Energy Company Obligation Demonstration Action

Analysis Report

Published: August 2022

CHIMELLA®

Demonstration action project delivery team

Sponsoring energy supplier: E.ON

Performance monitoring partner: Build Test Solutions

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Summary of Results

This field trial was a first of a kind for the Chimella product and to our knowledge no demonstration of chimney draught excluders at this scale has been delivered. This monitoring project was split into two phases. Phase 1 was conducted between October 2020 and March 2021, whilst Phase 2 was conducted between October 2021 and March 2022. Due to various constraints and recruitment challenges, this study resulted in a data analysis sample of 69 (58%) SmartHTC and 54 (45%) air permeability measurements of the minimum target sample of 119 properties.

The high-level findings from this study are:

- The chimney draught excluder product, Chimella, resulted in an average 13% reduction in air leakage (which is otherwise the source of draughts and discomfort). However, some participants saw a change in air permeability of up to 43% and others a change smaller than the measurement uncertainty of the air permeability test (i.e. no observed change).
- The mean Heat Loss parameter (HLP) was 2.2±2.2% lower (i.e. less heat loss) with the Chimella installed.
- A positive corresponding reduction in space heating demand of 269kWh was achieved on average. For gas central heating, the estimated fuel bill saving is £11.66/year (±100%), based on the SAP10 per unit gas price of 3.64p/kWh or £23.60 /year (±100%), based on an average per-unit gas price of 7.37p/kWh (Ofgem Price Cap - April 2022) for our modelled property. As energy prices rise, the fuel bill saving will effectively increase. Alternatively, for peak rate direct electric heating (CoP 1.0), the estimated fuel bill saving is higher still at £36.71/year (±100%) based on the SAP 10 standard tariff of 16.49p/kWh, or £63.10/year(±100%) based on an average per-unit electricity price of 28.34p/kWh (Ofgem Price Cap – April 2022).
- The Chimella therefore is expected to have a payback period[i] of around 3 years for a gas heated property, and around 1 year for direct electric using Ofgem Price Cap April 2022 figures[ii].
- Over the first 10 years of use, savings of 2,690kWh (±100%) in space heat demand or 673kg (±100%) of CO_2 (based on current gas emission factors and a boiler efficiency of 84%) could be achieved.
- The product can be installed by a professional or fitted by the end user. It is easily removed, and when replaced after removal, this does not appear to have an impact on the performance of the product.

[i] RRP £74.99 for a standard sized Chimella
[ii] based on an average per-unit electricity price of 28.34p/kWh (Ofgem Price Cap – April 2022)

- Whilst the sample of participants regularly using their fireplace during the study was small, the findings suggest that the removal and replacement of the Chimella does not impact its performance.
- Very positive qualitative feedback from trial participants with regards to ease of use, notable difference in comfort including reduced draughts, increased heat retention and warmer rooms.
- Post-installation of the Chimella, only one of the trial participants felt that the rooms with the Chimella installed were colder than others in the home, compared to 39% pre-installation.

The results demonstrate that Chimella reduces air flow, and therefore the deployment of this measure should deliver energy bill savings for consumers. However, the impact of the measure across the sample was varied due to the heterogeneity of the properties recruited so could warrant further testing.

Report Aims

This report aims to:

- review the data collected as part of the Chimella Demonstration Action
- compare the methodology against the original proposed methodology
- assess the data collected to provide an accurate assessment of the trial
- impartially present the key insights gathered over the course of the trial period.

Introduction

There are approximately 2.55 million households in fuel poverty in England, this equates to 11.1% of the population. Over 70% of these households live in pre-1964 properties, this compares to 54% non-fuel poor households living in older properties. Pre-1964 properties are more likely to have chimneys as they were built prior to the introduction of the 1965 Building Regulations. This means that fuel poor households could have greater exposure to draughts as a result of the draw from an open chimney.

The cheapest and best long-term solution to tackling fuel poverty is to make it cheaper for people to heat their homes through the installation of energy efficiency and energy saving measures. These measures can have a long-term impact on the cost of heating a home and help to keep homes warm all year around.

A home with open chimneys can be expensive to heat and uncomfortable to live in. A significant amount of heat can be lost through an uninsulated chimney and leaving it uninsulated could counter other energy efficiency improvements.

Chimneys are said to be one of the most significant air leakage elements in the house as they can lose as much heat as all the draughty windows and doors put together[iii]. A chimney is designed to force air to flow through a building, this is caused by the temperature difference between the outside air and inside air. If the inside air temperature is higher than the outside air temperature, the inside air density is less than the outside air density, and the inside air will flow up and out of the upper parts of the building. This means that on a cold day, the colder outside air will flow into the building via letter-boxes, cat flaps and under floorboards for example, thus cooling the property's indoor air temperature.

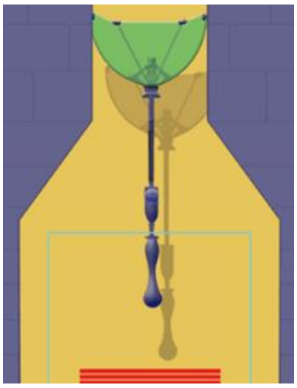

Figure 1 - illustration of Chimella installation

Permanently blocking a chimney is not an ideal solution for most homes with open chimneys as households may use their fire regularly. For households who only use the open fire occasionally, permanently blocking the chimney may not be preferable as they may wish to have the ability to use it, if only for a few times a year. Some households resort to using newspaper or fabric to prevent draughts. This is dangerous and can lead to significant problems including damp. The Chimella canopy is designed to allow a very limited airflow to prevent any water which may come down the chimney from causing damp. It allows water to dry quickly, preventing internal damage to the chimney itself.

[iii] Sharples and Mohammadpourkarbasi (2013) Draught Excluders for Chimneys

The British Research Establishment (BRE) previously assumed that the volume airflow rate attributed to chimneys was 40m^3/hr. However, a project by BRE[iv] found that this figure was significantly underestimating the airflow rate. They concluded that the airflow ranged from 5 to 150m^3/hr with an average 80.8m^3/hr, however the sample size was small (20 properties) in a single geographical location. The BRE recently published the updated specification for SAP which will come into effect in June 2022. This increased the airflow rate assumed with an open chimney from 40m^3/hr to 80m^3/hr. The new SAP10.2 also assumes that permanently blocked chimneys have an airflow rate of 20m^3/hr.

This Chimella ECO demonstration action study hopes to build on this work and collect real world data from lived in homes to further validate energy cost claims and assess the impact of installing chimney draught excluders across a larger sample of homes with greater geographic spread.

Recruitment methodology

The Chimella trial started recruitment in 2020 for the winter of 2020-21. The ECO demonstration action was approved in September 2020. This gave a limited timescale for recruitment which combined with the impact of covid-19 and social distancing restrictions made recruitment challenging.

Through a mix of gatekeeper engagement and social media campaigns over 200 households expressed interest in our trial in phase 1, however the majority of these were deemed ineligible or were unresponsive and thus excluded from our recruitment process. 57 properties were identified as ECO eligible with open fires. Of these 60% were eligible via the standard ECO eligibility, 37% via ECO flex and 4% via social housing declarations. However, 33 were deemed not suitable upon property visit and other households withdrew from the trial before the monitoring equipment could be installed or were unresponsive once eligibility had been confirmed. In total, 28 homes (10%) had monitoring equipment installed in Winter 2020/21. However, 3 households withdrew from the process during the trial due to covid-19 and property renovations.

[iv] https://www.bre.co.uk/filelibrary/SAP/2016/BRE-report-on-chimney-airflow.pdf

There are various recruitment challenges that we have faced. For example, we have found that COVID-19 has impacted installations in some cases with households self-isolating, recruiting households through the ECO flex route proved to be a longer process than expected, particularly in the lead up to Christmas and some homes upon installation were not suitable.

Our target sample size was 119 properties. As a result, Ofgem approved an extension to the project into 2021/22. In phase 1 our recruitment was geographically limited to the Midlands with this extended to cover England to improve the chances of success.

Figure 2 - Target postcodes for recruitment based on chimney density and fuel poverty rates.

The map (right) shows the top 100 target postcodes for recruitment based on the suitability of the building stock and households (presence of chimneys and vulnerability to fuel poverty). However, we also recruited based on household type and using social media algorithms.

Our second phase of recruitment commenced in April 2021 for the winter period of 2021-22. Our recruitment survey was adjusted to require images of the fireplace to better assess eligibility from a technical perspective prior to property visits.

During this phase we engaged 'gatekeepers' that were likely to engage with people who are within the qualifying criteria were contacted. The organisations that were contacted ranged from housing providers, relevant charities, local authorities and retrofit companies who dealt with ECO eligible consumers. The gatekeepers were provided with information about the trial as well as flyers that could be distributed to consumers that had the sign up details. Whilst there was some interest from gate keepers, very few were able to provide active support in regard to recruitment due to resource constraints linked to the impact of COVID-19 and limited availability. Some gatekeepers in energy related charities publicised flyers in their windows, a retrofit company spoke to targeted consumers as well as added information on Chimella on to their standard questions however these contacts provided few leads to follow up. We also ran a series of engagement workshops for local authorities and charities to promote the demonstration action. Gate keepers were offered incentives to refer eligible households to us. This approach was successful but came at an additional cost which was not budgeted for.

In addition to engaging with third parties, we also set up a social media campaign to gain further sign ups. The social media campaign was run through Facebook adverts that targeted areas that are known to have lots of chimneys as well as lower incomes. The cost of paid social media campaigns was additional to the amount originally budgeted for as part of our application.

During the TAP application we were repeatedly encouraged to reduce the cost of delivery and thus remove the incentives for household participation. However, given the challenges associated with recruitment, these were reinstated. This led to a cost over-run for the project.

The qualification criteria were clearly displayed before people entered information into our online survey that was then used to qualify them for the trial. This limited the number of ineligible applications. Once the sign up had been received, the Chimella recruitment team then worked to qualify the person firstly through the income and benefits route via the Department for Work and Pensions (DWP) check, along with the child benefits and Warmer Homes Discount route or if they did not meet those criteria then the recruitment team looked to qualify them via their local authority flex. If they met this criterion, we would contact participants and work with them to ensure that the local authority flex applications were completed, signed and sent off to the local authority for consideration.

We additionally partnered with two ECO intermediaries / installers to recruit households, but this was unsuccessful due to resource constraints within these organisations and the eligibility requirements which limited the pool of potential applicants.

A further 303 households expressed interest in the trial in phase 2. The recruitment team qualified 109 participants for the trial throughout the second recruitment phase. 77 of these participants were qualified via DWP checks to ensure that they met the criteria with a further one qualifying under the ECO child benefit rules. A further three participants were qualified via Housing Associations with the final 27 qualified via local authority flex. Additional households were expected to be eligible but were not qualified via local authority flex or could not provide the relevant documentation / information.

After qualification some of the households dropped out, the reasons ranged from building works that they had started to having blocked off their chimney since signing up or no longer wishing to take part. Covid-19 was also a contributing factor with vulnerable households shielding over the winter period and refusing access. In total, 63 households participated in the second phase of the monitoring trial which took part over the winter of 2021-22.

Sample Statistics

Location of sample properties

The sample includes dwellings from across England, geographically spread out from the south coast all the way up to Newcastle.

Throughout the demonstration action, a total of 82 properties were monitored pre and post installation. The geographic spread of all the properties that had monitoring equipment and Chimellas installed is shown in the graphic below.

Figure 3 - Map of properties in sample

Property types

Our aim was to recruit a sample that was representative of the UK Housing stock, in line with current House Condition Survey assumptions. We sought to also include properties with solid and suspended timber floors as per the TAP request and stated in the Ofgem award.

