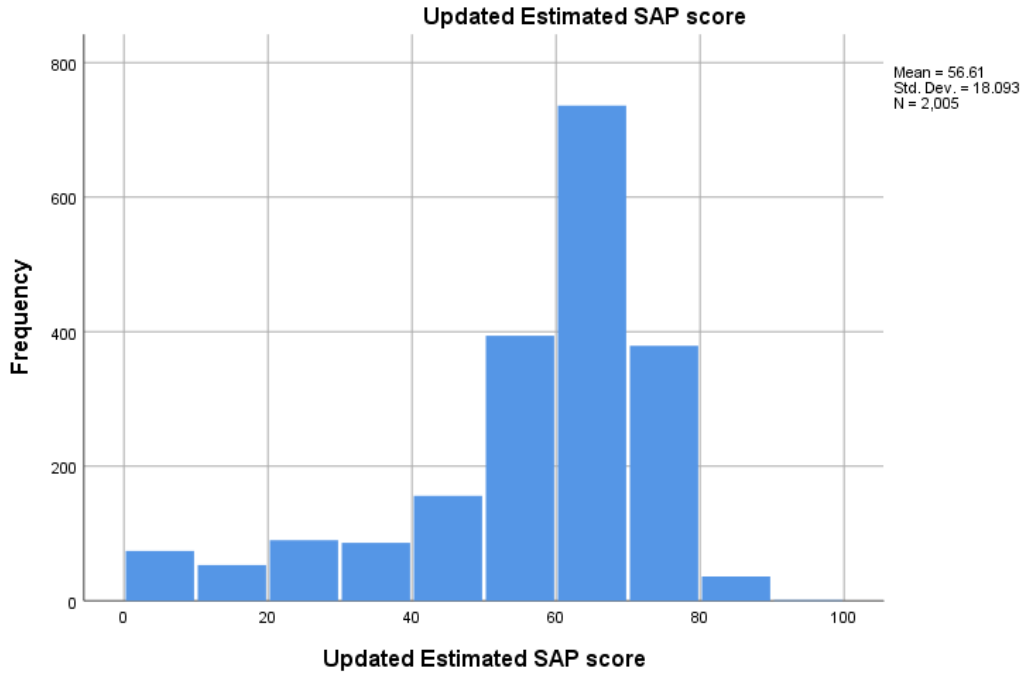


Figure 1414. Distribution of energy demand, before the Scheme

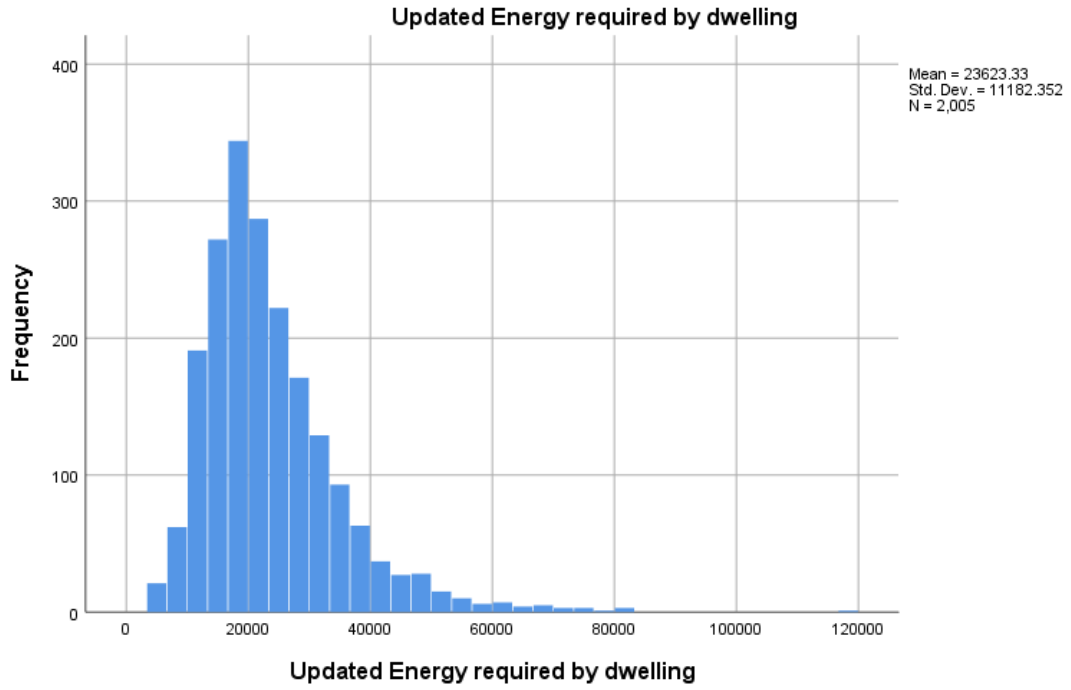


Figure 1515. Distribution of energy demand, after the Scheme

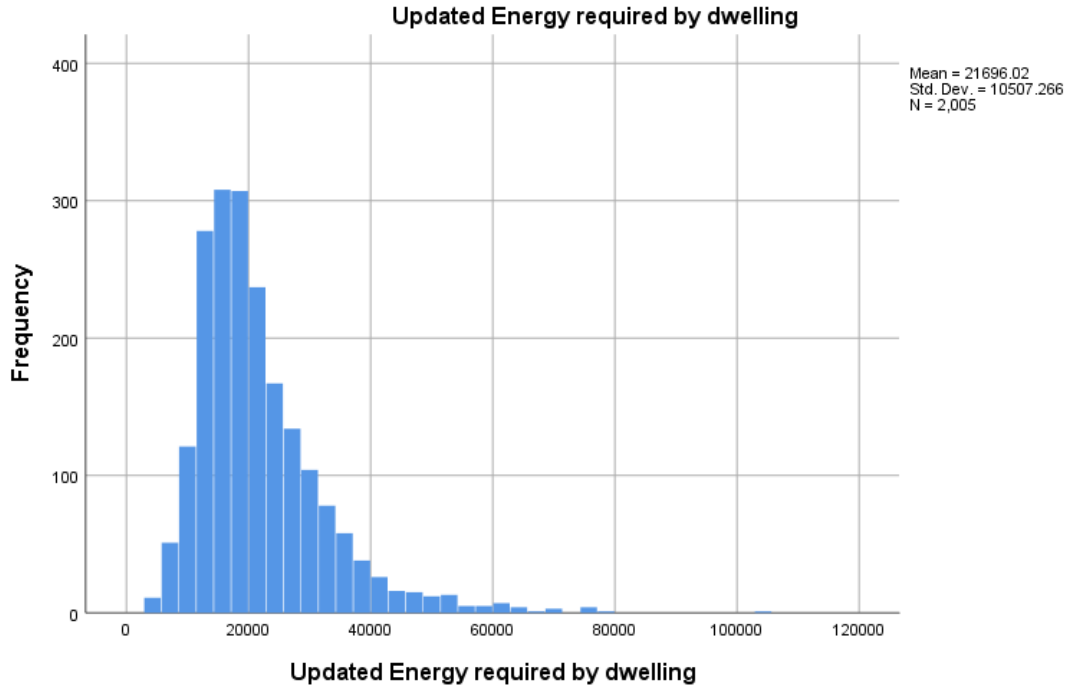


