Department for
Business, Energy
& Industrial Strategy

Evaluation of the Green Homes Grant Voucher Scheme (GHGV)

Interim Outcome and Economic Evaluation Report

Ipsos with Energy Saving Trust and UCL

BEIS Research Paper Number 2022/028

September 2022

Contents

Executive Summary

Introduction

The research presented in this report covers interim findings from the outcome and economic evaluations of the Green Homes Grant Voucher Scheme (GHGVS). This report provides early insights into the outcome and economic evaluations, which will conclude in March 2023.

The report builds upon research conducted from September 2020 to March 2022 on applicants and installers participating in the scheme and the number and nature of measures installed ('scheme data') and qualitative interviews with 79 stakeholders, including 30 scheme applicants, 10 installers and 36 members of the wider supply chain. It also draws upon qualitative interviews with 134 stakeholders, a survey of 218 installers and an online survey of 3,606 applicants conducted from October 2020 to August 2021 covering the GHGVS process evaluation.

The aims and reach of the scheme

The GHGVS is one of four 'Green Economic Stimulus' programmes announced by Government in July 2020 to support sustainable economic recovery after the pandemic. Although the Scheme comprised a mix of economic and environmental goals, it was primarily designed to maximise job retention, grow the UK retrofit market, and to have a wide reach of beneficiaries, i.e. to cover fuel-poor and low-income households as well as those 'able to pay'. The Scheme offered homeowners the opportunity to apply for up to £5,000 funding (£10,000 for low-income households) to install energy efficiency improvements and low carbon heat measures in their homes. Homeowners were expected to identify a certified installer and apply for vouchers, with the installer receiving the grant funding once they had fitted the measure. Tenants were not eligible for vouchers, although they could apply on behalf of a homeowner, such as their landlord.

The GHGVS achieved a reach of 169,430 voucher applications for 113,736 properties. By 6th December, 83,150 vouchers had been issued (49% of the total number of voucher applications submitted) and 49,002 measures had been installed in 42,907 properties (accounting for 59% of all vouchers issued by this date)[1].

In keeping with the objectives of the scheme, more voucher applications were received for primary measures than for secondary ones with the former representing 76% of all applications and the latter 24%. By 6th December 2021, only 8% of all secondary measures applied for had been installed, compared with 35% of primary measures.

[1] Cancellations post installation are not included in the scheme data. However 141 vouchers which had initially led to installations were subsequently cancelled meaning that 48,861 measures received government funding.

Despite being more likely to have had vouchers issued, low carbon heat measures were slightly less likely to have been installed by start of December 2021, compared to insulation (63% of vouchers issued for low carbon heat had proceeded to installation vs. 65% for insulation measures).

External solid wall, loft insulation, solar thermal were the measures with the highest number of vouchers issued, each with greater than 10,000 issued. After these the next most common was pitched roof insulation (8,537) and cavity wall insulation (6,301).

Measures varied in terms of their application to installation success, with 51% for pitched roof insulation achieving the highest conversion rate. The more expensive installations were also amongst the most installed. There were two measures, hot water tank insulation and hot water tank thermostats, for which no installations had been recorded by the start of December 2021.

A significant proportion of primary measure installations were completed between the months of March and October 2021.

The aims and reach of the scheme

Installer survey data suggests that most installers had participated in other schemes including Green Homes Grant Local Authority Delivery scheme (GHG LAD), Renewable Heating Incentive (RHI), Energy Company Obligation (ECO), and Whole House Retrofit (WHR). Based on scheme data, the firms involved in ECO3 and GHGVS had installed many more measures under ECO3 than GHGVS, which is not surprising due to the different time coverage of the two schemes[2]. Those involved in GHGVS and ECO3 were most likely to be installing insulation under GHGVS, while those delivering measures under the RHI and GHGVS were mostly delivering low carbon heating solutions under GHGVS. The evidence suggests that having more than one scheme operating at once did not create bottlenecks in supply.

The analysis of scheme data revealed that 15% of GHGVS applicants had also previously made use of ECO3 funding, whilst 3.3% had participated in the RHI, although this analysis does not capture the period until the end of ECO3 and RHI.[3]. Amongst households participating in both GHGVS and ECO3, 97% belonged to the low-income group, which suggests that having both schemes open to these households increased the ability of homes more likely to be fuel poor to increase their home's energy efficiency.

In these respects, it appears that the schemes were used in a way that maximised value to homes, enabling them to increase the comfort and/or efficiency of their homes more than they would have been able to with a single scheme.

[2] The GHGVS scheme data covered the period from 01/11/2020 to 07/12/2021, and the ECO3 scheme data the period from 01/01/2019 to 31/08/2021.
[3] The RHI scheme data covered the period from 01/01/2019 to 31/10/2021.See footnote 2 for the time coverage of the GHGVS and ECO3 scheme data used for this analysis.

Demand for the scheme and supply

Qualitative research conducted as part of the interim outcome and economic evaluation suggests that not all installations desired by households were possible within the timeframe of the scheme: applicants found it difficult to find suitable installers, which suggests that there were some challenges with supply from industry meeting demand. Some of the manufacturers interviewed also indicated that they would have struggled to meet demand had the scheme operated to the levels initially expected, due to the problems with material and product imports from Europe.

Overall, the scheme was additional in driving demand and in stimulating households to either install a measure that they would not have otherwise considered or to install it sooner. Installers in qualitative interviews reported that this demand generated larger volumes of work for them.

Overall, the feedback from multiple stakeholders consulted for this evaluation points to the need for more longer-term investment in the supply chain. For example, installers recognised the benefits and value of training, but training providers observed a drop-off after the scheme ended, suggesting that such training needs to be incentivised.

Most applicants would in future consider further installations and applications for similar schemes. Those who reported an overall positive experience or had measures installed by the time of interview were more likely to consider future installations than those with a negative view of the scheme or who had experienced challenges with their installations.

Benefits to households and energy use behaviour

Households mostly perceived that the scheme saved them money either because it enabled them to move away from gas heating, which they considered expensive; because it meant switching to more cost-efficient energy use (e.g., no longer using an emersion heater); or because the scheme provided them with a subsidy for a home improvement which they would have otherwise had to pay for themselves.

Households that installed low carbon heating measures under the scheme reported having changed their behaviour. Heat pump users had changed when and for how long they turned their heating on to increase comfort and / or reduce energy bills. Actions included increasing the length of time that the heating is on to compensate for the lower radiator temperatures, and carefully selecting the times of day that the heating is switched on to take advantage of off-peak electricity tariffs.

Quality of installation and service

The findings around quality vary slightly depending on the source of evidence. Qualitative interviews with applicants illustrate some salient cases of poor quality of service and suggest

that some installations may not have been carried out to 'publicly available specifications' (PAS)[4] or TrustMark standards (particularly where households were not given sufficient information on aftercare and maintenance of the installation). However, TrustMark audit data indicates that – overall – quality issues were proportionate to the scale of the scheme. Similarly, cases of fraud and wrongdoing do not appear to have been unusually high as confirmed by internal measurements of residual fraud.

Benefits to the market

Evidence from qualitative interviews with different stakeholder groups within the home improvement supply chain indicates that the GHGVS contributed to increased employment and turnover at least in the short-term, and in some cases helped longer-term growth. The effects on profit have not been similarly positive due to a range of external factors, as well as the costs of participation for installers.

However, whereas early qualitative research suggested that installers had faced significant employment and financial losses due to the scheme, the findings from further qualitative research with installers found a more mixed picture, with some installers reporting an increased turnover from the scheme.

Value for money

Overall, the analysis found that the costs of the scheme at societal level outweighed the benefits, largely due to the high costs of installation (and hassle costs to households) of external wall insulation, which was also one of the most frequently implemented installations under the scheme.

At the individual household level, on average the benefits of having one or more measure installed under the GHGVS outweighed the costs. This was particularly true for households accessing the scheme via the low-income route.

[4] Publicly Available Specifications (PAS) are fast-track standards, specifications, codes of practice or guidelines developed by sponsoring organisations to meet an immediate market need.

1 Introduction

1.1 The Green Homes Grant Voucher Scheme Evaluation

The Evaluation of the Green Homes Grant Voucher Scheme (GHGVS) began in November 2020 and will run until March 2023. The evaluation has been commissioned by BEIS and is being delivered by Ipsos in partnership with University College London (UCL), the Energy Saving Trust (EST), and Building Research Establishment (BRE). The evaluation programme includes: a process evaluation, which was completed in Autumn 2021 and an outcome and economic evaluation. This report presents the interim findings of the outcome and economic evaluation. The final findings will be available in March 2023.

1.2 The scope and approach of the GHGVS interim outcome and economic evaluation

1.2.1 Scope

This report covers the following themes and provides either full or initial responses to the evaluation questions set out in the Table below.

Table 1.1: The scope of the interim outcome and economic evaluation report

Theme	Evaluation question	Extent to which covered in this report	Chapter in which covered
Outstanding process evaluation questions	What was the profile of those applying, having a voucher issued, and receiving an installation? When customers were issued a voucher but the work was not completed, what caused this to happened? Where customers chose to not take the measure forward, why did they choose not to?	Covered to a large extent. Missing only additional views on reasons for withdrawals that will be gathered through the wave 2 applicant survey.	Chapter 2
Additionality / complementarity	How did the voucher scheme interact with other BEIS schemes?	Covered fully.	Chapter 3

	What was the extent of participation in multiple schemes? Were similar installers used for other stimulus schemes? To what extent were installations delivered which were not possible through other policies?		
Consumer demand for installation of energy efficient and low carbon heating measures	How effectively has the scheme driven consumer demand for installation of homes and low carbon heating measures? What have we learned about consumer preferences from the choice of primary and secondary measures in combination with any additional unrelated building work?	Covered to a large extent. Missing only additional views on demand that will be gathered through the wave 2 applicant survey.	Chapter 4
Supply chain capacity	Is the scheme delivering the number and type of installations originally expected? Does the energy efficiency / low carbon heating installer market have the capacity/ willingness to participate in these projects?	Covered fully.	Chapter 5
Benefits to households	How effectively has the installation of energy efficiency/low carbon heating measures led to property occupants improved health and well-being and/or warmer homes? How effectively has the scheme engaged low-income households, including those at risk of fuel poverty?	Covered in part. A more in-depth analysis of the scheme effects on health, well-being and fuel poverty will be provided in the final outcome evaluation report.	Chapter 6
Quality, Fraud and Gaming	To what extent did the scheme deliver energy efficiency installations which were high quality? To what extent has the scheme been affected by fraud and gaming?	Covered to a large extent. Missing only additional views on quality that will be available in the final evaluation through	Chapter 7

		an applicant survey and through further analysis of TrustMark audit data.	
Supply Chain Outcomes	How effectively has the scheme supported the creation or preservation of FTE jobs involved directly and indirectly in delivering? How effectively has the scheme driven the skills development needed to meet net zero? Did the scheme contribute to the creation of long-term growth in the energy efficiency/ low carbon heating supply chain?	Covered in part only. For a more in-depth analysis of effects on jobs see the final outcome evaluation report.	Chapter 8
Energy, carbon and bills savings	How effectively has the scheme delivered energy, carbon, and bill savings?	Covered in part only. For analysis (using smart meter data analysis) see the final outcome evaluation report.	Chapter 9
Economic outcomes / value for money of the scheme	What is the average cost of installing measures in homes applying and redeeming vouchers under the scheme? How does this vary by measure, tenure or property type? What costs are incurred by the different actors involved in the scheme? What are other outputs can be modelled and assessed as part of the cost benefit analysis – e.g. air quality? Have there been differences in costs and benefits between the different subgroups of participants/ installers?	Covered in part only for those costs and benefits that were observable / for which there was data at this point in the evaluation. For a more in-depth analysis see the final outcome evaluation report.	Chapter 10

	To what extent did the scheme deliver energy efficiency installations which represented good value for money?		

1.2.2 Analytical approach

Outcome evaluation

For each anticipated outcome of the scheme, we have assessed: (a) actual change – i.e. whether anticipated outcomes occurred, and (b) whether the scheme contributed to these.[5] This is reflected in the structure of Chapters 4 to 9 which describe how the scheme intended to achieve each outcome (as per the Theory of Change (ToC)); evidence of a change in the outcome area over the time of the scheme; and an exploration of the scheme's contribution to the observed change.

To ensure as robust an analysis as possible, we applied a four-step approach to the outcome evaluation, which is described in further detail in Annex 1:

Step 1: Understanding the ToC and developing causal hypotheses. We did this through consultation with BEIS via workshops and interviews with policy officers.

Step 2: Outcome-specific analysis. Different techniques were used to measure the distinct outcomes of the scheme. These are outlined in Annex 1.

Step 3: Triangulation. For several of the workstreams (health outcomes, quality, economic outcomes), many strands of research provide evidence that can be used to assess the outcome. Where this was the case, we triangulated the evidence and conducted analytical meetings to develop our conclusions.

In the final stages of the evaluation, we will also carry out the following step:

Step 4: Developing causal explanations and lessons for future policymaking. We will cross-compare evidence and dig into the literature to contextualise our findings, optimising the expertise we have within our team. As part of this step of analysis we will also assess why some outcomes might have been more readily achieved than others and what the different enablers and barriers might be.

Value for money assessment

Chapter 10 provides an initial value for money assessment of the scheme. It applies a quantitative cost-benefit-analysis that aligns with HMT Green Book advice, and the method applied is set out in Annex 4.

[5] The approach has similarities with Contribution Analysis, including the iterative approach and gathering of evidence to validate assumptions, but differs from Contribution Analysis in that the evaluation does not explicitly search for alternative theories of change nor consider the extent of contribution of the scheme to observed change.

1.2.3 Data sources

This report draws upon the following data gathered as part of the interim outcome and economic evaluation:

- Data on applicants and installers participating in the scheme and the number and nature of measures installed ('scheme data').
- Qualitative interviews with:
    - scheme applicants (30 in total – comprised of: 15 homeowner-occupiers, 15 landlords)
    - installers (10)
    - the wider supply chain (10 manufacturers, 10 auditors, 8 trainers, 8 certification bodies)
    - BEIS staff members involved in the policy design and delivery (3)

It also makes use of the following data gathered as part of the GHGVS process evaluation.

- An online survey of 3,606 applicants. ('wave 1 applicant survey'),
- A telephone survey of 218 installers.
- Qualitative interviews with:
    - scheme applicants (61 in total – comprised of: 41 homeowner-occupiers, 15 landlords, 1 tenant and 4 applying on behalf of other people)
    - installers (16)
    - non-applicants (18)
- the wider supply chain (11 manufacturers, 5 auditors, 6 trainers, 8 certification bodies), and
- BEIS staff members involved in the policy design and delivery (9).

Further detail on the sampling strategy and methodology can be found in Annex 1.

1.2.4 Sampling and fieldwork recruitment approach, and considerations on bias

The approach to sampling and fieldwork and the effect this may have had on bias within our findings is also set out in detail in Annex 1. In sum, the nature of the findings of the process evaluation as compared to this interim outcome evaluation suggest that installer, applicant and wider supply chain's experience of the scheme and their views on it were substantially affected by (a) the sudden closure of the scheme; (b) the pressures this created on installation delivery, and (c) broader issues with scheme delivery, including voucher processing, voucher redemption and communications. Applicants' perspectives on all aspects of the scheme were also clearly affected by their experience of installation. The resulting implication is that the difference in timing and context between the waves of applicant research is important for interpreting the findings in this report. This context has been considered in developing this report. When reporting on the perspectives of installers and customers, the timing of their

feedback has been highlighted in the analysis and contextualised. A more systematic analysis of views / perspectives of installers and of applicants from earlier in the scheme (i.e. during the process evaluation) to later (i.e. during the outcome evaluation) will be conducted in the final phase of the evaluation to assess whether a significant trend emerges in whether installers and applicants became more / less positive and why this might be.

1.2.5 Methodological strengths, challenges, and limitations

Strengths of the data collection and analysis include:

- **Enhanced credibility** through iterative analysis and a two-phase approach to the outcome and economic evaluation,
- **Good validity of the findings** due to the report drawing on multiple stakeholders' perspectives and types of evidence (observed, statistically representative and explanatory), and
- **Good plausibility of findings** due to the theory-based approach taken and the consultation at various stages of scheme 'experts' (i.e. BEIS policy officers and partners such as TrustMark).

The report is also subject to some **limitations**, the main one being that the evaluation could not gathered evidence of the 'counterfactual' – i.e. what happened in households or for businesses that did not participate in the scheme. Another limitation is in the current comparability of the data from the first wave of research (that informed the process evaluation) to the data from the second wave. For wave 1, two surveys (one of installers and one of applicants) were conducted; but this report relies on secondary data (especially scheme data) and qualitative interviews only. This limitation will be mitigated in the final outcome and economic evaluation report, which will draw upon a second wave of applicant survey and quantitative analysis of energy consumption data. There are also some limitations to the reliability of the value for money analysis at this stage in reporting (when a full set of data on outcomes is not available). The limitations on the fuel poverty analysis, as well as the potential bias in our sample and in reporting discussed under 1.2.4, also represent some limitations to the findings. Further detail on these is provided in Annex 1. However, overall, the report has been able to draw upon a wealth of evidence and a robust analysis which makes the findings and conclusions in the report highly credible.

1.3 The structure and content of this report

The remainder of this report covers: a description of the reach of the scheme in terms of measures, households and property types covered (Chapter 3); interactions between the GHGVS and other schemes and whether complementarity was achieved (Chapter 4); the extent to which there was consumer demand for the scheme and whether the scheme has influenced onward demand (Chapter 5); the scale of supply chain capacity to respond to the scheme and the extent to which the GHGVS influenced supply chain activity (Chapter 6); emerging evidence of the scheme's contribution to household benefits (Chapter 7); GHGVS quality of installation and service (Chapter 8); emerging evidence of the scheme's contribution

to the retrofit industry and market (Chapter 9); initial indications of the scheme's potential impact on energy consumption and decarbonisation (Chapter 10); an initial value-for-money analysis (Chapter 11); and report conclusions (Chapter 12). Annex 1 describes in detail the overall methodology for the interim outcome and economic evaluation; Annex 2 describes the ToC; Annex 3 summarises the validity of the ToC's assumptions; and Annex 4 sets out the methodology for the VfM analysis in detail.

2 The reach of the scheme

The GHGVS process evaluation found that the scheme's reach was lower than it could have been based on the funding available. It found, however, based on an initial fuel poverty analysis, that the scheme did attract a high proportion of owner-occupiers likely to be in fuel poverty.[6]

This Chapter provides more information on the profile of households benefitting from the scheme and compares the profile of those applying for vouchers, being successful in being issued vouchers, and having an installation. It begins with information on the progress of the scheme in processing vouchers and installing measures, then describes the types of measures and property types that were most represented in the scheme.

The analysis partially addresses the following two outcome evaluation questions:

- What have we learned about consumer preferences from the choice of primary and secondary measures in combination with any additional unrelated building work?
- How effectively has the scheme engaged low-income households, including those at risk of fuel poverty?

Further analysis of the scheme's effects on consumer demand is provided in Chapter 4, and a full and final analysis of the scheme's effects on fuel poverty status will be provided in the final outcome and economic evaluation report.

The analysis in this Chapter draws upon the following data: (1) scheme data covering the launch of the scheme in September 2020 through to 6th December 2021; and (2) the findings of the wave 1 survey of applicants, conducted from 10th July 2021 to 9th August 2021.

By December 2021, the figures for applications received were final, as the scheme had already closed to new applicants at the end of March 2021. Whilst, by this date, most applications had been processed, some remained, so the figures for vouchers issued, rejected, or withdrawn may still be subject to some minor change and will be updated in the final outcome and economic evaluation report in March 2023.

2.1 Applications received, vouchers issued, and installations completed

2.1.1 Overview

As reported in the GHGVS process evaluation report, the scheme received 169,430 voucher applications for 113,736 properties. By the start of December 2021, 83,150 vouchers had been issued (49% of the total number of voucher applications submitted) for 65,199 properties (an average of 1.3 vouchers issued per property). Additionally, by this date, 49,002 measures had

[6] As compared to 33% unlikely to be in fuel poverty and 25% who were not possible to assess.

been installed in 42,907 properties (an average of 1.1 measures per property). Installations by this date account for 59% of all vouchers issued by this date. Table 2.1 overleaf summarises this.

Table 2.1: Achieved coverage to 6th December 2021: voucher applications, vouchers issued, households and measures

	Total vouchers	Total households
Voucher applications	169,430	113,736
Vouchers issued	83,150	65,199
	Total measures	**Total households**
Measures installed	49,0027	42,907

2.1.2 The profile of measures under the scheme

Amongst the 169,430 measures applied for, 129,385 (76% of all applications) were for primary measures, and 40,045 (24%) were for secondary measures. Table 2.2 below presents figures showing the number of individual voucher applications that led to vouchers being issued and subsequent installations being completed by measure group.

Table 2.2: Individual voucher applications, vouchers issued and installations by primary and secondary measures

Measure type	Total number of vouchers applied for (a)	Number of vouchers issued (b)	% of applications subsequently issued (b/a)	Number of installations (c)	% of applications completed installation (c/a)	% of vouchers issued completed installation (c/b)
All measures	169,430	83,150	49%	49,002	29%	59%
All primary measures	129,385	71,305	55%	45,704	35%	64%

[7] 141 of them were cancelled therefore leaving 48,861 measures installed that will be processed further and eventually receive government funding.

Measure type	Total number of vouchers applied for (a)	Number of vouchers issued (b)	% of applications subsequently issued (b/a)	Number of installations (c)	% of applications completed installation (c/a)	% of vouchers issued completed installation (c/b)
All insulation	98,028	51,561,	50%	33,342	34%	65%
All low carbon heat	31,357	19,674	63%	12,362	39%	63%
All secondary measures	40,045	11,845	30%	3,298	8%	28%

Overall, just under half (49%) of all vouchers applied for have been issued (shown in the table as b/a). Applications for secondary measures were less likely to have been issued (30%) than applications for primary measures (55%). Vouchers for low carbon heat measures were the most likely to have been issued (63%).

Primary measures were considerably more likely than secondary measures to have completed installation. In the scheme dataset which covers the period to 6th December 2021, only 8% of all secondary measures applied for had been installed, compared with 35% of primary measures. This is likely to be due to applicants only being able to redeem vouchers for secondary measures once they had installed a primary measure, according to scheme rules.

Vouchers were more likely to be issued for applications for low carbon heat measures (63%) when compared to insulation (53%), however by the start of December 2021 figures show only a slight difference in terms of vouchers issued that resulted in an installation (63% of vouchers issued for low carbon heat had proceeded to installation vs. 65% for insulation measures).

Secondary measures made up 24% of voucher applications submitted and 14% of vouchers issued, but only 7% of completed installations (see Table 2.2). Taken together, while insulation measures comprise 58% of measure applied for and 62% of vouchers issued, they make up three quarters (68%) of all installed measures.

Table 2.3 overleaf provides more detail on the volume of applications, vouchers issued and installations by measure. Amongst the 22 measures eligible for support under the scheme, external solid wall insulation and loft insulation received the largest number of voucher applications, each with greater than 20,000 (29% of all applications). Nine measures received greater than 10,000 voucher applications, accounting for 76 percent (76%) of all applications. Fewer than 100 voucher applications were received for secondary glazing, biomass boilers, hot water tank thermostats, hot water insulation and ground source heat pumps.

External solid wall, loft insulation, solar thermal were also the measures with the highest number of vouchers issued, each with greater than 10,000 issued. After these the next most common was pitched roof insulation (8,537) and cavity wall insulation (6,301).

The measure with the highest proportion of applications resulting in a voucher being issued was pitched roof insulation - 70% of applications for this measure resulted in a voucher being issued. Solar thermal, hybrid heat pumps and park home insulation also had a high rate of voucher success with vouchers being issued in more than 60% of applications.

Measures varied in terms of their application to installation success rate. The measure with the highest application-to-installation success by the start of December 2021 was pitched roof insulation (51%). Other measures with relatively high installation rates included hybrid heat pumps (44%), cavity wall insulation (42%) and solar thermal (41%). Despite accounting for 15,816 and 12,784 voucher applications received, just 8% and 9% of energy efficient doors and heating controls had been successfully installed by December 2021 (although, again, this is likely due to them being secondary measures and therefore having both low success rates in having the voucher issued and them requiring later installation, post-primary measure installation).

Although a relatively low number of voucher applications (2,184) were received for hybrid heat pumps, 44% of these had been successfully installed by the start of December 2021, which is a higher rate than most other measures.

As a proportion of vouchers issued by measure, loft insulation, pitched roof insulation and cavity wall insulation had the highest installation success rate with 70%, 73% and 71% respectively.

Table 2.3: Numbers of individual voucher applications, vouchers issued and installations by measure type

Measure Type	Total number of vouchers applied for (a)	Number of vouchers issued (b)	% of voucher applications subsequently issued (b/a)	Number of installations (c)	% of voucher applications completed installation (c/a)	% of vouchers issued completed installation (c/b)
External solid wall insulation	26,074	15,393	59%	9,580	37%	62%
Loft insulation	23,706	11,198	47%	7,792	33%	70%
Solar thermal	17,926	12,288	69%	7,438	41%	61%

Measure Type	Total number of vouchers applied for (a)	Number of vouchers issued (b)	% of voucher applications subsequently issued (b/a)	Number of installations (c)	% of voucher applications completed installation (c/a)	% of vouchers issued completed installation (c/b)
Energy efficient replacement doors	15,861	5,874	37%	1,226	8%	21%
Heating controls	12,784	2,720	21%	1,168	9%	43%
Pitched roof insulation	12,180	8,537	70%	6,228	51%	73%
Cavity wall insulation	10,676	6,301	59%	4,445	42%	71%
Air source heat pump	10,380	5,864	56%	3,933	38%	67%
Under-floor insulation: Suspended floor	7,279	3,332	46%	1,898	26%	57%
Internal solid wall insulation	7,256	2,464	34%	1,103	15%	45%
Double/triple glazing	6,714	2,079	31%	861	13%	41%
Draught proofing	3,198	1,071	33%	16	1%	1%
Room-in-roof insulation	3,126	1,495	48%	770	25%	52%
Flat roof insulation	3,088	1,277	41%	848	27%	66%
Under-floor	2,737	369	13%	68	2%	18%

Measure Type	Total number of vouchers applied for (a)	Number of vouchers issued (b)	% of voucher applications subsequently issued (b/a)	Number of installations (c)	% of voucher applications completed installation (c/a)	% of vouchers issued completed installation (c/b)
insulation: Solid floor						
Hybrid heat pumps	2,184	1,462	67%	956	44%	65%
Park home insulation	1,906	1,265	66%	610	32%	48%
Secondary glazing	897	93	10%	27	3%	29%
Biomass boiler	608	9	1%	6	1%	67%
Hot water tank thermostats	327	4	1%	-	0%	0%
Hot water tank insulation	264	4	2%	-	0%	0%
Ground source heat pump	259	51	20%	29	11%	57%
TOTAL	169,430	83,150	-	49,002	-	-

Table 2.4 (below) also presents the total number of installations completed by measure type, but alongside the percentage of total installations each measure represents. In total, 20 out of 22 measures eligible under the scheme had been installed at least once by the start of December 2021. External solid wall insulation, loft insulation, and solar thermal accounted for 51% of total completed installations. **It is notable that some of the more expensive installations** (i.e. costing more than £10,000 on average for an installation under the scheme[8]), comprising external solid wall insulation, solar thermal and air source heat pumps,

[8] See the costs analysis in the Phase 1 Evaluation Report.

were amongst the most installed. This aligns well with the Government intention to address the market failure associated with these expensive measures.[9]

Less common installations included biomass boilers and ground source heat pumps, both of which require a lot of space in the property to install; under-floor insulation which can be disruptive to install, and secondary measures draught proofing and secondary glazing. All of these represented less than 1% of total installations. There had been no installations of hot water tank insulation and thermostats by the date of analysis.

Table 2.4: Proportion of Completed Installations by Measure Type

Measure type	Number of completed installations	% total measures installed
External solid wall insulation	9,580	20%
Loft insulation	7,792	16%
Solar thermal	7,438	15%
Pitched roof insulation	6,228	13%
Cavity wall insulation	4,445	9%
Air source heat pump	3,933	8%
Under-floor insulation: suspended floor	1,898	4%
Energy efficient replacement doors	1,226	3%
Heating controls	1,168	2%
Internal solid wall insulation	1,103	2%
Hybrid heat pumps	956	2%
Double/triple glazing	861	2%
Flat roof insulation	848	2%
Room-in-roof insulation	770	2%
Park home insulation	610	1%
Under-floor insulation: solid floor	68	0%
Ground source heat pump	29	0%

[9] This intention was expressed by BEIS policy colleagues in an interview conducted in November 2021.

