# HOW HEAT LOSS MEASURING SUPPORTS LOW-CARBON HEATING

BUILD TEST SOLUTIONS

www.buildtestsolutions.com

# Introduction

## Nearly 20% of total UK emissions are linked to heating buildings, according to research by the Government.

23 million homes in the UK have a gas boiler and two-thirds of UK residents planned on using gas central heating to heat their homes in 2023, show figures from Uswitch

If the UK is to reach net zero by 2050, it needs to shift from carbon-intensive fossil fuel-based heating to low-carbon heating solutions as a matter of urgency.

**Low-carbon heating is defined as a solution that delivers comfortable heat input into a home in a way that reduces the amount of carbon dioxide emitted into our atmosphere to the absolute minimum.**

The required shift presents manufacturers, installers and the wider industry with many business opportunities and the potential to unlock significant growth. Heating system installers are particularly well placed and will play a significant role in facilitating the shift to low-carbon heating in homes. They are customer-facing and recommend, specify, install and service heating solutions. By suggesting low-carbon alternatives, they can make a huge difference.

As homeowners' and residents' desire for sustainable homes increases, the business opportunities will only grow for sustainably-minded heating experts. Manufacturers, training providers and innovators can also support installers by helping to ensure the transition to low-carbon heating is as streamlined as possible.

There is never a one-size-fits-all solution when it comes to low-carbon heating. Training, measurement and software innovations are needed to help identify the most suitable heating technology for a given situation. There is also an opportunity for businesses to specialise in specific technology areas, like biomass boilers, heat pumps or direct electric combined with storage, and find their competitive position, route to business growth and expert status.

**The purpose of this guide is to help installers, manufacturers and the wider industry understand what technology and upskilling are required to meet the growing demand for low-carbon heating solutions.**

Split into three sections, the guide covers:

1. Our current situation – deciding on low-carbon heating suitability
2. Installation challenges – making the right technology choice
3. Improving efficiency – getting it right first time

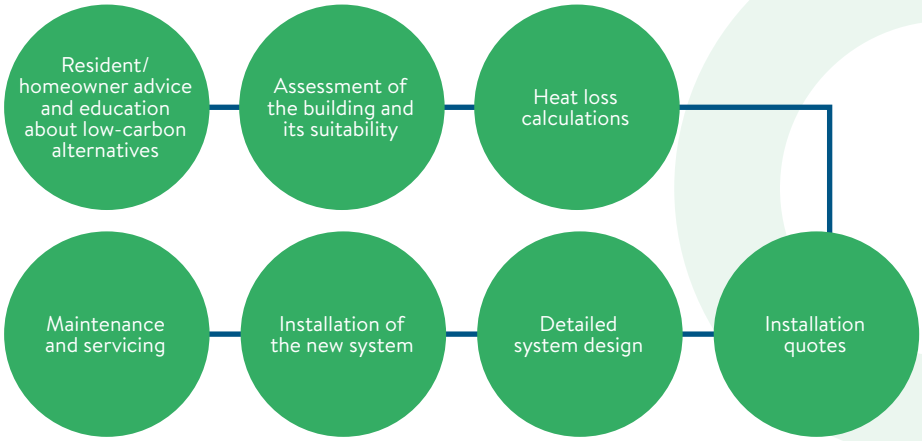
# 1.

# Our current situation – deciding on low-carbon heating suitability

## According to a Department for Energy Security and Net Zero (DESNZ) report on UK greenhouse gas emissions, the carbon emissions for the residential sector reached 56.4 MtC02 in 2022. This accounted for 17.0% of all carbon dioxide emissions in the UK.

Heating system installers are the lifeblood of the industry and are the experts needed to drive the transition from oil and gas boilers to a low-carbon heating solution – a critical way to support the UK's net-zero targets. According to Nesta modelling, the UK needs at least 27,000 qualified engineers by 2028 to meet the government's target of 600,000 heat pump installations.