Archetypes

The sample contains a good range of building types, but is skewed towards terraced houses and has very few flats compared to UK housing stock as shown in figure 6. That is likely to have been partially influenced by Chimella being a product designed for chimneys, as purpose-built flats are less likely to have chimneys in general. Open chimneys are more likely to be found in properties with two or more stories. However, the sample is comparable to the pre-1945 house archetypes (excluding flats) by the English Housing Survey. Up to the 1960s, chimneys were provided on virtually every new house[v].

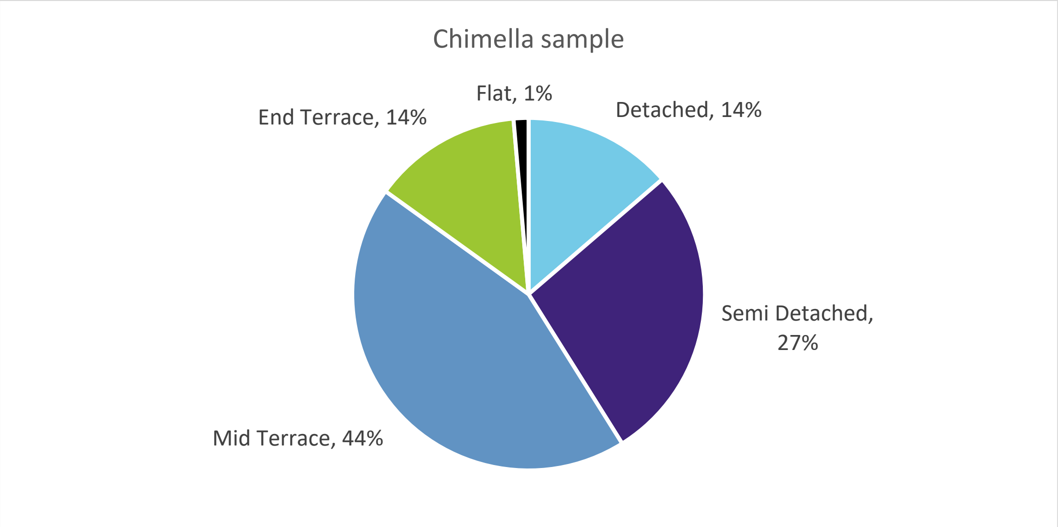

Figure 4: Proportion of property types in Chimella sample

[v] Sharples and Mohammadpourkarbasi (2013) Draught Excluders for Chimneys

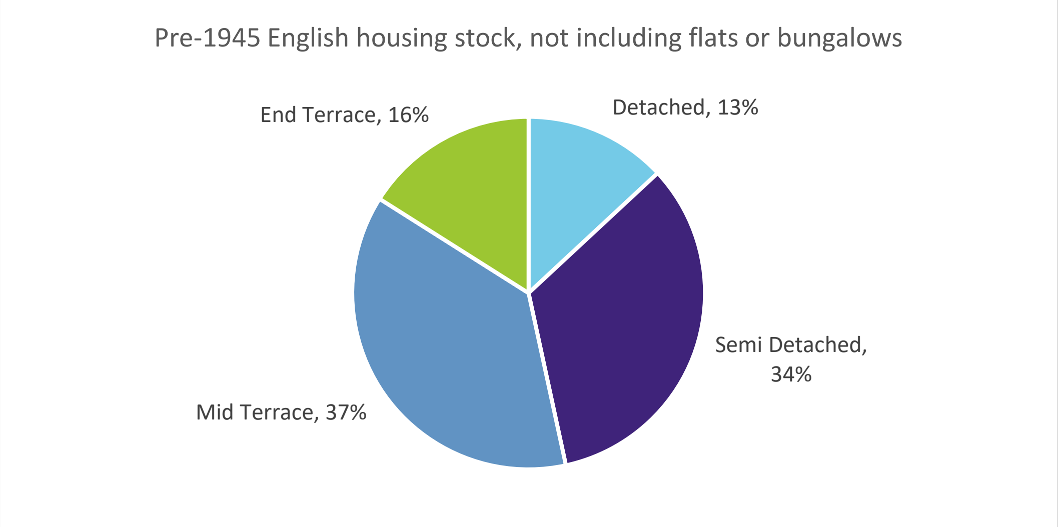

Figure 5: Proportion of pre-1945 house types in England (not including flats or bungalows), using English Housing Survey 2019-20 physical housing stock data[vi]

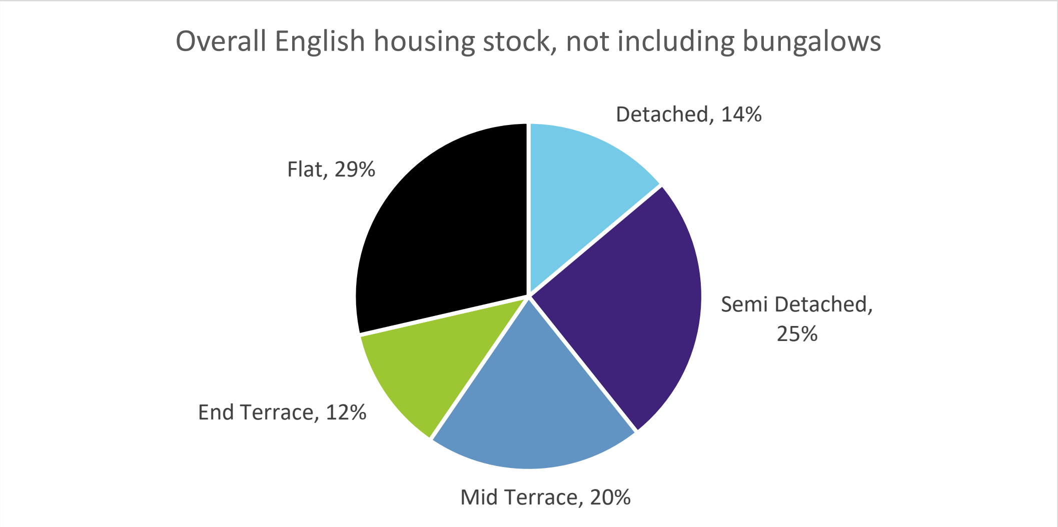

Figure 6: Proportion of property types in England (not including bungalows), using English Housing Survey 2019-20 physical housing stock data[vii]

Floor area

The average floor area across our sample was 106m^2. The distribution is shown below. English Housing Survey data[viii] indicates that the average floor area of pre

[vi] https://beta.ukdataservice.ac.uk/datacatalogue/studies/study?id=8923
[vii] https://beta.ukdataservice.ac.uk/datacatalogue/studies/study?id=8923
[viii] Floor space in English homes - GOV.UK (www.gov.uk)

1945 homes is 99m^2 suggesting that our sample is representative of this age category.

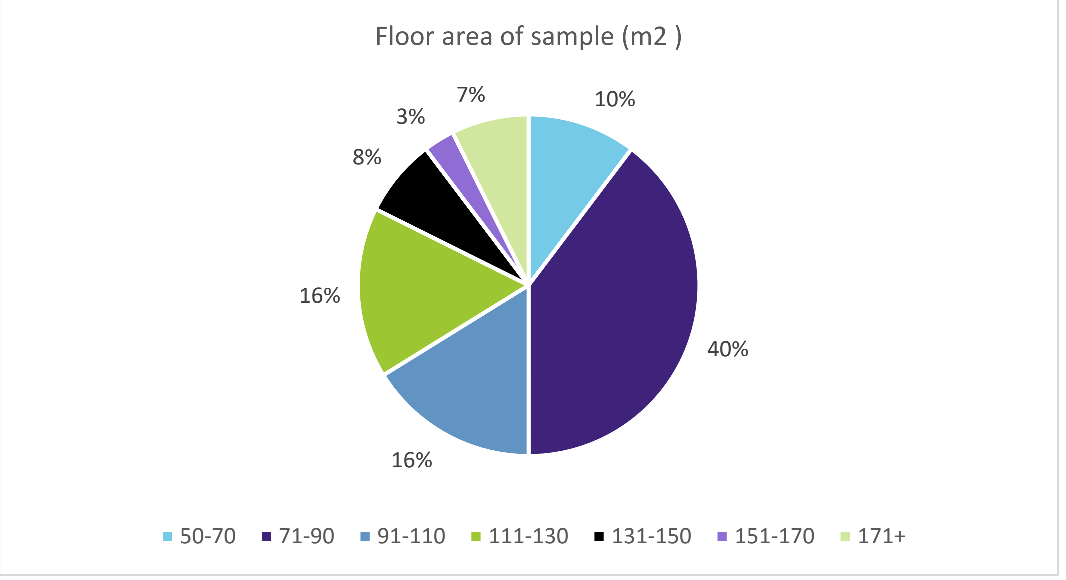

Figure 7 - Floor area of sample (m2)

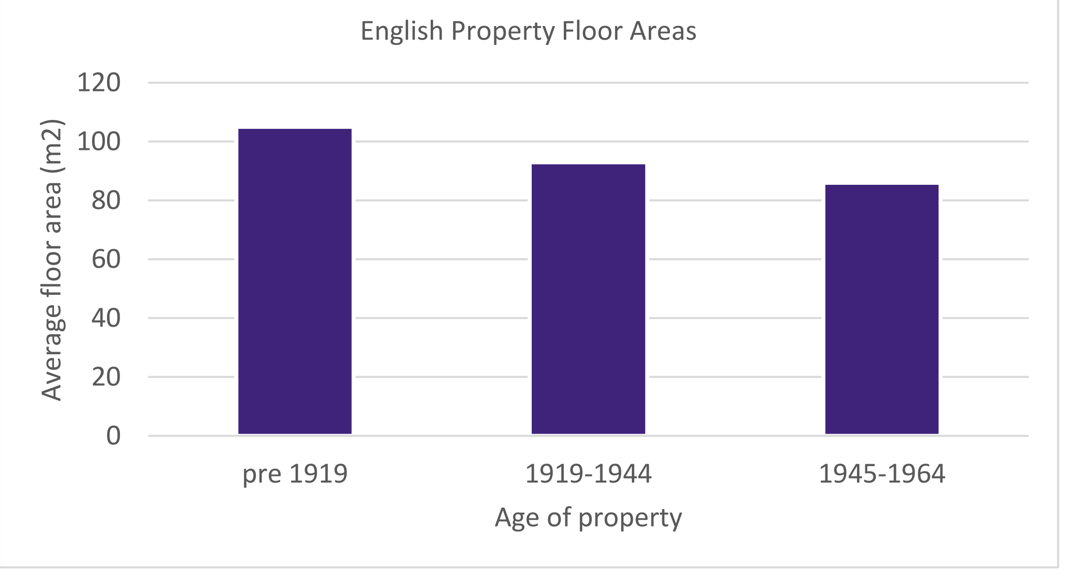

Figure 8 - Property floor areas across English housing stock. Source: English Housing Survey data[ix]

[ix] Floor space in English homes - GOV.UK (www.gov.uk)

Floor construction

Our sample also included a range of floor types. Over a fifth had solid floors throughout which broadly aligns with the English Housing Survey data. Across our sample, 28% had suspended floors and around 30% of properties had a mix of solid and suspended floors. Most homes with suspended timber floors have one room (usually the kitchen) with a solid floor. For 19% of the properties, the floor type could not be determined or was unknown. The higher proportion of non-solid floors in our sample was expected given the age of property targeted.