Secondary glazing	27	0%
Draught proofing	16	0%
Biomass boiler	6	0%
Hot water tank insulation	0	0%
Hot water tank thermostats	0	0%
Total	49,002	100%

2.1.3 The profile of properties participating in the scheme

Table 2.5 provides an overview of installations completed by building type. It illustrates how **the most common property type to have a completed installation was semi-detached houses**, followed closely by terraced houses (33% and 32% of all completed installations respectively), and then detached houses (22%) and bungalows (10%). Flats and maisonettes, and park homes were the property types with the smallest number of completed installations accounting for less than 5% collectively).

Table 2.5: Property types with at least one completed installation

Property type	Number of properties with at least 1 completed installations	% Completed installations
Semi Detached House	14,271	33%
Terraced House	13,557	32%
Detached House	9,289	22%
Bungalow	4,432	10%
Flats and Maisonettes	710	2%
Park Home	647	2%
Total	42,907[10]	100%

Proportionally, **bungalows were the type of property most likely to have had a voucher issued post-application** and **flats and maisonettes the least likely**. As set out in Table 2.6 below, bungalows were also the most likely to have had installations completed following their

[10] Completed installations by property types does not equal total due to missing data

voucher issuance, followed by terraced and detached houses. Semi-detached houses and flats and maisonettes had the lowest installation completion rates.

Table 2.6: Numbers of individual voucher applications, vouchers issued and installations by property type

	Applications applied for (a)	Applications with at least 1 voucher issued (b)	% of applications leading to at least 1 voucher (b/a)	Applications with at least 1 completed installation (c)	% of applications with at least 1 installation (c/a)
Semi Detached House	49,722	25,464	51%	14,271	29%
Terraced House	26,656	17,960	67%	13,557	51%
Detached House	22,447	13,740	61%	9,289	41%
Bungalow	6,562	5,225	80%	4,432	68%
Flats and Maisonettes	6,102	1,499	25%	710	12%
Park Home	2,244	1,310	58%	647	29%
TOTAL	113,736	65,199	-	42,907	-

Note: The totals by property type do not add up exactly to the total. Three observations (within the total figure) have not been classified by property type. Of these three records, one was issued with at least one voucher and had a completed installation.

2.2 Completed installations over time

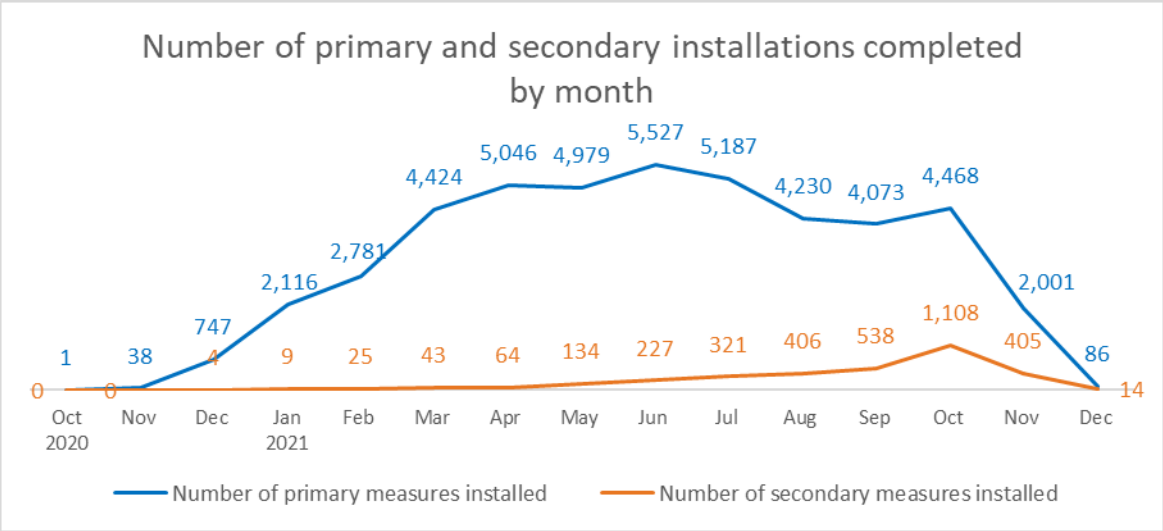
Figure 2.1 overleaf shows variation in primary and secondary installations throughout the period October 2020 to December 2021. The figures above each line relate to the total number of installations completed in a given month.

There was a **substantial increase in the rate of primary installations between the months of February to March 2021** when installations jumped from 2,781 to 4,424. This likely aligns with the period of return to work after the Christmas holidays and the easing of lockdown restrictions. **A significant proportion of primary measure installations were completed between the months of March and October 2021**, during which over 4,000 installations were completed each month (83% of total completed primary installations). Primary measure installations peaked in June 2021, the busiest month, in which 5,527 installations were completed (12% of the total completed primary installations). Completed primary installations

then fell from 4,468 in October 2021 to 2001 in November before falling further to 86 by December.

As described above, **secondary measures accounted for a much smaller proportion of total installations.** The first secondary measure was completed in December 2020. In subsequent months, secondary measure installations increased slowly but consistently to a peak of 1,108 in October 2021. Most secondary measure installations were completed later in the year and in the months of August, September, October, and November 2021, each of which consisted of more than 400 installations (74% of the total completed secondary installations).

Figure 2.1: Completed installations by measure group by month



2.3 Rejections and withdrawals

On 6th December 2021, according to scheme data, there were 51,936 household applications that had been rejected, withdrawn, or cancelled (**46% of households that applied**). The number of vouchers that were rejected, withdrawn, or cancelled was 92,588 (**55% of vouchers applied for**).

Table 2.7: Total and proportion of applications rejected, withdrawn, or cancelled (per application and per household)

	Total	Total with vouchers rejected, withdrawn, or cancelled	% of vouchers rejected, withdrawn, or cancelled
Households applying	113,736	51,936	46%

Voucher Applications (per measure)	169,430	92,588	55%

According to open-text annotation within the scheme data, reasons for voucher rejections include issues associated with property eligibility stated by householders on the application and administrators being unable to identify the type of property being applied for or the exact location of the property address.[11] For instance, some applications were rejected due to the property named on the application not being situated in England.

In a substantial number of cases, applications were rejected due to the **insufficiency and/or inaccuracy of the information required for scheme validation**. Examples included difficulties in confirming the identity of the applicant, their benefits status, and the owners/occupiers of the relevant property.

A considerable number of rejections were issued due to **installers** being **ineligible** or **uncertified** to undertake the proposed work. There were also instances where applications for secondary measures were rejected due to the applicant having **failed to apply for a primary measure beforehand.**

In some cases, there was evidence that applicants had applied via **the wrong scheme route**. For example, some landlords had their vouchers rejected because they had applied via the low-income route, for which they were ineligible. Other reasons for rejection were the property being a newly built home not yet inhabited, or because the application was a **duplicate submission.**

2.4 The profile of homeowners and landlords applying to the scheme

More in-depth information on a sample of the homeowners and landlords applying to the scheme was collected through the wave 1 applicant survey. This covered 3,310 households each of whom had applied to the GHGVS.

Almost half of applicants (45%) had a household income below £34,999 and their age was in alignment with the profile of the English homeowner population[12]. For instance, 11% of survey respondents[13] had a household income of less than £15,999 and were over the age of 55. For the same aged group with a household income of less than £24,999, this

[11] Systematic quantification of reasons for withdrawals/rejections was not possible due to data limitations, this section therefore represents a qualitative analysis of a string variable.
[12] Statistics on homeowners are obtained from The English Housing Survey, 2019 to 2020 and are provided for context purposes only https://www.gov.uk/government/statistics/english-housing-survey-2019-to-2020-home-ownership
[13] Figures are based on survey responses for individuals who applied for a voucher in their own home and exclude landlords.

percentage rose to 18%. Almost a third of respondents (27%), were aged 45 and older and had a household income of less than £24,999.

2.4.1 Gender, age, and ethnicity profiles

Amongst those responding to the survey, **56% were male and 42% female** with 2% identifying in another way or preferring not to say. When asked about their age, **47% of survey respondents was aged above 55.** Only 8% was younger than 34. Amongst respondents, 17% was aged over 65 and almost one in three households (28%) reported the presence of someone aged above 65 years old. These figures are in alignment to the average age of home ownership in England, which as of 2020 stood at 58 years of age. In terms of ethnicity, **75% of respondents identified themselves as white**, and 21% identified as being from an ethnic minority group, this compares to 90% and 7% respectively across all owner-occupied households in England.

2.4.2 Income, fuel poverty status, disabilities, and young children

Most applicants applied for vouchers via the low-income scheme, a high proportion of which were likely to be in fuel poverty.

Analysis of scheme data from 6th December 2021 indicates that a minority (31,035) of vouchers issued were issued via the main scheme (37%) compared to 52,115 via the low-income scheme (63%). A total of 19,049 (39%) installations completed were for households applying via the main scheme vs. 29,953 (61%) accessing the GHGVS via the low-income route.

Just over a fifth (22%) of households responding to the survey reported belonging to the lower household income band of below £15,999. Almost half (43%) reported a household income of between £16,000 - £44,999. Another fifth of applicants (21%) had a household income greater than £45,000.

Fuel poverty modelling conducted for the GHGVS process evaluation found that, across all occupiers (that is, applicants who applied to the scheme for their own homes), 42% were likely to be in fuel poverty. Annual fuel poverty statistics (for 2019) indicate that 13% of households in England are in fuel poverty. This therefore suggests that the GHGVS was successful in reaching households likely to be fuel poor.

According to survey data, 38% of respondents reported having someone with **a long-standing illness, disability, or infirmity in the household.** This is slightly higher than the proportion within all owner-occupied households in England, which stands at 31%. **Survey data shows that 34% of respondents reported having at least one child under the age of 13 in the home, this compares** to a quarter (25%) of owner occupiers with dependent children in the English homeowner population[14]. Households containing 2-3 persons were the most common applicants (53%). Table 2.8 shows the distribution of benefit type for those who reported that

[14] Both contextual figures in this paragraph are from the English Housing Survey, 2019 to 2020 https://www.gov.uk/government/statistics/english-housing-survey-2019-to-2020-home-ownership

someone in the household was in receipt of benefits: the most common were child benefit[15] and disability living allowance[16], accounting for 20% and 19% respectively. The third and fourth most common were child tax credit (12%) and working tax credit (10%).

Table 2.8: Distribution benefit type for households with at least one benefit recipient

Benefit Type	Low Income	Main	Total
Child benefit	15%	4%	20%
Disability Living Allowance	19%	0%	19%
Child tax credit	11%	0%	12%
Universal credit	12%	0%	12%
Working tax credit	10%	0%	10%
Council Tax benefit	7%	0%	7%
Other state benefits	6%	0%	7%
Employment support allowance	6%	0%	7%
Pension credit	4%	0%	4%
Income support	1%	0%	1%
Job seekers allowance	1%	0%	1%
Housing benefit	1%	0%	1%
% in receipt of benefit	93%	7%	100%

Note: as this is wave 1 survey data, respondents may include those whose vouchers were rejected, including, possibly, those whose vouchers were rejected because of an ineligible application for the low-income scheme, as well as those who went on to withdraw from the scheme.

2.4.3 Regional spread of applications (based on survey data)

Overall, applications for the scheme were spread out across the UK. The South-West, West Midlands and North-West each accounted for 14% of applicants and represented 42% of the total. The North-East saw the smallest number of applicants, followed closely by London and

[15] Note that child benefit is available to all households with a child under the age of 16 or under the age of 20 if they stag in approved education or training. A parent or guardian having an income of greater than £50,000 can still claim for child benefit, but is required to pay some or all of it back in income tax. This means that households with a joint income of nearly £100,000, which would not be considered a low-income household, could still have full access to this benefit.

[16] Disability benefit is not means-tested: https://www.gov.uk/dla-disability-living-allowance-benefit

Yorkshire and the Humber, with 6%, 9% and 10% respectively. Regional breakdowns are shown in Table 2.9 overleaf.

Table 2.9: Regional Breakdown of Survey Respondents

Region	% of total respondents
South East	14%
West Midlands	14%
North West	14%
East of England	12%
South West	11%
East Midlands	10%
Yorkshire and the Humber	10%
London	9%
North East	6%
Total	100%

3 Interactions between GHGVS and other schemes

This Chapter outlines the analysis on the complementarity of the GHGVS with other schemes sharing similar objectives of meeting the UK's carbon budget and reducing fuel poverty. It focuses on the Renewable Heat Incentive (RHI) and the Energy Company Obligation Phase 3 (ECO3), the two schemes most similar to GHGVS, which operated at the same time (thus creating the greatest risk of overlap at household level).[17] It answers the following evaluation questions:

- How did the voucher scheme interact with other BEIS schemes?
- What was the extent of duplication of funding?
- Were similar installers used for other stimulus schemes?
- To what extent were installations delivered which were not possible through other policies?

In this respect it explores **synergies** between programmes, risks of overlap, the extent to which **the market was able to respond** to multiple stimulus schemes at once,[18] and the **added value** of the GHGVS when compared to other schemes.

3.1 How the scheme was able / intended to interact with other BEIS schemes

The GHGVS scheme was designed to be delivered within a context of several other existing and new programmes, including the Green Homes Grant Local Authority Delivery (GHG LAD) scheme, the Social Housing Decarbonisation Fund Demonstrator (SHDF(D)), the Public Sector Decarbonisation Scheme (PSDS), ECO3 and RHI. The GHGVS was expected to **involve and draw upon the services of installers who would also be delivering installations under other schemes,** and to **support some households which might also be benefitting from / participating in other schemes.**

The GHGVS terms and conditions **included specific clauses aimed at preventing overlap of scope, double-funding and contradictions between the different government schemes**. These mostly involved preventing households from using more than one scheme to subsidise a single measure, but GHGVS, RHI and ECO3 could be used to fund different elements of a retrofit:

[17] This was agreed with BEIS as part of the scoping work for this outcome evaluation and is due to the fact that the comparison with GHG LAD and SHDF will be implemented as part of the cross-cutting evaluation.
[18] This question is only covered with a light touch in this Report, as it will be covered in greater depth in the Cross Cutting Evaluation of the stimulus schemes.

- **PSDS:** By scheme design, GHGVS did not overlap with PSDS in terms of properties covered, because PSDS supports retrofits in the non-domestic sector only.
- **GHG-LAD or SHDF(D):** It was not possible to apply for a GHG voucher if a grant had already been received as part of GHG-LAD.[19] SHDF(D) targets social housing, and therefore the same households cannot be eligible for both it and the GHGVS. ECO3: It was not possible to apply for a GHGVS voucher to subsidise the cost of a measure already being funded under ECO. However, ECO3 could be used for a different measure in the same property.
- **RHI:** An applicant could use both the Domestic RHI and GHGVS to fund the cost of a renewable heat installation, but the applicant was required to first claim the GHG voucher and then notify Ofgem for the value of the voucher to be deducted from the RHI payments.[20]

Table 3.1 provides a comparison of GHGVS, ECO3 and RHI, and suggests that **they complement, rather than substitute,** each other. Whilst they do reach some of the same target groups with the same measures, their distinct delivery models offer households different routes to retrofit and provide different options (which may be of differing value for money to the household) to applicants. They also offer the opportunity to lower-income households to maximise the support obtained from Government towards home decarbonisation.

Table 3.1: Scheme comparison

	GHGVS	ECO3	RHI
Duration	September 2020 – March 2021	ECO first introduced in 2013; ECO3: October 2018 – March 2022	April 2014 – March 2022
Target beneficiary	Homeowner-occupiers and private and social landlords, including the 'able to pay'.[21]	Mainly low-income and vulnerable households, including homeowners and tenants - after gaining landlord consent[22] - helping to meet the Government's fuel	Homeowner-occupiers, social and private landlords for properties where one heating system only serves a single household, tenants, and people who build their own homes or have them built for them and meet

[19] See: https://www.gov.uk/guidance/apply-for-the-green-homes-grant-scheme
[20] https://www.gov.uk/guidance/apply-for-the-green-homes-grant-scheme.
[21] Defined as those in receipt of at least one eligible benefit.
[22] https://www.ofgem.gov.uk/environmental-and-social-schemes/energy-company-obligation-eco/support-improving-your-home/faqs-domestic-consumers-and-landlords

	GHGVS	ECO3	RHI
		poverty commitments.[23]	specific requirements.[24]
Geographical coverage	England	Great Britain	Great Britain
Funding	£5,000 to cover up to two-thirds of the installation; £10,000 for the low-income scheme, covering 100% of the installation cost.	Variable - A supplier funds all or part of the eligible installation and funding is arranged prior to the installation. A supplier may jointly fund a measure with a third party, for example local government or a devolved administration	Variable - payments received based on annual heat consumption in the property, as deemed by the EPC. Exceptions to this rule are if installation is 1) solar thermal – payments based on the Estimated Annual Heat Generation found on Microgeneration Certification Scheme (MCS) certificate, 2) metered for payment – payments based on the meter readings.[25]
Measures	Wide range of energy efficiency and low carbon heating measures.	As for GHGVS, except for pitched roof insulation, hot water tank insulation, energy efficient replacement doors,	Low carbon heating measures only. As for GHGVS, the domestic scheme[26] covers biomass boilers, solar thermal

[23] https://www.ofgem.gov.uk/sites/default/files/2021-07/Energy%20Company%20Obligation%202018-22%20%28ECO3%29%20Guidance%20Deliveryv1.7.pdf
[24] https://www.ofgem.gov.uk/sites/default/files/docs/drhi_factsheet_therhidomornondom_v2_0_mar_2016_web.pdf
[25] https://www.ofgem.gov.uk/environmental-and-social-schemes/domestic-renewable-heat-incentive-domestic-rhi/tariffs-and-payments
[26] The non-domestic scheme covers: air source, ground source and water heat pumps, solid biomass, solid biomass (waste), deep geothermal, solar thermal, biogas, biomethane, CHP (from geothermal, biogas, solid biomass or solid biomass from waste).

	GHGVS	ECO3	RHI
		and solar thermal, (not available in ECO3) and district heating system, electric storage heater, time and temperature zone control, and solar PV (available through ECO3, but not GHGVS)	and air source and ground source heat pumps; but does not cover hybrid heat pumps (which GHGVS does).
Delivery model	Homeowners, including landlords, directly apply for vouchers which subsidise (and in some cases fully cover) the costs of eligible measures.	Energy suppliers deliver energy efficiency improvements to domestic premises in order to meet legal obligations about achieving cost savings.[27]	Quarterly payments for seven years for the amount of clean, green renewable heat the system produces - applicable to the domestic sector[28].
Certification and standards requirements on installers	TrustMark registration, 'publicly available specifications' (PAS) 2030:2017,[29] PAS 2035:2019, MCS for heating/microgeneration technologies.	Trustmark registration (or equivalent) since January 2020, PAS 2030 (later 2035) certification, MCS certification for heating/microgeneration technologies.	MCS certification.

[27] https://www.ofgem.gov.uk/sites/default/files/2021-07/Energy%20Company%20Obligation%202018-22%20%28ECO3%29%20Guidance%20Deliveryv1.7.pdf
[28] Payments are for 20 years in the non-domestic sector.
[29] The 2017 standard was expired in October 2021 and many installers have updated their certification to the 2019 standard throughout the lifetime of the scheme.

3.2 Evidence of scheme interactions

3.2.1 Complementarity at industry level: whether installers operated across schemes

According to the survey conducted for the process evaluation of the GHGVS, **82% of the 218 responding installers had participated in other schemes** including the GHG-LAD, RHI, ECO and Whole House Retrofit. From the qualitative interviews with installers there is also evidence of installers working across GHGVS with LAD, ECO 4 and ECO3 and RHI.

GHGVS scheme data for installers and TrustMark data was used to determine the number of GHGVS installers who had also delivered measures under other schemes. Just over one fifth (22.5%) of GHGVS installation firms also deliver measures under ECO3, and 16.1% also deliver measures as part of the RHI scheme.[30]

Table 3.2: Overlap at firm level

Scheme	Firms participation (N)	GHGVS firms overlap with other schemes	GHGVS firms overlap with other schemes (%)
GHGVS	783		
ECO3	693	176	22.5%
RHI	620	126	16.1%

Notes: Information about installation firms under GHGVS can be found in GHGVS installer scheme data and Trustmark data. Information about installation firms under RHI is based on MCS installer data. Information about installation firms under ECO3 comes from ECO3 scheme data.

The 176 firms involved in both GHGVS and ECO3 have **installed many more measures under ECO3 than GHGVS** – amounting to 151,191 ECO3 measures compared to 24,537 under GHGVS (a ratio of 6:1). However, the time coverage of scheme data of GHGVS and ECO3 used for this analysis is different, with the timeframe of the latter being greater.[31] The businesses involved in both schemes were **most likely to be installing insulation under GHGVS** (78% of the GHGVS measures they installed were insulation, 14% were low carbon technologies, and 4% and 3% were heating controls and windows/doors, respectively). By contrast, 54% and 45% of the **ECO3 measures they installed were for insulation and heating controls** respectively.

The 126 firms delivering measures under the RHI and GHGVS, were **mainly delivering low carbon heating solutions under both, though some were also delivering insulation**

[30] Note that it is not possible from the analysis conducted to determine whether firms were delivering on GHGVS and the other schemes at the same time. It should be noted that the other schemes were running before GHGVS, so it is possible that installers were not delivering on those schemes for the duration of GHGVS.
[31] The GHGVS scheme data covered the period from 1st November 2020 to 7th December 2021 while the ECO3 scheme data covered the period from 1st January 2019 to 31st August 2021.

under GHGVS (14% out of the 8,427 measures delivered by these businesses under GHGVS), heating controls (11%) and windows and doors (4%). Under RHI, these same firms were delivering, out of the total measures of 8,240, air source heat pumps (42% of all measures delivered by these firms under RHI), solar thermal (28%), solar PV (22%) and ground and water source heat pumps (both together 8%). Nevertheless, the timeframe of GHGVS installations used in this analysis is not the same as the one of RHI installations.[32]

3.2.2 Complementarity at household level: whether installations were delivered which were not possible through other policies

Analysis based on scheme data

A comparison of GHGVS and ECO3 scheme data, matched by property address, indicates that, **amongst the households participating in GHGVS, 15% had also benefitted from ECO3**.[33] The analysis for the households involved in both GHGVS and RHI was implemented by BEIS and shows tha**t 3.3% of households participating in GHGVS have also participated in the RHI,** although this analysis does not cover the period until the end of RHI.[34] Table 3.3 provides the number of households/properties benefitting from installations under each scheme and the proportion of households benefitting from GHGVS that also participated in ECO3 and RHI.

Table 3.3: Overlap at household level

Panel A: GHGVS and ECO3

Scheme	Properties participation (N)	GHGVS properties overlap with other schemes	GHGVS properties overlap with other schemes (%)
GHGVS	42,744		
ECO3	327,343	6,438	15.1%

[32] The RHI data covers the period from 1st January 2019 to 25th July 2021. See footnote 28 for the timeframe of the GHGVS data.
[33] This interaction was assessed by comparing GHGVS customer and measures scheme data with ECO3 scheme data, using property addresses (postcode, house number, street name). The GHGVS scheme data used covered measures installed from 1st November 2020 to 7th December 2021, while the ECO3 scheme data covered measures installed from 1st January 2019 to 31st August 2021. Details on the matching procedure of households involved in the two schemes are provided in Annex 2.
[34] The household interaction between GHGVS and RHI was assessed based on addresses of properties involved in the schemes, linked to the Ordnance Survey Address Base dataset to retrieve Unique Property Reference Numbers (UPRN). The GHGVS data used for this analysis covered measures installed from 1st November 2020 to 7th December 2021, while the ECO3 scheme data covered measures installed from 1st January 2019 to 31st August 2021.

Panel B[35]: GHGVS and RHI

Scheme	Properties participation (N)	GHGVS properties overlap with other schemes	GHGVS properties overlap with other schemes (%)
GHGVS	37,029		
RHI	31,801	1,219	3.3%

Notes: The figure of the overlapping properties does not capture the full extent of the domestic RHI; it covers RHI measures installed from 1st January 2019 to 31st October 2021. The latest RHI statistics publication from May 2022 indicates that "At the end of May, the RHI had received 1,634 valid applications (excluding cancelled, rejected or failed applications) from recipients of a Green Homes Grant voucher. Of these 1,591 have been accredited. The vast majority (98%) of these dual applications are for Air Source Heat Pumps." (RHI monthly deployment data: May 2022 - GOV.UK (www.gov.uk)).

A majority (97%) of the households involved in both GHGVS and ECO3 applied to GHGVS through the low-income route, while the remaining 3% have entered through the main route. This finding is not unexpected since ECO3 targets low-income and vulnerable consumer groups, yet it indicates that the schemes are not mutually exclusive and are, instead, being used by households to maximise the support they receive from the Government to decarbonise their homes.

A similar proportion of semi-detached houses (37%), mid-terraced houses (30%) and end-terraced and detached houses together (22%) participated in in both GHGVS and ECO3. Only 7% and 4% of the properties involved in both schemes were bungalows and terraced houses respectively. The majority of GHGVS households (74%) who have also been involved in ECO3 do not have smart meter technology installed in their properties.[36]

Just under half (49%) of all households making use of GHGVS and ECO3 had installed insulation measures through both. Only 0.4% of the households participating in both GHGVS and ECO3 had installed low carbon heating measures using both schemes. This low proportion is, however, not surprising, households do not usually upgrade their heating systems (e.g., boilers) more than once within a seven-year period (seven years being the period covered between the two schemes). Three percent of households involved in both schemes used both to install heating controls.

The scope and design of the programmes influenced how households combined the two schemes. Amongst households installing at least one insulation measure under ECO3, 23% used GHGVS to install low carbon heating measures. Further, 8% of those installing insulation through ECO3 installed windows/doors (not available through ECO3) through GHGVS. By contrast, 49% of households using both schemes had used GHGVS for insulation and ECO3 for heating controls (because heating controls were only a secondary measure

[35] This is based on BEIS' analysis. The number of GHGVS properties is different compared to Panel A due to the different coverage period of GHGVS installed measures.
[36] The percentage of GHGVS households overall who have not installed smart meter technology in their properties is also 74%.

under GHGVS and therefore slightly more complex to access through that scheme than primary measures) and 22% had used GHGVS for low carbon heating installations and ECO3 for heating controls.

Additional findings from the applicant survey and qualitative interviews

Participants in the first wave of the applicant survey had applied for other schemes prior to GHGVS to fund different measures. There was no evidence from the survey nor qualitative research with applicants of applicants attempting to double fund their chosen measure(s) by obtaining other sources of government support to supplement the GHGVS voucher. In the wave 1 applicant survey, 15% of applicants reported that the property for which they had applied for a voucher had previously had energy efficient or heating improvements through other government or local authority schemes. Three fifths (60%) of participants stated that they had not done so, with the remaining quarter (24%) of applicants answering 'don't know' when asked the relevant question. Among landlords, 6% had utilised a previous scheme on the property in question, while for owner-occupiers the figure was 16%. **Those on the low-income scheme were far more likely to have utilised schemes in the past, with 22% reporting having done so compared with 7% of those on the main scheme.**

Among those schemes listed[37] as options from which to select for survey participants, the scheme utilised by the most was **Warm Front,** cited by 6% of applicants overall and 10% of applicants to the low-income scheme. This was followed by **Energy Company Obligation (ECO) scheme, CERT, CESP, EEC** cited by 3% of applicants overall and 5% of applicants to the low-income scheme. Lower numbers of applicants cited **Green Deal** (2%) and **Domestic Renewable Heat Incentive** (1%), while 4% reported having utilised another scheme not listed among the response options.

There is also evidence from applicant and installer qualitative interviews that, **on the one hand, installers played some role in influencing which schemes were used by households**, as some applicants reported that installers had tried to encourage them to seek measures under specific schemes and that, **on the other hand, consumer behaviour dictated which schemes were used by installers**, sometimes to the benefit of the installation companies:

> *"I talked to local installers for advice and available options. The installers [helped us with] GHG guidelines, they checked we qualified for the full voucher." (Applicant interview, February 2022)*

> *"We were able to avoid losing staff after the closure of the GHGVS because of customers moving from GGHVS to RHI." (Installer interview, February 2022)*

[37] The relevant question in the wave 1 applicant survey provided the following answer options, in addition to "none of these" and "don't know": ECO, CERT, CESP, EEC; Domestic RHI; Green Deal; Warm Front; another scheme.