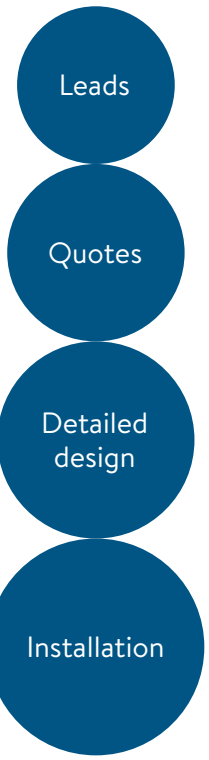
**Heating engineers are central to providing much of the following:**




With all these moving parts and the growing demand for low-carbon solutions, heating installers either need new tools to help improve their efficiency or need support from others in the customer journey to carry out tasks such as initial advice, education and building assessment.

In the pursuit of maximising operational efficiencies, it is imperative that the transition to any low carbon heating solution is well considered. Very rarely is it possible to install a replacement to a conventional gas boiler system without first considering the required heat load or changes to pipework, electrics, emitters, hot water storage or where to site new equipment.

We need to recruit and train more installers and help consumers to understand how the technology options work and the benefits available. This additional education and support increases the chance that customers will feel confident enough to transition to low-carbon heating, and help to **build a pipeline of demand**.



Naturally, interest in low carbon heating solutions is bolstered by Government grants such as the Boiler Upgrade Scheme (BUS), but in order to deliver the increasing numbers of installs, Government and industry at large must generate more interest and enquiries from property owners and occupants. This is ultimately an outreach and education challenge. From here, capacity to deliver will grow and greater efficiencies in installation must follow.

One example of efficiency in installation can be seen in the increasing use of standardised kits of parts, allowing for simpler specification, supply and install.

## Replacing a gas boiler

Commonly, gas boilers are replaced as a reactive 'distress purchase' when a boiler breaks. Unfortunately, this rarely gives enough time to consider alternative low-carbon heating solutions because they require a few more considerations, like peak heat demand and the type of heating emitters and pipework.

Heating installers decide on the type and size of low-carbon heating for each home, which positions them in a unique situation to provide impartial advice about the best low-carbon heating solution for the property.

## To insulate or not to insulate

There are many considerations to make before installing a low-carbon heating solution, including the order in which different solutions are installed.

The main key consideration is peak heat demand and how this can be most efficiently met. While a heat pump system can be designed to meet any peak load, there can be benefits to improving the thermal efficiency of the building with basic insulation and draught stripping measures. This not only reduces the size of the heat pump required but also additional work that might need to be done to rework pipework and radiators.

> **"The most efficient unit of energy is the one that you don't need to make. To make an effective low-carbon home, it is a balancing act between thermal efficiency and meeting the required heat load in the least carbon intensive way possible. Alongside this we can also consider solar photovoltaic (PV) and battery storage options."**
>
> **Luke Smith, managing director at Build Test Solutions**

There is debate about the value of insulating a property before a low-carbon heating solution installation is carried out. The Nesta insulation impact report explained that *"insulation investments should happen alongside a low-carbon heating rollout, and households should not be discouraged from buying a heat pump if their home is poorly insulated."*

By working on multiple methods to reduce carbon emissions, the UK is more likely to reach net zero. These methods include:

- Replacing fossil fuel heating and cooking systems with electric solutions
- Installing smart technology and thermostats and using a smart tariff
- Measuring energy usage
- Investing in solar and energy storage solutions

## Carbon saving can't just rely on installing a low-carbon heating solution - heat loss reduction is needed to make a lasting impact.

With different opinions in the industry, customers need support when making investment decisions. Heating installers need to provide credible and tailored information about a specific property to help residents to make the most low-carbon and effective choice.

# 2.

# Installation challenges – making the right technology choice

## Low-carbon heating solutions can be much more efficient than traditional gas and oil boilers. For example, heat pumps have 300% efficiency compared to energy intake, against around 90% for gas boilers.

Efficiency can significantly decrease if the heating solution is incorrectly sized for the home or if the property has poor thermal performance.