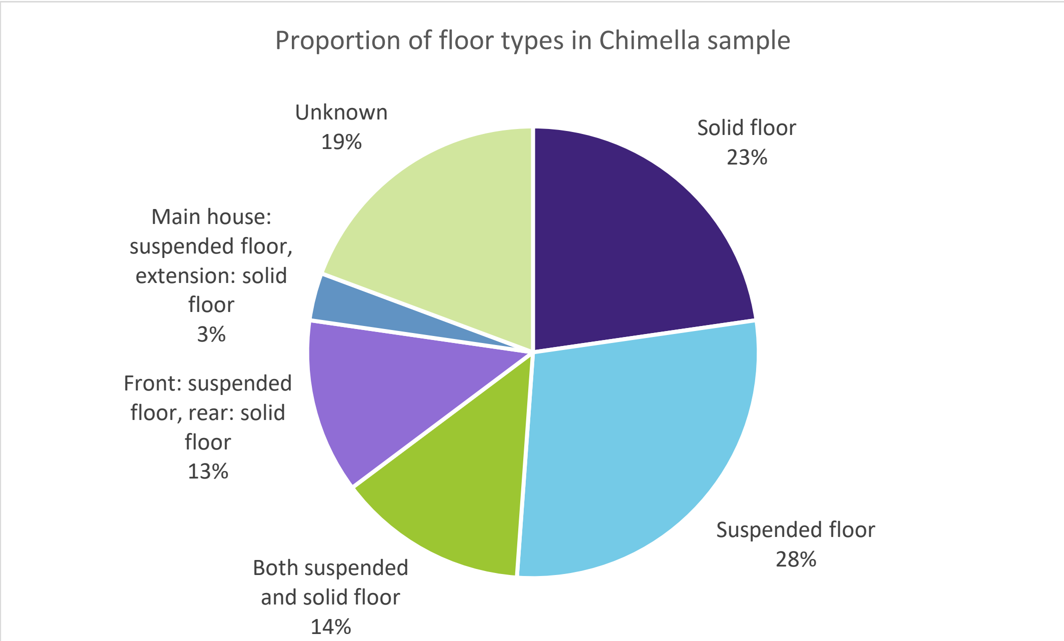

Figure 9: Proportion of properties in Chimella sample with given floor type

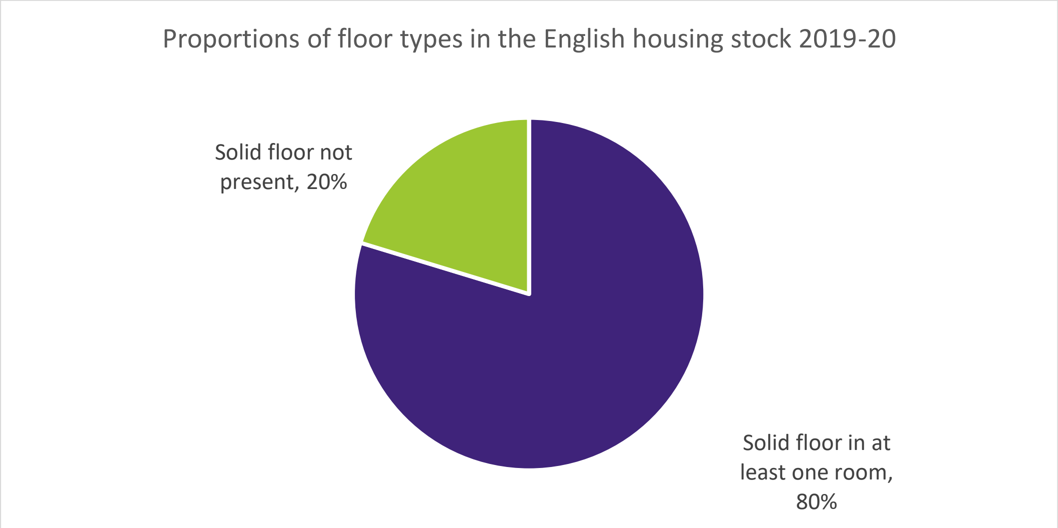

Figure 10: Proportion of properties in England with solid floors present or not, using English Housing Survey 2019-20 data[x]

[x] https://www.gov.uk/government/statistics/english-housing-survey-2019-to-2020-energy

Number of chimneys

The vast majority of dwellings in the sample (61%) only had one open operable chimney, whilst three dwellings had 4 or more chimneys (4%). Our preference when designing the study was to focus on single chimney households with this largely achieved.

In the properties where multiple open chimneys were present, the instruction was for all chimneys to be open during the pre-monitoring phase and then all chimneys treated the same way and sealed with a Chimella for the post-monitoring phase. Ultimately, partly down to the small sub-sample size, no notable correlation was found between the number of chimneys and the change in heat loss. Whilst it was not part of our original methodology, the flue sizes were recorded for information purposes. The chimney flue diameters ranged from 20cm – 60cm. The mean flue diameter was 37cm.

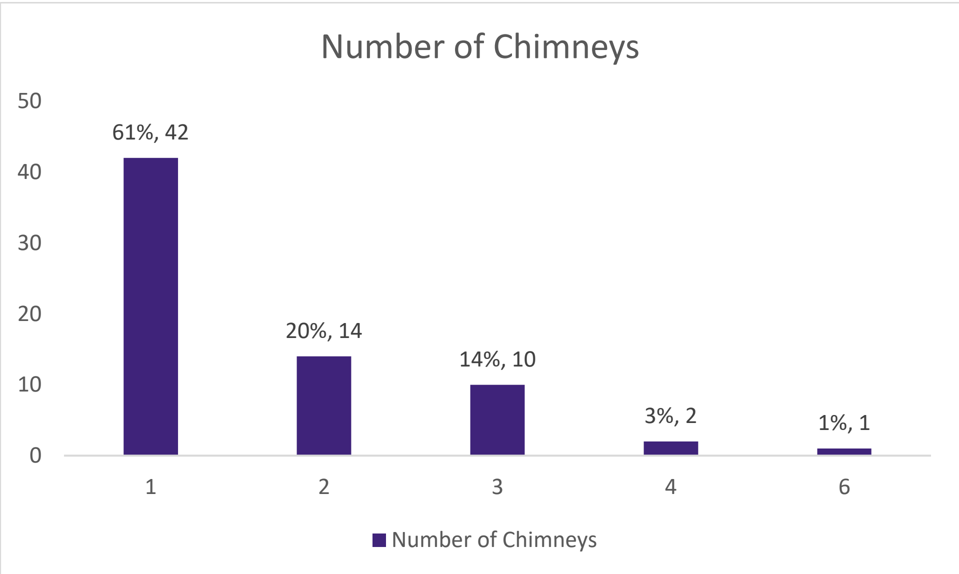

Figure 11 – Number of chimneys per property across the sample (by percentage and count)

As shown by the Figure below, the vast majority of properties were expected to have a single open chimney based on English Housing Survey data. Participants were asked to ensure that there was no loose debris in the chimney prior to participation in the trial, however we did not require householders to sweep their chimneys in advance.

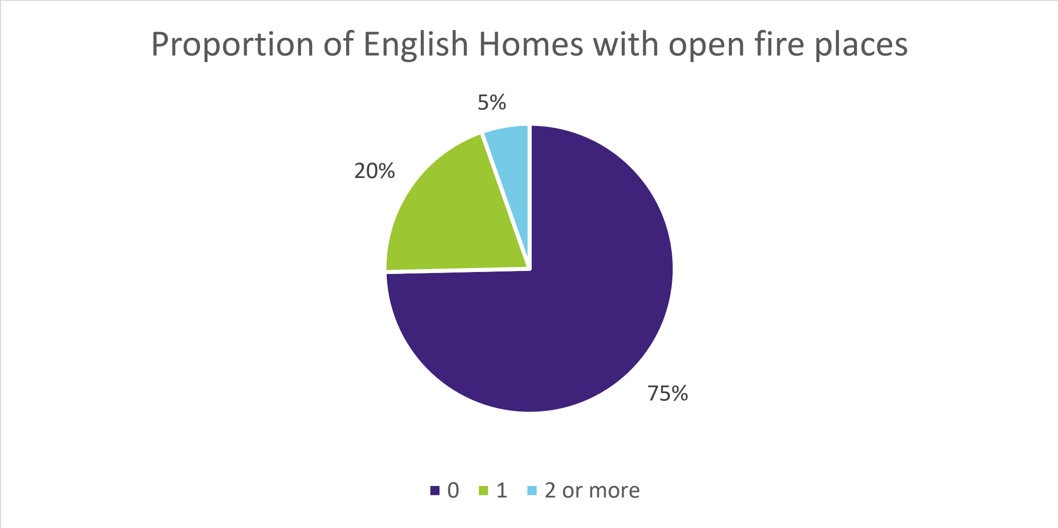

Figure 12 – Proportion of English Homes with Open Fire Places. Source: English Housing Survey (2014-15) Exploration of Energy Efficiency Measures and Condensation[xi]

Number of occupants

On average, the households in our sample consisted of 2-3 people. The most common household size was 2.

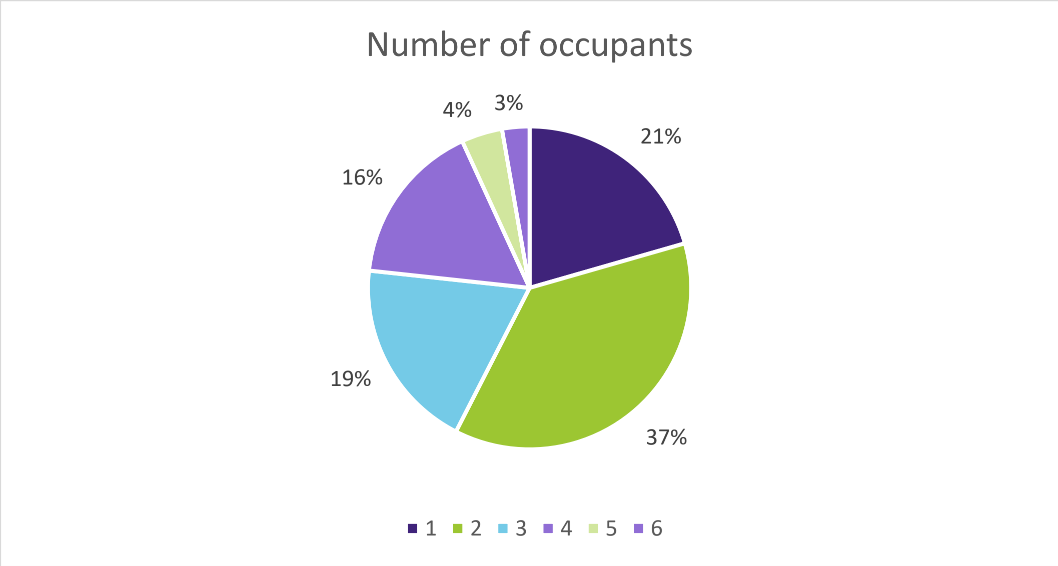

Figure 13 - Number of occupants by household

xi https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/539570/Energy_report.pdf

The below figure shows the proportion of households by number of occupants in the UK. Our sample broadly aligns with the UK population. The low number of single person households in our sample compared to the UK average could be due to the age and archetypes of the properties recruited as there is a low proportion of flats within the demonstration action sample and the size of property tended to larger than the UK average. The underrepresentation of single person households is therefore not surprising and is instead a reflection of the population with open chimneys.