3.3 Exploring complementarity

The findings above indicate that there was a **low risk of duplication of funding and that schemes were designed to be complementary**. Whilst some of the same measures could be accessed under different schemes, there were terms and conditions that prevented double funding, and which enabled households to combine the funding in a way to maximise value from each. Whilst it was not explicitly explored in the research for this evaluation, the discussion above suggests that the differences in the delivery models, scope of measure coverage and the terms and conditions of GHGVS, ECO3, and RHI had **different attractions for households.** GHGVS added value compared to other schemes: to RHI by offering energy efficient measures, as well as low carbon heating; and to ECO3 by being available not only to vulnerable or lower-income households, but also the able-to-pay. Finally, by enabling some households to utilise more than one scheme, the Government increased the incentive for these households to make their homes more energy efficient and use less carbon, thus increasing the likelihood that these homes will decarbonise.

One of the assumptions underpinning the ToC is that the supply chain is able and willing to scale up to meet the demand anticipated from the GHGVS and other schemes operating at the same time. This evaluation has found that there were problems with supply that affected the GHGVS (see Chapter 5), but this was **not due to an inherent incapacity of the supply chain, nor to competition for labour between schemes**. Installers and the wider supply chain, when interviewed, reported that– by and large – have the capacity to participate in and respond to multiple programmes at once. However, the process evaluation of the GHGVS found that the GHGVS (and this is also the case for GHG-LAD) did not operate at the scale for which it had budget, meaning that the ToC assumptions about the scale of supply needed were not finally valid. As will be set out in Chapter 6, findings from consultation with the supply chain indicate that a lack of participation from installers appears to have been due to: little time, interest or willingness to invest amongst installers for acquiring the certifications and registrations to be eligible to install measures under the GHGVS; later in the programme, there was a low level of willingness amongst installers to deliver new installations under the scheme due to a lack of trust in it.

At household level, the ECO3, RHI and GHGVS complement each other. The programmes are designed to prevent duplicate funding at the measure-level whilst enabling access – particularly for low-income households – to multiple sources of government funding. This **aligns well with Government policy fuel poverty reduction and housing decarbonisation goals.** The extent to which it was easy for households to access more than one scheme at a time has not been within the scope of this evaluation. However, we have not found evidence to suggest there were any aspects of each programme's design or administration which made this challenging. Altogether the three schemes offer a complementary range of technologies which also facilitate using more than one scheme.

3.4 Summary and conclusions

The GHGVS operated at the same time and with similar objectives to a suite of other programmes targeting slightly different audiences, with slightly different measures, via different delivery mechanisms. The analysis for this evaluation has focussed on interactions between GHGVS and the two most similar schemes: ECO3 and RHI.

At industry level, there is evidence of installers working across schemes. Around 23% and 16% of GHGVS installation firms were also involved in the delivery of ECO3 and RHI measures respectively. Having more than one scheme operating at once does not appear to have driven bottlenecks in supply.

At household level, 15% of GHGVS households had also made use of ECO3 funding. Regarding the relationship between GHGVS and RHI, the current complementarity analysis suggested that 3.3% of GHGVS households were also involved in the RHI. Almost half of these households had installed different insulation measures under both schemes. However, this estimate of overlapping households does not cover the period until the end of RHI. According to the latest RHI statistics report (May 2022), approximately 1,600 successful applicants to the RHI had also received a GHG voucher.

Amongst households participating in both GHGVS and ECO3, the great majority of them (97%) belong to the low-income group, which suggests that having both schemes open to these households increased the ability of homes more likely to be fuel poor to increase their home's energy efficiency. In these respects, it appears that the schemes were being used in a way that maximised value to homes, enabling them to increase the comfort and/or efficiency of their homes more than they would have been able to with a single scheme.

4 Consumer demand for the scheme

A key part of the ToC for the GHGVS was an assumption that demand for the scheme would be sufficient to drive some of the behavioural and market changes that the scheme hoped to create. The scheme was expected to interact with demand in three ways:

1. The scheme depended on a sufficient level of existing demand for energy efficient home retrofits and for low carbon heating to drive initial take-up.
2. It was expected then that publicity around the scheme, the financial incentive being offered, and positive early experiences with the scheme would generate 'feedback loops' that would encourage additional households to apply within the lifetime of the scheme.
3. Longer term it was expected that the scheme would contribute to onward demand for energy efficient and low carbon home retrofits and/or for similar programme.

This is reflected in the fact that the ToC states two of its target outcomes as:

1. Increased interest in/understanding of energy efficiency for consumers outside of early adopters.
2. Increased installation of heat pumps, solar thermal, and heat controls.

This Chapter explores the above-mentioned ToC hypotheses further and answers the following two primary evaluation questions:

- How effectively has the scheme driven consumer demand for home insulation and low carbon heating measures?
- What have we learned about consumer preferences from the choice of primary and secondary measures in combination with any additional unrelated building work?

4.1 How the scheme was intended to drive and influence consumer demand

Participation in (and consumer demand for) the scheme was expected to be encouraged by (a) scheme publicity and announcements, (b) the scale of financial incentive being offered, and (c) the terms and conditions of the scheme in terms of the measures that were primary vs. secondary, the (broad) eligibility requirements. The Supply Chain Demonstrators scheme, commissioned by BEIS in 2018, tested different approaches for increasing the rates of energy efficiency improvements amongst able to pay owner occupiers, and found strong indications of customer demand.[38] However, the Demonstrator research was not able to assess whether this was latent or newly generated demand. The GHGVS aimed to encourage demand 'beyond early-adopters',[39] though it also sought to accelerate take up of energy efficient measures and

[38] Evaluation of the Supply Chain Demonstrator Project, BEIS, 2021
[39] See the GHGVS ToC.

low carbon heat solutions amongst those who would have had the measure completed anyway (but at a later date).

Various assumptions underpinned these causal hypotheses. It was assumed that householders and landlords would recognise the value of outcomes such as savings on energy bills and increased home comfort. It also assumed that consumers would not be deterred by the COVID-19 pandemic in seeking these installations, nor hindered by any negative impacts of COVID-19 on the supply chains or installation industry. There was also an assumption that households would be prepared to contribute to the costs of installation.

In terms of onward behaviours, the ToC posited that scheme applicants would seek additional improvements to their homes in future and that other consumers would be encouraged to seek installations through word-of-mouth recommendations from scheme applicants. This outcome rested on the assumption that scheme applicants would maintain their interest in improving their homes after their installation was completed and be prompted by their experience to look further into ways to make their homes more energy efficient. It also assumed that scheme applicants would have positive views of their installations and be willing to 'pass the message on' to other consumers.

Research and analysis for the GHGVS process evaluation led Ipsos to confidently conclude that the assumptions underpinning the GHGVS (see Annex 3) around consumer demand for, willingness to participate in and to contribute to the costs of installations under the scheme were valid. This is supported by the interim findings of the outcome evaluation presented in this report.

4.2 Evidence of consumer demand for the scheme and for similar schemes

4.2.1 Demand for the scheme

As presented in the GHGVS process evaluation report, the GHGVS achieved a much lower number of vouchers than the ~600,000 for which funding was available, with 113,739 households having applied for the measures by the time of the scheme's closure. However, as set out in Chapter 2, by early December 2021, only 49% of the total number of voucher applications submitted had been successful. Qualitative research with participating households suggests that demand for the scheme was higher than the number of applications suggests, as some (potential) applicants were unable to apply at all due to a lack of suitable installers or due to them missing the timeframe for applications (because of the short window between the closure of the scheme being announced and the scheme closing).

4.2.2 Demand for future schemes

This is described in section 4.3.1 below in considering the scheme's contribution to such demand.

4.3 Exploring contribution

4.3.1 Evidence indicating a contribution of the scheme to consumer demand for measures

The quantitative and qualitative work found a consistent theme of consumers reporting that they would not have installed the measure without the GHGVS. **This gives a strong indication of the scheme driving demand.** There appears, nonetheless, to be a sizeable minority who may have sought measures without the scheme. Evidence from the wave 1 applicant survey (see below) indicates that this is especially the case for those who applied for less costly measures.

In the wave 1 survey of applicants, **when asked how likely they would have been to have the measures installed if the scheme had not been available, a majority stated that they would have been unlikely to do so.** Those who applied for loft insulation were almost evenly split between those who would have been unlikely to install the measure without the scheme (43%) and those who would have been likely to do so (39%). By contrast, 72% of those who applied for external solid wall insulation and of those who applied for heat pumps, three quarters of those who applied for pitched roof insulation and park home insulation (74% and 76% respectively), and 80% of those who applied for solar thermal stated that they would have been unlikely to have these installations without the scheme. **Applicants for measures which tend to be less expensive and / or require less intrusive work in the home were more likely to state that they would have installed the measure without the scheme than applicants for measures that tend to cost more and / or require more intrusive work in the home.**

Table 4.1: Applicants' likelihood of installing the measure without GHGVS support

Measure for which application was made	% Likely to have installed without GHGVS	% Unlikely to have installed without GHGVS	Cost of measure	Required labour to implement
Loft insulation	39	43	Low	Low
Double triple glazing	33	50	High	Medium-high
Flat roof insulation	30	55	Low	Low
Biomass boiler	30	55	Medium-high	Medium-high
Energy efficient replacement doors	30	52	Medium	Low-medium

Measure for which application was made	% Likely to have installed without GHGVS	% Unlikely to have installed without GHGVS	Cost of measure	Required labour to implement
Cavity wall insulation	29	53	Low	Low
Secondary glazing*	28	61	Medium	Medium
Draught proofing*	27	47	Low	Low
Heating controls	26	57	Medium	Low-medium
Room-in-roof insulation	26	60	Low	Medium
Internal solid wall insulation	25	61	High	High
Under floor insulation (solid floor and suspended floor	19	63	Low-medium	Low-medium
Heat pumps (air source, ground and hybrid)	18	72	High	Medium-high
Pitched roof insulation	15	74	Low	Low
External solid wall insulation	14	72	High	Medium
Park home insulation	14	76	High	Medium-high
Solar thermal	9	80	Medium-high	Medium-high

Note: Measures marked with * had low base sizes. Hot water tank insulation and hot water tank thermostats are omitted from the table below due to low base size

Landlords participating in qualitative interviews also indicated that the scheme influenced them to install measures. At least one landlord stated explicitly that, without the scheme, they would have been obliged to sell the house in question, explaining that the cost of improvements

necessary to bring the house up to the upcoming minimum EPC rating for rental properties would not have been economical considering the income being made through rent. Others questioned how they would have been able to finance the necessary improvements in the absence of a government grant.

4.3.2 Evidence of the relationship between satisfaction with the scheme and whether consumers would recommend it to others / participate in future schemes (onward behaviour)

Applicants participating in the wave 2 outcome evaluation qualitative interviews had mixed views as to whether they would recommend the scheme to a friend or not. **Those who had experienced no issues with their installation largely concurred that they would recommend the scheme to others.** They explained that, in making such a recommendation, they would caveat that applications to the scheme would require a significant degree of patience, but that the outcome would ultimately justify the administrative difficulties encountered. Those who had experienced issues since the installation did not share this view; they felt that they had not obtained their expected benefits from the scheme and could therefore not recommend it to a friend. **This suggests that negative experiences with the scheme would not necessarily deter future participation in government schemes, but that a negative experience of an installation might deter such participation.**

> *"Yes [I would recommend the scheme to a friend], but I would be honest and tell them what to expect. You have to be on top of it." (Wave 2 interview, homeowner, solar thermal, double glazing)*

> *"I would recommend it [as long as] you're persistent and prepared to deal with the angst." (Wave 2 interview, landlord, solar thermal)*

> *"I would recommend to a friend with the proviso that you should look into it, need to keep record of each email and phone call. Proceed with caution." (Wave 2 interview, landlord, loft insulation)*

> *"It was very stressful, but I got the outcome which I wanted in the end, which I'm ecstatic about." (Wave 2 interview, homeowner, solar thermal, replacement doors, double glazing)*

In the wave 1 applicant survey, when asked whether having their new installation had made them more or less likely to consider other energy efficient or heating improvements in future, 78% of those whose installation had been completed by the time of survey stated that it had made them more likely, with only 5% stating that it had made them less likely (a further 14% said it had made no difference). Three quarters (74%) of those applicants stating that they would consider future heating improvements, had also stated that they were overall satisfied with the scheme. In qualitative research conducted as part of this interim outcome and economic evaluation, applicants who expressed satisfaction with their installation broadly concurred that future schemes would be attractive to them.

4.3.3 Evidence of the scheme's influence on choices around measures

There is clear evidence from the qualitative research with applicants (both waves) that some applicants had not heard about the measures available on the scheme and **only learned about them on speaking to installers to see how best they could use the available subsidy**. Some applicants wished to have specific installations to resolve specific problems in their home (e.g. cold spots in the home, draughts). Others knew little about the available measures but, on hearing about the scheme, enquired with installers about what measures were available and which would be most appropriate to their personal priorities and circumstances. Other motivations for choosing one measure above the others available included recommendations from family or friends, or the elimination of alternative measures that would not have been appropriate for the house in question (e.g. insufficient space around the home for a heat pump). Others had **particular measures in mind but were drawn to install others due to the terms and conditions of the scheme.**

> *"There are some [government schemes] that I have already benefitted from, but nothing for windows. I wanted to get the windows done [but] I had to get a primary measure, and solar thermal seemed the most straightforward and also cheap enough for there to be enough money left for the windows. A heat pump would have been too expensive." (Wave 2 Qual, Homeowner, solar thermal, double / triple glazing)*

Evidence from qualitative research with auditors (see Chapter 7) suggests that, in at least one extreme case, the conditions of the scheme and the maximum voucher values set steered a household to install measures which were unnecessary and "a waste of money".

Some applicants consulted for the evaluation had chosen not to install secondary measures because their preferred secondary measure would have cost more than their chosen primary measure.[40] This suggests that the price capping policy in place for secondary measures may have discouraged certain formations of application.

4.3.4 Other factors driving the installation of measures (during the scheme)

The primary motivations for applying to the scheme amongst those responding to the wave 1 applicant survey were: a desire to save money on energy bills (86%), an interest in making the property warmer or more comfortable (70%), and a desire to reduce energy for environmental reasons (61%).

Particularly prominent amongst applicants participating in qualitative research **was an interest in making the home feel warmer or more comfortable,** also closely linked to the **desire to resolve specific issues in the home**. Some participants elaborated that certain areas or rooms in the home were particularly exposed and became especially cold in the winter or excessively warm in the summer, with a few applicants stating that certain rooms in the home were essentially unusable at certain times of year. This motivation was more prominent

[40] The Green Homes Grant Voucher Scheme capped the available subsidy for any secondary measure to the cost of the primary measure.

amongst homeowners, but also present among landlords, who wished to improve the warmth of their homes for the benefit of tenants. One homeowner with disabilities explained that, prior to the scheme, the home's poor insulation had restricted them to just one or two rooms in the home, and that uptake of the scheme would enable them to make use of other rooms, improving their general well-being.

Landlords were frequently motivated above all by an interest in increasing the EPC rating of the home to ensure it would meet upcoming minimum EPC requirements. They chose measures that they felt would be well-suited to enabling them to achieve this. In choosing measures, some landlords were also concerned about **minimising the degree of disruption to tenants during installation.** One landlord chose solar thermal for this reason, and another chose loft insulation. An additional motivation for landlords was a desire to increase the comfort of their tenants, with at least one mentioning that their tenants were on low incomes and struggled to pay their fuel bills.

Summary and conclusions

Evidence strongly indicates that scheme was successful in catalysing demand for energy efficient and low carbon heating measures amongst a large number of households. It also accelerated the behaviour of some homeowner-occupiers and landlords who had long-term plans to install measures but who were not seeking to do so before the scheme (due to financial or pragmatic constraints).

There is evidence from the qualitative research that the scheme influenced consumers' choice of measures, with some applicants having little to no knowledge of the available measures prior to undertaking research on learning of the scheme. The categorisation of measures into primary and secondary categories caused some whose preferred measure was a secondary measure to apply for a primary measure.

Wave 1 applicant survey data indicates that most applicants would be willing to take advantage of future schemes, though qualitative findings indicate that this willingness was frequently dependent on applicants' installations being complete by the time of interview and experience of the measure since installation being broadly positive.

5 Supply chain capacity

The GHGVS process evaluation found that the supply of installers under the scheme was not consistent across all regions or types of measures. This presented challenges for some applicants in finding registered and qualified installers to provide services under the GHGVS. Installation supply issues were driven by the fact that some installers didn't want to, or weren't able to, gain the appropriate certifications and qualifications within the lifetime of the scheme. However, it was also driven by an unwillingness of some installers to participate in the scheme. This became increasingly the case in later stages of the GHGVS delivery, once installers who had had a negative experience of the scheme pulled out of it.

This Chapter explores supply chain capacity in more detail. It assesses the extent to which the scheme contributed to supply chain capacity through its design, and through its contributions to training and support for certifications and qualifications. It answers the following evaluation question:

- How effectively has the scheme driven the skills development needed to meet net zero?
- Does the energy efficiency / low carbon heating installer market have the capacity/ willingness to participate in these projects?

5.1 How the scheme was intended to support supply chain capacity

The scheme was intended to increase supply of energy efficient and low carbon heating installations to the market. As set out in Chapter 4, this was based upon an assumption that COVID-19 and social distancing guidelines had **reduced demand** in the home repair, maintenance, and improvement industries. This was **expected to persist** (due to a reduction in household consumption and expenditure following COVID-19) particularly in the able-to-pay energy efficiency sector where investment and action, even prior to COVID-19, had been limited (particularly for high cost, more disruptive measures).[41] It was expected that by **stimulating demand, supply would follow.**

This was then expected to generate **spill-over effects into the wider supply chain**, as installer demand for materials, products and services increased. Longer term, the scheme had an aspiration to contribute to building market enablers for net zero, **including improved supply chain quality and skills in the home improvements sector**, by **requiring that installers obtain accreditations, register with TrustMark and adhere to PAS standards** to redeem vouchers for work completed under the scheme. Chapter 7 provides more detail on how these standards and certifications influenced quality under the scheme.

[41] GHGVS Full Business Case

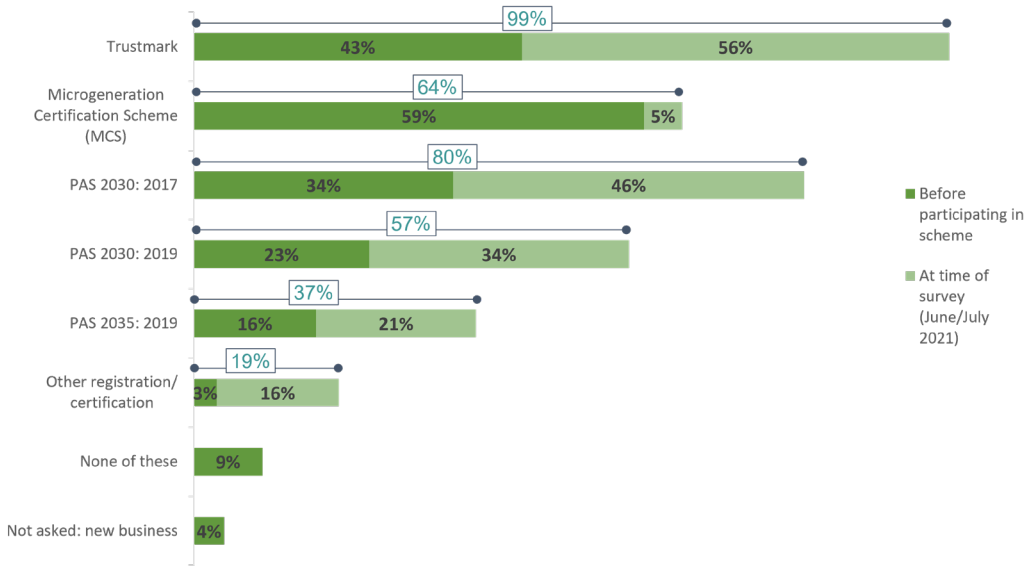
Using GHGVS funding, BEIS also launched a £6.9m **skills training competition**[42] to award grant funding to a range of suppliers to deliver accredited training at scale to the low carbon installation sector. The training was set to run from November/December 2020 to October 2021 and covered training to be available free or subsidised for trainee at point of delivery on PAS and MCS, and delivered either online, in physical classroom sessions, or a combination of the two as appropriate.

5.2 Evidence of improved supply chain capacity over the course of the scheme

5.2.1 Capacity of installers to deliver installations under the scheme

The GHGVS process evaluation research (qualitative and quantitative) with installers found that they were initially keen to participate in the scheme and prepared to hire new staff. Several installers participating in qualitative interviews (before the announcement of the scheme closure) considered that the scheme would stimulate new work for their business, an assumption which they also saw validated in the surge of quotes for work received. As shown in Figure 5.1 below, many participating businesses gained certifications to participate in the scheme suggesting that there was an interest in the scheme and ability to scale up to participate.

Figure 5.1: Certifications held before and after participating in the scheme



B7: And still thinking about that time, before you became involved in Green Homes Grant Voucher Scheme, which, if any, of these registrations or accreditations did your business hold/ D1: Which, if any, of these additional certifications or accreditations has your business gained to enable you to participate in the Green Homes Grant Voucher Scheme?
Source: Green Homes Grant Voucher Scheme Installer Survey
Base: all installers (218). NB 4% of installers were set up as a result of the scheme and were therefore not asked about certifications held prior to participation.

[42] The Green Homes Grant Scheme Skills Training Competition: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/979838/green-homes-grant-skills-training-competition-withdrawn.pdf

However, in the wave 1 applicants survey, more than half (55%) of applicants reported that it was either fairly or very difficult to find installers to provide quotes for the desired energy efficient or low carbon heat improvements. These findings were reflected in the qualitative research for the GHGVS process evaluation, in which applicants reported encountering numerous challenges when looking for installers to provide quotes. Problems included: that there were not enough installers listed on the scheme website offering their preferred measure in their region; that installers were unresponsive to phone calls / emails when contacted; that installers were fully booked due to high demand from the scheme; and that installers were reluctant to provide a quote when contacted, in some cases because they had decided not to carry out installations on the scheme due to concerns about delays in payment or problems with the organisation of the scheme.

The supply of installers will be investigated in more detail in the final outcome and economic evaluation.

5.2.2 Capacity within the upstream supply chain

During the GHGVS process evaluation, **trainers, auditors, and certification bodies** indicated that they had responded to the announcement of the GHGVS and, alongside other factors driving greater demand (the introduction of ECO3 and of PAS 2035, and an increased demand in the market for home improvements), had scaled up capacity to respond. All reported that they were willing and able to scale up to meet the demand for certification during the scheme and should it increase in future.

Research with **manufacturers,** however, found that the scheme generated imbalanced demand across the manufacturing industry, overwhelming certain areas while having no impact on others. Manufacturers of solar thermal and some insulation types indicated that even if the scheme had generated the intended demand, and the installer capacity existed**, it would have been impossible to service that demand within the timeline with the existing manufacturing capacity**. This could have created a significant negative side-effect on the quality and cost of products. Other manufacturers suggested they did not need to grow as they could meet any demand generated by the scheme.

Manufacturers consulted in the interim outcome and economic evaluation reported a **marked effect of COVID-19 on shortages of supply of materials (which also became more costly)** and a shortage also of workforce coming from Europe. The change in reporting between the GHGVS process and outcome evaluations is likely to have been driven in part by the time difference in consultations, with supply of material issues becoming more acute and problematic in the later stages of the scheme (when installations were also more frequent). In many instances, installers interviewed in for both the process evaluation and this interim outcome and economic evaluation reported that they experienced **severe delays in getting the necessary equipment to perform installations and that they had seen a decrease in workforce from continental Europe** (for the latter, the UK's exit from the EU was deemed the main driver and COVID-19 a secondary one). That the supply of materials and specialised workforce would have been unaffected by the external shocks does not appear to have therefore been a valid assumption.

5.2.3 Capacity following training

Training providers reported that, despite challenges in the delivery of training caused by e.g., COVID-19 social distancing restrictions, they had **seen an improvement in the industry's average level of skills for installations over the past year.** This aligns with what auditors report to be **an improvement in the quality of installation** as well as with the findings of the GHGVS process evaluation. Auditors attribute this rise in quality to the introduction and application of **standards for installers** (especially PAS 2035), **better training** and the **improved inspections** that monitor installations.

In the GHGVS process evaluation, the results of the telephone survey with installers highlighted that, amongst those who gained any of the necessary accreditations in order to participate to the programme, the average number of people attending training[43] was 1.61 staff per business and average out of pocket expenditure for training (e.g. on training fees, hiring external trainers, paying for training materials) was £5,026.44 All ten installers participating in qualitative interviews as part of the interim outcome evaluation had participated in some type of training in order to participate in the scheme. These included courses related to gaining PAS certifications, how to install specific measures (especially heat pumps) and sales training. **Installers interviewed noted the benefits of training**. One company mentioned that, following the training attended, they became more conscious of post-installation quality checks.

> *"It's good to get refreshers of doing things properly. [It made us more conscious of] health and safety, materials, how to do the job." (Wave 2 interview, installer)*

Another company had seen a significant positive effect of upskilling on their business:

> *"A 1 million percent improvement. The admin person does compliance now, the surveyors and installers are all now self-sufficient in their roles." (Wave 2 interview, installer)*

Training providers reported that the feedback from installers following the training was positive. The benefits of the training were **new practical skills** (with some installers claiming that they learned new skills that they did not know they needed), **the confidence** provided to find work and complete the job to a high standard, and **increased quality** in the sector. Training providers believed that the benefits obtained through the training are not specific to the GHGVS and can be **more widely applied,** meaning that the skills acquired are **still valuable now that the GHGVS has ended.**

5.2.4 Capacity following certification and TrustMark registration

When asked about the advantages of certification and TrustMark registration, and any disadvantages, installers participating in wave 2 qualitative interviews reported that **being**

[43] This was retrofit training in general – to cover all retrofit schemes and not just the GHGVS.
[44] Average number of employees trained is derived from question D3 and average amount spent from question D5 of the survey of installers, base (135) and (69) respectively of all who gained any certification at D1.

registered with TrustMark or PAS-certified did not bring tangible benefits to their business.

> *"I haven't used TrustMark to find work since the voucher scheme ended because it's not a necessity. We try to keep costs down to the customer. We work with NICEIC and MCS for notifications. … We get the odd inquiry through TrustMark from customers. Normally we get inquiries through the MCS register." (Wave 2 interview, installer)*

These same installers fed back that PAS certifications, though advertised on the company website, had not made a large difference in terms of customers' trust. Feedback from qualitative interviews with installers also suggest an increased administrative workload relating to TrustMark registration and follow-up post-installation:

> *"It was more labour-intensive on the administrative side (point e) so it cost about £70 to get all the photographic evidence for the checks to get the voucher. […] It costs about 100 – 150 extra to the customer, reflected on the quote." (Wave 2 interview, installer)*

> *"We've killed several thousand trees with paperwork". (Wave 2 interview, installer)*

5.3 Exploring contribution

5.3.1 The scheme's contribution to stimulating supply (via increased demand)

In the process evaluation, interviews with installers and manufacturers that mainly took place in January and February of 2021, indicated that **demand for home improvements was high during the first lockdown**, as people spent more time in the home and identified improvements they wished to make. Research with applicants also uncovered minimal evidence of households deciding not to install a measure because of concerns around having installers in the home. As a result, the assumption underpinning scheme design about the immediate need for an economic boost or rapid stimulus to demand appeared not wholly valid; and **this perceived absence of need for demand** may have driven some of the installer unwillingness to participate in the scheme (because they were already busy with non-scheme work activity). The research for the GHGVS process evaluation therefore suggested that the scheme was not additional to existing demand and therefore **did not majorly contribute to supply.**

By contrast, qualitative interviews with installers as part of the outcome evaluation suggest that **the scheme stimulated demand which benefitted businesses, helping them to either maintain or increase supply.** This is illustrated in the following five quotes:

> *"For the business, it was good to have the scheme because it really kick-started demand. One of the things with the RHI was that the customer had to pay everything upfront. With GHGVS, money was given up front, which I think was a*

good idea […]. If [Government] don't put money towards [installations], the demand will disappear. Especially with air source heat pumps, for which the installation is very expensive. And for many customers it doesn't save money on bills. And I think if there is no incentive, it will drop off the face of the earth. We used to do a lot of PV panels, but since they stopped subsidising that I do hardly any of those, maybe 2 a year." (Wave 2 interview, installer, air source heat pump, solar thermal)

"The benefit was all the extra customers, and some of them, even if we didn't get them done on the GHGVS scheme, they have come to us since and had the installations off-scheme, paying for it themselves." (Wave 2 Interview, installer, internal wall insulation)

"A benefit of the scheme was it continued to keep workforce in work over the COVID-19 period. [But there was] no financial gain - a lot of work to make no money". (Wave 2 interview, installer, insulation)

"The scheme was good for business – it generated customer interest and was an easy sell because the costs to customers were either nothing or heavily subsidised." (Wave 2 interview, installer, heat pumps, Solar PV, cavity wall insulation)

5.3.2 The scheme's contribution to supply in the upstream supply chain

Findings from qualitative interviews with auditors, training providers and certification bodies indicate that **the scheme stimulated demand, which encouraged these businesses to scale-up supply.** Interviews with manufacturers suggest a more mixed effect depending on the material or product produced. Overall, these findings point to **schemes such as the GHGVS having an impact on supply chain capacity**. However, they also indicate that **more time and/or resources might be needed to enable manufacturers to respond to demand**, which is particularly challenging when the sector is facing external barriers such as import issues created by the UK's exit from the EU and COVID-19 related effects on trade.