Figure 1616. Distribution of carbon emissions, before the Scheme

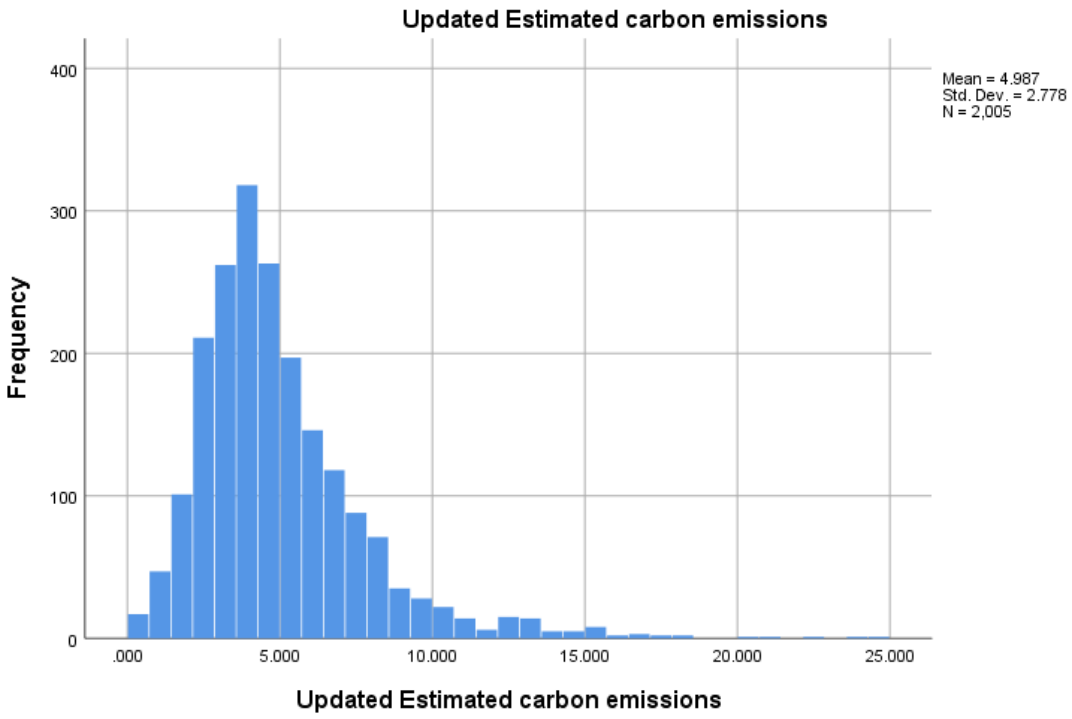


Figure 1717. Distribution of carbon emissions, after the Scheme

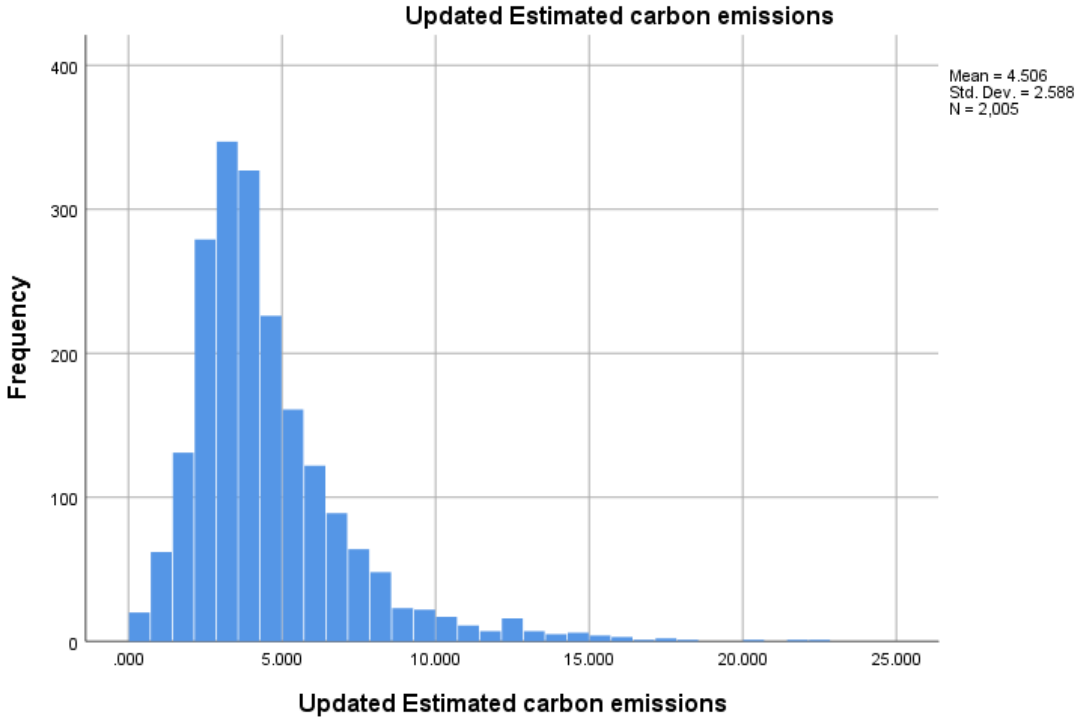


Figure 1818. Distribution of annual energy bills, before the Scheme