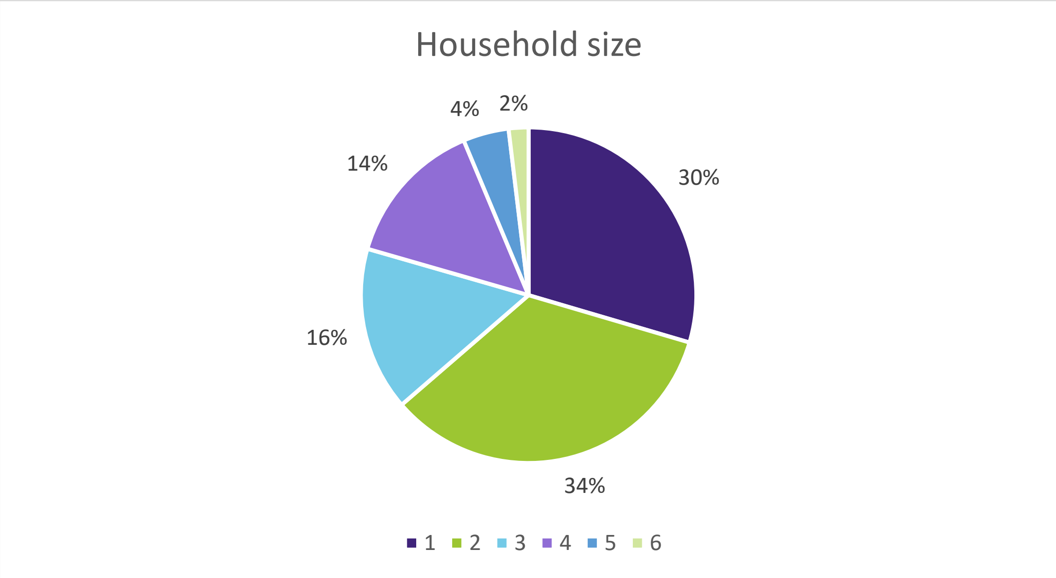

Figure 14 - UK households by size. Source: ONS[xii]

Monitoring Methodology Overview

The aim of the project was to determine the change in both total building heat loss (Heat Transfer Coefficient (HTC)) and airtightness that results from having the Chimella draught excluder umbrella installed in dwellings with chimneys.

The monitoring project was split into two phases. Phase 1 was conducted between October 2020 and March 2021, whilst Phase 2 was conducted between October 2021 and March 2022.

A total of 136 properties were recruited initially across both phases. After excluding dropouts (due to property renovations, covid etc. making the property inaccessible), cancellations (due to self-isolation, personal circumstances, illness etc) and unsuitable properties (due to chimney not being accessible during property visit), this sample size was reduced to 88 dwellings in total that actively

[xii] Families and households - Office for National Statistics (ons.gov.uk)

participated in the monitoring. Further dwellings were filtered out from the data analysis due to data issues, resulting in a data analysis sample of 69 (58%) SmartHTC and 54 (45%) air permeability measurements of the minimum target sample of 119 properties. Information about the implications of the reduced sample size and challenges associated with recruitment and attrition throughout the study is provided in the Limitations section.

The statistical significance of the observed relationship is dependent on the size of the observed change, the variance of the sample and the size of the sample. Therefore, the reduction in the sample size compared to the original targeted size decreased the likelihood of observing a statistically significant change in building performance due to the installation of the Chimella devices.

Table 1 – Overview of measurements performed across sample

Measurement Type	Dwellings Measured	% of Minimum Target Sample	Data Issues	Included in Data Analysis	% of Minimum Target Sample
Airtightness	74	61%	20	54	45%
SmartHTC	87	73%	18	69	58%
Total Measured *	88	74%	-	82	69%

* Some dwellings only had one measurement type performed so there isn't a complete overlap

Air Tightness Testing

The airtightness of each dwelling was measured using either a traditional blower door fan or a low-pressure Pulse device, with results presented at 50 Pa. Pulse is a low-pressure airtightness testing method, air is compressed into an air receiver and then released in a series of short pulses of air. The airtightness is calculated based on the pressure response in the building to the release of air.

During Phase 1, there were only 6 valid pre and post intervention results using the Pulse Test. It is believed that this is due to the property sample being too leaky / inefficient. Whilst higher pressurisation was achieved with the Chimella installed, the number of valid results meant that the decision was made to transition to using blower door fan testing for phase 2.

In all instances, tests were carried out by certified airtightness testers both with and without the Chimella umbrella installed. Each test on the same day, within approximately 20 minutes of each other. Firstly, Chimella installed (as per the HTC measurement period), then a second time with the Chimella removed.

Table 2 - Air tightness methods deployed

Method	Make / Model	Serial No.	Calibration Dates
Blower Door Fan	Minneapolis Model 4 / DG700 Minneapolis Model 3 / DG700 Retrotec 3000 / DM32 Minneapolis Model 3 / DG700	CE1636 / 6369.4.700 9653 / 10375.6.700 PH200150 / 402516 15375 / 7402	27/01/2022 / 26/01/2022 14/09/2021 / 14/09/2021 14/09/2021 / 21/09/2021 08/06/2021 / 07/06/2021
Low-Pressure Pulse	Pulse 2.0 - 38.9L Twin air receiver system	AR1: 2001003 AR2: 2001005 Control: 2001003 Comp: 3001033	19/03/2021 valid for 24 months

The majority of properties in our study had single chimneys, however for those with multiple, all chimneys in the property were however sealed using a Chimella device. This approach was agreed by the Ofgem Technical Assurance Panel in recognition that if only a single chimney were sealed and others are left open, the others will work harder to draw more air which would cancel out any benefit of having the Chimella installed, and the results would have been skewed.

SmartHTC Monitoring

The outputs are the 'Heat Transfer Coefficient' and 'Heat Loss Parameter'. The Heat Transfer Coefficient (HTC) is a measure of the overall rate of heat loss from a property, with units of Watts per Kelvin, a higher HTC means more heat loss and hence worse thermal performance. The HTC is not normalised by any measure of the size of a building, so a large building would typically have a larger HTC, to allow comparison between building the Heat Loss Parameter (HLP) is used, it is calculated by dividing the HTC by the total floor area of the building.

The Heat Transfer Coefficient (HTC) was monitored for a minimum 3-week period both prior to having the Chimella installed (referred to as the pre-period) and afterwards (referred to as the post-period) to accurately determine the effect that the device has on whole house heat loss, due to a predicted decrease in infiltration losses as a result of blocking up any chimneys.

Measurement Data

SmartHTC requires measurements of internal temperature, external weather and electricity/gas consumption to calculate an HTC. The following equipment and data collection methods were used to source these measurements.

Table 3 - Measurement data collected

Measurement	Collection Method / Equipment	When / Logging Frequency
Internal temperatures	Elitech RC-4HC data logger	10 minutes
External temperature	Sourced from weatherbit.io	Hourly
Solar irradiance	Sourced from weatherbit.io	Hourly
Energy consumption	Manual meter readings collected by assessor	At start & end of each pre-/post-period

The original intention was that energy consumption data was to be collected via smart meters in the homes in order to provide half hourly interval energy consumption data, however with the challenges around recruitment, the smart meter criteria was dropped as this was deemed a limiting factor to our target population, with total gas and electricity energy consumption recorded for the pre and post period only. During phase 1, it was evident that the requirement for homes to have smart meters was restricting the eligible population substantially.

Air Tightness Data Issues

Of the 74 dwellings where airtightness testing was attempted, there were 17 houses affected by an issue with the testing equipment, which had a damaged room pressure sensor that was not detected until several tests had been carried out, and 3 in which the chimneys were unstable with lots of loose debris and hence impractical for testing.

SmartHTC Data Issues

Of the 87 dwellings where SmartHTC was installed, it was not possible to determine the change in HTC in 16 of them due to data collection issues preventing either the pre-, post-period or both from being calculated. Additionally, 2 further dwellings were excluded from the data analysis due to having an insufficient internal-external temperature difference. This brought the total number of dwellings with complete SmartHTC datasets to 69.

The reasons for the data collection issues varied. One dwelling had a new boiler installed at some point during the trial meaning the seasonal efficiency of the boiler would have changed. Meter reading problems generally occurred with Secure Liberty 100 smart meters where the monthly consumption reading had been incorrectly taken instead of the total consumption, and in one case the gas meter was changed during the monitoring with no final meter reading available for the meter that was removed.

At least two dwellings had solar PV installed during the trial, resulting in 3 in total being excluded due to failure to capture the generation and export-to-grid meter readings correctly. Lastly, a further 3 dwellings were excluded due to having either oil/LPG boilers or a hybrid heat pump/combi boiler where it was not possible to calculate the heating energy consumption accurately.

Table 4 - Overview of data collection issues and exclusions from the sample

Reason for data collection issues	Frequency
Boiler change	1
Chimella installation issue	2
Meter reading issue	4
Solar PV not accounted for	3
Temperature sensor failure	3
Unsupported boiler type (oil/LPG/hybrid)	3
TOTAL	*16*

Table 5 - Overview of reasons for filtering out from SmartHTC analysis

Reason for filtering out from SmartHTC analysis	Frequency
Excluded due to outlier	1
Mean temperature difference too low	2
TOTAL	*3*

SmartHTC Monitoring Duration

SmartHTC requires a minimum of 3-weeks (21 days) of data to generate a result but as a precautionary measure, the methodology for this project set an objective to measure over a 3 month duration with the product installed and the same 3 months with the product fitted. Best efforts were made to achieve this however the length of each pre- and post-period varied based on location and availability of assessors:

Table 6 - SmartHTC monitoring duration pre and post Chimella installation

Period	Minimum Days	Mean Days	Maximum Days
Pre	26	74	131
Post	23	48	98

The mean temperature and energy monitoring period without the product installed was therefore 10.6 weeks (74 days) and 6.9 weeks (48 days) with the product installed. None of the measurements taken were ever over a period less than what SmartHTC requires for a valid HTC assessment.

SmartHTC Temperature Change

A basic analysis of the mean temperatures during the pre- and post-periods for the 69 SmartHTC dwellings showed a negligible increase of 0.1 °C in mean internal temperatures but also the same increase in mean external temperature. The resulting mean temperature difference (dT) was therefore identical both with and without Chimella installed.

Table 7 – Mean recorded temperature pre and post Chimella installation

Period	Mean Internal Temperatures (°C)	Mean External Temperature (°C)	Mean Temperature Difference (°C)
Pre	18.1	6.6	11.5
Post	18.2	6.7	11.5

SmartHTC Weather Data

For SmartHTC calculations, weather observation data was used to record the external temperature and solar irradiation at each dwelling location on an hourly basis. The data was sourced from an online weather service (weatherbit.io) using the geographically closest weather station.

The table in Annex 1 shows the distance from the geographic centre of each unique postcode location to the weather station used. The mean distance was 10.2 miles, with a maximum distance of 22.3 miles and minimum distance of 1.4 miles.

Data Analysis

Airtightness

There was a mean average reduction (improvement) in the air permeability of 13% across the sample of 54 buildings where measurements were successfully carried out with and without the Chimella installed. In calm conditions, the overall uncertainty of a blower door test is lower than 10% in most cases, according to BS EN ISO 9972:2015.

Table 8 - Mean Air permeability pre and post Chimella installation

	Without Chimella	With Chimella	Change
Mean Air Permeability @50Pa (m^3/m^2h@50Pa)	13.2	11.4	-13%

The air permeability was lower in 52 of 54 houses, in the 2 cases where the measured air permeability was higher with the Chimella installed the increase was within the measurement uncertainty (there was a 2% increase in each case). A paired sample t-test demonstrates that there is a statistically significant difference between the measurements with and without Chimella installed (P-value of 1.4*10-7).