Traditional heat loss calculations, based on visual surveys, are prone to inaccuracy. This can cause critical factors to be hard or impossible to see, such as the:

- Amount of insulation
- Quality of insulation installation
- Airtightness of the building
- Thermal bridging issues

Incorrect estimates can also cause the house to be considered unsuitable for a specific low-carbon heating solution, unnecessarily forcing residents to stick with higher carbon output alternatives.


### The risk of under-sizing

**According to research from Build Test Solutions, heat loss was overestimated in 57% of homes with heat pumps installed and underestimated in 21%.**

Unfortunately, residents are unlikely to raise issues with heating installers or engineers about their low-carbon heating solution being too small until it is too late. For example, the heating solution may be able to easily service hot water demands during


summer, but when winter comes, residents could find themselves unable to heat their homes properly. This can lead to additional heating solutions, like fan heaters, being added to the space. These are far less energy-efficient and much more costly to run, so the benefits of installing a low-carbon solution are lost.

## The impact of oversizing

The financial impact inaccurate sizing can have on a homeowner is significant.

> **In our field trial, it was found that the overestimates in heat loss rate led to an average of 10% increase in the capital cost of a heat pump. The maximum additional cost for one property was £3,100, which can easily become the homeowner's deciding factor when determining whether to invest in a low-carbon heating solution."**
>
> **Richard Jack, technical director at Build Test Solutions**

Unfortunately, if the heating solution is too large for the property, residents won't be able to tell until the energy consumption exceeds their original bills. This may not become a noticeable trend for months. **Oversized heating solutions can cause unnecessary long-term costs, rather than save residents money.**

Manufacturers can support heating engineers to ensure the size of the heating solution they are installing is correct. If they aren't, residents can risk increased bills that compound yearly and increase the possibility that the heating solution is replaced in the future.

Educating residents about how to maximise the efficiency of their low-carbon heating solution, like successfully using a smart thermostat to control the system, is one final step many heating engineers can overlook. It is the difference between successful rollout and ineffective resident use.

# Our research shows the true impact of incorrectly sized low-carbon heating solutions:

## SmartHTC and the Heat Pump Ready Project


Build Test Solutions (BTS), Veritherm and Elmhurst Energy wanted to demonstrate how accurate home heat loss measurement could be a vital tool in understanding peak heat demand, while also supporting heat pump specification, sizing and system design. It carried out a field trial of 56 UK homes with heat pumps installed, in line with BS EN12831 - the method for determining design heat load for heating systems in buildings. Heat load demonstrates the amount of cooling or heating needed in a building to maintain a constant temperature.

### The process:

All BS EN12831 calculations were carried out using the Heat Loss Calculator, a bespoke design from Elmhurst Energy, to create an accurate and realistic result. BTS and Veritherm measured the heat transfer coefficient of the homes, which is also directly compatible with BS EN12831.

BTS carried out the testing over a three-week period while the home was occupied, which is a less disruptive process for residents. Veritherm carried out overnight testing in a vacated house. This involved a short period of heating, followed by a monitored cooling-down period.