5.3.3 The scheme's contribution to supply chain skills and training

All installers interviewed for the outcome evaluation, and many interviewed for the process evaluation, had participated in some type of training to participate in the scheme. **This suggests that the scheme did contribute to the upskilling of installers.** The fact that the scheme had encouraged or obliged them to participate in training (which they report to have found beneficial) suggests a causal link between the scheme and this upskilling.

No installers interviewed had knowingly participated in training specifically funded through the GHGVS scheme. However, training providers interviewed indicated that the **GHGVS skills competition had played an important role in training up installers**. They reported that installers faced challenges in accessing, investing in, funding, and committing to training. They also stated that the recent lack of funding (after the end of the GHGVS training skills competition) meant fewer installers were willing to invest in it (from their point of view). Training

providers also reported a **lack of training staff,** especially heat pump training, which limits access and may mean longer travel distances to access courses. Some training providers reported a **drop in interest amongst installers as the training skills competition ended and when the scheme was announced to end.**

5.4 Summary and conclusions

The findings from the analysis of supply under the GHGVS conducted as part of the interim outcome and economic evaluation suggest that, whilst certain upstream suppliers (e.g., training providers, auditors, and certification bodies) were able to scale up to meet demand under the scheme, some installers and manufacturers' capacity was more limited.

When taken together, process and outcome evaluation findings show that the scheme contributed to stimulating supply, to the extent that increased or maintained demand in the face of shocks from COVID-19 to some parts of the industry.

Installers reported benefitting from the training they undertook in order to participate in the scheme, though also seeing fewer benefits to their business from certification and TrustMark registration (which they do not consider to play a role in attracting new business).

6 Benefits to households

This Chapter provides an early assessment of benefits to households generated by the scheme, based upon research with applicants during this interim outcome and economic evaluation phase and during the process evaluation. It provides initial responses to the following evaluation question:

- How effectively has the installation of energy efficiency/low carbon heating measures led to property occupants improved health and well-being and/or warmer homes?

A detailed assessment of benefits to households, particularly in terms of health benefits generated by the installations of measures under the scheme, will be carried out in the next phase of the evaluation.

6.1 How the scheme intended to create benefits for households

In the wave 1 applicant survey, numerous applicants reported the presence of heating-related problems in their home prior to their participation in the scheme. Half (51%) reported that it was **too expensive to heat their property to a comfortable temperature**, with a slightly lower proportion (44%) reporting that it was difficult to heat their home to a comfortable temperature even with heating on. Just under a third (30%) reported **drafts**, a quarter (26%) reported **condensation** on windows, a fifth (20%) reported **mould / mildew**, and a fifth (20%) also reported **damp walls / floors** as problems present in the home prior to the scheme. A tenth (9%) reported **rot** in windows, frames, or floors.

Inefficient homes impose unnecessary energy costs on occupants and the wider economy and can lead to poor health outcomes, with a resulting resource pressure on health services[45]. The scheme was intended to address these problems by: (1) helping households to make their homes warmer; (2) supporting quality of installation (to reduce the risk of condensation) (see Chapter 7); and (3) targeting fuel poor households who are often the most affected by these problems.

6.2 Evidence of benefits to households

The potential benefits to households of improved health and reduced fuel poverty will be assessed in the final outcome and economic evaluation report, based on modelling as well as data collected through the second wave of the applicant survey on levels of warmth and comfort. Section 6.3 below provides some considerations of the link between the scheme and emerging evidence of benefits from the wave 2 qualitative interviews with applicants.

[45] Age UK estimate this to cost the NHS roughly £.14 billion per year (The Cost of Cold, Age UK, 2012)

6.3 Exploring contribution to household benefits

6.3.1 Contribution of the scheme to accelerated or alternative decisions around measures

Both the wave 1 survey of applicants and both waves of qualitative interviews with applicants indicate that the scheme accelerated installations amongst some groups who would have likely installed the measure anyway, but at a future point in time. For example, one applicant interviewed had begun looking into solar thermal systems a few years before the scheme on recommendation of a family member and thought that they may after a few years have found the money to install it, but the scheme allowed them to do it sooner than anticipated. Another applicant explained that they had considered solid wall insulation before the scheme but that the idea was “on the back burner” before the scheme opened. At least one participant stated that they wanted to replace their boiler with a heat pump in future but had initially planned to do so once their gas boiler stopped working. The scheme’s offer of a subsidy caused this participant to expedite their plans.

One applicant whose previous heat pump had broken a few years previously had relied on a wood burner in the interim, had been reticent to invest in another heat pump, but the GHGVS convinced them to buy another one, because of the subsidy provided. For certain landlords, the money prevented them from having to sell the houses in question. Others explained that the cost of improving their homes to meet upcoming minimum EPC requirements would be equivalent to several years’ rent and therefore not financially viable without a government grant.

6.3.2 Contribution of the scheme to money savings

Insights into the scheme’s potential effects on energy spending at household level have been challenging to develop for this evaluation because this report relies only on self-reported data and households find it difficult to accurately measure changes in their energy bills given that bills are driven by numerous factors including tariffs, time of energy use, and – most recently – the energy crisis and its effects on energy prices. This made it difficult for applicants to evaluate whether energy bills had been positively affected by the scheme. Some applicants interviewed also mentioned that they had not had the installation for long enough to make a proper assessment about the installation’s impact on bills. There was, however, evidence that the scheme had decreased energy use among many applicants (see Chapter 9), and several homeowners and landlords participating in the wave 2 qualitative research highlighted that participation in the scheme had saved them money in a home upgrade they would have otherwise had to pay for independently.

6.3.3 Contribution of the scheme to increased warmth and comfort

Applicants were broadly positive about their new installations and the improvements they had made to heating-related problems in the home. Applicants who reported difficulties heating their home adequately prior to the scheme **emphasised the increased comfort in their**

home. One homeowner consulted in wave 2, who had installed internal solid wall insulation reported the following:

> *"Two rooms have gone from being the coldest to the warmest in the house. It is transformational but I am still using a lot of heat". (Wave 2 interview, homeowner, external wall insulation)*

Landlords who had heard from their tenants since the installation was completed reported universally positive feedback from tenants about the impact on the comfort of the home.

> *"The tenants are chuffed to meatballs! Their energy use is down by 50%, they think" (Wave 2 interview, landlord, external wall insulation)*

6.3.4 Contribution of the scheme to improved health

As part of wave 2 qualitative research with households, certain individuals reported a positive impact of their GHGVS installation on their **well-being and mental health,** a finding especially prominent amongst the small number of individuals interviewed who had disabilities. One applicant with disabilities, following the installation of solar thermal and double glazing, began using more rooms in their home and opening the curtains during the day where previously high fuel costs had caused them to restrict themselves to one or two rooms and keep the curtains closed during the cold months. Another applicant (who did not have disabilities) mentioned that their air source heat pump had improved their mental health by making their home significantly more comfortable.

In terms of **physical health**, certain individuals living in homes with a disabled person reported their expectations in the qualitative research that the scheme would prove beneficial for their household. For the process evaluation, one applicant whose partner had recently had to stop working due to COVID-19 related long-term health issues, expected that the scheme would prove especially beneficial given that their partner would likely be spending most time in the home. Another applicant mentioned that the reduced cost of heating water with their new solar thermal installation was especially appreciated as one family member needed more time for bathing due to their disability. One individual interviewed as part of the qualitative research for this report, who had disabilities and did not have central heating in the home before the scheme, noted that the installation of solar hot water system had positively impacted their health by providing them with reliable heating and hot water.

Landlords were unable to comment on the impact of the measures on the health and well-being of their tenants.

6.3.5 Contribution of the scheme to home functionality

A notable benefit reported by several applicants was the ability to **make rooms in their home usable,** where previously they had not had the funds to make the necessary improvement. One applicant with disabilities was able to afford to heat more rooms in the home following the grant where previously they had been restricted to one part of the home.

“It’s made it a lovely room. The room is [now] usable. In the summer I can lie down in bed any time rather than having to wait until very late. Before you would feel the heat when walking upstairs. It’s now like any other room in the house.” (Wave 2 interview, homeowner, room-in-roof insulation)

"It’s definitely warmer. Some of the rooms are usable now. I can open curtains where before had to keep them closed to stop draughts.” (Wave 2 interviews, homeowner, solar thermal and double glazing)

'We’ve now got a room we can use, it used to be cold like a fridge in the winter and too hot in summer!' (Wave 2 interviews, homeowner, room-in-roof insulation)

6.4 Summary and conclusions

The initial evidence presented in this Chapter suggests that installations implemented under the scheme contributed to increased comfort, well-being, and physical health for benefitting households. Where the installation increased the functionality of the house (e.g., by making rooms ‘usable’ because they were warmer), this also brought benefits in well-being and potentially also productivity to the home.

Chapter 4 presented evidence to suggest that the scheme drove some applicants to install measures where they would not have done so without the scheme. This Chapter has shown that, for some households which would have installed the measure without the scheme, the scheme accelerated that decision, meaning that they installed the measure (and benefitted from it) at an earlier date.

Several benefitting households perceived that the scheme “saved them money” either because it enabled them to move away from gas heating, which they considered expensive; or because it meant switching to more cost-efficient energy use (e.g., no longer using an emersion heater); or because the scheme provided them with a subsidy for a home improvement which they would have otherwise had to pay for themselves.

7 Quality of installation and service

This Chapter assesses quality of installations and service under the scheme. In this sense, it follows a definition of 'quality' that is based upon the 'SERVQUAL' framework, updated for application in the construction industry by Landy et. al. (2020),[46] which considers eight dimensions to quality of service.

Service Quality Dimension	Definition	Success Factors
Reliability	The ability to perform the service in a careful and reliable manner.	Total quality of work output Reputation and experience Delivery times
Responsiveness	The willingness to help clients and provide fast service.	Professionals' skills Workers' behaviour Incident resolution Level of work disruption
Assurance	Knowledge and attentions shown by employees and their abilities to generate credibility and confidence.	Competence Credibility Confidentiality
Empathy	Personalised attention with kindness and courtesy.	Access Courtesy Communication Understanding the customer Interaction with customers
Tangible elements	Aspect of physical facilities, equipment, personnel, and communication materials.	Technological tools
Quality Aesthetic	The visual appeal and technical execution of the completed service.	Aesthetic workmanship Technical workmanship

[46] M F B Landy et al 2020 IOP Conf. Ser.: Mater. Sci. Eng. 800 012035

Service Quality Dimension	Definition	Success Factors
Design	The utility and appropriateness of the design.	Flexibility Adaptability
Care in execution of work	The social and environmental impact of the service.	Sustainability Social responsibility

Within this broad sense of quality, we are also assessing the extent to which the scheme was affected by fraud and gaming. The chapter answers the following evaluation questions:

- To what extent did the scheme deliver energy efficiency installations which were of high quality?
- To what extent has the scheme been affected by fraud and gaming?

7.1 How and why the scheme was intended to support quality

7.1.1 The rationale for quality of installation and service

The rationale for the GHGVS quality and fraud prevention systems (described below) was learning from previous UK energy efficiency programmes, particularly the Green Deal Home Improvement Fund (2014-2016) and Warm Front (2012). It also built upon findings from a review into the Australian Home Insulation Programme (2009-2010), which had a high and rapid take up, which led to poor quality of workmanship and materials and claims of fraud, and which was linked to four deaths and over 100 fires. The GHGVS quality and anti-fraud design measures also respond to the Each Home Counts Review,[47] which recommended that registration with TrustMark be a requirement of Government schemes and that a framework of standards be introduced (which led ultimately to the requirement for PAS 2030: 2017[48] in the GHGVS).

Poor quality of installation can have negative effects on comfort, safety, and efficiency of the home, as well as sustainability of the installation and well-being of the building's occupants. As set out in Chapter 4, service quality can affect the extent to which people will want to have measures installed in their homes further and have confidence in such schemes.

[47] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/578749/Each_Home_Counts__December_2016_.pdf

[48] Publicly Available Specification 2030 of 2017. More information can be found on the UK Accreditation Service (UKAS) website: https://www.ukas.com/resources/latest-news/ukas-pas-2030-green-homes-communication-to-certification-bodies-change-in-beis-transition-policy/

7.1.2 How the scheme was intended to support quality of installation

TrustMark registration

The scheme relied on TrustMark registration to drive quality assurance. All installers wishing to deliver measures under GHGVS were required to first be TrustMark registered. TrustMark is a government-endorsed quality scheme that supports quality in the following ways:

- It requires registered businesses to keep up to date with the most recent standards and practices and provides support with guidance on technologies and procedures. At the outbreak of COVID-19, TrustMark produced detailed guidance on how installers should conduct business safely. It also provides guidance and advice on quality improvements to specific measures.
- For installers it supports with Trading Standards approval, insurance, and escrow services, and ensures registered businesses remain up to date with training and certification.
- For households it requires that all installations be 'lodged' within the TrustMark database for the voucher to be redeemed. This process was expected to support quality ensuring that only the chosen business could make the necessary lodgements for the agreed measure type at the property, and that lodgements met the PAS 2030 standard.
- It implements a two-stage audit regime to ensure its standards are maintained by every business (covered later in this section).
- For households, TrustMark requires registered businesses to provide financial protection to cover the costs of defects, damage, and non-compliance with building regulations from an installation by a TrustMark-registered installer.

To register with TrustMark, businesses must:

- Gain an appropriate level of qualification (this necessitates training from an accredited provider if they are not already qualified).
- Certify that they will operate to the appropriate standard for all installations they wish to offer under TrustMark by becoming a member of an accredited certification body, (meaning that the businesses undergo compliance checks and assessments to demonstrate their qualifications, ability and commitment to meet the standards).
- Register via a TrustMark Scheme Provider (a role often fulfilled by certification bodies). Where a business has been established for a shorter timeframe, registration requires further checks to ensure it is legitimate.

TrustMark audits and follow-up

The TrustMark audit regime is the same for all PAS installations (regardless of scheme). TrustMark auditors carry out both desk and site-based audits of installations by a company. Desk-based audits involve checking lodgements to ensure all aspects of the installation are to the expected quality and standard based on paperwork, forms and photographic evidence of the installation lodged by the installer. Site inspections involve a visit from a trained auditor.

Each audit is constituted of measure-specific and general questions and observations which determine the outcome of the audit. For example, an audit on external wall insulation will cover questions about adequacy of thickness, percentage completion, waterproofing, fire barrier installation, presence of air vents, structural soundness, safeguarding electrical cables and other areas. These questions have been developed by TrustMark based on the PAS 2030 standard. Upon a site inspection an auditor will visually check the installation and score each question with an outcome of “pass” or “non-compliance” (and potentially also “unable to validate” where they are unable to gain access). It is important to note that measure types may have different numbers of question in their audits (e.g., one measure type may have 10 questions while another may have 14).

After the audit, the business is given the opportunity to rectify any areas of non-compliance. In most cases, this is resolved by installers and evidenced by at second site inspection or via lodgements of photos. However, if the issue is not resolved or it continues to persist across installations, this is escalated by the auditor to the business’ Scheme Provider. The Scheme Provider takes steps to ensure the business begins addressing the issues immediately by rectifying the existing problems and improving the standard for upcoming installations. This may involve providing more guidance to the business or carrying out a 100% audit of an appropriate number of subsequent installations (i.e., the next ten jobs to be inspected by a site auditor). In extreme scenarios, this may also mean revoking the registration of the member. Although this path is taken only when other routes are not available as TrustMark and scheme providers prioritise improvement of business practices and being able to provide a resolution for customers. Revoking certification typically ends these possibilities.

7.1.3 How the scheme was intended to support quality of service and technical quality (certification)

To carry out work under GHGVS, these standards had to be attained:

- PAS 2030:2017 for any energy efficiency measures
- PAS 2035:2019 for any energy efficiency measures in park homes, high rise buildings and buildings that were both traditionally constructed and protected.
- MCS for any low carbon heat measures such as heat pumps.

PAS 2030 is based on a Quality Management Systems which requires business to maintain standards in skills, competence, and training; internal inspections and verifications, processes dealing with issues (e.g., complaints, equipment, product suitability); and health and safety. Importantly, it also has criteria for specific measures. These cover installation methods for fabric measures (insulation, glazing, doors), mechanical measures (heating systems) and electrical measures (lighting and controls). Some examples of issues that installation methods seek to address are: provisions to minimise thermal bridging at the edges of installations; resilience of installation to rainwater ingress; airtightness of the building; and management of moisture to prevent long-term damp and deterioration.

PAS 2035:2019 is a whole-house approach which incorporates and builds on PAS 2030:2019. Building on the latter, it sets out roles and responsibilities of specialists such as Retrofit Assessors (whose job is to collect data from the property at various points) and Retrofit Coordinator (who is the project lead and ultimately responsible for the outcome of the installation). It also lays out procedures such as a long-term retrofit plan with the most appropriate measures and their order; the installation process; record-keeping; and ongoing monitoring and evaluation. GHGVS was launched with only PAS 2030:2017 as the requirement as the industry was not yet fully prepared for the updated PAS 2030:2019 or PAS 2035:2019. BEIS took a specific policy decision with the GHGVS not to require retrofit assessors (i.e. PAS 2035 standards) for properties except for those that were particularly hard-to-treat (park homes and high-rise buildings) so as to not reduce access to the scheme. For the same reason an EPC certificate was not required for a voucher application.

7.1.4 How the scheme was intended to prevent and detect fraud and gaming

Controls to prevent and detect fraud and gaming were integrated into the scheme at multiple levels. At the **installer registration stage**, the dual registration recognition process with TrustMark helped the Scheme Administrator to check company identity and eligibility to participate in GHGVS. The **applicant eligibility terms and conditions** referred to in Chapter 3 aimed to **prevent duplication of funding for the same measure**. Applications for a voucher were required to include the quote provided by the installer. The Scheme Administrator **audited applications**, challenging areas of risk such as any suspected cases of price inflation or fraudulent or unfair quoting, as well as any suspected issues with business identity or credentials. The Sightline Manager (SLM) system operated by the Scheme Administrator drew upon various existing data on installers and applicants to **verify identity and profile information** in combination with external data (e.g., Department for Work and Pension, Credit Reference Agency, Land Registry, etc) to verify eligibility criteria, including property ownership, identity, and benefits receipt where relevant. This led to several rejections based on incorrect applicant statements. The scheme administrator also undertook data analysis combining other data sources such as Companies House and using Energy Performance Certificate (EPC) and other data to detect fraud risks such as nested landlord companies, incorrect property characteristics and so on.

The number, type and targeting of audits was based on various factors but had them both as risk based and random.

To log their work to have vouchers redeemed, installers were required to **upload photos onto the SLM before and after the works were completed**. Logs that omitted a photo or had a photo which was unclear would trigger an onsite or virtual audit by the Scheme Administrator's network of domestic energy assessors. At one stage in delivery photo omission triggered an audit in all cases, but it was found to be cost ineffective, so audits were reduced to only a third of applications without photos. One issue flagged by BEIS was that **customers were supposed to redeem the voucher** as a way of confirming their satisfaction with and approval of the works completed. However, the system enabled installers in possession of the customer's email address, voucher number and application number to do this. Once this behaviour became apparent, additional measures were introduced to enable the customer to

still confirm or refute their satisfaction with the work undertaken before redemption would be authorised. The evaluation's second wave of qualitative research with applicants has found instances of this happening.

The scheme was also subject to numerous assurance and advisory reviews such as by the National Audit Office, the Government Internal Audit Agency, Ernst & Young, HMRC, the Cabinet Office, and others to assure the competency of fraud management in the scheme.

7.1.5 Other aspects of scheme design intended to support quality[49]

There were also assumptions underpinning scheme design around the level of information that households would have before embarking upon or seeking an installation. BEIS assumed that the scheme would attract 'early adopters' of low carbon heating technologies and rarer types of insulation who were already informed about these technologies either through prior research or through research conducted in preparing to apply for a voucher. BEIS explicitly linked the voucher application process up with the Simple Energy Advice[50] website, which provides information on different types of energy saving improvements that can be made to homes and whether these are right for the home's needs, as well as information on TrustMark installers operating within postcode areas. BEIS also saw it as the task of the Scheme Administrator who audited all applications to assess whether measures were appropriate for the building concerned.

7.2 Evidence of quality under the scheme

7.2.1 Audit outcomes

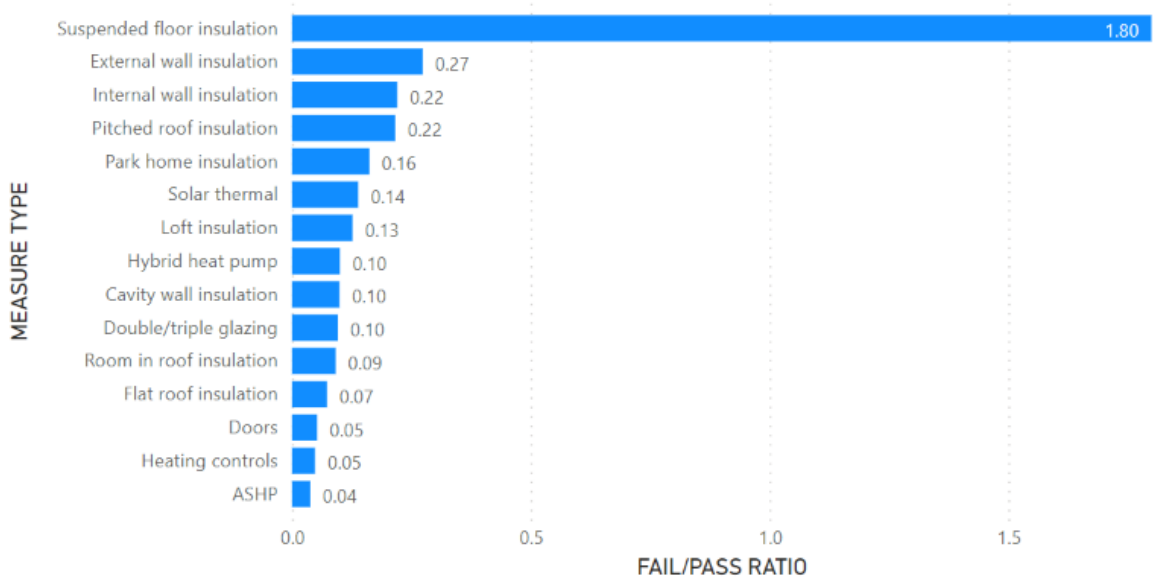
This section covers evidence from auditor and certification body interviews as well as scheme audit data provided by TrustMark. There were 1,221 GHGVS audits recorded in the most recent TrustMark Site Audit Data Report available (January 2022). Most of these audits (approximately 1,100) took place in August and September 2021, with the remaining audits taking place in October and November 2021. A total of 21,852 questions were scored across all scheme audits. Only the results of a preliminary analysis are used for this report; the last phase of this evaluation will analyse the data in greater depth.

Amongst the 1,221 audits there were 3,588 instances of non-compliance out of the 21,852 questions asked (amounting to 16% non-compliance) (around 1 non-compliance for every 6 questions passed). TrustMark data from audits presented in Figure 7.1 provides a contextualised overview of compliance. It illustrates the "fail/pass" ratio per measure by dividing the instances of failures by instances of passes to provide a relative rate of non-compliance regardless of the number of audits. Suspended floor insulation faced the most significant issues and is the only measure with more non-compliant results than passes (i.e., a fail/pass ratio greater than 1). However, there is a challenge with being able to capture this data. Auditors explained that many of these instances have been classed as non-compliant

[49] Information shared with Ipsos by BEIS at the Phase 2 Theory of Change workshop.
[50] www.simpleenergyadvice.org.uk

because customers refused to give access as checks can require invasive action (removing floorboards) after an installation is completed (see discussion below on mid-point audits and consistent monitoring). In effect, it is not possible to determine multiple aspects of quality for suspended floor insulation because auditors cannot view the installation. External wall insulation has an above average fail/pass ratio of 0.27. This indicates that its 1,718 non-compliance instances are not only owed to its high number of audits but also slightly higher-than-average rates of failure. **Other than suspended floor insulation and, to a lesser degree, external wall insulation measures, the TrustMark audit data do not indicate concerning levels of non-compliance.**

Figure 7.1: The fail/pass ratio of each measure type



Note: The fail / pass ration has been calculated as: instances of failures / instances of passes. Data is calculated using all questions asked across all installations

7.2.2 The views and experience of auditors (from wave 2 qualitative interviews)

All nine auditors interviewed had encountered properties with installation issues while undertaking site audits for the GHGVS. The most common types of issues they had encountered comprised: inadequate ventilation when installing fabric measures and sub-par installation of external wall insulation and, more generally, all types of insulation. **Auditors considered these to be relatively frequent but not hugely problematic.**

Evidence from auditor interviews conducted for the process evaluation had indicated very low levels of quality issues compared to the current standard. However, the audit data and qualitative interviews conducted with auditors for the outcome and economic evaluation suggest a slightly higher rate of failure. One reason for this difference in findings over time may be that the first wave of auditor interviews occurred mostly in February 2021 before most site audits (and installations) had taken place.

7.2.3 Applicant experiences

Applicants responding to the wave 1 survey of applicants, who had also completed the installation process by the time of the survey, were overwhelmingly satisfied with the quality of their works: 84% indicated satisfaction, including 58% who were very satisfied. Less than one in ten (8%) said they were dissatisfied, with 3% very dissatisfied. Amongst the applicants participating in the first wave of qualitative interviews, those whose installations were completed typically reported high levels of satisfaction with their installations. Where issues with the works were raised, these were either relatively minor (e.g., a roof membrane not being perfectly flat) or the result of unmet expectations (e.g., where installers had not completed minor ancillary works that they had previously said they would complete). The satisfaction of applicants is being investigated further through the wave 2 applicant survey, which will be reported on the final outcome and economic evaluation report.

Wave 2 qualitative research with applicants suggests that applicants' experience of installations was mixed, with some salient feedback from several that suggests poor quality installations were still able to pass by the scheme's quality systems. The prevalence of such feedback vs. the otherwise satisfactory experiences is being investigated through the wave 2 applicant survey and will be reported in the final outcome and economic evaluation report.

> *"The installation went fine. Only problem is they accidentally dropped a scaffold pole through the glass roof. They initially denied that it was them, but I had it on CCTV! It took 3 months for the repair, and they did pay but I had to be firm with them. It made the conservatory black, and water was everywhere. But it was fine, I just repainted it. […] The hot water isn't getting hot all the time. I've been contacting them in recent weeks about this and they are not getting back to me about it. I am assuming I will have to pay for my own plumber now, which is annoying because I thought there was a guarantee on it". (Homeowner, wave 2 interview, solar thermal)*
>
> *"We're very satisfied, the installers worked quickly and efficiently, leaving everything clean [after they left]." (Landlord, wave 2 interview, solar thermal)*
>
> *"They left the kitchen a mess and drilled through two pipes. They did not give them any advice when they installed the tool and left us without water because they had another job to complete. The last two guys that came in September (from the same company) instead were excellent and they did a great job, but before it was a nightmare". (Homeowner, wave 2 interview, solar thermal)*
>
> *"I was satisfied. [After the installation was complete] they asked to return to do a few bits with plastering, so I'd say very satisfied, they did a really good job." (Homeowner, wave 2 interview, room in roof insulation)*
>
> *"I am not really satisfied. I have an unanswered question: in a period property, will my internal wall insulation affect dew point and create damp issues? The company said they would conduct a test but then didn't. So far I haven't seen any*

problem, but I am keeping an eye on the situation" (Homeowner, wave 2 interview, internal solid wall insulation)

"[The installers] were very efficient, they sent lots of documentation about the product and the company, so I knew all about the product before it arrived" (Homeowner, wave 2 interview, solar thermal and double / triple glazing)

"I am not satisfied. Installers had to come back to rectify completed work and replaster a ceiling. The finishing was rubbish – they were using sub-contractors who were not trained - they chopped off architrave from doors and cupboards. I got a proper carpenter in after the installation to rectify things. The guy in charge had never done roof installation just external wall insulation. The installation was supposed to take 2 days but took 8 days in total." (Homeowner, wave 2 interview, room-in-roof insulation)

"I'm satisfied with the outcome, [there have been] no problems. It's made a difference to the warmth of the property, [and] the tenants are happier. They recognise it has made a difference to comfort" (Landlord, wave 2 interview, room in roof insulation)

"For the solar panels the scaffolding was in wrong place so the workmen had to scramble across the roof. This was unsafe as underneath is concrete and the ladder was inappropriate – one of the installers looked nervous. The electrician made a huge hole in the wall that my son (a plasterer) had to correct. I had to chase [the installers] up as there were exposed black wires coming out of the solar installation on the roof." (Homeowner, wave 2 interview, solar thermal)

"The tenant was happy with the work taking place. Installer left the tenant full instructions – left paper documents, an instruction manual, and talked her through every single part of the process. The place was very tidy and pristine when the installers had finished." (Landlord, wave 2 interview, air source heat pump)

"The government didn't have sufficient installers – we trusted the installers because the government said they needed to be TM registered so we thought we would have the best installers. No confidence re: window installation. The loft was a good job, but the windows were bad." (Homeowner, wave 2 interview, loft insulation and double glazing)

7.2.4 Evidence of price manipulation and inflation

Applicants participating in the first wave of qualitative interviews identified some **instances of price inflation**. Auditors and certification bodies had also come across cases of over-inflation of prices but did not consider these unusually high. Wave 2 qualitative research identified cases where installers had **pushed the prices of measures to the limits of the voucher or added inappropriate measures** (c.f. pitched roof insulation where there was loft insulation) to gain additional income. For example, an auditors recalled instances of installers classing some core work, such as replastering and repainting walls, as "subsidiary costs" not included in the

voucher budget, leaving homeowners with the responsibility to complete this. **Some of these behaviours were difficult to identify via photographic evidence and were only uncovered via site inspection**, especially where customers were unaware of the technical rules and expectations.