As shown in the Figure below, 18 properties experienced a reduction in air permeability of 15% or more. The highest recorded change in air permeability was 43% (6069) and the lowest was +2% (property ref 6182). The mean change in air permeability in the 19 houses with more than 1 chimney was slightly larger (-14%) than for the 35 with only 1 chimney (-12%).

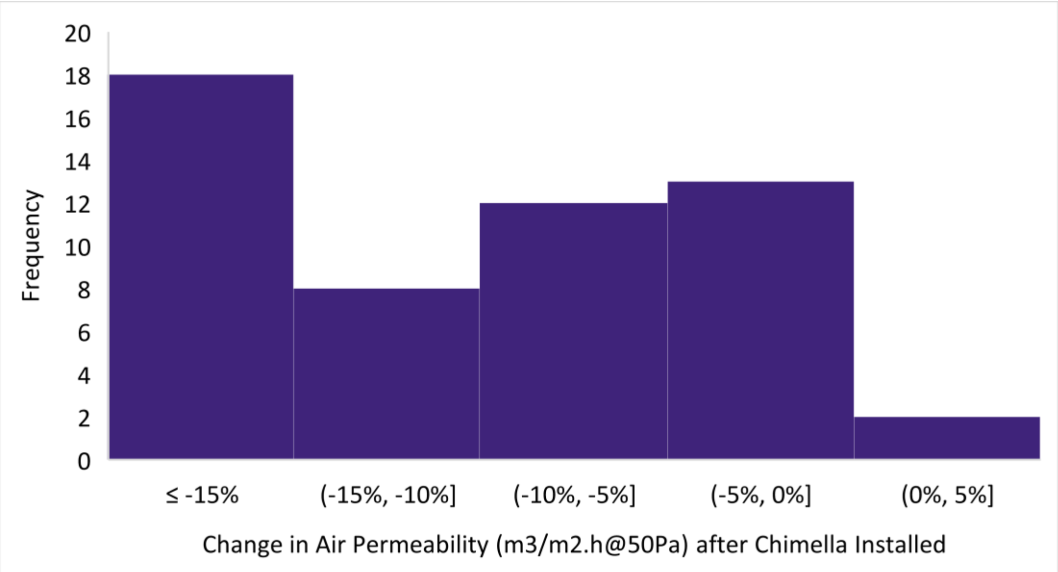

Figure 15 - Change in air permeability with Chimella installed compared to open flue

A BRE study in 2016 which investigated a very small sample of 16 homes in a geographically limited area noted that dwellings with solid floors generally had lower airflows. It was suggested that solid flows could restrict the air available for the chimney. The report acknowledged that the sample was small and further dwellings would need to be monitored to draw conclusions on a robust basis.

The relationship between airtightness and floor construction type was therefore investigated in this study. It is important to note that the small sub-sample sizes were small therefore, it is difficult to conclude with any confidence as to whether these are material differences which might inform the relative effectiveness of sealing up a chimney.

Table 9 – Observed relationship between air tightness and floor construction

Floor Type	Sample	Air permeability without Chimella ($m^3/m^2h@50Pa$)	Mean change in air permeability ($m^3/m^2h@50Pa$) with percentage change
Solid	10	9.7	-2.0 (-22%)
Partially solid	19	16.1	-2.4 (-13%)
Suspended floor	14	13.4	-1.5 (-11%)
Unknown/not recorded	11	10.8	-0.7 (-6%)

The Effect of Airtightness on Heat Loss

To consider the effect of a change of 13% in the air permeability of a dwelling on its heat loss, SAP models (version 2012 9.92) were used. SAP models were created of a mid-terrace, solid-walled house, which was the most common building type in the sample, with a floor area of $92m^2$, which was the median floor area of the sample. To calculate the infiltration heat loss the mean measured air permeability values with and without the Chimella installed were used, $13.2m^3/m^2.h@50Pa$ and $11.4m^3/m^2.h@50Pa$, respectively.

The air permeability was the only variable that was changed between the two models, so that the heat loss by infiltration was the only heat loss source that changed. The calculated effect of the 13% reduction in air permeability was a 2% reduction in the total heat loss for the building. This change in HTC of 2% is rather small in comparison to the typical confidence interval of a SmartHTC measurement, which is c.15-20%, thus highlighting the importance of having a large statistically representative sample of measurements across a range of different house types.

Table 10 - Modelled effect of change in air tightness on heat loss in a property

Heat Loss (W/K)	Without Chimella	With Chimella
Fabric	168	168
Infiltration	42	37

Ventilation	31	31
TOTAL (HTC)	239	234
Estimated change in total heat loss (HTC) after Chimella installed		*-2%*

SmartHTC

To allow a comparison of the heat loss across multiple dwellings of different sizes, the HTC has been converted into a Heat Loss Parameter (HLP, expressed W/m^{2}K). The HLP is the HTC divided by the floor area and produces a normalised value that can be compared between different size buildings.

Across the sample of 69 buildings, where SmartHTC measurements were successfully completed, the mean HLP was 2.2±2.2% lower (i.e. less heat loss) with the Chimella in place. This closely matches the predicted fall in total heat loss of 2% as outlined above.

The mean confidence interval of the SmartHTC measurements was ±25%, this confidence interval is calculated for each measurement, with and without Chimella installed. It is calculated to take into account factors which could influence the accuracy of the HTC measurement, such as sensor accuracy and placement, weather, heating system efficiency and occupancy variables.

For the paired sample analysis adopted in this study, where the thermal performance with and without Chimella installed is compared for the same house, many of these variables are taken into account by the experimental design. This is because several key variables which the individual SmartHTC confidence intervals account for are the same for the with and without Chimella measurements which are compared.

The effect of this paired sample design is that the confidence interval in the observed change in the mean HLP is different than for an individual SmartHTC measurement. For that reason, a 95% confidence interval in the change in the mean HLP was calculated based on the sample characteristics of the dataset, the calculated confidence interval is ±2.2%, so that the observed change in the HLP is a reduction of 2.2±2.2%. The size of the confidence interval relative to the observed change is large because the observed change is relatively small, and the standard deviation of the results is relatively high.

Table 11 - Observed change in mean Heat Loss Parameter pre and post Chimella installation

	Without Chimella	With Chimella	Change
Mean Heat Loss Parameter (W/m^{2}K)	2.55	2.50	-2.2±2.2%
Standard Deviation	0.65	0.59	

The change in mean HLP with and without the Chimella in place was not statistically significant at a 95% significance level, despite quite a large sample size. This was influenced by the relatively large standard deviation of the HLP measurements (c.25% of the measured HLP), which is likely to be due to the wide variety of house sizes and types in the sample and varying sizes of chimney flue; there was a total range of 1.2 W/m^2K to 4.9 W/m^2K in the HLP measurements across the buildings.

There was also no statistically significant change in the measured HTC for the buildings. As the sample included buildings of very different sizes the standard deviation of the change in HTC was larger compared to the mean change in HTC than for the HLP, making the result less statistically significant.

The statistical significance of the result is dependent on the size of the observed effect, the sample size and the standard deviation of the data. As well as the large standard deviation in the sample already discussed, the relatively small observed change in mean HLP is important to the lack of statistical significance in the results. In order to demonstrate a statistically significant change of this magnitude, a large sample size would be required. For the mean and standard deviation in the change in HLP in this study a sample size of 74 would be required to observe a statistically significant change in the HLP. If a more homogeneous sample was chosen, likely leading to a lower standard deviation in the observed change in HLP, then a statistically significant relationship would also have been more likely. However, the study sought to analyse a sample of properties that was representative of the English Housing Stock as far as reasonably practicable and thus a variety of properties and locations were selected.

One of the potential reasons for the high standard deviation in HTC could be the differences in flue diameter across the sample. Whilst it was not part of our original methodology, the flue sizes were recorded for information purposes. The chimney flue diameters ranged from 20cm – 60cm. The mean flue diameter was 37cm. Other factors not recorded that could have influenced this could be flue length, fireplace opening size, presence of debris and existing obstructions in the flue, position of flue opening in the home, etc.

The box whisker plot below shows that the HLP samples with and without a Chimella installed had similar results, but with a lower mean HLP and interquartile range with the Chimella installed. A regression of the measured HLP with and without a Chimella also shows a 3% improvement in the HLP with the Chimella installed, the similarity of the observed difference in total heat loss rate to the predicted value gives additional confidence in the results, despite the difference in the datasets not being statistically significant at a 95% level.

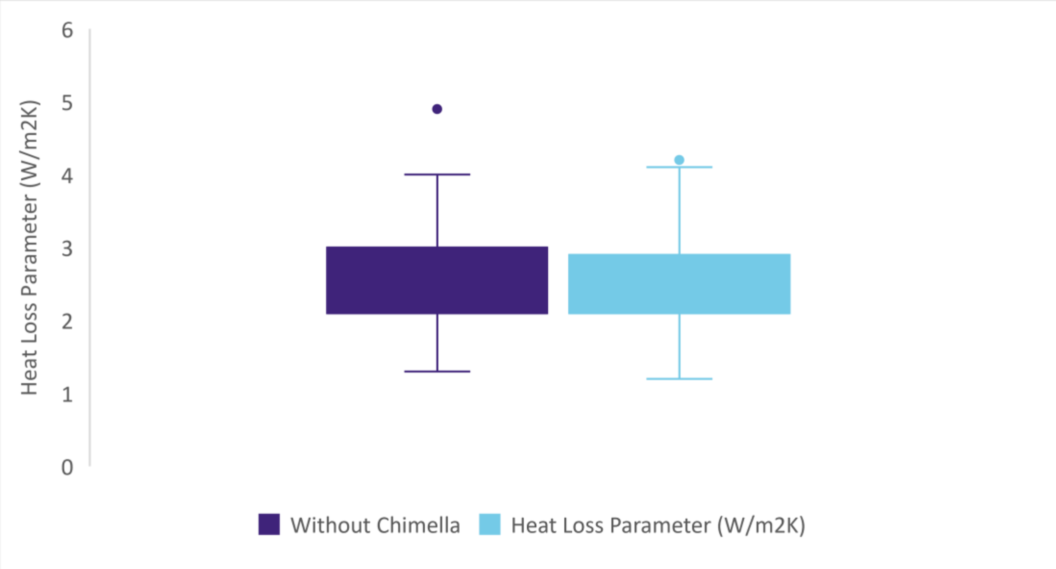

Figure 16 - Box whisker plot for the sample with and without a Chimella installed

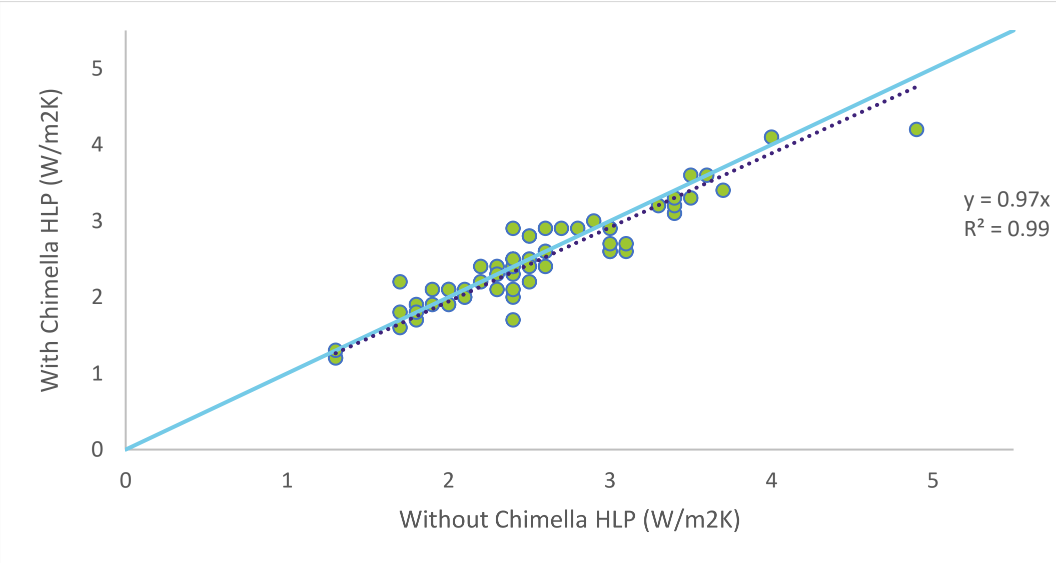

Figure 17 - Regression of the measured HLP with and without a Chimella installed

Fuel Bill Savings

A reduction in heat loss rate means that less energy is required to maintain a house at a comfortable internal temperature. The size of the energy saving is dependent on the reduction in heat loss but may also be influenced by the external weather and the behaviour of the occupants.

