RETROFIT ACADEMY CIC

Module 6 Workbook | **Evaluate and Review**

RETROFIT ACADEMY CIC

Essex County Council

Thank you to everyone for participating in our first Fit for Retrofit programme.

Moat

CHP

BRENTWOOD BOROUGH COUNCIL

norse GROUP

Estuary HOUSING ASSOCIATION LTD

southend onsea BOROUGH COUNCIL

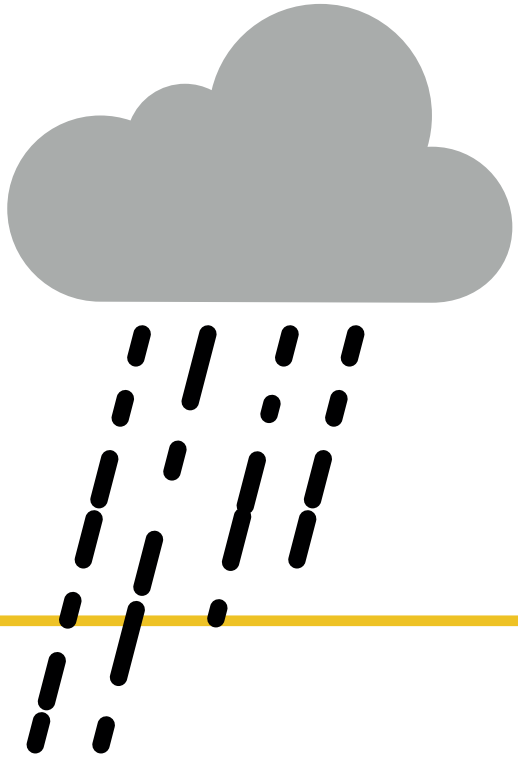
swan somewhere to feel at home

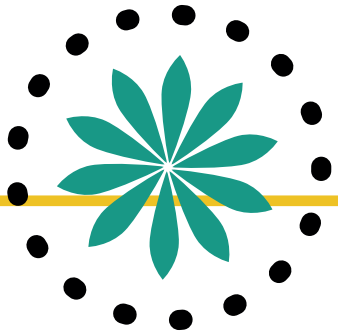
Colchester Borough Homes

Tendring District Council

HM Government

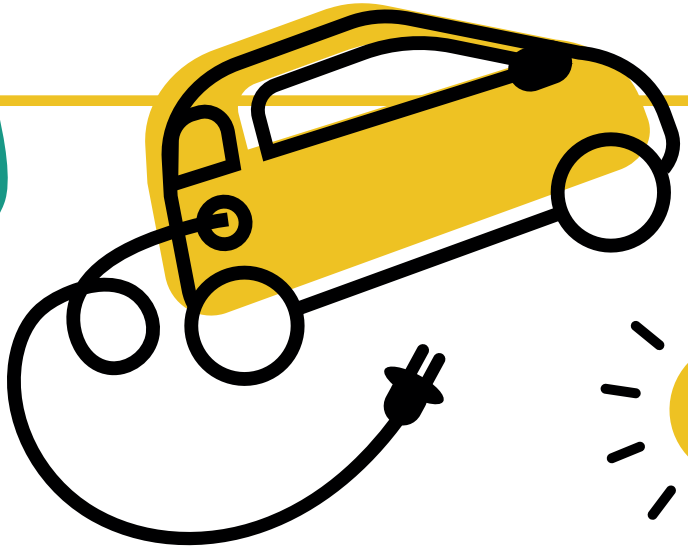
This project is fully funded by the UK Government through the UK Community Renewal Fund





“Our vision is a world where every home is warm, healthy and low carbon. To deliver 27 million retrofits over the next 30 years in the United Kingdom, we need an army of retrofitters in professional, technical and skilled craft roles. Our mission is to enable this.”

David Pierpoint, The Retrofit Academy



6

MODULE 6 | EVALUATE AND REVIEW

Aimed at a range of people from compliance and policy officers to asset managers.