7.2.5 Evidence of fraud, suspected wrongdoing from the GHGVS process evaluation

BEIS, with inputs from the Scheme Administrator have estimated the range of **residual fraud of the scheme at 0.2% to 1.8% of spend**. This was within the originally agreed tolerance of 2%. Although some instances of fraud are likely to have occurred, their measurement aligns with the departmental fraud tolerance level of 'low/very low'. It would have been unrealistic to implement a system that would guarantee the complete absence of fraud instances in a scheme of this scale, as such the GHGV was instead designed with the aim to deter, prevent, and then detect as many instances of fraud as possible (to drive the residual level down), whilst avoiding the introduction of overly burdensome controls.

The GHGVS process evaluation report found some evidence of suspected fraud and wrongdoing under the scheme. For example, two out of eight **certification bodies** interviewed at this stage of the research said they had encountered gaming or fraudulent activity in the scheme. Three **applicants** also reported wrongdoing, including installers charging for quotes and requesting pre-payments for EPC ratings. **Auditors** interviewed for wave 2 had witnessed gaming or fraud in relation to scheme installations but considered these instances rare.[51]

Ultimately the scheme **rejected more vouchers than it awarded** (see Chapter 2). Some of the reasons for rejections are described in Chapter 2 and these appear logical (ineligibility, unclear information, etc.). Some applicants interviewed as part of the process evaluation of the scheme found the scheme complex, whilst most applicants surveyed had generally found the application process overall unproblematic. However, it is plausible that the high number of rejections may have **slowed down the processing of some vouchers**, leading to some of the delays, frustrations and inadvertent effects on installation experience and quality described in Chapters 4 and in 7.2.3 above.

7.3 Exploring contribution

7.3.1 The views of auditors on the contribution of the GHGVS to quality

Most auditors considered that there had been an improvement in the general quality of installations across the PAS-based market, but that this **cannot be attributed to GHGVS**. Auditors considered this, rather, to be a result of PAS 2030/2035 rollout and constant monitoring and the impact of auditing, but also natural industry evolution, whereby the sector is

[51] Auditors have direct interactions with customers and properties benefitting from installations and are independent of the installer, as well as experts in determining the outcome of installations. This makes them the best available source of information to evaluate potential cases of fraud.

gradually improving because of a range of factors including ECO, product innovation, and the market maturing.

Eight out of nine auditors **did not consider the scheme processes and structure to have contributed to improving quality of installations delivered in the scheme**. Only one auditor reported that the GHGVS played a positive role in improving the quality of installations because the scheme adhered to PAS2030:2017, which consequently improved the quality of installations delivered:

> *"Green Homes Grant voucher scheme had to follow PAS2030:2017, so in theory there was a set of standards that every install should be installed to, which is good because it gives a bit of confidence that the consumers are getting quality work and all work should be done to the same standard." (Auditor, wave 2 interview)*

Auditors were asked about the role of the scheme in the quality control. They highlighted **four characteristics of the scheme which gave rise to avoidable instances of non-compliance.**

First, three auditors noted that the **short length of the scheme and unexpected announcements created uncertainty** which in turn caused some installers to **rush their jobs.** For example, scheme delays led to a later-than-planned start date which was coupled with a tight deadline, leading installers to complete jobs as quickly as possible to fit within the timelines to be able to draw as much funding as possible. Auditors reported that this caused some neglect toward the quality of their work. Instances of 'rushed jobs' driven by the scheme's announcements of closure are also recalled in qualitative interviews with applicants.

Second, two auditors recalled some **cases of installation designs which were not the most appropriate for the customer's needs**. They surmised this to be a result of installers pushing for designs based on commercial interests rather than suitability to the customer and property. This, coupled with the previous issue of rushing jobs, resulted in some occurrences of inappropriately matched installations executed inadequately – e.g., pitched roof insulation in properties which did not have a room-in-roof and already had standard loft insulation. This resulted in two systems of insulation, making the pitched roof insulation a redundant and costly addition mainly for the purposes of claiming scheme funds.

> *"In my eyes the[se] pitch roof jobs should never [have] been done and was a full waste of money." (Auditor, wave 2 interview)*

Third, two auditors claimed that some installers were **not being properly vetted by the GHGVS administration or scheme providers (certification bodies),** leading to some new **inexperienced installers as well as new businesses established to take advantage of the scheme.** This was based on these experienced auditors frequently noting new companies which they had not encountered before. While new installers were expected and it was an objective of the scheme to attract new business to grow the supply chain, these auditors argued that some installers with a heavy bias toward short-term and low-quality installations slipped through. Two certification bodies also claimed that some of their competitors had

lower-than-expected certification standards and let unsuitable installers into the scheme. However, these claims are likely **based on a limited number of cases, given the overall level of non-compliance in the scheme is not significantly high and the issue is identified only by a minority of auditors and certification bodies** (against their competition).

Fourth, three auditors noted some areas where they could not fail an installation even when they considered certain issues to be inadequate.

“I couldn’t have failed it anyway because there was no option for me to fail. So it's pointless failing it because it's just going to get thrown back. It's just a paperwork situation...” – Auditor, wave 2 qual

One example of this was that **installers were allowed to partially insulate** homes (e.g. leave one or more sides uninsulated). This occurred in situations where the budget of the voucher was lower than the installer’s quote for insulating the entire home and the customer could not fund the remaining cost. Since insulating a portion of a property was not explicitly disallowed under PAS 2030:2017 there was technically no compliance breach under the scheme. However, auditors considered these cases to be quite problematic since partially insulating a property contravenes good practice; it raises concerns about cost-effectiveness, appearance and the likelihood of technical issues for future installations. In these situations, the auditor view is that these installations should not have been allowed to proceed. Another example is, as mentioned earlier, there were cases of pitched roof insulation being installed when a home already has loft insulation, auditors initially failed these installations, but they were eventually instructed to stop failing them as the voucher had already been permitted.

Auditors suggested that the following **requirements would improve the quality of future installations:**

- Require **PAS2035 in all future schemes** to provide a consistent overview and monitoring throughout. Make the role of the retrofit coordinator independent of the installer before they can be fit-for-purpose.
- Require installers to have a **minimum level of experience** to ensure quality and prevent exploitation of the scheme by short-term businesses.
- **Expand the criteria for audits** so that gaps such as partial completion of an installation or damage done to the property, are included, and aligned between the audit and scheme rules.
- Give auditors discretion and flexibility in certain areas to be able to **monitor quality more holistically**. Auditors noted that a fixed set of questions can often be limiting as there is a balance to maintain between the complexity/length of process and being able to cover all the major areas. In practical terms, this means a question set cannot cover everything. Telling installers they will be scored on a list of ten issues may mean they focus on these to the neglect of other areas.
- Auditors also suggested that routine monitoring of installations, including **mid-point inspections**, would improve quality because installers would be aware that their work will be regularly inspected. Mid-point checks act as a preventative step to identify any

mistakes early in the process which can be rectified more easily compared to when the measure has been completed. This is most useful for suspended floor insulation, as mistakes cannot be identified nor rectified after installation.

7.3.2 Quality under GHGVS compared to other schemes

When asked about the quality of installations in the scheme compared to those in other schemes as well as those outside any scheme, respondents had diverging opinions. On the one hand, six (of nine) auditors and six (of eight) certification bodies stated that there was ultimately no major difference in quality of PAS installations across any scheme, including GHGVS, or outside of schemes. These respondents considered **PAS 2030 as an important tool to maintain this equivalency**. They argue that **TrustMark has a comparable monitoring regime across all installations**, and the standard has the same focus on addressing recurring issues such as a lack of ventilation and mould growth in any PAS installation. Aside from PAS, auditors also stated that there are **other factors such as general level of skill in the market which also played an important role in determining quality levels.**

7.3.3 Exploring the contribution of the scheme to reduced fraud and gaming

The evidence gathered indicates that scheme delivery had a **singular role in preventing and detecting (and thus lowering potential cases of) fraud.** However, it is also possible that the system may have **prevented some genuine applications from being successful**. In some instances, the fraud detection processes may have also **lengthened the voucher issuance and redemption processes,** which created frustrations and inadvertent effects on installers and applicants. The fraud controls were largely automated and often generated outright rejections (e.g. for non-TrustMark registered installers, for significantly overpriced work, etc.). These were very effective in controlling the inherent levels of error and fraud that would have otherwise caused incorrect payments. Other controls followed a set of defined rules and did not cause significant delays for those applicants/installers that were able to satisfy them. However, in those instances where applicants/installers were given the opportunity to explain a potential screening failure, or appealed a decision, the Scheme Administrator had to follow a manual process to request, process and adjudicate on provided information. In these instances, delays would have been likely due to challenges faced by the Scheme Administrator in dealing with discrepancies falling out of the automated checking processes.

7.4 Summary and conclusions

The GHGVS **quality and fraud prevention systems were effective** at (a) preventing cases of poor quality or fraudulent installations; and (b) detecting them when they occurred. However, the evaluation's independent research with auditors, certification bodies and applicants has shown that – nonetheless – **cases of wrongdoing by installers and poor-quality installations still occurred**. The wave 2 qualitative interviews with applicants provided some examples of poor quality of service and that some installations may not have been carried out to PAS or TrustMark standards (particularly where households were not given sufficient information on aftercare and maintenance of the installation). However, TrustMark audit data

indicates that – overall – **quality issues were proportionate to the scale of the scheme**. Similarly, cases of fraud and wrongdoing do not appear to have been unusually high and **BEIS is satisfied with the scheme estimates of residual fraud.**

In terms of the scheme's contributions to these outcomes; the GHGVS contributed to the quality of installations observed **to the extent that it integrated systems of quality improvement in the sector** (TrustMark, PAS, MCS and other certifications) that were established and evolved under previous policies such as the Each Home Counts Review and ECO. In this way, scheme design was **coherent** with existing policy and **economic** in utilising existing tools rather than 'reinventing the wheel' for quality. However, the evaluation findings also indicate that, where cases of poor quality of installation occurred, this was sometimes due to installations being rushed, the short timescales of the scheme and/or the pressure to complete installations and redeem vouchers within the deadlines of the scheme. In this way **scheme design negatively impacted on quality**. Whilst the scheme's fraud prevention and detection systems clearly contributed to reducing cases of fraud and gaming, they may have also contributed to unintended negative effects on delivery timelines and the experiences of installers and applicants in the scheme.

8 Benefits to market

This Chapter explores the effects of the scheme on installers and the upstream supply chain (training providers, auditors, certification bodies, manufacturers). It builds upon analysis in Chapter 5 (capacity of the supply chain) and draws on insights from qualitative interviews and from the survey of installers conducted for the GHGVS process evaluation. A more in-depth analysis of employment and growth will be provided in the final outcome and economic evaluation. This Chapter answers the following evaluation questions:

- How effectively has the scheme supported the creation or preservation of full-time-equivalent (FTE) jobs involved directly and indirectly in delivering?
- Did the scheme contribute to the creation of long-term growth in the energy efficiency/ low carbon heating supply chain?

8.1 How the scheme was intended to bring market benefits

It was anticipated that the scheme would **help to maintain employment** within the home improvements sector either by enabling businesses to retain staff, or for them to **bring in new staff recruited from elsewhere in the industry**. The idea was that there were people working within other areas of the construction and home improvements industry that could be brought into the energy efficient and low carbon heating industry. There was an intention that measures that required many man-hours (including heat pump installations and external wall insulation[52]) would be supported through the scheme and that this would **increase the amount of labour required (thus increasing job security)**. Whilst no specific objectives around increased profits or turnover were established, there was an **explicit objective** to grow the low carbon heat sector and to sustain the wider home improvements sector.

8.2 Evidence of market benefits and other changes

8.2.1 Employment

Evidence collected through qualitative interviews with installers throughout this evaluation suggested that the scheme had an effect on participating firms' employment. Most interviewees reported having **hired additional staff in preparation for the scheme** in various roles (administrative, surveying and engineers). Businesses also reported having used subcontractors in periods of high demand. This pattern was more common among large or medium sized businesses while small firms, in general, did not take on additional staff.

Around 20 representatives of organisations upstream of installers (auditors, manufacturers, certification bodies and training providers) were asked about changes in FTE employment

[52] By contrast, solar thermal installations are expensive because of the product cost; they require fewer man-hours than other measures.

rates in the energy efficiency, low-carbon heat, and renewable energy parts of their business. Approximately two-thirds of these businesses reported **an increase in the number of employees directly providing or indirectly supporting energy efficiency, low-carbon heat and renewable energy activities over the past year**. Increases in employment ranged from two new recruits to an increase of 50% in FTE staff.

8.2.2 Changes to market offerings

In terms of market offering, most companies reported that they **did not change their portfolio of installations offered because of the scheme**. Only two firms were able to extend their offer to additional measures that they were not installing prior to GHGVS. In one instance, one company that until the start of the scheme only installed pitched roof insulations seemed to have particularly benefitted from the scheme, noting that they had begun to offer cavity wall insulation and would soon be offering heat pumps.

8.2.3 Unintended negative effects of the scheme on installers

Research with installers for the GHGVS process evaluation suggested that, following initial issues in vouchers approvals, they complained about the delays related to payments and some reported that this impacted on their cash-flows as well as staffing levels. However, in qualitative interviews for this outcome evaluation, **only two companies (out of ten interviewed) had laid off staff as a result of the scheme**. Others reported that, post scheme closure, they had managed to retain all their employees and if needed reallocate them to other work strands.

8.2.4 Other scheme effects

Installers participating in later (outcome evaluation) qualitative interviews reported that one of the immediate effects of the scheme was a sharp increase in demand for quotations. Businesses were *“utterly swamped”,* though many quotes did not lead to actual installations, because customers did not know what they wanted in the first place, and they called simply to understand what they could have done in their property. A few installers however recognised a **positive effect from this increase in quotes, either because it increased the pipeline of work, or because it raised awareness among customers about the specific services offered.** Despite the issues related to vouchers approval, the general attitude of installers participating in the later wave of (outcome evaluation) qualitative interviews was much more positive towards the scheme than that of those participating in the process evaluation research (which was conducted at the height of the scheme’s delivery challenges – e.g., delays in redeeming vouchers). However, it should be noted that a much larger sample of installers were consulted for the process evaluation and therefore the two datasets cannot be compared like-for-like.[53]

[53] It should be noted that there was no overlap in the installers sampled for interview in the two phases of qualitative research. Two installers who took part in the survey also took part in the outcome evaluation research, but this number is too low to make reliable longitudinal analysis.

8.2.5 Effect on turnover

Of the ten installers participating in wave 2 interviews, only three reported either a decrease in turnover or no effect compared the previous year. One installer recognized a negative impact of COVID-19, prior to the start of GHGVS, saying that it obliged him to furlough the staff, but once the scheme was up and running *"it was definitely a lifeline and were back up to the level we would have been if the pandemic had never happened".* Although interviewees recognised the negative impact of the initial problems with scheme delivery, **most firms reported a positive effect of GHGVS on their turnover, as they noted they were busier than usual.**

8.2.6 Effects on profit

Wave 2 qualitative interviews with installers did not point, overall, to a positive effect on profit except in the case of one participant. **Some installers saw a drop in profit**, which they attributed to a mix of the costs of participating in GHGVS, the effects of COVID-19, the rise in prices of raw materials, and office overheads. In one instance an interviewee complained about the costs to comply with the scheme's eligibility criteria (i.e., getting the PAS certification).

8.2.7 Growth in new businesses

No further evidence was collected on companies created specifically to deliver the GHGVS, so in this respect it is not possible to say that the scheme had a significant role in the creation of new businesses in this sector. According to the installer quantitative survey, **most companies participating in the GHGVS (96%) were businesses already in operation before the start of the programme**; only 4% (~six businesses) were companies or subsidiaries set up for the purpose of delivering the scheme.

8.3 Exploring contribution

In terms of employment the drivers appear to have been mixed. Installers reported that they increased employment and subcontracting in response to the GHGVS. Auditors, training providers and certification bodies reported the same, but they also considered the following factors may have driven growth:

- General business growth.
- The BEIS Training Skills Competition (for training providers).
- The requirements for low carbon technologies as part of building regulations.
- Consumers spending more time at home due to the pandemic and wanting home improvements.
- Implementation of PAS 2035 in schemes such as ECO (training providers and auditors especially).
- SAP methodology updates (particularly impacting certification bodies).

- Organisations expanding into new business areas.
- Anticipated growth in MCS installations.
- The demand for other schemes such as ECO and SHDF (main fund).

When specifically asked whether the GHGVS had any influence on the growth in employment of their business, training providers who had benefitted from the **GHGVS skills training competition** reported increases (attributed largely to the competition). A slight increase to the number of auditors was also reported and one of the eleven manufacturers interviewed reported increases in their FTE staff due to the scheme. In sum, the scheme **contributed to pockets of employment**, especially to businesses in receipt of direct grants or indirect funding to support the delivery. However, there was **no evidence of the scheme driving employment within the sector at large.**

In terms of business' growth, while the scheme had a negligible role for the creation of new businesses, due to its short duration, it does appear to have benefited companies' turnover. This effect materialised only after the GHGVS had been closed, when the issues with delivery had been resolved. The findings of the qualitative interviews indicated that the **initial reported negative impact on cash-flows was offset over time and participant firms experienced an increase in turnover as well as size.** Profits, however, did not rise as much, due to a general surge in raw material costs, and offices overheads.

Amongst training providers, certification bodies and manufacturers, ECO, LAD and SHDF were named by multiple respondents to be an important driving force for their products and services, as was the rollout of PAS 2035 across schemes causing demand in certification which, in turn, drove demand for training. This is because PAS 2035 has introduced several new roles (such as the Retrofit Coordinator and Retrofit Evaluator) which require intensive training.

8.4 Summary and conclusions

Evidence from qualitative interviews with different groups (for both process evaluation and this outcome and economic evaluation) within the home improvement supply chain indicates that the GHGVS contributed to increased employment and turnover at least in the short-term, and in some cases helped longer-term growth. However, it was not able to positively effect profit due to a range of external factors, as well as due to investments that companies had to make in preparing for the scheme and losses due to administrative delays.

Whereas evidence collected for the process evaluation suggested that installers had faced notable employment and significant financial losses due to the scheme, the installers consulted for the outcome and economic evaluation seemed to suggest that this was not the case. As the evidence base was larger for the process evaluation (as a survey of installers was conducted in addition to qualitative data collection), the findings from both evaluations are not directly comparable.

9 Indications of the scheme's impact on energy use behaviours

This Chapter sets out the findings from qualitative interviews with applicants aimed at investigating the scheme contribution to changes in energy use behaviours. It therefore provides an initial response to the evaluation question:

- How effectively has the scheme delivered energy, carbon, and bills savings?

The findings in this short Chapter are based upon information self-reported by a small sample (<20) of households. It is therefore not representative analysis of all participating households nor based on actual energy data. The next phase of the evaluation will include a detailed analysis of the scheme's effects on energy consumption in participating households via information collected through a second survey of applicants and smart meter data analysis for a subset of these.

9.1 How the scheme intended to affect energy use behaviours

As set out in Annex 2 (ToC), the GHGVS intended to reduce the use of energy in households installing insulation (on the assumption that improved thermal efficiency would lead to reduced use of energy for heating) and in those installing low carbon heating solutions where the new heating system would require less energy than the system (e.g., gas boiler) that it replaces. The scheme's ToC recognised that where houses became more thermally efficient, this would not necessarily mean that households would use less heat, as they might continue to use the same energy to have a warmer home (where thermal efficiency improvements mean that the same amount of energy use generates greater warmth). However, it still assumed that, on average, GHGVS installations would support a reduction in energy use and a shift to more energy-efficient behaviours in participating homes. As is set out below, the scheme measures had a diverse effect on energy use behaviour including changing when and for how long households used energy throughout the day, as well as how much they used overall.

9.2 Evidence of changes in behaviour use post GHGVS installation

In terms of a reduced use of energy, some applicants participating in qualitative research for this outcome and economic evaluation mentioned that their new insulation meant that they **could now turn the heating to a lower level than previously**, while others had **stopped relying on additional sources of heating** (on top of their central heating), such as plug-in heaters, gas fires, or wood burners, to heat their home. An applicant who had installed a heat pump had noted that their **household's gas use had fallen** by 80% since installation, though the electricity use had increased somewhat.

> *"We use the immersion heater less now. It now comes on just a couple of hours a day instead of all day, which probably will have an impact on heating bills" (Homeowner, wave 2 interview, solar thermal)*

The broad feeling **amongst those homes that had had insulation installed was that the measure had not changed their heating habits but that it had decreased their energy use.** As one homeowner who had installed solid wall insulation explained, the thermostat was still set to the same temperature, but the boiler was not having to use as much energy to reach that temperature. However, there were some with insulation measures who had stopped using supplementary heating once the insulation was put in place. For example, one homeowner who had previously used a plug-in heater to heat the bedroom in the home's loft conversion prior to having room-in-roof insulation was able, post-installation, to rely on the central heating alone to keep the room at a comfortable temperature, while another householder had stopped using a wood burner to supplement the gas heating following installation of solid wall insulation.

Households that installed low carbon heating measures under the scheme frequently reported having changed their behaviour. **Heat pump users had changed when and for how long they turned their heating on to increase comfort and / or reduce energy bills.** Actions included increasing the length of time that the heating is on to compensate for the lower radiator temperatures, and carefully selecting the times of day that the heating is switched on to take advantage of off-peak electricity tariffs. One applicant with a solar thermal system installed under the GHGVS had begun **taking baths and using the dishwasher at the times of day which would make most efficient use of hot water.**

Landlords interviewed in the qualitative research were unable to provide detailed information regarding their tenants' energy-using habits.

9.3 Summary and conclusions

Qualitative research with households for this outcome and economic evaluation, particularly research with homeowner-occupiers, suggests that measures installed influenced energy use behaviours but that these effects were not uniform across all measure types nor households. Critical factors affecting energy use behaviour post-installation included the extent to which: a) the installation increased the use of different rooms in the house, b) the thermal efficiency of the home prior to the installation had been so poor that the house was cold (and the same level of heating post installation brought the house to a comfortable temperature only), and c) households considered that savings in energy from heating could be used for other forms of energy use.

Further insights into the contribution of the scheme to energy use behaviours will be explored in the next stage of the outcome and economic evaluation when more evidence (smart meter data) will be available on energy consumption in participating households and data from the second wave of applicant survey will be available.

10 Value for money of the GHGVS

This Chapter presents an analysis of the value for money of the programme in response to the following evaluation question:

- To what extent did the scheme deliver energy efficiency installations which represented good value for money (VfM)?

Among the two most widely used VfM methods, i.e., social cost-benefit analysis (CBA) and social cost-effectiveness analysis (CEA), this Chapter adopts the CBA approach as it allows for monetisation of short-term and long-term impacts based on data availability.[54] As it is possible to monetise the key benefits associated with the scheme, this chapter presents interim findings from CBA. In doing so it also answers the following evaluation question:

- What is the average cost of installing measures in homes applying and redeeming vouchers under the scheme? How does this vary by measure, tenure, or property type?

The analysis considers the costs and benefits of the scheme to society as a whole (social CBA), calculated as a net benefit/cost,55 as well as the benefits and costs of the scheme to participating households (private CBA) in order to assess the benefit to cost ratio (BCR) at property level. In this respect, it provides interim responses to the following questions:[56]

- What benefits have been achieved by the voucher scheme?
- What costs are incurred by the different actors involved in the scheme?
- Have there been any differences in costs and benefits between the different subgroups of participants/ installers?

Annex 4 provides a detailed description of the methodology along with the list of benefits and costs included in the analysis.

These interim analyses will be updated in the final outcome and economic evaluation report.

10.1 Value for money of the scheme to society (societal CBA)

Overall, at societal level, the costs related to the scheme appear to exceed the anticipated benefits generated, which implies a net loss from the society's point of view. However, a net benefit for the society is obtained after excluding external solid wall insulation,

[54] The CEA is normally adopted when benefits cannot be monetised or the cost to do so is very high. Inability or intrinsic difficulty in monetising benefits limits the value of CEA compared to CBA as described in the HMT Magenta Book.: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/879438/HMT_Magenta_Book.pdf

[55] Social value (or public value) is based on principles and ideas of welfare economics and reflects the overall social welfare efficiency, not simply the economic market efficiency from an individual perspective (see Green Book, Ch.2) https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent.

[56] The analysis has incorporated about 60% of all measures installed as part of the scheme.

which is the least cost-efficient technology but also the most commonly installed measure among those covered by this interim assessment. In this Chapter, this is presented as a sensitivity analysis to identify the main contribution to the overall costs of the scheme.

10.1.1 Limitations of the approach and data

This interim analysis presents the following limitations which have limited the ability to quantify and monetise some potential societal benefits. However, the main benefits that are included in other appraisals of energy efficiency schemes have been included and, therefore, we consider the overall estimates to be valid.

- It covers costs and benefits for only 60% of the measures installed as part of the scheme by the start of December 2021. This is because this interim analysis draws from estimates of energy savings per measure and property type as calculated by Ofgem for ECO3.[57] A GHGVS-specific analysis will be provided in the final outcome and economic evaluation.[58]
- A lack of monetisable data was available on hassle cost to installers (time allocated to issue quotes) and to households (time to complete the application). These costs are expected to be very small compared to the summative costs already included in the analysis, therefore the impact of not including them is also expected to be minimal.
- Potential benefits of the scheme were not easily monetisable and have therefore not been included in the CBA. These comprise improved security of energy supply and the potentially reduced cost of meeting peak energy demand; decreases in the long-run variable cost of energy supply from a reduced demand for energy; benefits to the aesthetics and value of property arising from an increased quality of installations; the benefits of increased understanding of energy efficiency technologies and amongst homeowners and landlords.
- Employment benefits will be assessed for the final outcome and economic the evaluation report but will not be incorporated into the final CBA. Inclusion of these benefits normally depends on the extent to whether they can be precisely quantified, and the opportunity cost of labour can be reliably computed.[59] It is more straightforward to evaluate such an effect for targeted employment programmes compared to programmes with a wider focus on environmental objectives and economic stimulus, as in the case of GHGVS. Therefore, employment benefit will not be evaluated as part of the final CBA.
- Improved health outcomes and reduced health costs will be assessed as part of the final CBA, though this interim analysis monetises estimated benefits from ‘comfort taking’.

[57] More specifically, the interim analysis covered part of the GHGVS measures, in particular those for which energy savings were available from ECO3 Ofgem estimates.
[58] During this process, ECO3 energy savings calculations will be retained only for specific GHGVS measures for which available observations do not allow empirical estimation of energy savings.
[59] The opportunity cost of labour should include the total value of output produced by the employees (Green Book, 6.2).

- The VfM presented here and to be carried out for the final outcome and economic evaluation does not include an equity analysis.[60]
- The calculations involved in this interim analysis do not take into account recent changes in the energy market prices. Analysis in the next phase of the evaluation will consider sensitivity checks regarding these recent changes.