In order to calculate a representative energy saving for a Chimella, the same SAP model which was used to predict the expected change in heat loss rate for a given change in air permeability was used. This was thought to be reasonable as the observed reduction in HLP in the field trial was approximately equivalent to the predicted reduction in heat loss of 2%. This SAP model is for a 92m^2, mid-terraced house with an HTC of 239W/K and savings were calculated based on the mean reduction in measured HTC/HLP of -2.2%, equating to an HTC of 234W/K with Chimella installed.

Within the SAP model, energy costs are impacted by the space heat demand but also the responsiveness of the heating system. Within SAP, a higher space heating demand is assigned to a home with electric storage heaters than a more responsive heating system, like direct electric or gas, because their lower responsiveness means that some heat is wasted by being emitted outside of the desired heating hours. In turn this means that the mean internal temperature per day is higher for storage heaters, due to the extra heating outside of demanded hours, which leads to more heat loss and energy demand and relatively slightly higher energy savings.

It has been assumed that the property's heating is provided by a central heating system with a post-1998 combi boiler, gas central heating was by far the most common in the field trial and is the most commonly used heating type across in the UK generally. However, a less efficient heating system or different fuel type could impact fuel bills savings.

The average internal temperature within our sample was 18 degrees, however, as is the SAP convention, the model assumes a standardised occupancy, heating pattern and set point temperatures. The building is also modelled as being located in the midlands of England, as such the fuel bill saving would be higher for colder regions and lower for warmer regions.

- For gas central heating, the estimated fuel bill saving is £11.66/year(±100%), based on the SAP10 per unit gas price of 3.64p/kWh or £23.60/year(±100%), based on an average per-unit gas price of 7.37p/kWh (Ofgem Price Cap - April 2022) for our modelled property. As energy prices rise, the fuel bill saving will effectively increase.

- Alternatively, for an electrically heated house with slimline storage heaters with automatic charge control on an Economy-7 tariff, the estimated fuel bill saving would be larger at £42.43/year(±100%) based on the SAP10 low rate tariff of 9.4p/kWh, or £75.11/year(±100%) based on an average price derived from the Ofgem Price Cap for April 2022 for our modelled property due to the higher per-unit cost of energy. This is based on a night-rate that averages 51.7% of the day-rate (average historical 2021 Economy-7 night-rate vs day-rate) and using an average per-unit electricity price of 16.64p/kWh (58.7% of 28.34p/kWh, Ofgem Price Cap - April 2022).

- For peak rate direct electric heating (CoP 1.0), the estimated fuel bill saving is £36.71/year(±100%) based on the SAP 10 standard tariff of 16.49p/kWh, or £63.10/year(±100%) based on an average per-unit electricity price of 28.34p/kWh (Ofgem Price Cap – April 2022).

Predicted savings are given in the tables below for the mean observed improvement in HLP after Chimella installation of 2.2%, the lower 95%confidence interval in HLP improvement of 2.2%-2.2%=0%, and the upper 95% confidence interval in HLP improvement of 2.2%+2.2%=4.4%.

Table 12 - Predicted annual space heating demand and cost for 2.2% improvement in thermal performance

	Energy price (p/kWh)	Without Chimella	With Chimella	Annual Saving	Lifetime Saving
Indicative space heat demand for gas heating		12,217kWh	11,948kWh	269kWh (2.2%)	6,725kWh
Gas central heating cost	3.64p/kWh	£529	£518	£11.66 (2.2%)	£291
	7.37p/kWh	£1,072	£1,048	£23.60 (2.2%)	£590
Economy-7 electric storage heater cost	9.40p/kWh	£1,746	£1,704	£42.43 (2.4%)	£1,061
	16.64p/kWh	£3,092	£3,017	£75.11 (2.4%)	£1,878
Direct electric heating cost (1.0 CoP)	16.49p/kWh	£1,880	£1,844	£36.71 (2.0%)	£918
	28.34p/kWh	£3,231	£3,168	£63.10 (2.0%)	£1,577

Table 13 - Predicted annual space heating demand and cost for 0% (2.2%-2.2% confidence interval) improvement in thermal performance

	Energy price (p/kWh)	Without Chimella	With Chimella	Annual Saving	Lifetime Saving
Space heat demand		12,217kWh	12,217kWh	0	0
	3.64p/kWh	£529	£529	0	0

	Energy price (p/kWh)	Without Chimella	With Chimella	Annual Saving	Lifetime Saving
Gas central heating cost	7.37p/kWh	£1,072	£1,072	0	0
Economy-7 electric storage heater cost	9.40p/kWh	£1,746	£1,746	0	0
	16.64p/kWh	£3,092	£3,092	0	0
Direct electric heating cost (1.0 CoP)	16.49p/kWh	£1,880	£1,880	0	0
	28.34p/kWh	£3,231	£3,231	0	0

Table 14 - Predicted annual space heating demand and cost for 4.4% (2.2%+2.2% confidence interval) improvement in thermal performance

	Energy price (p/kWh)	Without Chimella	With Chimella	Annual Saving	Lifetime Saving
Space heat demand		12,217kWh	11,679kWh	538kWh (4.4%)	13,450kWh
Gas central heating cost	3.64p/kWh	£529	£506	£23.31 (4.4%)	£583
	7.37p/kWh	£1,072	£1,025	£47.20 (4.4%)	£1,180
Economy-7 electric storage heater cost	9.40p/kWh	£1,746	£1,666	£80.79 (4.6%)	£2,020
	16.64p/kWh	£3,092	£2,949	£143.03 (4.6%)	£3,576
Direct electric heating cost (1.0 CoP)	16.49p/kWh	£1,880	£1,802	£78.22 (4.2%)	£1,955
	28.34p/kWh	£3,231	£3,097	£134.43 (4.2%)	£3,361

Based on the above, it is estimated that the payback period for a Chimella could be between 1.2 and 3.2 years at current energy prices and for the mean observed HLP change of -2.2±2.2%. With an expected lifespan of over 25 years[xiii], this product is expected to deliver significant energy savings over its lifespan as presented in the table above for the three primary fuel supply options. It is

[xiii] The Chimella is robust and contains no degradable materials. In our central scenario, we assume a relatively short lifetime of 25 years however it is thought that a Chimella will last much longer.

important to note that the savings may be higher or lower for alternative fuel sources, locations or property types.

Comparison against previous studies

This field trial was a first of a kind for the Chimella product and to our knowledge no demonstration of chimney draught excluders at this scale has been delivered. Historic assessments of the impact of blocking chimneys have taken place in laboratory / controlled settings or have been modelled using computer software.

Whilst a computer simulation or desktop analysis is not a replacement for a field trial it is interesting to compare the observed impact against studies that have been delivered to date. It is important to note that there are many factors that could influence the above results and therefore it was unlikely that the field trial would deliver equivalent savings to those modelled in SAP or in previous studies. Moreover, any previous studies have used different assumptions and thus direct comparisons cannot be drawn.

SAP 2012 modelling undertaken in advance of this study indicated that the addition of an open chimney to a typical property would deliver a 5% increase in total energy consumption. The typical test case property reviewed was a detached house, 112m^2 with Air Permeability 9.5 @50Pa.

The realised reduction in energy consumption is lower than the modelled savings across the two examples above. However, the differences between the scenarios could be explained by the characteristics of the modelled properties not being reflective of the typical property within our sample and the inability to reflect reality due to uncontrollable variables and differences in property characteristics across the sample. Moreover, the SAP analysis assumed the addition of a chimney to a property compared the same property without a chimney rather than the installation of draught proofing and it did not take into consideration different flue sizes, structures or consumer interaction.

Household Diary (Chimella Use)

Household diaries were completed by 87 households. The majority of households (over 90%) did not use their fire whilst the Chimella was installed. Of those that did remove the Chimella 5 households removed it less than 5 times, the remaining three households removed the Chimella 14, 15 and 22 times respectively. The results show that the majority of participants left the Chimella in place throughout the monitoring, suggesting that the effect of the Chimella is likely to be sustained long term.

As the majority of residents left the Chimella in place throughout the monitoring, there was a very small sample of measurements to analyse where the Chimella was temporarily removed, just 7 which have both a completed diary and

SmartHTC measurements. Note that temporary removal of the Chimella during occupancy would not affect the air permeability measurements as these were deliberately undertaken with and without the Chimella in place. The mean change in HLP for those 7 houses was not significantly different from those in which the Chimella was left in place. This suggests that the temporary removal of the Chimella did not affect the impact that it made, and that the households which removed the Chimella more than 10 times continued to realise benefits with improvements in airtightness and reduction in HLP with the Chimella installed.

As described, the sample of participants regularly using their fireplace during the study was small and this analysis is therefore anecdotal rather than statistically significant. This small sample, however, does suggest that the removal and replacement of the Chimella does not impact its performance.

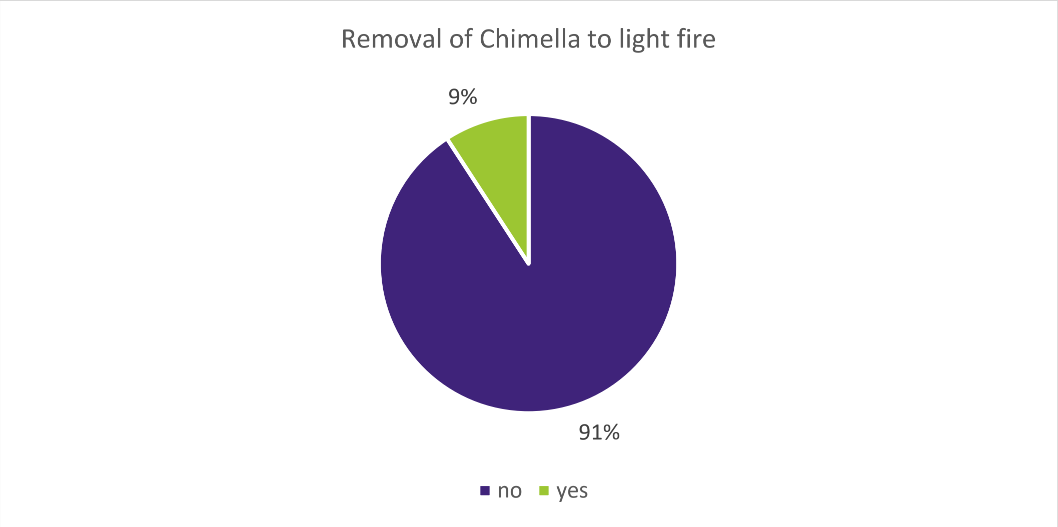

Figure 18 - Proportion of households that removed the Chimella to light a fire during the trial period (data from 88 properties)

Household Survey (consumer feedback)

We received feedback from 65 participants across the trial. Two-thirds of participants noticed a difference following the installation of the Chimella.