IT IS DESIGNED TO: Bridge the gap between ‘as designed’ and ‘as installed’ and it will help with, writing tender requirements.

- Help you to start with the end in mind – how does this link to your Why
- Explore what you wish you had known
- Understand key metrics and what they will tell you
- Create a feedback framework to learn from mistakes and focus on continuous improvements

Starting Point

Let's Discuss

Part of the Fit for Retrofit programme is a self-reporting diagnostic that enables you to see where your organisation is at the beginning and the end in regard to Retrofit. These are the questions relevant to this module. The whole organisation score will be shared with you in the session and there will be a revisit of the questions in the group coaching session at the end.

Does every section of your organisation know about the retrofit challenge?

Does every section understand its role in the retrofit challenge?

Does every section know the relative priority of retrofit to other activities?

Does every section understand how retrofit fits with other objectives?

Does every section have a budget?

What methods do you use to evaluate, and review retrofit projects?

What have you learned from previous retrofit (or other) projects/works?

How is this information disseminated internally/ externally?

What impacts/ outcomes have affected your organisation with regards to retrofit?

Introduction

Fit for Retrofit is an interactive programme covering the areas required to be 'organisation ready' for Retrofit.

It differs from other training programmes in that it does not just focus on the asset team and their role but enables cross organisational understanding and action. Up to 6 people from an organisation can attend the module that explores the competencies and knowledge required for their area of the business.

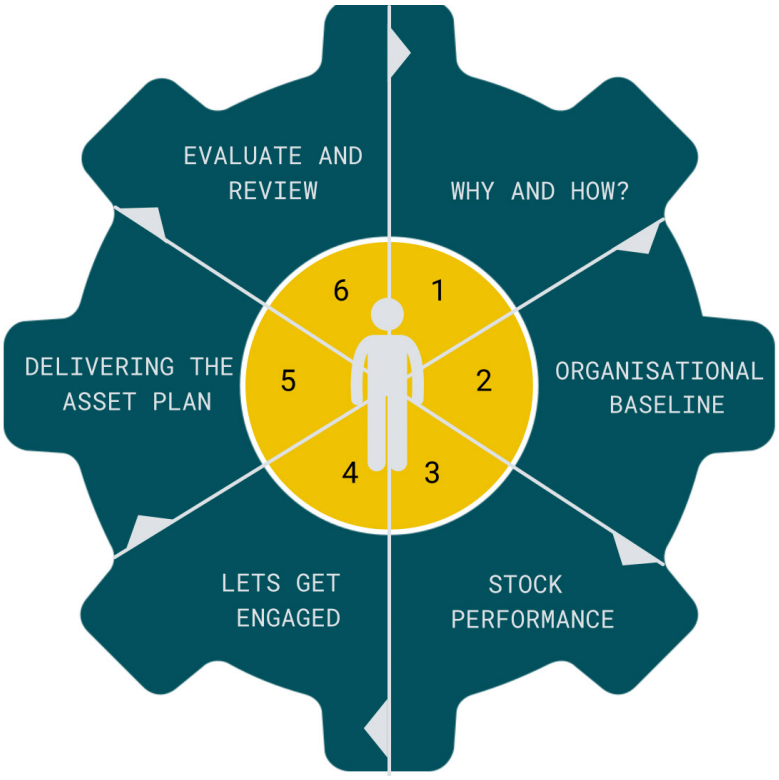
The whole purpose of home retrofit is to improve its performance. Odd then, that the performance was rarely actually asked for and even stranger it was nearly always never checked. So used to we are to asking for 'measures' that we simply assume that they will perform and that performance is always delivered. Of course, we check that the cavity wall insulation installer turned up but did the work save the level of energy we were expecting. What were we expecting?

This evaluate and review module is all about asking questions – from the start of the process to the end.

When it comes down to it, nothing complicated:

- What was wanted?
- What was asked for?
- What was promised?
- What was checked?
- What was the outcome?