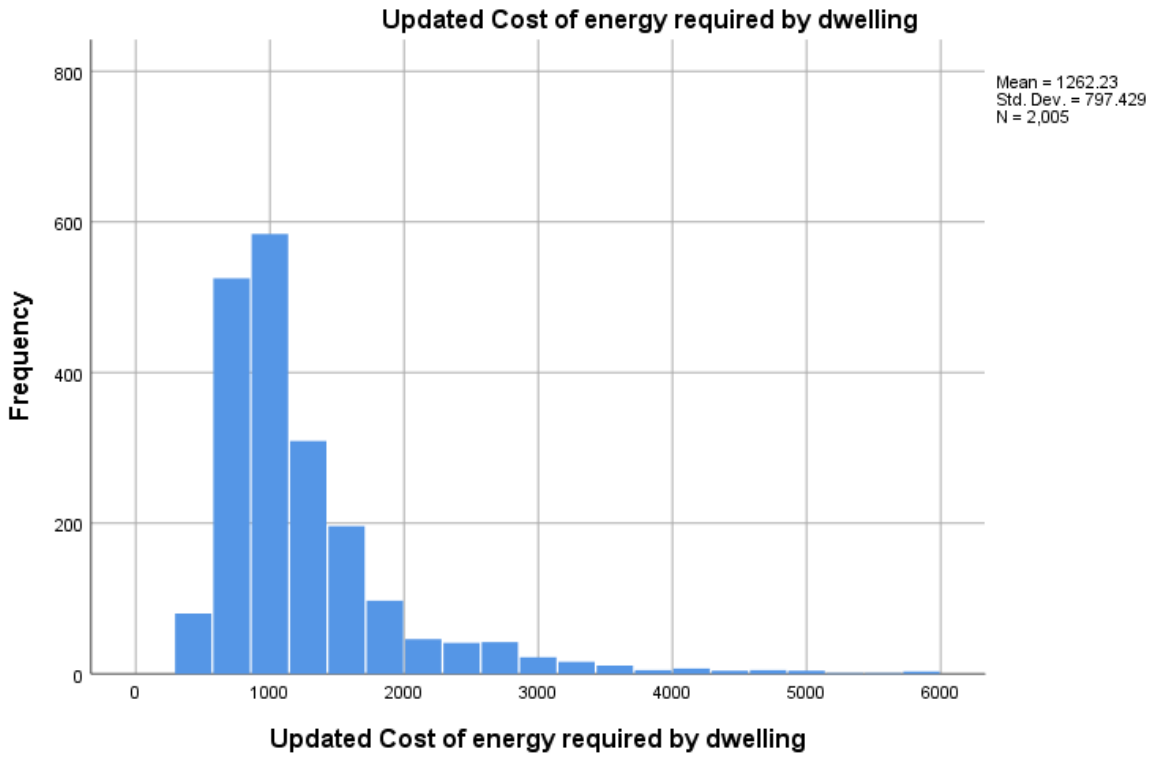
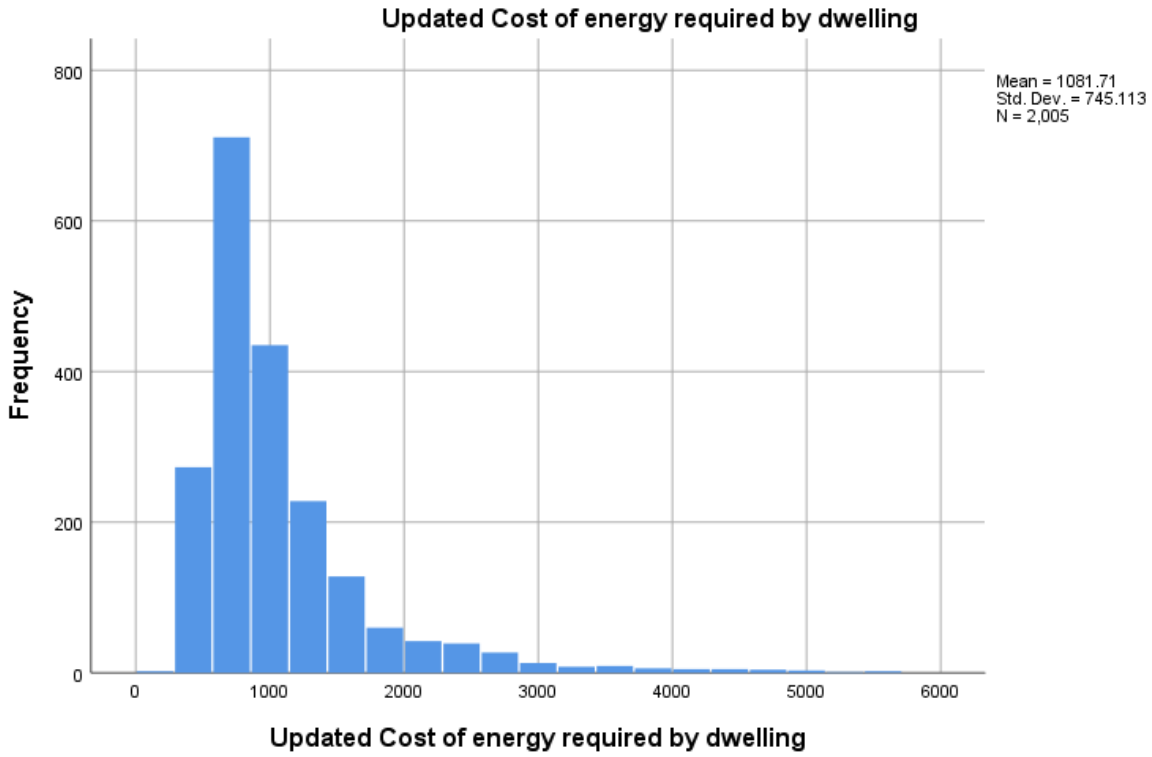


Figure 1919. Distribution of annual energy bills, after the Scheme



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ISO 9001

This is the international general company standard with a focus on continual improvement through quality management systems. In 1994, we became one of the early adopters of the ISO 9001 business standard.

ISO 27001

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