To support our conclusions regarding energy bill savings, participants were asked to comment on the warmth and heat retention of the rooms with the Chimella installed, before and after installation. The majority of participants noticed a benefit with 90% stating that they would recommend the Chimella to a friend.

Before the Chimellas were installed, 39% of participants stated that the rooms with the open chimneys were colder than the other rooms in the property and a similar proportion considered the room to be a similar temperature to other rooms in the house. However, post-installation only one of the trial participants felt that the rooms with the Chimella installed were colder.

Whilst our analysis shows that the average room temperature did not increase as a result of the Chimella installation, over two-thirds of participants stated that the rooms with the Chimella installed were warmer than other rooms in the house. This could be linked to perceived improvements in heat retention with 67% of participants reporting that rooms held the heat for longer.

Participants commented that:

- The lounge has a large chimney so that room has previously felt colder than the rest.
- When heating goes off, the rooms did seem to stay warmer for longer.
- Warmer then back to normal.
- Down draught stopped / Less draughty.
- Reduced draught drawing warm air from the hall stairway, through the room and up the chimney.
- No wind howling down the open chimney.
- On walking in the room difference was very noticeable.
- Need to have heating on for less time and stays warmer.
- Less heat loss up the chimney.
- No heat loss up the chimney, no draught down it.
- Warm air not escaping up the chimneys.
- They were sure it saved them money and is so easy to use.

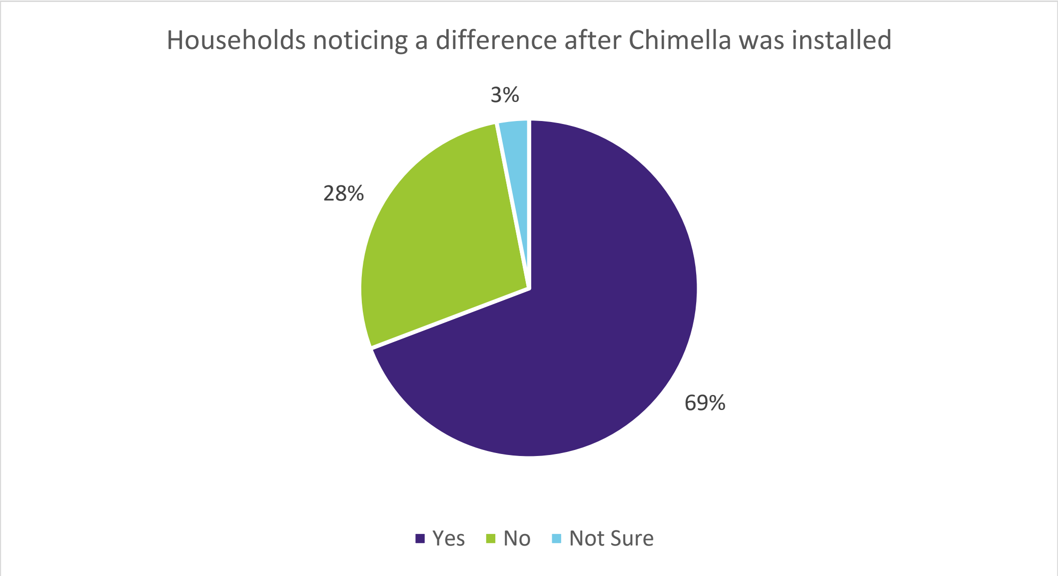

Figure 19 – Participant feedback survey results: impact of Chimella being installed

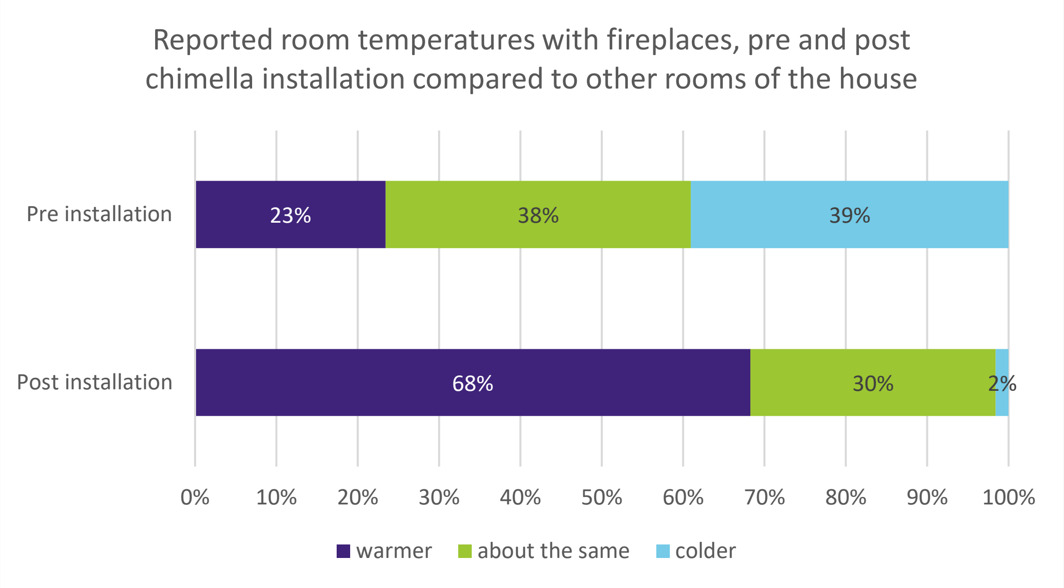

Figure 20 - Participant feedback survey results: impact of Chimella being installed on room temperature

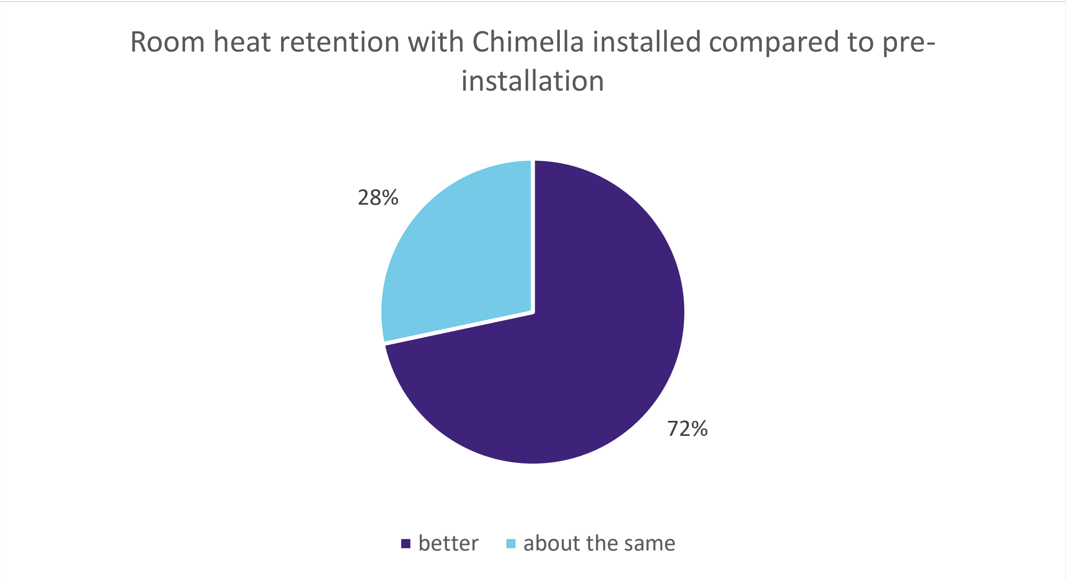

Figure 21 - Participant feedback survey results: impact of Chimella being installed on room heat retention

Limitations of the Study

Although no fundamental changes were made to the trial design, recruitment challenges and property access issues due to Covid-19 led to a series of knock-on effects in terms of what was practical to deliver within the available time frames and budgets. None of which at the expense of the overall robustness of the findings but disclosed here by way of comparison against the original methodology agreed with Ofgem.

Sample size and composition

Overall, the study sought to carry out SmartHTC and air permeability measurements on a minimum sample size of 119 properties. Air permeability was successfully measured pre and post intervention in 54 properties (45% of the target) but nevertheless, a statistically significant change was observed at a 95% confidence interval. Successful valid HLP measurements were carried out on 69 properties pre and post (58% of the target) but here the large standard deviation caused by the wide variety of house sizes and types led to the observed change not being statistically significant at a 95% confidence level. To overcome this uncertainty and overall shortcoming in the sample size and nature, further work has therefore been undertaken with regression analysis and cross-checking using models to verify the observed change.

The reduced sample size compared to the original target had a significant effect on the data analysis, as the final sample was insufficient to demonstrate a statistically significant difference in the HLP of the buildings after the installation of Chimella. The sample is roughly representative of UK houses with chimneys, as a result of this broad representation of building types in a relatively small sample, there are lots of different buildings represented and no large sample of one type. This means that the buildings have quite different levels of thermal performance, which leads to a high standard deviation in the thermal performance of the buildings which further reduced the statistical power in demonstrating the effect of Chimella.

It is recommended that future work consider a larger or more homogenous sample to reduce the variability across the findings and increase the probability of demonstrating a statistically significant change in the mean HLP.

External Factors

The study was undertaken across two winter periods with varying degrees of social distancing restrictions which could impact behaviours within the home. Whilst the study tried to mitigate these factors, this should be considered as energy demand, occupancy could have changed. To our knowledge, none of the properties changed ownership during the study.

As noted in the BRE study into Chimneys and flues in 2016, the variation in results could be linked to a wide range of factors including:

- The airtightness of the room allowing air into and up the chimney; both the leakiness of the dwelling envelope and the opening of the internal door(s) to the rest of the house and the opening of windows to the outside,

- The wind speed and direction and the effect of the roof configuration affecting the airflow around and over the top of the chimney, creating changes in pressure,
- The shape of the chimney at the fireplace opening and on its way up to the roof, including the extent the flue may or may not already be blocked with soot and debris. Note that participants were not asked to sweep / clean the chimney prior to participation.
- Removal of Chimella (although significant usage of the fireplace was considered during the sample selection for data analysis).

Data collection – SmartHTC

The two primary deviations concerning SmartHTC data collection was in respect to energy data collection frequency and the total pre and post monitoring period duration. Neither of these which are expected to have any influence on the accuracy or validity of the final HLP measurements.

Due to challenges around the recruitment of households with smart meters, no half hourly energy data was collected as originally proposed. During phase 1, only around 20% of households confirmed that they had smart meters, the vast majority of households were unable to provide this information or did not have them installed. Our recruitment was not able to find sufficient properties with smart meters to deliver a statistically significant result and the alternative monitoring equipment had been discontinued. The low prevalence of smart meters was highlighted as a concern to the TAP and whilst we had hoped to recruit more households with smart meters, this was not possible. Given budget and time constraints and the need to achieve the recruitment targets, we were unable to collect the half hourly energy consumption. Instead, only total energy consumption for the pre and post period was collected. The impact of this is something that has been investigated and reported to the TAP separately in relation to other Demonstration Action projects, with the mean observed difference in measured HTC results just 0.5% when using 30 minute interval smart meter data vs. start and end meter readings. A more detailed description of the comparison undertaken to derive this mean difference of 0.5% in the calculated SmartHTC result when using total energy consumption rather than half-hourly smart meter data is given in Section 6.1 of the SmartHTC Validation Report, available here:
https://www.buildtestsolutions.com/files/62d7f83708601f8b97c3fca7781399d9fde132f3.pdf.