10.1.2 Findings

External wall insulation was the costliest measure, when considering the overall price of the installation (as taken from GHGVS scheme data[61]), **and the hassle cost to the household** associated with the installation (using ECO3 Impact Assessment data as a proxy[62]). **Loft insulation and cavity wall insulation were amongst the least costly.** The costs of measures tend not to vary significantly between property types, except for external solid wall insulation, which has a lower cost in flats, and cavity wall insulation, which is higher in detached houses, but which is also the most common property type selecting this measure within the GHGVS.

The partial CBA (which excludes 40% of all measures – *see also the additional limitations listed above*) indicates a **net societal cost of the scheme, meaning that costs outweigh benefits from society's perspective.** By conducting a sensitivity analysis to figure out where the greatest cost comes from, we notice that external solid wall insulation (EWI) is one of the most inefficient technologies from a VfM perspective. By excluding the set of the most cost inefficient EWI measures installed in two property types (mid-terraced and semi-detached), we obtain a net societal benefit of the scheme, which indicates that societal benefits exceed societal costs suggesting good scheme value for money. By excluding all EWI measures from the analysis, the overall net societal benefit of the scheme becomes even higher. Table 10.1 below presents the costs and benefits and BCRs for each of the ten measure types considered in this interim CBA analysis. Table 10.2 overleaf presents the comparison of the net benefit/cost depending on whether EWI is included or not in the CBA, as explained above, and the corresponding BCRs.

[60] Such a procedure would involve a weighted analysis of the costs and benefits depending on which groups they apply to, with the financial benefits for lower income households being given a higher social value than the equivalent benefits for higher income households (Green Book, A3). In line with the Green Book, there are two main points to consider when applying a weighted analysis: 1) whether it is targeted at individuals or a mixture of households of different size and composition, and if the latter then equivalisation may be required before applying weights; and 2) whether it is possible to use the income of the groups affected (if known) to calculate weights or the Household Below Average Income (HBAI) groups. With regard to the first point, equivalisation applies a scaling factor to household income to adjust for compositional factors like age, income and size. Available scheme data does not contain such a type of information for participating households. With regard to the second point, calculation of weights is not feasible because household income is not available. The alternative approach (HBAI income groups) cannot be used because it provides equivalised income by quintile, therefore encompassing information on household composition which is not available.

[61] 30 November 2021 cut of data.

[62] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749638/ECO_3_Final_Stage_IA__Final.pdf

Table 10.1: Societal costs and benefits, appraisal period 2021-2063[63] (2020 prices) - Net benefit/cost

Measure Type	*N*	Lifetime	Benefits £	Costs £ [1]	Value of benefits compared to costs £ (Net benefit/cost)	Benefit-to-cost ratio (BCR)
Cavity Wall Insulation	*4,333*	42	34,132,165	8,524,788	25,607,378	4.00
Internal Solid Wall Insulation[2]	*1,057*	36	7,374,171	7,892,184	-518,013	0.93
External Solid Wall Insulation[3]	*9,145*	36	70,026,484	111,428,424	-41,401,940	0.63
Flat Roof Insulation	*810*	20	6,513,866	6,266,380	247,486	1.04
Under-floor Insulation Timber	*1,816*	42	6,646,342	5,375,107	1,271,235	1.24
Under-floor Insulation Solid	*60*	42	144,165	250,581	-106,416	0.58
Loft Insulation	*7,544*	42	18,278,915	11,365,739	6,913,177	1.61
Roof-to-Room Insulation	*713*	42	7,551,090	5,520.267	2,030,823	1.37

[63] The period up to 2063 reflects the longest lifetime of the measures installed. However, the net cash flows are computed separately for each technology depending on the lifetime, and consequently summed-up to provide the net cash flow for the scheme as whole.

Measure Type	*N*	Lifetime	Benefits £	Costs £ [1]	Value of benefits compared to costs £ (Net benefit/cost)	Benefit-to-cost ratio (BCR)
Park Home Insulation	*420*	30	772,340	3,283,131	-2,510,731	0.24
Heating Controls	*1,131*	12	2,759,637	1,078,560	1,681,077	2.56
Window Glazing	*832*	20	3,448,826	2,947,797	501,028	1.17
All	*27,861*		157,648,062	163,932,958	**-6,284,896**	**0.96**

[1] As benefits were monetised based on available prices of 2020 reference year, the total costs were adjusted to reflect the same reference year. The GDP deflator used can be found at Data Table 19, https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal.
[2] On average, 77% of the property area is treated.
[3] On average, 91% of the property area is treated.

Table 10.2: Costs and benefits, appraisal period 2021-2063 (2020 prices) – Net benefit/cost comparison based on EWI treatment

CBA type	Measure Type	*N*	Benefits £	Costs £	Value of benefits compared to costs £ (Net benefit/cost)	Benefit-to-cost ratio (BCR)
Baseline (all measures included)	**EWI (all)**	*9,145*	70,026,484	111,428,424	-41,401,940	0.63
	All measures	*27,861*	157,648,062	163,932,958	**-6,284,896**	**0.96**

CBA type	Measure Type	*N*	Benefits £	Costs £	Value of benefits compared to costs £ (Net benefit/cost)	Benefit-to-cost ratio (BCR)
Excluding most inefficient EWI measures	**EWI (partial)**	*2,222*	21,058,788	28,072,548	-7,013,759	0.75
	All measures	*20,938*	108,680,366	80,577,082	**28,103,284**	**1.35**
Excluding all EWI measures	**No EWI**					
	All measures	*18,716*	87,621,578	£52,504,534	**35,117,044**	**1.67**

10.2 Installation costs in homes redeeming vouchers under the scheme

As set out in Chapter 2, the most common measures installed under the scheme were external solid wall insulation, loft insulation and cavity wall insulation. However, external solid wall insulation also has the highest average cost compared to other measures, without significant variation across average property types, except for flats for which the cost has been typically lower. Loft insulation was most costly for detached bungalows but was most-commonly installed in detached and semi-detached houses. Cavity wall insulation was most-commonly installed under the scheme in detached houses and within this housing type also had the highest average cost.

Table 10.3: Average installation costs per technology and property type according to GHGVS data

Property Type	Cavity Wall Insulation £	Internal Solid Wall Insulation £	External Solid Wall Insulation £	Flat Roof Insulation £	Under-floor Insulation Timber £	Under-floor Insulation Solid £
Bungalow detached	1,454 (524)	5,852 (9)	10,114 (241)	7,556 (51)	3,054 (94)	3,322 (2)
Bungalow mid- terrace	985 (7)	5,656 (11)	8,940 (129)	6,563 (4)	2,345 (22)	5,292 (1)
Bungalow semi-detached, end-terrace	1,107 (174)	6,653 (23)	9,319 (240)	6,125 (30)	2,473 (61)	2,625 (2)
Detached	1,887 (1668)	6,877 (72)	11,360 (530)	7,098 (170)	2,806 (355)	3,609 (16)
End-terrace	1,378 (232)	6,223 (139)	10,361 (949)	5,877 (79)	2,342 (149)	3,624 (6)
Flat	1,016 (95)	6,016 (73)	7,118 (129)	6,723 (24)	2,649 (25)	-
Maisonette	1,052 (8)	6,397 (11)	7,002 (4)	25,607 (7)	3,484 (3)	-
Mid-terrace	980 (319)	5,819 (468)	9,080 (3,019)	5,516 (123)	2,170 (370)	3,554 (16)
Semi-detached	1,339	6,453	10,172	5,777	2,306	3,072

Property Type	Cavity Wall Insulation £	Internal Solid Wall Insulation £	External Solid Wall Insulation £	Flat Roof Insulation £	Under-floor Insulation Timber £	Under-floor Insulation Solid £
	(1,306)	(251)	(3,904)	(322)	(737)	(17)
All property types64	1,522 (4,333)	6,131 (1,057)	9,814 (9,145)	6,353 (810)	2,430 (1,816)	3,429 (60)

Note: Average cost figures in £, based on number of properties in parentheses.

Table 10.4: Average installation costs per technology and property type according to GHGVS data

Property Type	Loft Insulation	Roof-to-Room Insulation	Heating Controls	Window Glazing		Park Home Insulation
Bungalow detached	1,450 (687)	6,295 (32)	722 (41)	3,092 (31)	**Single**[65]	6,271 (88)
Bungalow mid- terrace	1,099 (41)	6,348 (6)	677 (24)	1,987 (11)	**Double**[66]	6,458 (332)
Bungalow semi-detached, end-terrace	1,033 (233)	6,151 (26)	591 (53)	1,764 (20)		
Detached	1,233 (2,553)	6,907 (113)	958 (181)	2,938 (94)		
End-terrace	952	6,173	724	3,247		

[64] Weighted-average cost.
[65] It refers to single park home insulation - The ‘single’ park homes are roughly 12 metres long and 3 meters wide (36m2).
[66] It refers to double park home insulation - The ‘double’ park homes are roughly 12 meters long and 6 meters wide (72m2).

Property Type	Loft Insulation	Roof-to-Room Insulation	Heating Controls	Window Glazing		Park Home Insulation
	(528)	(61)	(134)	(112)		
Flat	1,163 (169)	6,671 (24)	848 (9)	3,101 (13)		
Maisonette	1,161 (25)	-	790 (3)	4,863 (2)		
Mid-terrace	939 (1,009)	5,900 (192)	771 (262)	2,720 (218)		
Semi-detached	1,017 (2,299)	6,500 (259)	769 (424)	2,975 (331)		
All property types 67	1,119 (7,544)	6,385 (713)	783 (1,131)	2,909 (832)		6,419 (420)

Note: Average cost figures in £, based on number of properties in parentheses.

10.3 Costs and benefits to participating households

On average, the benefits of having one or more measure installed under the GHGVS outweighed the costs from the private (household) perspective. However, the monetary value of installing different technologies varied by type of property. Bungalows tended to have a lower BCR compared to other property types for about half of the technologies implemented. Conversely, they have a very high BCR compared to other properties in the case of roof-to-room insulation, making this type of measure very cost-efficient for this specific property type. The group of end-terrace, mid-terrace and semi-detached properties have a high BCR compared to other properties in the case of solid wall insulation (both external and internal), while detached houses have a relatively high BCR for cavity wall insulation.

For households accessing the scheme via the low-income route, the benefits of participation outweighed the costs for all measure types. This was also the case for most

[67] Weighted average cost.

of the households using the main route to participate in the scheme, except for those installing external solid wall insulation and park home insulation, for whom a net loss was observed.

In terms of differences across technologies, **heating controls, under floor insulation and internal solid wall insulation provided the greatest benefit-to-cost ratio** for households entering the scheme via the low-income route. For households participating via the main route, roof-to-room insulation, cavity wall insulation and heating controls provided the highest benefit-to-cost ratio.

Table 10.4: Private benefit-to-cost ratios per technology and property type

Measure Type	Property type	N	Main Benefits £ (bills savings + comfort taking)	Main Costs £ (household contribution + hassle cost when relevant)	Value of benefits compared to costs £ (Net benefit/cost)	Benefit-to-cost ratio (BCR)
Cavity Wall Insulation	Bungalows	*705*	1,976,260	342,899	1,633,361	5.76
	Detached	*1,665*	10,950,580	1,125,936	9,824,644	9.73
	End / Mid / Semi [1]	*1,854*	6,547,450	863,283	5,684,167	7.58
Internal Solid Wall Insulation	Bungalows	*43*	72,443	20,467	51,976	3.54
	Detached	*72*	434,959	88,752	346,207	4.90
	End / Mid / Semi	*854*	2,243,999	247,226	1,996,773	9.08
External Solid Wall Insulation	Bungalows	*610*	1,202,087	1,349,839	-147,752	0.89
	Detached	*529*	3,195,741	2,363,216	832,525	1.35

Measure Type	Property type	N	Main Benefits £ (bills savings + comfort taking)	Main Costs £ (household contribution + hassle cost when relevant)	Value of benefits compared to costs £ (Net benefit/cost)	Benefit-to-cost ratio (BCR)
	End / Mid / Semi	*7,862*	22,747,552	12,488,648	10,258,905	1.82
Flat Roof Insulation	Bungalows	*85*	583,024	127,244	455,780	4.58
	Detached	*170*	1,160,008	311,000	849,008	3.73
	End / Mid / Semi	*524*	2,168,813	497,518	1,671,296	4.36
Under-floor Insulation Timber	Bungalows	*176*	446,394	85,469	360,925	5.22
	Detached	*335*	1,072,481	186,074	886,407	5.76
	End / Mid / Semi	*1250*	2,188,312	398,482	1,789,830	5.49
Under-floor Insulation Solid	Bungalows	*5*	9,174	554	8,620	16.55
	Detached	*16*	35,635	2,69	32,942	13.23
	End / Mid / Semi	*38*	37,743	3,633	34,110	10.3

Measure Type	Property type	N	Main Benefits £ (bills savings + comfort taking)	Main Costs £ (household contribution + hassle cost when relevant)	Value of benefits compared to costs £ (Net benefit/cost)	Benefit-to-cost ratio (BCR)
Loft Insulation	Bungalows	*961*	1,726,111	419,605	1,306,506	4.11
	Detached	*2,549*	4,462,752	1,160,93	3,301,822	3.84
	End / Mid / Semi	*3,833*	4,049,493	1,278,923	2,770,570	3.17
Roof-to-Room Insulation	Bungalows	*79*	617,926	42,222	575,704	14.64
	Detached	*113*	901,810	157,864	743,945	5.71
	End / Mid / Semi	*511*	2,758,688	381,425	2,377,264	7.23
Heating Controls	Bungalows	*118*	142,203	2,249	139,954	63.24
	Detached	*181*	452,989	10,394	442,595	43.58
	End / Mid / Semi	*817*	1,173,218	13,268	1,159,950	88.42
Window Glazing	Bungalows	*61*	113,135	16,933	96,202	6.68
	Detached	*94*	348,946	51,560	297,385	6.77

Measure Type	Property type	N	Main Benefits £ (bills savings + comfort taking)	Main Costs £ (household contribution + hassle cost when relevant)	Value of benefits compared to costs £ (Net benefit/cost)	Benefit-to-cost ratio (BCR)
	End / Mid / Semi	*657*	1,666,482	266,803	1,399,679	6.25

[1] Group of end-terrace, mid-terrace and semi-detached properties.

Table 10.5: Private Benefit-to-cost ratios per means of participation and technology

Measure Type	Means of participation	N	Main Benefits £ (bills savings + comfort taking)	Main Costs £ (household contribution + hassle cost when relevant)	Value of benefits compared to costs £ (Net benefit/cost)	Benefit-to-cost ratio (BCR)
Cavity Wall Insulation	Low	551	2,257,156	63,899	2,193,257	35.32
	Main	3,776	17,401,08	2,309,259	15,091,823	7.54
Internal Solid Wall Insulation	Low	821	2,220,470	17,826	2,202,645	124.57
	Main	232	674,294	456,782	217,512	1.48
External Solid Wall	Low	6,755	19,637,127	5,399,397	14,237,730	3.64

Measure Type	Means of participation	N	Main Benefits £ (bills savings + comfort taking)	Main Costs £ (household contribution + hassle cost when relevant)	Value of benefits compared to costs £ (Net benefit/cost)	Benefit-to-cost ratio (BCR)
Insulation						
	Main	2,379	7,718,550	11,160,943	-3,442,393	0.69
Flat Roof Insulation	Low	486	2,400,821	131,670	2,269,151	18.23
	Main	323	1,676,566	997,392	679,174	1.68
Under-floor Insulation Timber	Low	892	1,805,326	8,797	1,796,529	205.22
	Main	917	2,015,161	688,818	1,326,343	2.93
Under-floor Insulation Solid	Low	50	67,567	0	67,567	0
	Main	9	14,986	6,890	8,096	2.17
Loft Insulation	Low	2,092	2,780,573	304,319	2,476,254	9.14
	Main	5,445	7,752,888	2,644,627	5,108,261	2.93

Measure Type	Means of participation	N	Main Benefits £ (bills savings + comfort taking)	Main Costs £ (household contribution + hassle cost when relevant)	Value of benefits compared to costs £ (Net benefit/cost)	Benefit-to-cost ratio (BCR)
Roof-to-Room Insulation	Low	599	3,949,595	53,970	3,895,625	73.18
	Main	2,546	19,538,340	1,602,251	17,936,088	12.19
Park Home Insulation	Low	276	173,959	8,951	165,008	19.44
	Main	143	91,532	308,403	-216,871	0.30
Heating Controls	Low	1,043	1,624,433	2,234	1,622,199	727.22
	Main	85	154,885	23,912	130,974	6.48
Window Glazing	Low	733	1,613,071	216,654	1,396,416	7.45
	Main	94	215,030.74	121,588	93,443	1.77

10.4 Summary and conclusions

Overall, the costs of the scheme at societal level outweighed the benefits, largely due to the high costs of installation (and hassle costs to households) of external wall insulation, which was also one of the most frequently implemented installations under the scheme. At the individual household level, on average the benefits of having one or more measure installed outweighed the costs. This is particularly the case for households accessing the scheme via the low-income route.

In terms of differences across technologies, heating controls, under floor insulation and internal solid wall insulation provided the greatest benefit-to-cost ratio for households applying via the low-income route. For households participating via the main route, roof-to-room insulation, cavity wall insulation and heating controls provided the highest benefit-to-cost ratio.

11 Conclusions

Overview

Overall, the GHGVS produced benefits for participating households and installers. These include warmer homes, a reduced reliance on gas for homes installing low carbon heating, and financial savings for participating fuel-poor homes. For some installers, the scheme increased demand and turnover, incentivised them to participate in training, which they found useful, and enabled them to increase their workforce. However, the short timescale of the scheme and the significant administrative challenges it faced, have had implications for some of the scheme's target outcomes, including the quality of installation in some homes, the financial benefits to some installers, and the sustainability of benefits to the wider supply chain (manufacturers, trainers).

The reach of the scheme

The GHGVS achieved a reach of 169,430 voucher applications for 113,736 properties. By the 6th of December 2021, 83,150 vouchers had been issued (49% of the total number of voucher applications submitted) and 49,002 measures had been installed in 42,907 properties (accounting for 59% of all vouchers issued by this date).

A significant proportion (46% of all applications) were rejected, withdrawn or cancelled and, whilst the reasons stated in the scheme data do not indicate that rejections were unreasonable, this high proportion may also be indicative of some of the procedural barriers identified in the process evaluation, which – in particular – affected landlords.

One of the factors that may have driven the high numbers of rejections was the fraud prevention and detection system which was thorough, and which has generated a residual fraud figure of 0.2 to 1.8% of spend.

Most applicants accessed vouchers via the low-income scheme, a high proportion of whom were likely to be in fuel poverty; and the wave 1 survey of applicants suggests that the scheme also reached households with other types of vulnerable groups: around a third had a long-standing illness, disability, or infirmity; another third had at least one child under the age of 13; and a third also reported that one or more persons aged above 65 years old lived in the property.

The complementarity of the scheme to other BEIS schemes

The GHGVS operated at the same time and with similar objectives to a suite of other programmes targeting slightly different audiences, with slightly different measures, via different

delivery mechanisms. Installers worked across schemes, but this does not appear to have created any bottlenecks in supply.

At household level, 15% of GHGVS households had also made use of ECO3 funding and 3.3% had participated in the RHI. Amongst households participating in both GHGVS and ECO3, 97% belonged to the low-income group. Having both schemes open to households homes more likely to be fuel poor increased the incentive for such households to make their homes more energy efficient (and thus the homeowners less likely to be fuel poor).

Demand for the scheme and supply

Qualitative research for the outcome and economic evaluation also indicates that some installations desired by households were not possible to request and install within the timeframe of the scheme. That applicants found it difficult to find suitable installers also suggests that there were some challenges with the supply of industry meeting demand. Manufacturers interviewed indicated that some of them would have struggled to meet demand had the scheme operated to the levels initially expected, due to the problems with material and product imports from Europe.

Overall, the scheme was additional in driving demand and in stimulating households to either install a measure that they would not have otherwise considered, or to install it sooner. Installers in qualitative interviews reported that this demand increased volumes of work for them.

The feedback from multiple stakeholders consulted for this evaluation points to the need for longer-term investment in the supply chain. For example, installers recognised the benefits and value of training, but training providers observed a drop-off after the scheme ended, suggesting that such training needs to be incentivised longer-term if it is to be sustained.

Benefits to households and effects on energy use behaviour

Installations implemented under the scheme contributed to increased comfort, well-being, and physical health for benefitting households. Where the installation increased the functionality of the house (e.g., by making rooms ‘usable’ because they were warmer), this also brought benefits in well-being to the home.

Depending on the measure – particularly whether it was insulation or low carbon heating – qualitative interviews with applicants suggest that post-installation they were either using less energy for heating (insulation measures) or had changed when and for how long they heated their house and water to increase comfort or reduce energy bills (low carbon heating).

Quality of installation and service

The GHGVS quality and fraud prevention systems were effective at preventing cases of poor quality or fraudulent installations and detecting them in cases where they occurred. Cases of wrongdoing by installers and poor-quality installations still occurred, but these appear to have been proportionate to the scale of the scheme. To the extent that it integrated systems of quality improvement in the sector (TrustMark, PAS, MCS and other certifications) the scheme did contribute to improved quality. However, where cases of poor quality of installation occurred, this was sometimes due to installations being rushed due to the short timescales of the scheme and/or the pressure to complete installations and redeem vouchers within the deadlines of the scheme. In this way scheme design negatively impacted on quality.

Benefits to the market

Evidence from qualitative interviews at all stages of this evaluation with different groups within the home improvement supply chain indicates that the GHGVS contributed to increased employment and turnover at least in the short-term, and in some cases helped longer-term growth. The effects on profit have not been similarly positive due to a range of external factors, as well as the costs of participation for installers.

However, whereas research for the GHGVS process evaluation suggested that installers had faced significant financial losses due to the scheme, and had had to lay off staff, the findings from qualitative research conducted with installers for this outcome and economic evaluation were not as strong in this regard.

Value for money

Overall, the costs of the scheme at societal level have been found to outweigh the benefits, largely due to the high costs of installation (and hassle costs to households) of external wall insulation, which was also one of the most frequently implemented installations under the scheme.

At the individual household level, the benefits of having one or more measure installed under the GHGVS outweighed the costs on average and in all cases for households accessing the scheme via the low-income route. For households participating via the main route, roof-to-room insulation, cavity wall insulation and heating controls provided the highest benefit-to-cost ratio. For households participating via the low-income route, heating controls, under floor insulation and internal solid wall insulation provided the greatest benefit-to-cost ratio.

Annex 1: Methodology

Evaluation scope

This report focussed on the evaluation questions listed in the evaluation matrix in Table A1.1 below. The evaluation matrix sets out the core evaluation questions, sub-questions developed by the evaluation team, and shared with BEIS, and the extent to which these have been covered, as well as whether the analysis will be updated or further covered in the final phase of this evaluation.

Table A1.1: Interim outcome and economic evaluation scope (evaluation matrix)

Evaluation questions	**Sub-evaluation questions**	**Aspects not fully covered in this report, to be covered further in next phase of evaluation**
Outstanding process evaluation Qs	When customers were issued a voucher but the work was not completed, what caused this to happened? Where customers chose to not take the measure forward, why did they choose not to? *Profiled by measure, application type, household etc.*	This has been **fully covered (Chapter 2**), but there may be updated with the final scheme data analysis, and with any further considerations provided by BEIS.
Additionality / complementarity How did the voucher scheme interact with other BEIS schemes? What was the extent of participation in multiple schemes Were similar installers used for other stimulus schemes?	**Interaction:** Were the same houses / consumers eligible for GHGVS + other schemes (if so, which)? What conditions underpinned multi-programme eligibility? To what extent were applicants aware of the ability to apply to 1+ and did they understand how to do this?	This question has been **fully covered (Chapter 3).**

Evaluation questions	**Sub-evaluation questions**	**Aspects not fully covered in this report, to be covered further in next phase of evaluation**
To what extent were installations delivered which were not possible through other policies?	**Multiple scheme participation:** What were the implications (+ve/-ve) of multi-programme eligibility? How many homes actually benefitted from 1+ scheme and what was the scale in GBP? **Installer overlap:** What was the overlap in terms of installers working across GHGVS + other schemes? What were the implications (+ve/-ve) of this? **Additionality:** Are there any installations which have been possible through GHGVS, but not others and/or more prominent in GHGVS than others? What are they and what are the explanations?	
Energy, carbon and bills savings How effectively has the scheme delivered energy, carbon and bills savings?	Have participating households seen a reduction in their energy consumption post-installation? Why?[68] Bearing in mind fluxes in electricity and gas markets, what would have been the effects of the measures on bills without the flux in prices?	This question has only been **partially covered (Chapter 9)** based upon findings from qualitative interviews with households benefitting from installations. It will be covered in much greater detail in the final outcome and economic evaluation using an energy consumption analysis to be conducted by UCL and drawing upon data collected

[68] The extent to which a robust disaggregation of as to *why* certain outcomes emerged will ultimately depend on the sample – budget allocated to this might also be a limiting factor in terms of the extent to which analysis can be disaggregated. However, we have added the 'why' question for the moment on BEIS' advice.

Evaluation questions	**Sub-evaluation questions**	**Aspects not fully covered in this report, to be covered further in next phase of evaluation**
	Which households have seen the greatest reduction? Why? Which types of installations have seen the greatest reduction in energy consumption, carbon and bills savings? Why? What does the above tell us about the targeting of the scheme and any opportunities that were maximised / could have been better optimised?	from benefitting households via the wave 2 applicant survey.
Improved health and well-being and/or warmer homes How effectively has the installation of energy efficiency/low carbon heating measures led to property occupants improved health and well-being and/or warmer homes?	To what extent are the measures likely to have reduced the risk of mould in houses? To what extent are the measures likely to have made homes warmer? To what extent are the installations completed through the scheme likely to have led to improvements in the health of participating households? Which profile of applicant, household and installation are more likely to have seen an improvement in their health? What is the difference in outcome for classified fuel poor (proxy	This question has only been **partially covered (Chapter 6)** based upon findings from qualitative interviews with households benefitting from installations. It will be covered in much greater detail in the final the outcome and economic evaluation using modelling to be conducted by UCL and drawing upon data collected from benefitting households via the wave 2 applicant survey.

Evaluation questions	**Sub-evaluation questions**	**Aspects not fully covered in this report, to be covered further in next phase of evaluation**
	assessment) vs. classified non-fuel-poor? How do these findings compare to benefiting households' perceptions of improved health? What factors appear to be driving (a) modelled health outcomes, and (b) perceived health outcomes? What are the barriers to improved health (modelled / perceived)?	
Consumer demand for installation of homes and low carbon heating measures How effectively has the scheme driven consumer demand for installation of homes and low carbon heating measures? What have we learned about consumer preferences from the choice of primary and secondary measures in combination with any additional unrelated building work?	How effective was the scheme in attracting consumers to install measures which wouldn't have otherwise had them installed? How, if at all, does this differ by household profile and by type of measure? What can the scheme data (and consultations with applicants) tell us the factors driving applications for primary vs. secondary measures? What are applicants (and other stakeholders)' views on the scheme's distinction between secondary and primary measures – what (if any) effect did this have on applicant participation, installation choice,	Consumer demand has been **fully covered (Chapter 4)** based upon applicant research (survey and qualitative research). Effects on low carbon heating market has been partially covered (Chapter 8) based upon findings from qualitative interviews with installers and manufacturers, as well as a reanalysis of the survey of 218 installers, and scheme data. It will be covered in greater detail in the final outcome and economic evaluation using survey data on the turnover, staffing and supply chains of installers participating in GHGVS available through the ONS Secure Research Service.

Evaluation questions	**Sub-evaluation questions**	**Aspects not fully covered in this report, to be covered further in next phase of evaluation**
	satisfaction with the scheme, and outcome (e.g. energy efficiency)? What do households who have participated in the scheme say about their interest in / willingness to install future measures? Does this differ for applicants (in general) vs. those who have had installations completed, and by installation type?	
Fuel poor and low-income customers How effectively has the scheme engaged low-income households, including those at risk of fuel poverty?	How does the proportion of fuel poor households applying for the scheme compare to the proportion of fuel poor households nationally? For what reasons did fuel poor households participate? Did this differ at all from the reasons other applicants participated? What measures did fuel poor households request? Did this differ at all from other applicants? To what extent are the measures implemented likely to have taken households classified as fuel poor out of fuel poverty?	This question has **not been covered**. This report **(Chapters 2 and 6)** refers to analysis conducted, and conclusions drawn for the process evaluation; but it does not elaborate on the analysis. An updated analysis using final scheme data and wave 2 applicant survey results will be presented in the final outcome and economic evaluation.