## Results:

### 56 houses across the UK were included in the field trial.

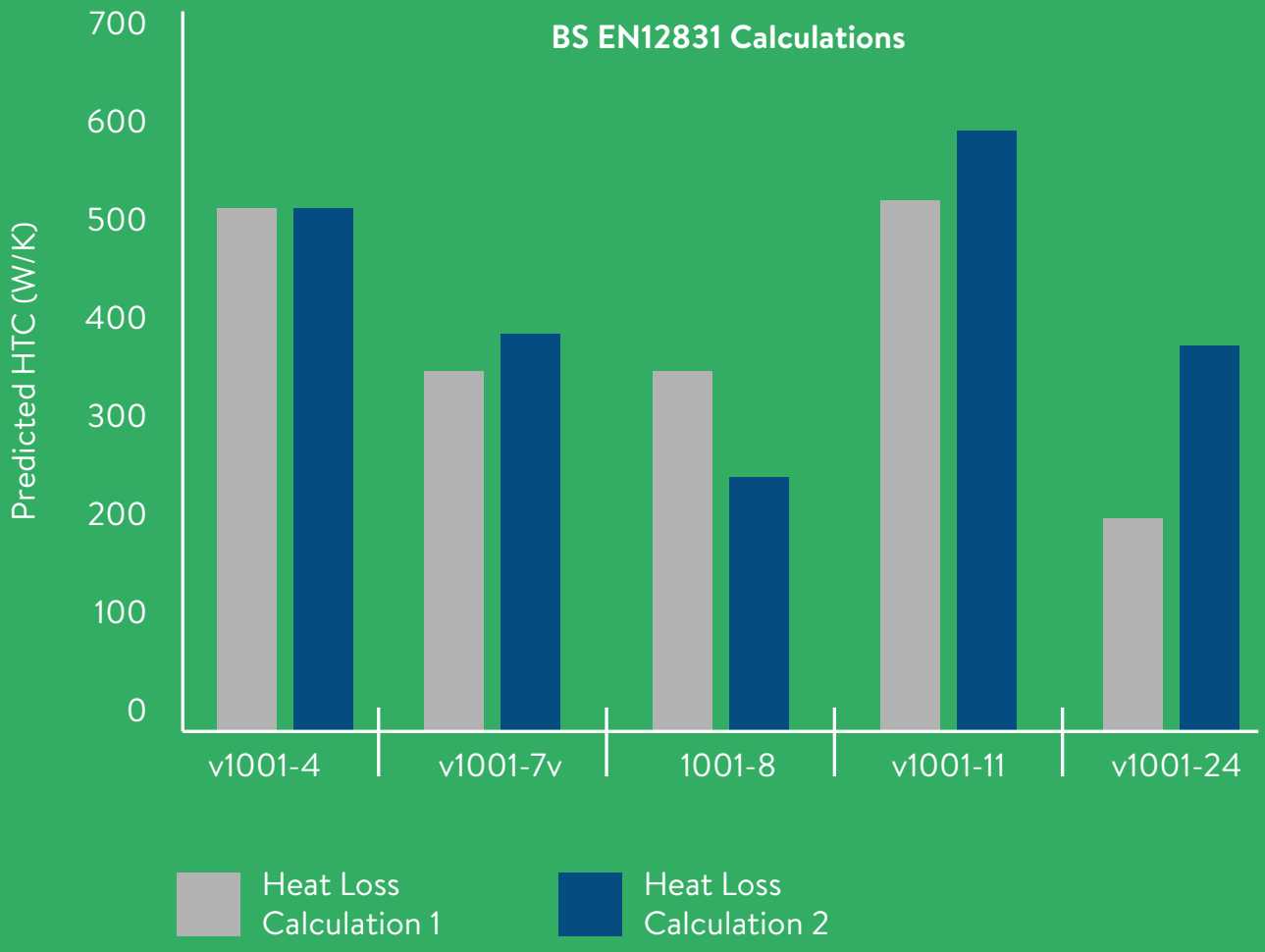
The testing found that traditional BS EN12831 calculations only delivered an accurate assessment of heat loss 30% of the time. The majority of assessments (59%) created an overestimation. A fifth of the measurements were incorrect by more than 50% against the presumed figures. This could significantly impact the size or type of low-carbon heating solution residents are recommended, the eventual efficiency of the system, and the future carbon impact these properties could have.

In a post-testing survey, residents reported that the heat loss measurements didn't cause significant disruption, which shows the limited impact these tests had on their daily lives.

## How do different heat loss calculators compare

As well as comparing measured against calculated results, heating engineers need to be aware of the impact that heat loss calculators have on results.

Currently, there is little control over the 12831 heat loss calculations software used for MCS compliance. This graph shows an average difference between the two calculations of 23%, with a range from 0-48% difference in figures. As a result, it is impossible to compare the different figures, especially around U-values, airtightness and internal and external design temperatures where the differences were most apparent.