The original award also sought for the SmartHTC monitoring period to be a minimum of 8 weeks with the product installed and 8 weeks without. Ultimately the project achieved 10.6 weeks pre and 6.9 weeks post but again this is far in excess of the minimum 3 weeks required for a valid SmartHTC measurement and therefore has no bearing on the final measurement results. Indeed, published validation work on SmartHTC has shown the method to be repeatable over multiple back-to-back three week (21 day) sample periods with results for each period within 1%.

Pulse Test

The proposed methodology included deploying both pulse test and blower door tests to assess the air tightness of the properties within the sample. Ultimately the majority of the air tightness testing was carried out using just the blower door fan technique due in part to technical limitations presented by the overall size and leakiness of the buildings in the sample but also the widened geographical spread which made it very challenging to get both sets of kit to surveyors across the country.

Lack of occupancy data

Limited data was collected on the occupancy profiles in the houses studied. To mitigate these issues as much as possible, the sample was large, and the data analysis focussed on measured HLP. Air permeability measurements are a one-off test, and therefore not affected by occupancy, while the SmartHTC methodology is designed to eliminate variations due to occupancy. It is also not thought that occupancy would significantly impact the effectiveness of Chimella as it is a passive measure.

Data collection

COVID-19 disrupted the project throughout phase 1 and 2 with participants and assessors shielding as a result of COVID-19 infection or health concerns. The elongated time period for some properties between monitoring equipment being installed and the Chimella installed was largely attributable to COVID-19 and an inability to access properties. The COVID-19 pandemic is very likely to have also affected occupancy patterns.

Conclusion

This field trial was a first of a kind for the Chimella product and to our knowledge no demonstration of chimney draught excluders at this scale has been delivered in occupied dwellings. The monitoring project was split into two phases covering a large geographic area. Previous studies have been desk based and computer generated or across very small localised samples.

Phase 1 was conducted between October 2020 and March 2021, whilst Phase 2 was conducted between October 2021 and March 2022. Following a challenging recruitment process and attrition through the study, the project resulted in a data analysis sample of 69 (58%) paired (with and without Chimella) SmartHTC measurements and 54 (45%) paired air permeability measurements of the target sample of measurements in 119 properties.

The Chimella reduced energy consumption across our sample. There was a mean average reduction (improvement) in the air permeability of 13% across the sample of 54 buildings where measurements were successfully carried out with and without the Chimella installed. Across the sample of 69 buildings, where SmartHTC measurements were successfully completed, the mean HLP was 2.2±2.2% lower (i.e. less heat loss) with the Chimella in place. A large variation was observed across the sample in terms of HTC measurement. However, the study sought to analyse a sample of properties that was representative of the English Housing Stock as far as reasonably practicable meaning a mixture of properties types were recruited.

This observed change was then modelled in SAP to estimate the fuel bill savings a typical home (a 92m^2, mid-terraced house in the Midlands) could expect to realise with the installation of a Chimella. Two different energy cost scenarios were modelled based on the SAP10 assumptions and the Ofgem price cap.

When modelled using SAP10 figures, the energy bill savings are less than when using the Ofgem price cap due to the lower assumed energy costs. For gas central heating, the estimated fuel bill saving is £11.66/year (±100%), based on the SAP10 per unit gas price of 3.64p/kWh. Whereas, for peak rate direct electric heating (CoP 1.0), the estimated fuel bill saving is higher still at £36.71/year (±100%) based on the SAP10 standard tariff of 16.49p/kWh. It is important to note that current energy prices are higher than this, so savings are likely to be closer to the modelled amounts above.

When modelled using the current Ofgem price cap, for a property using gas central heating, the estimated fuel bill savings were £23.60/year (±100%)[xiv]. Whereas if the property was heated using peak rate direct electric heating (CoP1.0), the estimated fuel bill savings would be £63.10/year (±100%) based on an average per-unit electricity price of 28.34p/kWh (Ofgem Price Cap – April 2022).

The Chimella therefore is expected to have a payback period[xv] of around 3 years for a gas heated property, and around 1 year for direct electric using Ofgem Price Cap April 2022 figures[xvi].

The majority of participants noticed a benefit with 90% stating that they would recommend the Chimella to a friend. Before the Chimella was installed, 39% of participants stated that the rooms with the open chimneys were colder than the other rooms in the property and a similar proportion considered the room to be a

[xiv] based on an average per-unit gas price of 7.37p/kWh (Ofgem Price Cap - April 2022) for our modelled property.

[xv] RRP £74.99 for a standard sized Chimella

[xvi] based on an average per-unit electricity price of 28.34p/kWh (Ofgem Price Cap – April 2022)

similar temperature to other rooms in the house. However, post-installation only one of the trial participants felt that the rooms with the Chimella installed were colder. It was also reported that rooms retained heat better with the Chimella installed. This highlights the thermal comfort benefits that can be realised in addition to the energy bill savings. Participants also noted reductions in wind howling and fallen debris.

As noted throughout this study, there are many factors which can affect the overall energy efficiency of a home further studies should seek a larger and more homogenous sample to confirm the direct impact of blocking a chimney with a chimney draught excluder.

Annex 1 – Weather data

Table 15 - Weather data used by post code

Property			*Weather Station*			
Postcode	Latitude	Longitude	SYNOP Station ID	Latitude	Longitude	Distance (miles)
B63 2BS	52.46	-2.08	35290	52.15	-2.03	21.6
B79 7EE	52.64	-1.7	35350	52.48	-1.69	10.8
BN15 9NE	50.83	-0.33	38760	50.83	-0.28	1.9
BS16 2DH	51.48	-2.54	37243	51.38	-2.72	10
BS16 2HW	51.48	-2.53	37243	51.38	-2.72	10.6
BS16 3JE	51.48	-2.53	37243	51.38	-2.72	10.2
BS16 3RG	51.47	-2.52	37243	51.38	-2.72	10.3
BS16 4AE	51.48	-2.52	37243	51.38	-2.72	10.9
BS2 9UG	51.47	-2.57	37243	51.38	-2.72	8.6
BS23 2QA	51.35	-2.98	37243	51.38	-2.72	11.5
BS3 4LY	51.44	-2.59	37243	51.38	-2.72	6.6
BS4 1PN	51.43	-2.59	37243	51.38	-2.72	6.3
BS4 2DD	51.44	-2.57	37243	51.38	-2.72	7.2
BS4 3LF	51.44	-2.55	37243	51.38	-2.72	7.9
BS4 4EH	51.45	-2.55	37243	51.38	-2.72	8.5
BS5 0DL	51.46	-2.57	37243	51.38	-2.72	8.2
BS5 0TA	51.46	-2.57	37243	51.38	-2.72	8.2
BS5 6BU	51.47	-2.56	37243	51.38	-2.72	8.9
BS5 6EH	51.47	-2.56	37243	51.38	-2.72	9
BS5 6JR	51.47	-2.56	37243	51.38	-2.72	9
BS5 6XG	51.47	-2.57	37243	51.38	-2.72	8.9
BS5 7HZ	51.46	-2.54	37243	51.38	-2.72	9.3
BS5 9AT	51.46	-2.56	37243	51.38	-2.72	8.9
BS6 5LZ	51.47	-2.59	37243	51.38	-2.72	8
BS7 8PR	51.48	-2.59	37243	51.38	-2.72	8.6
BS7 9QY	51.48	-2.58	37243	51.38	-2.72	9.1
BS7 9TN	51.48	-2.57	37243	51.38	-2.72	9.3
CV47 8LZ	52.25	-1.32	35440	52.37	-1.33	8.4
DE15 0DL	52.81	-1.59	34185	52.83	-1.33	11.2
DE4 4EG	53.08	-1.58	33475	53.38	-1.38	22.3
FY4 2ET	53.79	-3.04	33180	53.77	-3.03	1.7

	Property		Weather Station			
Postcode	Latitude	Longitude	SYNOP Station ID	Latitude	Longitude	Distance (miles)
HP1 3DZ	51.76	-0.49	36800	51.81	-0.36	6.3
HP3 0ET	51.72	-0.53	36800	51.81	-0.36	9.5
LE10 3PG	52.52	-1.3	35440	52.37	-1.33	10.7
LE4 2SB	52.69	-1.15	34185	52.83	-1.33	12.5
NE34 0LU	54.97	-1.44	32433	55.03	-1.7	11.3
NG16 2WX	52.99	-1.28	33540	53	-1.25	1.4
NG18 3BY	53.15	-1.17	33540	53	-1.25	10.6
NG31 7HT	52.9	-0.62	33723	52.97	-0.57	4.9
NN1 4ST	52.25	-0.87	35573	52.07	-0.62	16.9
NN4 8UQ	52.23	-0.92	35573	52.07	-0.62	17
NN5 5BU	52.24	-0.92	35573	52.07	-0.62	17.7
PO4 8AR	50.79	-1.07	38720	50.82	-0.92	6.8
PR6 9LB	53.62	-2.61	32145	53.75	-2.88	14.2
PR9 0NB	53.66	-3	32145	53.75	-2.88	7.8
RM8 1PH	51.56	0.14	37683	51.51	0.06	5.4
S12 2UR	53.35	-1.43	33475	53.38	-1.38	2.8
S71 5NR	53.56	-1.43	33475	53.38	-1.38	12.4
SE13 5NH	51.45	0	37683	51.51	0.06	4.3
SG6 4PF	51.99	-0.22	36733	51.87	-0.37	10.8
SR6 7SU	54.95	-1.41	32433	55.03	-1.7	12.7
ST11 9HJ	52.97	-2.07	33300	53.13	-1.98	11.7
ST16 1BH	52.8	-2.13	34145	52.63	-2.3	13.6
ST16 2RH	52.82	-2.12	34145	52.63	-2.3	14.6
ST16 3ES	52.81	-2.12	34145	52.63	-2.3	14.6
ST18 0SD	52.8	-2	34145	52.63	-2.3	17.1
ST3 7PH	52.96	-2.11	33300	53.13	-1.98	13.1
ST5 3LG	52.99	-2.24	33300	53.13	-1.98	14.4
TA6 6AG	51.12	-3	38400	50.87	-3.23	20.3
TF9 2NT	52.86	-2.42	34140	52.8	-2.67	11.3
TN34 2HH	50.87	0.57	38820	50.9	0.32	11.3
TN37 6SE	50.86	0.56	38820	50.9	0.32	10.9
TS12 2RL	54.57	-0.94	32750	54.56	-0.86	3.4
WA11 9BJ	53.46	-2.71	33233	53.33	-2.85	10.5

	Property		*Weather Station*			
Postcode	Latitude	Longitude	SYNOP Station ID	Latitude	Longitude	Distance (miles)
WA16 8JJ	53.31	-2.36	33510	53.37	-2.38	4.2
WN8 7NW	53.59	-2.77	32145	53.75	-2.88	11.8
WR3 7AB	52.21	-2.23	35290	52.15	-2.03	9.2
WS10 9LJ	52.57	-2.03	34145	52.63	-2.3	12.3

Annex 2 – Chimella Installation Images

The Chimella was installed in a variety of houses that were built at different times and had different styles of chimneys. The Chimella fits to the chimney shape blocking it off preventing air movement via the chimney and also catching debris that may fall down the chimney. Below are some images of different chimney styles without the Chimella installed and with the Chimella installed.




CHIMELLA®

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