Evaluation questions	Sub-evaluation questions	Aspects not fully covered in this report, to be covered further in next phase of evaluation
	Whether the trend of fewer completions for Fuel Poor Households (identified in Ph1) remains and what that barriers to completion for this group were?	
Supply Chain Outcomes How effectively has the scheme supported the creation or preservation of FTE jobs involved directly and indirectly in delivering? How effectively has the scheme driven the development of skills needed to meet Net Zero? Did the scheme contribute to the creation of long-term growth in the energy efficiency/ low carbon heating supply chain?	**Jobs:** Did participating firms recruit new employees as a result of participating in / in preparation for the scheme? Did they retain these jobs? Did the scheme have any (+ve / -ve) effect on job retention / loss? What are the employment figures for firms before and after the schemes start and closure, as compared to a counterfactual analysis? **Skills:** To what extent did participating installers participate in training? Through what mechanisms did the scheme encourage and/or enable training? What were the reasons for non-participation in training? What were the barriers to training? Considering these findings all together, what value (if any) did the scheme training programme offer? Could anything have been done differently / better? **Business growth**: What are the growth figures for firms before and after the schemes start and closure,	This question has been **partially covered (Chapters 5 and 8)** based upon findings from qualitative interviews with installers and manufacturers, as well as a reanalysis of the survey of 218 installers, and scheme data. It will be covered in greater detail in the final outcome and economic evaluation using survey data on the turnover, staffing and supply chains of installers participating in GHGVS available through the ONS Secure Research Service.

Evaluation questions	**Sub-evaluation questions**	**Aspects not fully covered in this report, to be covered further in next phase of evaluation**
	as compared to a counterfactual analysis? Based on qualitative data and an analysis of the variables between participating firms (within the results) what factors appear to have driven these results?	
Quality[69] To what extent did the scheme deliver energy efficiency installations which were high quality?	What does the scheme data tell us about quality? What do auditors report on the overall quality of installations within the scheme? To what extent does the profile of installations complete support this? What do applicants perceive to be the quality of the installations completed? What do these findings tell us about the effectiveness of the scheme in supporting higher quality installations? To what extent were the results likely to have been driven by scheme design?	This question has been **fully covered (Chapter 7)**. However, it will be elaborated and explored in further detail in the final outcome and economic evaluation using a final cut of TrustMark audit data.
Fraud and Gaming To what extent has the scheme been affected by fraud and gaming?	What does the scheme data tell us about fraud and gaming?	This question has been **fully covered in this report (Chapter 7).**

69

Evaluation questions	**Sub-evaluation questions**	**Aspects not fully covered in this report, to be covered further in next phase of evaluation**
	Is there sufficient data to profile which types of household / consumer might have been more / less likely to be a victim of the fraud? Do applicants report (further) instances of fraud and gaming? How were instances of this dealt with and what were the scheme mechanisms for prevention, reporting and dealing with fraud and gaming? What do these findings tell us about the effectiveness of the scheme in mitigating against fraud and gaming? To what extent were the results likely to have been driven by scheme design?	
Economic Outcomes[70] What is the average cost of installing measures in homes applying and redeeming vouchers under the scheme? How does this vary by measure, tenure or property type?	*The overarching EQs for the economic evaluation are currently comprehensive, sub-questions and lines of inquiry may emerge as the data collection and analysis begins.*	This question has been **partially covered in this report (Chapter 10).** It will be covered in greater detail in the final outcome and economic evaluation once the final analysis of all outcomes has been developed.

[70] Note that we will not be able to answer the original outcome evaluation question 'What benefits have been achieved by voucher scheme?' as it deals with complex issue of attribution and market dynamics. If helpful we can discuss this further with BEIS.

Evaluation questions	Sub-evaluation questions	Aspects not fully covered in this report, to be covered further in next phase of evaluation
What costs are incurred by the different actors involved in the scheme? What are other outputs can be modelled and assessed as part of the cost benefit analysis – e.g. air quality? Have there been differences in costs and benefits between the different subgroups of participants/ installers? To what extent did the scheme deliver energy efficiency installations which represented good value for money?		

Analytical approach

Overarching approach

For each anticipated outcome of this outcome evaluation, we have assessed: (a) actual change – i.e. whether anticipated outcomes occurred, and (b) whether these were caused by the scheme (attribution / contribution). This is reflected in the structure of Chapters 5 to 10 which describe how the scheme intended to achieve each outcome (as per the ToC); evidence of a change in the outcome area over the time period of the scheme; and an exploration of the scheme's contribution to the observed change.

To support our analysis, and to ensure as robust an analysis as possible, we applied a three-step approach to the outcome evaluation.

Step 1: Iterative understanding the ToC and its causal hypotheses. This step also had the following sub-steps:

1. The evaluation team participated in a ToC workshop, conducted in November 2020 and led by BEIS. The workshop was attended by 10-20 policy officers from BEIS

working on the Green Economic Stimulus package. The ToC built upon the strategy and hypotheses set out in the scheme's Full Business Case.

2. As part of the process evaluation final report, produced in August 2020, Ipsos conducted a review of the scheme ToC. We reviewed the ToC assumptions against the findings of the process evaluation to assess validity. We found that some of the assumptions were valid, but that others had proven to be invalid.

3. At the beginning of this interim stage of the outcome and economic evaluation, we presented this understanding to BEIS policy stakeholders via (a) a presentation of the process evaluation findings, and (b) a ToC workshop, in which we presented six outcome pathways[71] and their associated assumptions. These outcome pathways were based around those identified by BEIS at the beginning of the evaluation as reflecting the scheme's intended benefits. We posed questions to BEIS and thus derived additional assumptions and hypotheses to test. We followed up this workshop with interviews with three BEIS policy officers and one TrustMark representative to further understand these in detail. On this basis we set our framework for investigation (see Table A1.1 above) and developed the data collection and analysis tools.

The final presentation of the ToC and outcome pathways in this report follow a slightly different structure to the pathways as presented and discussed in the ToC workshop. This is because the narrative of the report has been developed to reflect the evaluation findings which have revealed more nuances to the GHGVS ToC.

Step 2: Outcome-specific analysis. Different techniques described briefly below in the next subsection ('approaches to outcome assessment') were used to measure the distinct outcomes of the scheme.

Step 3: Triangulation. For several of the workstreams (quality, benefits to households, market outcomes), several strands of research (e.g. scheme data analysis, TrustMark data analysis, survey data and qualitative interviews) provided evidence that informed the outcome assessment. Where this was the case, we triangulated the evidence. To ensure a joined-up robust analysis, we held several internal analysis meetings (between Ipsos, UCL and EST) to draw agreement on the findings.

Step 4: Developing causal explanations and lessons for future policymaking. To understand why and how the scheme does / does not contribute to different outcomes and to explain any variations within our findings according to type of applicant, installer and/or measure, we cross-compare evidence and dig into the literature to contextualise our findings. To do this we optimised the expertise we have within our team to consider explanations and further elaborate the nuances of the ToC and its assumptions and their validity.

In the final outcome and economic evaluation we will repeat steps 2-4 and, as part of step 4, we will also try to understand why some outcomes might have been more readily achieved than others and what the different enablers and barriers might be. To develop our arguments,

[71] Energy efficiency, growth of the low carbon heat market and consumer behaviour, fuel poverty, increased employment and improved skills, quality, and fraud and gaming.

we may hold analytical workshops on all or on individual outcome areas. This is to be decided depending upon whether this seems efficient and effective as a way of developing our arguments closer to the time.

Approaches to outcome assessment

Coverage of fuel-poor households: Chapters 2 and 6 consider coverage of low-income and likely-to-be fuel poor households based upon an analysis of scheme data and reference to the findings and analysis of likely-to-be fuel poor households conducted by BRE during the process evaluation. In the final phase of the evaluation, BRE will update the modelling of the fuel poverty status of all households who had installations.

Complementarity: UCL developed the analysis of complementarity based upon a review of programme design information and a comparison of scheme data and TrustMark data alongside that of RHI ECO3. By comparing the type of eligible technologies between the GHGVS on one hand and the ECO3 and RHI on the other hand, UCL assessed the extent to which the GHGVS scheme involved the same installers and contributed to the delivery of measures that have not been supported by other schemes.

Consumer demand: Consumer's interest in, and demand for, the scheme has been described in Chapter 4 based upon qualitative interviews with scheme's applicants and further analysis of the wave 1 applicant survey conducted for the process evaluation. This evidence will be complemented by the second wave of quantitative survey of applicants, starting at the end of April 2022 and reported in the next stage of this outcome and economic evaluation.

Skills: Our conclusions around effects of the scheme on skills has been described as part of a broader analysis of the viability of the supply chain in Chapter 5 of this report. The analysis drew upon several strands of research: the survey of installers, qualitative data collection with installers, and qualitative data collection amongst upstream businesses in the GHGVS supply chain (training providers, auditors, manufacturers and certification bodies).

Energy, carbon and bills savings: Analysis of the scheme's effects on energy, carbon and bills savings will be conducted by UCL using smart meter (SM) data from participating households who have consented to this in the next stage of this outcome and economic evaluation (once all installations have been completed and consents from households obtained). For this report, a proxy analysis using estimates from the ECO3 database was developed.

Property occupant health and well-being: Initial analysis of occupant health and well-being has been conducted in this report by Ipsos based upon qualitative interviews with scheme's applicants and further analysis of the wave 1 applicant survey conducted in the process evaluation. In the final phase of the evaluation, analysis of this outcome will be carried out in greater depth using modelling and estimates to be developed by UCL using the Health Impact of Domestic Energy Efficiency Measures (HIDEEM) model. The model uses data on indoor environmental changes (such as changes to indoor temperature and ventilation following a new installation in the house) to determine the effect on household occupant health.

Jobs: Analysis of the scheme's effects on jobs has been described in brief detail using evidence from the survey of installers, and qualitative data collection with installers. In the next stage of this outcome and economic evaluation this will be assessed in more detail via an econometric analysis of businesses who performed installations under the scheme (the treatment group), with similar companies that did not participate into the GHGVS (the control group).

Long-term growth in the energy efficiency/ low carbon heating supply chain: An initial qualitative analysis of growth in the low carbon heat market has been developed based upon evidence from scheme data, the survey of installers, qualitative data collection with installers, and manufacturers. In the next and final phase of the evaluation, we will look at the impacts on business' turnover using the same datasets and econometric techniques applied to estimate the potential effects on job's creation. This will enable us to understand if the scheme affected firm's growth in the short term. This analysis will be paired with another wave of qualitative consultations among the wider supply chain lead by EST.

Analysis of quality: This has been conducted based upon an initial analysis of TrustMark audit data and though qualitative interviews with certification bodies and auditors, as well as interviews with relevant BEIS policy officers and TrustMark. This strand was led by EST.

Analysis of fraud and gaming: As for the analysis of quality, analysis of fraud and gaming has been based upon analysis of TrustMark data, scheme data, and interviews with BEIS, TrustMark, auditors and certification bodies.

Approach to data collection

Summary of data sources and data collection methods

Information on the numbers of interviews conducted so far is given in Table A1.2. All interviews undertaken lasted 45-60 minutes and were conducted via Microsoft Teams or telephone.

Table A1.2: Data sources for this report

Secondary data source	Type of data covered	Volume of data – process evaluation	Volume of data – outcome evaluation
Scheme data	Number and profile of applicants, households (incl. building type), installers & applications/ installations (incl. by type).	For all / as many as possible installations conducted to 01 March 2021	For all / as many as possible installations conducted to 6th December 2021

Primary data source	Type of data covered	Volume of data – process evaluation	Volume of data – outcome evaluation
Qualitative interviews with applicants (homeowners, landlords, tenants)	How became aware of scheme, reasons for participation, confirming & understanding experience of customer journey, COVID-19 effects/other barriers, additionality/free-rider effects, likelihood to install similar measure in future, satisfaction with the installation, energy bills savings.	41 homeowner-occupiers 15 landlords 1 tenant[72] 4 applying on behalf of other people	16 homeowner-occupiers 15 landlords
Qualitative interviews with non-applicants	Awareness of the scheme, views on the relevance of the scheme, barriers to (and potential motivations for) application.	18 participants	n/a
Qualitative interviews with installers	How became aware of scheme, reasons for participation, confirming & understanding experience of installer journey (incl. training and accreditation), COVID-19 effects/other barriers. Effects of the scheme on jobs, skills development, firm growth.	17[73] installers	10 installers
Qualitative interviews with manufactures	Effects of GHG scheme on service offering, amount of business incoming, growth, business capacity, turnover, staffing and skills;	11 manufacturers	11 manufacturers

[72] The evaluation team was only able to interview one tenant, due to the lack of this audience among applicants. Where the scheme data recognised applicants as 'people applying on behalf of someone' these were in most cases not tenants but people who applied for a relative or someone they cared for. Some reasons of why this may be the case are explained in section 3.2.

[73] 16 installers were interviewed qualitatively between February and May 2021. One additional installer was interviewed on the 11/08/2021, was recruited on the back of the quantitative survey.

Primary data source	Type of data covered	Volume of data – process evaluation	Volume of data – outcome evaluation
	viewpoints on scheme effects on quality and energy efficiency market.		
Qualitative interviews with certification bodies	Effects of GHG scheme on service offering, amount of business incoming, growth, business capacity, turnover, staffing and skills; viewpoints on scheme effects on quality and energy efficiency market.	8 certification body representatives	7 certification body representatives
Qualitative interviews with training providers	Effects of GHG scheme on service offering, amount of business incoming, growth, business capacity, turnover, staffing and skills; viewpoints on scheme effects on quality and energy efficiency market.	6 trainers	8 trainers
Qualitative interviews with auditors	Effects of GHG scheme on service offering, amount of business incoming, growth, business capacity, turnover, staffing and skills; viewpoints on scheme effects on quality and energy efficiency market.	5 auditors	9 auditors
TrustMark	The quality systems underpinning the GHGVS.	2 representatives	1 representative
BEIS officials	The design of the scheme, delivery challenges and scheme achievements.	9 officers	3 officers

Sampling approach for qualitative data collection

Qualitative interviews were conducted with four different audiences, the sampling approach for each group is detailed below.

Applicants – process evaluation

A total of 41 homeowner-occupiers, 15 landlord applicants, four not owning the property but 'applying on behalf of others', and one tenant were interviewed from a sample of 1,677 applicants drawn from the scheme data supplied by BEIS. Ipsos aimed for a mix of demographics, region, application stage, measure installed and property type within the sample (see Table A1.3 below). The target for number of homeowner-occupiers and landlords was met, but only one tenant[74] was interviewed due to the number of tenants attracted by the scheme having been low. People 'applying on behalf of someone' were most often those people applying for a relative or someone they cared for who was less able to compete the form themselves.

Table A1.3: Qualitative interview sampling characteristics - applicants (process evaluation)

	Homeowners	Landlords	Applied on behalf/tenants
Scheme type			
Low income	16	2	2
Main scheme	25	13	3
Property type			
Bungalow Detached	2	-	-
Flat	-	2	-
Detached	22	3	2
Mid-Terrace	2	-	
Semi-Detached	15	9	3
Terraced house	-	1	

[74] Possible reasons behind the lack of tenants are detailed in paragraph 3.2.

	Homeowners	Landlords	Applied on behalf/tenants
Region			
Midlands	14	5	-
North	8	5	3
South	18	5	2
South East	1	-	-
Measure type			
Air Source Heat Pump	9	5	2
Biomass boiler	1	-	-
Cavity Wall Insulation	6	2	-
External Solid Wall Insulation	6	3	-
Flat Roof Insulation	1	1	-
Loft Insulation	6	2	1
Pitched roof insulation	-	-	1
Room-in-roof	1	-	-
Solar Thermal	10	1	1
Under-floor insulation: Suspended floor	1	1	-
Gender			
Male	22	10	5

	Homeowners	Landlords	Applied on behalf/tenants
Female	19	5	-
Age			
36-45	5	-	-
46-55	9	5	-
56-65	15	7	1
66+	12	3	4
Total			
	41	15	5

Applicants – interim outcome evaluation

A total of 16 homeowner-occupiers and 15 landlord applicants, were interviewed from a sample of 16,623 applicants (16,067 homeowners and 556 landlords) drawn from the scheme data supplied by BEIS. Interviewees were selected based on the type of installation applied for, date of installation, property type, property age and geographical location (see Table A1.4 below). Interviewees were not purposively sampled as to age or gender, though only people aged over 40 were reached, both because higher numbers of these applied to the scheme (see section 2.4.1).

Table A1.4: Qualitative interview sampling characteristics – applicants

		Homeowners	Landlords
Gender	Female	6	9
	Male	10	6
Age	40-50	2	2
	51-60	3	0
	61 +	11	13
Installation type	Installation in progress	1	0

		Homeowners	Landlords
	Air source heat pump	4	2
	Double/triple glazing	4	1
	Internal solid wall insulation	2	1
	Room in roof insulation	3	5
	Solar thermal	2	2
	External wall insulation	0	2
	Flat roof insulation	0	1
	Loft insulation	0	1
Property type	Detached	3	0
	Semi-detached	9	1
	Semi-Detached/Terrace	1	0
	Terraced	3	8
	Flat	0	1
	Other	0	5
Property age	1900-1929	4	6
	1930-1949	1	0
	1950-1966	2	2
	1976-1982	1	0
	1991-1995	1	0
	2007-11	1	0
	N/A	1	0
	Not on list	2	7
	Pre 1900	2	0
	Pre-1900	1	0

		Homeowners	Landlords
Geography	Midlands	5	6
	North of England	6	0
	South of England	5	5
	Other	0	4
Installation date	Q1 2021	5	0
	Q2 2021	0	4
	Q3 2021	7	7
	Q4 2021	4	4
	Total	16	15

Ipsos focussed on measures the following measures:

- Internal solid wall insulation
- Air source heat pump
- Solar Thermal
- Room-in-roof insulation
- Double/triple glazing

The rationale for choosing these was to ensure evidence on these criteria were collected:

- The level of disruption, in terms of the installation (see Table A1.5)
- The level of technical know-how / guidance to use it afterwards
- Cost
- Levels of labour – i.e. person-days (vs. easy-to-install)

This was to test assumptions around:

- Any difference in experience depending on level of disruption
- Consumers' ability to manage measures post-installation
- The extent to which costs affected behaviour

Table A1.5 sets out our ex-ante understanding (based upon expertise within the team) of the relative level of disruption, 'technical difficulty' of usage, cost and level of effort of labour required to install each measure. The analysis is based upon ex-ante understanding acquired from outside of this evaluation and has not been updated to reflect the findings of e.g. the research into costs and benefits and installation experience gathered for this report.

Table A1.5: Level of disruption – installations

Measure installed	Level of disruption	How technical is it to use afterwards	Cost	Required more labour to implement
internal solid wall insulation	High	Low	High	High
external solid wall insulation	Low	Low	High	Medium
cavity wall insulation	Low	Low	Low	Low
under-floor insulation (solid floor)	Medium	Low	Medium	Medium
under-floor insulation (suspended floor)	Low	Low	Low/Medium	Low/Medium
loft insulation	Low	Low	Low	Low
flat roof insulation	Low	Low	Low	Low
pitched roof insulation	Low	Low	Low	Low
room-in-roof insulation	Medium	Low	Low	Medium
insulating a park home (assume external wall insulation)	Low	Low	High	Medium/High
air source heat pump	Medium/High	Medium	High	Medium/High
ground source heat pump	High	Medium	High	High
solar thermal (liquid filled flat plate or evacuated tube collector)	Medium	Medium	Medium/High	Medium/High

Measure installed	Level of disruption	How technical is it to use afterwards	Cost	Required more labour to implement
biomass boiler	Medium	Medium	Medium/High	Medium/High
draught proofing	Low	Low	Low	Low
double or triple glazing	Medium/High	Low	High	Medium/High
secondary glazing	Medium	Low	Medium	Medium
energy efficient replacement doors	Low/Medium	Low	Medium	Low/Medium
hot water tank thermostat	Low	Low	Low	Low
hot water tank insulation	Low	Low	Low	Low

Installers – process evaluation

We aimed to reach a total of 15-20 installers for the purposes of the process evaluation to understand their experience of the scheme, these were sample from different sources. Twelve contacts willing to speak to the evaluation team were provided by the certification body Cavity Insulation Guarantee Agency (CIGA) and a further nine from MSC. In addition, contacts for 20 installers were provided by EST through their networks / web-searching. To reduce potential biases related to convenience sampling and to achieve greater variation among the installers recruited, some contacts were drawn from scheme data and one contact from the installer quantitative survey. In total, 17 interviews were conducted with the profile as per Table A1.6.

Table A1.6: Qualitative interview sampling characteristics – installers (process evaluation)

Company size	Interviewed
<10	5
<25	6
25-50	4

50-100	1
100-250	1
Company structure	**Interviewed**
Delivery through own staff only	12
Delivery through subcontractors (in addition to staff)	4
Delivery through subcontractors only	1
Service coverage	**Interviewed**
National	5
North	1
North East	1
North West	1
South East	2
South West	3
South	1
East	1
No info	2
Company base	**Interviewed**
National	0
North	1
North East	1
North West	1
South East	6
South West	2
South	1
East	1

Wales	2
No info	2
Measure type	**Interviewed**
Air Source Heat Pump	3
Biomass boiler	5
Cavity Wall Insulation	7
External Solid Wall Insulation	2
Flat Roof Insulation	2
Loft Insulation	7
Pitched roof insulation	2
Room-in-roof	1
Solar Thermal	5
Under-floor insulation: Suspended floor	3

Installers – Interim outcome evaluation

We aimed to reach a total of 10 installers to understand their experience of installations, the impact of the scheme on jobs and skills' development. These were sampled from the scheme data from a total of 925 enrolled companies. The sampling criteria were:

- Region: to include a spread across North, Midlands, South
- Insulation type: even split between insulation and low carbon heath installers
- Certifications obtained: installers that obtained any certification to participate in the scheme

The profile of the installers interviewed in for this report (interim outcome evaluation) is presented in table A1.7 below:

Table A1.7: Qualitative interview sampling characteristics – installers (outcome evaluation)

	Installers
Company size	**Information not collected**

		Installers
Company structure	**Information not collected**	
Service coverage	Midlands	3
	North of England	2
	South of England	5
Measure type	Air source heat pump	1
	Air source heat pump, Solar thermal (liquid filled flat plate or evacuated tube collector)	1
	Cavity wall insulation, Loft insulation, Air source heat pump, Hybrid heat pump	1
	Pitched roof insulation	1
	Solar thermal (liquid filled flat plate or evacuated tube collector)	1
	Solid wall insulation (internal or external)	2
	Solid wall insulation (internal or external), Cavity wall insulation, Under-floor insulation (solid floor, suspended floor), Loft insulation, Flat roof insulation, Pitched roof insulation, Room-in-roof insulation	1
	Under-floor insulation (solid floor, suspended floor), Insulating a park home	1
	Under-floor insulation (solid floor, suspended floor), Loft insulation	1
Certifications gained in order to participate in the GHGVS	TM registration	3

		Installers
	TM registration, MCS	1
	TM registration PAS 2030: 2017	1
	TM registration, MCS PAS 2030: 2017 PAS 2030: 2019 PAS 2035: 2019	1
	TM registration, MCS PAS 2030: 2017 PAS 2030: 2019 PAS 2035: 2019	1
	TM registration PAS 2030: 2019	2
	TM registration PAS 2035: 2019	1
	Total	**10**

Wider supply chain – process evaluation

A total of 20 interviews with representatives from manufacturers, certification bodies, auditors and training providers were scheduled for the process evaluation.

Participants were posed questions on their organisational context, recent demand for products and services, recently added products and services, changes in workforce, skills and innovation, prospects of business growth, and views on the scheme.

Manufacturers (11 interviews): A diverse mix of manufacturers was recruited covering all four measure sub-categories defined in the scheme (i.e. insulation, heat pumps and solar thermal, heating controls, and windows and doors) and all sizes of businesses (i.e. SME and large). Manufacturers were selected through a combination of EST's existing business database and online searches. Businesses were requested to put forward senior employees with an understanding of business strategy and the ability to speak on behalf of the business.

Certification bodies (8 interviews): This included a balance of TrustMark and MCS certification providers. They varied in the length of time they have been certifying and the

number of members. Areas of specialism were also diverse, including measures such as insulation, biomass, electrics, windows, doors, roofing and energy assessment.

Training providers (6 interviews): These providers varied in the work packages they delivered and the length of time they had been training. All training providers were delivering training exclusively for energy efficiency and renewable energy measures.

Auditors (5 interviews): Their recruitment was quite challenging as very few quality inspections had been conducted on the measures installed at the time of these interviews.

Wider supply chain – Interim outcome evaluation

Fieldwork for this phase of the evaluation was conducted between mid-January and 4th March 2022. Interviewees were recruited by EST, who directly emailed and phoned suitable participants within the industry to invite them to take part in an interview. Interviewees were identified through a combination of EST's existing business database as well as online research. A diverse range of interviewees were considered for an interview to ensure each category of participants ranged in specialism, organisation size and experience. Although the majority of interviewees did not participate in the GHGVS process evaluation, there were some who provided feedback in this earlier round of interviews in 2021. These interviewees were approached again due to the limited sample size of the population.

A semi-structured telephone interview, ranging in length from 20 minutes to over an hour, was conducted with each respondent. Questions varied depending on which category the interviewee belonged to, but each group was asked about the interviewee's organisational context and experience, description and demand of their products and services, scheme influence on employment and business and any other impacts that the scheme had on their business that had not already been discussed.

Interviews were recorded and transcribed manually. The raw qualitative data was analysed in NVivo by coding the main themes across all interviewees in each group type. The thematic analysis was used as evidence for the key findings in this report.

Training providers (8 interviews): Respondents delivered training for numerous different work packages: heat pumps and solar thermal, heating and hot water controls, retrofit assessor and retrofit coordinator training, insulation and non-fabric measures.

Auditors (9 interviews): Although they all inspect a wide range of installations examining different types of measures, certain auditors also had specific areas of specialism, including heating, insulation and ventilation, though they were not limited to these types of inspections. The number of audits personally undertaken by each interviewee under the GHGVS ranged from five to over 1,500.

Certification bodies (7 interviews): They covered a variety of specialisms including heating sector registration, audit inspection, PAS 2030 certification, retrofit coordination certification, window energy rating, competent person scheme, training and renewable certification, MCS and TrustMark. All certification bodies interviewed have been operating in the renewable energy, energy efficiency and low carbon heat sector for at least one decade.

Manufacturers (11 interviews): Respondents covered a variety of products including insulation, heat pumps, biomass, solar PV, and hot water, glazing, ventilation systems, heat recovery and building management systems. The manufacturers interviewed had been in the renewable energy, energy efficiency and low carbon heat sector for between 20 and 50 years.

Furthermore, to supplement quality analysis, EST collected quantitative audit data from TrustMark. This data constitutes the outcomes of all site audits conducted by Trustmark for the scheme. It covers all questions and their respective outcomes for each audit.

Installer survey

The installer survey was conducted by telephone. All installers listed in the GHGVS who had provided consent to be contacted for the research were included in the sample for the research: 791 records were issued for fieldwork.

The questionnaire was developed by Ipsos, in consultation with BEIS and other partners (to ensure that data met the needs of different parts of the evaluation). The survey was 'soft launched' and reviewed after the first nine interviews were complete: including collating feedback from the interviewers and reviewing survey data. Briefing notes were made available to help interviewers to deal with participant comments and queries. The average interview length was 24 minutes.

A total of 218 interviews was completed with installers, with the soft launch running from 10 to 12 May 2021, and the main phase of fieldwork from 1 June to 6 July 2021. Because of a lack of suitable profile data in the installer database, the installer data is presented unweighted.

Applicant survey (wave 1)

The applicant survey employed a push to web method. This entails contacting applicants by post to invite them to complete a survey online. Those who cannot complete online complete the survey by telephone). Sampled applicants received a written invitation at the applicant address which contained a request to visit the survey website to complete the survey online. Access to the survey was controlled by password, which was provided in the invitation letter. Participants who were unable to complete the survey online were invited to call the survey helpline and request to complete the interview by telephone. All applicants were offered a £10 shopping voucher as a thank you for completing the survey. A total of 3,606 applicants completed the survey.

The sample for the applicant survey was drawn from the scheme data. To be eligible to complete the survey, applicants had to have:

- Applied for at least one Green Homes Grant Voucher,
- Consented to be re-contacted for the research, and
- An applicant status in one of the following categories:
    - In progress
    - Grant application incomplete
    - Grant application completed
    - Grant application update received

- Eligibility verification
- Request sent – grant application incomplete
- Landlord
- Park home
- Application received.