# 3.

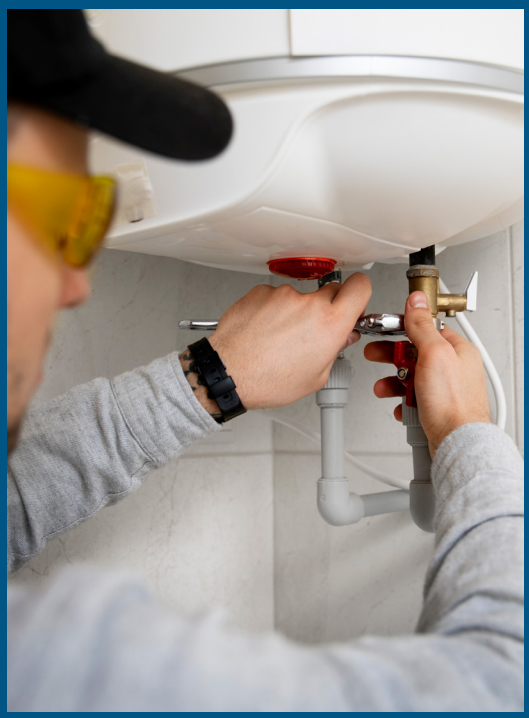
# Improving efficiency – getting it right first time

## The heating industry must focus on getting the heat solution selected and installed right first time and measurement can support this.

### Building measurement

Undertaking a heat loss measurement before installation, using technology like Build Test Solutions' SmartHTC, allows heating installers to make informed decisions based on measured data, rather than assumptions derived from visual inspections or estimates. SmartHTC can also measure the peak heat demand (kWp) of a property, confirming the suitability of a heat pump or alternative low-carbon heating system being installed.

This measuring process is typically less onerous than conducting a full room-by-room heat loss calculation. This can make it a useful tool to engage householders and educate them about the merits of insulation versus heating system size and cost. As a project advances, measurement can also help calibrate the full room-by-room heat loss calculation, as required by MCS design standards.



**Heating installers may consider the following of the customer journey:**

**Step 1:**
Measure heat loss for three weeks during normal occupancy using SmartHTC sensors.

**Step 2:**
Use the data to educate the householder and to inform the design and size of a heating solution.

**Step 3:**
Provide a quotation and agree on a way forward.

**Step 4:**
Use the same measurement data to help heating engineers make more detailed and accurate designs.

**Step 5:**
Finalise the specification, purchase and installation.

**Step 6:**
Complete system commissioning, customer care and support.

## Impacting regulations and advice

The drive for more measurement and the deployment of low-carbon heating is quickly gaining momentum and heating installers need to be aware of it or risk falling behind.

The Future Homes and Building Standards Consultation, which was updated in March 2024, states that new builds are required to adopt high fabric standards, low-carbon heating and must be 'zero carbonready'. The document also suggested a sampling-based approach to measuring and checking the as-built thermal performance of new homes and how this marries up to the specified ventilation and heating systems.

The (Microgeneration Certification Scheme) MCS design standards require the need for room-by-room heat loss calculations to be conducted in accordance with BS12831. The latest version of the MCS-hosted calculator accepts the input of measured whole building heat loss, allowing for better calibration and checking of design models.

Some funding schemes, such as the Great British Insulation Scheme and the ECO4 Grants, are also set to introduce a 'pay for performance' mechanism. Payments will be based on measured fabric performance, further helping to encourage more measurement and testing in the existing housing sector. This also stretches to the social housing industry, which is seeing increasing levels of measurement and verification as a result of Social Housing Decarbonisation Fund requirements and PAS2035.

## Taking data further

Pre-installation testing improves the relationship that heating engineers have with their customers because they can factually back up the recommendations that they are making.

The heating industry is about to transition toward various low-carbon heating solutions. Capacity needs to be increased and measured heat loss is key to this process. Heating engineers can use measurement to optimise the customer journey and improve conversion rates and customer satisfaction. New industry professionals can indirectly support installers with pipeline building, carrying out measurements and educating householders before passing them on to installers.

**Learn more about BTS' heat loss measurement system on the website www.buildtestsolutions.com**

## Contact

For more information about heat loss measurement, please contact Build Test Solutions on:

**enquiries@buildtestsolutions.com**
**www.buildtestsolutions.com**

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