The sample was drawn from an anonymised version of the scheme data. With an anticipated response rate of around 20%, and a target of 3,000 interviews, a total sample of 15,506 was selected (assuming 8% of addresses would be unusable e.g. empty, applicant moved, away/on holiday through fieldwork period, etc.). The sample was stratified by key variables including scheme type (main vs. low income), applicant type (owner-occupier, landlord, other), property type (house vs. flat vs. park home) and measure (aiming for a minimum of 100 completed interviews per primary measure, and a minimum of 50 interviews per secondary measure). In the event, all eligible addresses were issued for landlords and those applying for vouchers for some measures (heat pumps, biomass boilers) with the aim of achieving the target number of interviews. For other applicants, a random sample was drawn following stratification by property type (house vs. flat), scheme type (main vs. low income), number of measures for which vouchers were applied, and region. A total sample of 17,331 records was drawn.

After the sample was drawn, it was sent to BEIS where addresses and contact details for applicants were appended. Following cleaning of addresses, and other quality checks, a total sample of 15,506 was issued for fieldwork.

It was originally envisaged that three reminder mailings would be required to reach the target of 3,000 completed interviewers. However, after just the first invitation, the target number of interviews was reached for most analysis groups. The survey was left open until the communicated end date to allow anyone wishing to still respond to do so. The only sub-groups with shortfalls in response were landlords, and applicants for vouchers for biomass boilers. To increase the response rates among these two groups, the non-responders in these categories were sent a further reminder letter asking them to take part.

The questionnaire was developed by Ipsos, in consultation with BEIS and the evaluation's consortium partners (to ensure that the survey data met the needs of different parts of the evaluation, including the cross-cutting evaluation). The average interview length was 20 minutes.

In total, 3,606 participants completed the survey, including 3,365 owner-occupiers, 177 landlords and 64 participants who had applied on behalf of others. This represents a total response rate of 23%. Fieldwork ran from 10th July to 5th August 2021, though the majority of interviews were completed within the first week of fieldwork (2,227 completes were received by 15th July). The target number of interviews for applicants for biomass boilers was reached (n=59 against a target of 50), though despite targeted reminders we fell slightly short of the target number of interviews with landlords (n=177 against a target of 200).

Data were weighted to the profile of the applicant database by key variables including scheme type, applicant type, property type and region. The impact of the weighting was slight, and the final effective sample size was 88%.

Methodological challenges and limitations

Sampling and fieldwork recruitment approach, and considerations on bias

The approach to sampling and fieldwork and the effect this may have had on bias within our findings is set out below.

Applicants

For the wave 1 applicants' survey, a sample of 15,506 applicants were invited to take part (the target was to have 3,000 completed interviews and the anticipated response rate was about 20%). Applicants were selected from the scheme data supplied by BEIS, which was stratified by key variables including scheme type, applicant type, property type, and measure. The survey was completed between 10th July 2021 and 9th August 2021. The findings in this interim outcome and economic evaluation have been slightly limited by the lack of follow up survey, which will be conducted in Spring / Summer 2022 and its findings feed into the final outcome and economic evaluation.

Qualitative research with applicants for the process evaluation was completed between mid-January 2021 to June 2021.[75] It covered a total of 41 homeowners, 15 landlords, four non-homeowners 'applying on behalf of others'[76], as well as one tenant. For the wave 2 qualitative research with applicants, a total of 30 people (15 landlords and 15 homeowners) whose installation had been successfully installed were recruited for interview (applicants who had not had an installation were screened out of the research). These qualitative research participants were selected from the scheme data supplied by BEIS. At both phases, Ipsos aimed for a mix of demographics, region, application stage, measure installed and property type within the sample.

The difference in timing and context between the waves of applicant research is important to note interpreting the findings in this report. Applicants participating in the first wave of (process evaluation) research were much less likely to have had an installation completed and those who had been successful in completing an installation represented a minority, less likely to have faced challenges with the installation. Several interviews with applicants also took place before the closure of the scheme. The closure - and the implications this created for households wishing to install measures within an agreed timeline or who had initially intended to apply for further measures under the scheme - have clearly coloured some of the views of those applicants interviewed after this event. For example, whether or not an installation was completed at the time of interview had an impact on applicants' responses to the wave 1

[75] Fieldwork ran to the 22nd March 2021, but then had to pause for six weeks to abide by the rules of purdah that take place around local and national government elections.
[76] This mainly comprised family members living outside of the property applying on behalf of those living in it (who were unable to apply for it on their own).

applicant survey.[77] As part of the theory-based approach taken to the outcome evaluation, this context is taken into account in developing our findings and conclusions.

Another aspect of context we have taken into account in interpreting the findings of this phase of the evaluation are the sharp increase in energy prices and the associated collapse of domestic energy providers that occurred in the winter of 2021-2022. This may have impacted consumer energy behaviours and their perspectives on energy consumption and therefore shaped the findings of the wave 2 qualitative research (which investigated the impact of the new measures on energy behaviours and perceptions of energy savings and home thermal performance).

Finally, we consider that the sample of responses to both the applicant survey and qualitative research may represent some element of self-selection bias, in which participants with a particularly negative or positive experience of the scheme may have felt more inclined to participate in fieldwork than those with more neutral experiences. This is because the qualitative research demonstrates a high number of partially negative experiences under the scheme. However, given that the scheme did face significant delivery challenges and high levels of applicant and installer dissatisfaction have been reported within other sources such as the National Audit Office Report of September 2021 and in the media, it is fair to assume that these experiences are representative.

Installers and wider supply chain

As part of the process evaluation qualitative research with 16 installers were carried out between mid-January 2021 and mid-February 2021. The survey of installers was conducted from the 1st June to 6th July 2021. Fieldwork with auditors, trainers, certification bodies and training providers was conducted from mid-January 2021 to May 2021. One additional interview with installers was conducted after the quantitative survey, in the first week of August 2021. All wave 2 qualitative research with these stakeholder groups was conducted in January and February 2022.

As with the applicant consultations, the data collected for this interim outcome evaluation has not been to the same scale as the data collected amongst installers for the process evaluation (for which a survey, as well as qualitative interviews was conducted).

As with the applicant research, the policy context at the point of each interview had a bearing on the views of the research participants, particularly in relation to their satisfaction with and views on the GHGVS and other government schemes, but also their views on the effects of training, quality of installations and the home improvement market. As with the applicant research, we have taken this context and the influence it is likely to have on participant views and experiences into account in developing our analysis and conclusions.

In implementing the research, we also encountered the following methodological challenges:[78]

[77] See the GHGVS Evaluation Phase 1 Final Report, p35, section 3.9.
[78] Challenges faced in conducting Phase 1 of the evaluation are covered in the Phase 1 Report and are not repeated here.

- We did not **reach the target number** of manufacturers (11 reached instead of 13) or certification bodies (7 instead of 8) anticipated. However, the findings gathered, which provide a full picture of perspectives, as well as some consistency in points of view, suggests that with the numbers reached we reached saturation of evidence from these groups.
- There were some **delays to obtaining data and getting clarification on queries** from TrustMark. This was due to capacity issues driven by COVID-19 within the TrustMark organisation. This had **some impact on delivery timelines**, which meant that there was less time for the final triangulation and synthesis activities, which also contributed to a **delay in the full submission of version 1 of the report.**
- The **data on costs** – particularly costs to installers – is limited and we do not anticipate uncovering new sources of these data in the final phase of the evaluation – this has generated some limitations to the value for money analysis (see below).
- The applicant survey may present some **self-selection bias**, resulting in a higher proportion of people with completed installations being represented in the survey responses than within the scheme data. This is possibly because – as demonstrated in feedback received from the telephone and email helpline - some applicants invited to the survey incorrectly understood that they had to have a completed installation to participate.
- We were **unable to assess fuel poverty status for 31% of the applicant households** in the survey. Some sub-groups are disproportionately represented in that chunk meaning that there may be some over- or under-estimation of FP levels for those groups.

In terms of **limitations,** the main one is the lack of counterfactual to support the analysis presented in this report. This has limited the evaluation's power to attribute benefits (and disbenefits) to participating installers and to observed changes such as an increase in demand to the GHGVS. This will be partly addressed in the final phase of the evaluation when an econometric analysis will be used to assess outcomes for installers and a comparative analysis (involving controls) will also be used to assess energy savings.

The potential bias in our sample and reporting, as discussed under 1.2.4 and in Annex 1, as well as the limitations on our fuel poverty and value for money analyses also represent limitations to the findings and conclusions in this report. However, overall, the report has been able to draw upon a wealth of evidence and a robust analysis which makes the findings and conclusions in the report highly credible.

CBA

The limitations in relation to the interim CBA are discussed in section 10.1.

Methodological strengths

In carrying out this outcome evaluation, the team were able to build upon the lessons of the process evaluation, and the following aspects of the outcome evaluation research went particularly smoothly, resulting in **strengths of the data and analysis** achieved:

- An **iterative** analysis, building upon hypotheses tested and refined at multiple stages, in consultation (and further data gathering) with the policy officers delivering the scheme at BEIS. This has enhanced the credibility – and thus the strength – of our findings.
- Linked to the above, the two-stage approach to the outcome and economic evaluations, which was set up by BEIS as part of the ITT to this evaluation has enabled the team to explore lines of inquiry emerging as significant or interesting, in order to test and refine these in the next phase of the evaluation. This should also increase the strength of the conclusions that we develop as part of the final outcome and economic evaluation– report.
- Analysis that draws upon and brings together the findings from **all stakeholder groups affected by the scheme**, as well as multiple **types of data** (observed evidence in the form of scheme data, statistically representative evidence in the form of survey data, explanatory (i.e. qualitative) evidence in the form of stakeholder views gathered through interviews) to increase the **validity** of the findings and conclusions.
- An analysis that explores the 'why' and 'how' of our findings around scheme results by taking a **theory-based approach.** The four-step analytical approach described above has increased the precision of our interpretation of the ToC, so that the most relevant hypotheses and assumptions can be tested.
- Reaching *nearly* **all of the target numbers for stakeholder groups** to be covered (though see below). **A largely representative spread** of regions, measures, building types and demographics covered in the installer and applicant qualitative research (though see below).

Annex 2: The GHGVS Theory of Change

The overall strategy and aims of the GHGVS

As set out in the Full Business Case, the aims of the GHGVS were:

1. To bring forward investment in domestic energy performance and low carbon heating through subsidies, supporting an industry impacted by COVID-19, by securing jobs and creating new long-term jobs; and
2. Accelerate the installation of energy performance upgrades to the housing stock including installation of low carbon heat technologies, delivering increased carbon savings, and fuel poverty alleviation, in the residential sector, to support the Government's Carbon Budgets and Fuel Poverty Target.

GHGVS was developed within the context of COVID-19 driving a new mission for BEIS, of Leading Britain's Recovery and BEIS priorities of Backing Business and Tackling Climate Change.

As set out in the Business Case, the GHGVS also had the following objectives to:

- Help the Government meet its commitment to upgrade all fuel poor homes to Energy Performance Certificate (EPC) Band C by 2030, and as many other homes as possible to EPC Band C by 2035.
- Ready homes for low carbon heating technologies.[79]
- Support the adoption of 'least regrets' – i.e., future-proofed - low carbon heating measures (particularly in existing off gas grid homes).[80]

Support for energy efficiency installations through GHGVS was designed to:

- Increase the energy performance (and thermal comfort) of homes and reduce their carbon emissions.
- Raise households' disposable income because of reduced energy costs, allowing them to increase their spending elsewhere in the economy.
- Support jobs throughout the economy, as materials manufacturing (much of which is UK based) ramps up to meet demand, and accredited installers bring back furloughed staff and grow their workforce to deliver the physical work.

[79] In conjunction with wider BEIS policy to: (a) set minimum energy performance standards across tenure types at key trigger points (e.g. point of rental, sale, financing, home improvement); (b) support market enablers such as information, communications, supply chain quality / skills, consumer redress, and availability of low-cost green finance); and (c) target public funding where it is most needed to drive improvements to fuel poor / vulnerable households, and accelerate adoption of higher cost, more disruptive measures).

[80] As set out in the October 2021 Net Zero Strategy, no or low-regrets actions are those which are cost-effective now and will continue to prove beneficial in future. For example, installing energy efficiency measures reduce consumer bills now, while making buildings warmer and comfier, but have the added benefit of making future installations of low carbon heating more cost effective.

- Prepare the energy efficiency/performance industry for the growth needed to fully decarbonise homes and meet carbon budget and net zero obligations.

Support for low carbon heating under GHGVS was designed to:

- Contribute to decarbonising heating in the UK and to meeting carbon budgets.
- Develop the low carbon heat market and supply chain to support the mass roll out of low carbon heating technology required in the 2020s.
- Contribute to the UK Government's legal obligation to reach net zero emissions by 2050.

The above was based upon the assumption that, by subsidising low carbon heat installations through GHGVS, the cost differential between installing fossil fuel and low carbon heating systems could be reduced, incentivising deployment of low carbon technologies.

Causal pathways and assumptions

Outcome pathways

In November 2020, BEIS led a workshop with policy officers to develop a more detailed ToC that set out causal pathways and underpinning assumptions. Six outcome pathways were identified, as follows:

1. Energy efficiency improvements,
2. Low carbon heat market growth,
3. Decreased fuel poverty,
4. Increased employment and improved skills within the installation sector,
5. Improved quality standards, and
6. Market improvements (market competition, increased awareness of new technology and/or increased the cost of measures).

These were expected to eventually lead to the following scheme impacts:[81]

1. Reduction of future carbon emissions
2. Improved health outcomes
3. Warmer and more comfortable homes
4. Homes that are cheaper and more efficient to heat
5. A reduction in energy bills in fuel poor homes
6. Growth in the energy efficiency and low carbon heating sector contributing to recovery from the COVID-19 related economic recession
7. An increase in the quality of future installations (outside of the scheme)
8. An increased understanding of the use of energy efficiency measures/tech for installers and consumers

[81] It is not within the scope of this evaluation to assess these impacts. They will be assessed as part of a cross-Green Economic Stimulus Impact Evaluation anticipated in 2023.

On 3rd November 2021, Ipsos led a second ToC workshop with BEIS to understand the outcome pathways in more detail. This led to further understanding for Ipsos around BEIS' assumptions underpinning the improved energy efficiency, low carbon heat growth and consumer behaviour, employment and skills, fuel poverty, and improved quality standards pathways; the findings of which have been integrated into the relevant chapters of this report.

Annex 3: Validity of the ToC assumptions

In the first (November 2020) ToC workshop, BEIS identified a number of assumptions, which Ipsos reviewed as part of the process evaluation. Based upon research conducted as part of the process evaluation, Ipsos was able to confidently conclude that the following assumptions around **consumer demand for the scheme and costs to them**, as well as **certification bodies' capacity** to meet scheme demand were valid:

- Demand not affected by unwillingness to go ahead with installations in the light of COVID-19 or adverse publicity about the scheme.
- Owner occupiers/ landlords are prepared to contribute to costs.
- Quantity of installations not affected by COVID-19 lockdowns.
- Applicants recognise the value of outcomes such as comfort and bill savings.
- Consumers will not face a loss of investment due to the scheme.
- TrustMark, certification bodies for PAS and MCS are able to scale up (systems and dispute resolution mechanisms) before and during the live scheme.

Based on the process evaluation research, Ipsos was also able to confidently conclude that the follow assumptions around **delivery** and **installer experience** were **not valid** due to the way that the scheme materialised:

- Scheme administrator platform is able to be up and running to the timescales.
- Training not affected by COVID-19/lockdown.
- Installers will not face a loss of investment due to the scheme.
- Messages from BEIS on future policy are clear, have weight and are timely to encourage supply chain build up.

Based upon the findings of this report, the effects of COVID-19 on training appear to have been less severe than initially concluded (in the process evaluation).

At the end of the process evaluation, confident judgements could not be made on the following assumptions set out in Table A3.1. The Table provides new analysis and conclusions based upon the interim outcome evaluation research.

Table A3.1 Further analysis on the ToC assumptions

Theme	Assumption	Analysis
Consumer demand and delivery	Customers take up primary measures and demand meets expectations.	Analysis in the process evaluation report suggested that demand did not meet government expectations – or at least not the levels of take-up that were possible within scheme budget. However, it did suggest, and

Theme	Assumption	Analysis
		this has been further validated for this report, that there was notable demand for the scheme's offering.
Consumer demand and delivery	Installations will be completed in enough time for vouchers to be redeemed.	The qualitative research conducted for this interim outcome and economic evaluation suggests that not all installations desired by households were possible within the timeframe of the scheme. The conclusion set out in Chapter 4 of this report is that demand outstripped the capabilities of the scheme and market to respond to demand (within the scheme's timeframes).
Installer skills and training	Suitable training is available to build up supply chain skills.	Analysis in Chapter 5 of this report suggests that suitable training was available to build up the supply chain.
Installer skills and training	Training is delivered in line with industry standards.	This evaluation has not assessed whether the training was delivered in line with industry standards – this falls outside of the scope of this evaluation.
Installer skills and training	The capacity exists in the training industry to supply the required amount of training.	Findings presented in this report indicate that there were some constraints on training, particularly for heat pump installation, though these do not appear to have been significant.
Installer skills and training	Installers will be qualified and will deliver installations that meet quality standards.	Analysis in Chapter 7 of this report indicates that, whilst the scheme did have a positive effect on certifications (as outlined in the process evaluation report and in Chapter 5 of this report), this did not always result in the quality installations desired.

Theme	Assumption	Analysis
Wider capacity of the supply chain and external influencing factors	Supply not affected by future COVID-19 restrictions. Supply of materials and manufacturing capacity able to meet demand without reduced quality.	Research conducted for the GHGVS process evaluation found that there were some issues with the home improvement supply chain, but that these were rather linked to the EU exit. Interviews with the supply chain for this interim outcome and economic evaluation (see Chapter 5) has generated stronger evidence of challenges with the supply of technology, products, material and labour force from Europe driven by both the EU exit and COVID-19.
Wider capacity of the supply chain and external influencing factors	Supply chain is able to build up skills in the timescale required.	Those installers who wished to participate in the scheme seem to have been able to build up the skills within the timescale required.
Wider capacity of the supply chain and external influencing factors	Supply chain is able and willing to scale up numbers of quality installers, retrofit co-ordinators etc.	Research conducted for the GHGVS process evaluation identified a lack of installers as one of the issues creating challenges for applicants seeking an installation. This was further confirmed by research with applicants conducted for this report. Qualitative interviews with all stakeholders for both the process and this interim evaluation suggest that this was driven by an inability, unwillingness or disinterest of (some) installers to participate in the scheme, at least in part due to the requirements of the scheme to acquire the necessary certifications.
Wider capacity of the supply chain and external influencing factors	Any regional differences in supply chain are minimised.	The research conducted for this report does not provide evidence with which to assess this assumption. It would be useful to discuss with BEIS to what extent Ipsos should carry out further

Theme	Assumption	Analysis
		research to assess this in the final outcome and economic evaluation.
Wider capacity of the supply chain and external influencing factors	Cost rises do not take place as a result of increased demand.	There has been some evidence of cost inflation (see Chapter 7 of this report), but this has not been due to demand.
Quality of installations, fraud, and gaming	There are sufficient protections, inspections, and auditing to prevent poor quality installations or criminal activity.	Analysis set out in Chapter 7 suggests that, despite the detailed prevention measures put in place under the scheme, poor quality installations did occur, and this was – at least in part - driven by the pressures on installers created by the short timeframes and rapid change in timeframes under the scheme.
Quality of installations, fraud, and gaming	Fraud and gaming are minimised by delivery body and other protections put in place.	As reported in Chapter 7, BEIS' analysis of fraud and gaming has found instances to be low. It is not within the scope of this evaluation to fully validate this, though qualitative research with applicants conducted for the GHGVS process evaluation found instances of fraud and wrongdoing taking place.
	Future retrofits for consumers are not impacted by experience of the scheme.	Analysis in Chapter 4 suggests that, where households had a poor experience of installations under the scheme, this affected their views on future measures; but where they were satisfied with the installation, even where they had had a poor experience of the scheme, this did not affect their willingness to install measures in the future.

Annex 4: Detailed methodology for the Cost-Benefit Analysis

This section provides a detailed description of the monetisation of benefits incorporated in the CBA used to assess the scheme's VfM. Table A4.1 sets out the costs and benefits assessed and the data sources for these.

Scope of the benefits and costs considered and assessed

Table A4.1: Costs and benefits assessed and sources of data

Impacts	Data sources
Main Costs	
Energy efficiency measure installation costs	GHGVS scheme data (November 2021)
Administration and programme management costs	GHGVS NAO report[82] (September 2021)
Training costs for installers' skills	GHGVS NAO report (September 2021)
Hassle costs associated with installations	ECO3 Impact Assessment[83]
Main Benefits	
Societal energy savings	Ofgem ECO3 measures energy savings Long Run Variable Cost (BEIS webpages[84])
Comfort taking	Ofgem ECO3 measures energy savings

[82] Green Homes Grant Voucher Scheme - National Audit Office (NAO) Report
[83] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749638/ECO_3_Final_Stage_IA__Final.pdf
[84] Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk) – Data Tables.

	ECO3 Impact Assessment:15% of energy savings retail fuel price (BEIS webpages)
Carbon savings	Ofgem ECO3 measures energy savings emission factors + carbon price (BEIS webpages)
Air quality improvements	Ofgem ECO3 measures energy savings damage costs/activity costs (BEIS webpages + Supplementary documentation of Green Book[85])

The main cost in the CBA is the installation cost of measures, the majority of which have been implemented in 2021.[86] The other monetised costs are the administration and programme management costs, and training costs for installers which were based on the NAO report. The NAO report provides an estimate of the expected total spend on issued vouchers, £256 million, and total spend on the scheme, £313.8 million, over two years of 2020-21 to 2021-22, including programme management, administrative cost, training for installers and vouchers spending. In particular, it attributes 16% of the total spend to programme management and administration of the scheme, £50.5 million, and 2% to training for installers, £7.3 million. This corresponds to 20% and 3% of the amount spent on vouchers, respectively.[87]

Hassle (or hidden) costs associated with the installations comprise the time needed for households to liaise with installers, preparation of property for the installation, cleaning-up or redecoration costs. Since an estimate for such costs is not available from primary data collection or the scheme's business case, we use figures retrieved from the impact assessment of the ECO3 scheme which are available for specific technologies only.[88]

Other potential costs include hassle cost to installers, regarding the time allocated to issue quotes, and application cost to households. These are not monetised as part of the present analysis, and we do not anticipate to include them in the final analysis due to data availability. However, these costs are expected to be very small compared to the summative costs already

[85] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
[86] We used the variable 'quote_amount' collected by the scheme data to reflect the installation cost of measures installed up to 07/12/2021.
[87] Therefore, we use 20% and 3% of the quote amount available from the scheme data to calculate the costs described above, for the subset of the whole spending used in this analysis.
[88] The available hassle (hidden) costs per installation are the following; £115 for cavity wall insulation, £145 for loft insulation and £235 for external solid wall insulation.

included in the analysis. Such types of costs are not included in other impact assessments[89] either which reflects their minimal nature compared to the key monetised costs.

Employment benefit will be assessed in the next and final phase of the evaluation but will not be incorporated in the final CBA. Inclusion of such a benefit normally depends on the extent to whether it can be precisely quantified and the opportunity cost of labour can be reliably computed.[90] It is more straightforward to evaluate such an effect for targeted employment programmes compared to programmes with a wider focus on environmental objectives and economic stimulus, as in the case of GHGVS. Therefore, employment benefit will not be assessed as part of the final CBA.

Wider benefits of the scheme may include improved security of energy supply and potentially reduced cost of meeting peak energy demand. These are associated with societal energy savings due to energy efficiency but cannot be monetised in a straightforward way. Saved energy can be used for alternative uses and the reduction in energy demand may lead to a decrease in the long-run variable cost of energy supply. Improved health outcomes and reduced health costs are benefits associated with better living standards. These are related to the increased comfort taking which is part of the interim analysis. The final analysis will include a health impact assessment to quantify health related impact, which is currently proxied to a great extent by increased comfort taking. Other non-monetised benefits of the scheme are related to increased quality of installations, increased understanding of the energy efficiency technologies and lessons learnt. These will be qualitatively assessed after the full primary data collection during the next phase of the evaluation.

Societal value of energy use

Although many policies have objectives other than energy use, they will include energy use as part of the wider impact (Green Book, 2020). Therefore, changes in energy use should be quantified and valued within the evaluation. This applies also to the GHGVS, which has the dual aim of facilitating post-pandemic economic recovery and decreasing carbon emissions towards the UK's target for net zero by 2050. Valuation of energy use is based on the Green Book and supplementary guidance to the Green Book (BEIS 2019).[91] Net changes in energy use, associated with energy efficiency measures installed as part of the GHGVS, are calculated using Ofgem estimates for similar ECO3 measures.

Policy interventions increasing energy efficiency and facilitating heat decarbonisation have an impact on energy consumption and related costs. Financial savings from increasing energy efficiency might however be used to raise consumption, an outcome known as direct rebound effect and related to increased comfort from warmer buildings and associated welfare gains.

[89] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749638/ECO_3_Final_Stage_IA__Final.pdf, as an example.
[90] The opportunity cost of labour should include the total value of output produced by the employees (Green Book, 6.2).
[91] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

Net energy changes in this case are obtained by subtracting the rebound effect from the expected savings from the intervention.

Net energy changes are valued based on the social cost of energy, the Long Run Variable Cost (LRVC) of energy supply. The LRVC reflects the production and supply costs of energy which vary according to the amount of energy supplied.[92] The supply costs vary over time and according to the type of fuel and the sector being supplied (supplementary guidance to the Green Book, Data Tables 9-13[93]). The value of energy use is expressed as follow, where Δ indicates change in the variable of interest:

$$value\ of\ energy = \Delta \mathrm{E}\ x\ LRVC.$$

By including the value of energy savings in the VfM analysis, one can capture social benefits both in the long run and short-run. In the short-run, they release energy for alternative uses. In the long-run, the LRVC can be reduced due the decreased energy demand so that the construction of new plants can be prevented (BEIS, 2018)[94].

Value of increased comfort (direct rebound effect)

As comfort taking (direct rebound effect) increases the welfare of the users of affected homes, it should be quantified and valued in the VfM analysis. In this study, this effect is estimated at 15% of energy savings[95], and its valuation is based on the retail price of energy, as this captures the gain in welfare. This means that the rebound effect (RE) is given by 15% of the expected energy changes estimated by Ofgem for similar ECO3 measures.

The computed RE is multiplied by the retail price of energy found in Data Tables 4-8[96], so that

$$value\ of\ RE = \mathrm{RE}\ x\ \text{retail price}.$$

Societal value of changes in GHG emissions

The quantification of GHG emissions changes $(\Delta\ \mathrm{GHG})$ is based on net energy changes and emissions factors (Data Table 2a[97]). Valuation of changes in GHG emissions is calculated by multiplying the changes in GHG $(\mathrm{CO2}\quad \mathrm{e})$ by the value of carbon. Carbon prices $(£/\mathrm{tCO2}\quad \mathrm{e})$

[92] The valuation of energy use is based on the LRVC instead of retail fuel prices, as the latter includes fixed costs, carbon costs and taxes which reflect transfers.
[93] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
[94] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749638/ECO_3_Final_Stage_IA__Final.pdf
[95] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43000/3603-green-deal-eco-ia.pdf.
[96] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
[97] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

are retrieved from Data Table 3 [98]. The value of changes in GHG emissions is expressed as follow:

$$value\ of\ GHG = \Delta\ \mathrm{GHG}\ x\ value\ of\ carbon.$$

Societal value of air quality

Air pollution can have adverse health impacts, and direct long-term environmental impacts. As policy intervention targeting the reduction of emissions have an impact on air pollution, changes in air quality are expected to be part of the appraisal work and incorporated in the VfM analysis.

Air quality effects are estimated by applying 'activity costs' given the estimated changes in fuel. Activity costs or damage costs (2018 p/kWh) for specific types of fuel can be found in the supplementary guidance to the Green Book [99]. More specifically, Data Table 15 provides air quality damage costs from primary fuel use – both in terms of national averages and domestic values (inner conurbation, small urban, medium urban, big urban, rural). The estimates for national averages are used. The changes in the value of air quality are provided by:

$$\mathrm{value}\ of\ air\ quality = \Delta E\ x\ activity\ costs.$$

[98] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal.
The 2020 carbon values are provided for the period up to 2050. To obtain post-2050 values, we applied an annual growth rate of 1.5% after 2050 following guidance from https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation.
[99] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

This publication is available from: www.gov.uk/government/publications/green-homes-grant-voucher-scheme-evaluation

If you need a version of this document in a more accessible format, please email alt.formats@beis.gov.uk. Please tell us what format you need. It will help us if you say what assistive technology you use.