The stages to complete a successful retrofit programme

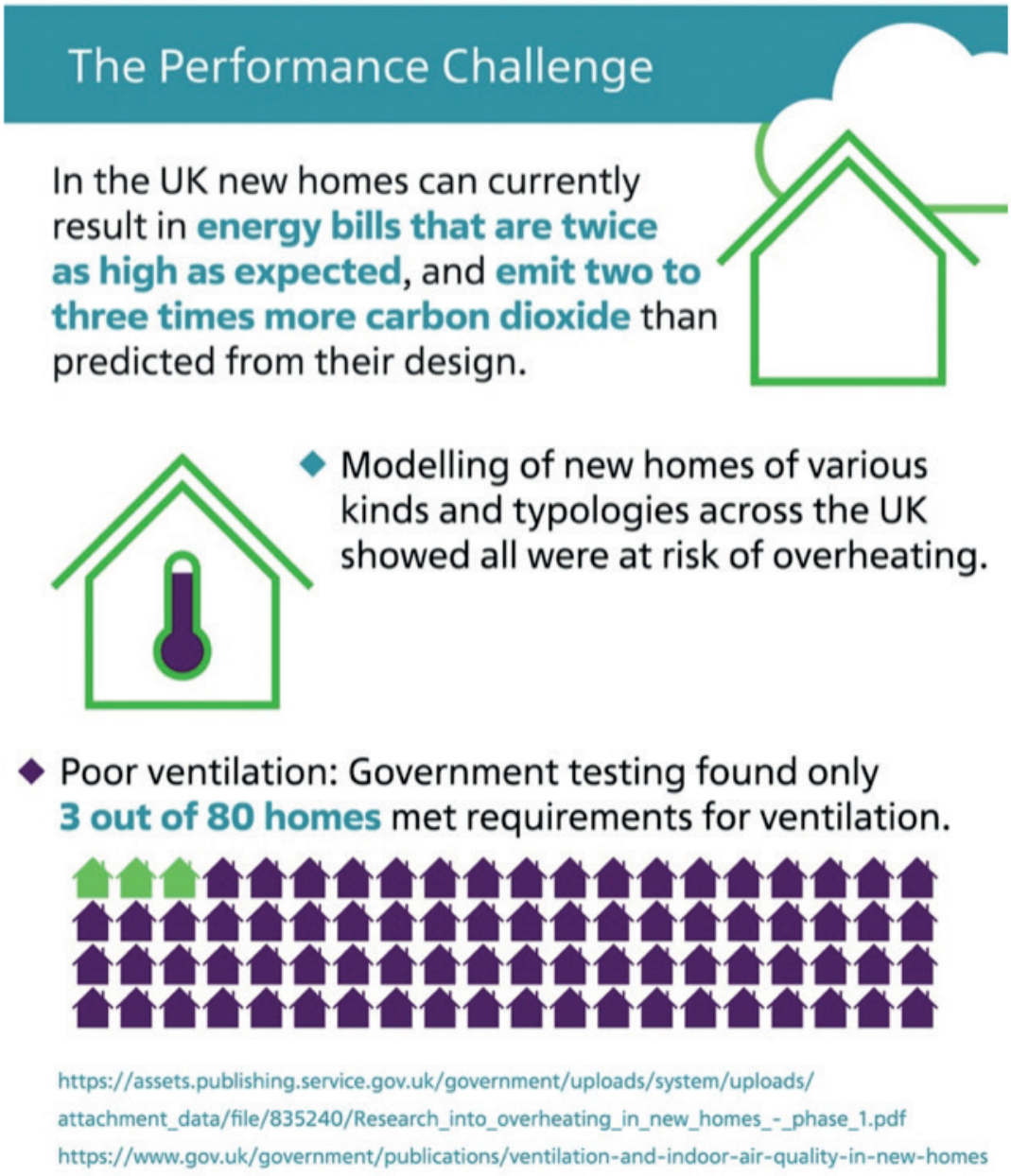


Why review Performance?

It may seem so obvious a question it's not worth asking. However, undertaking performance reviews takes time and costs money.

Some within your organisation may need convincing. So, what is the evidence base for concluding that new and retrofitted homes are underperforming?

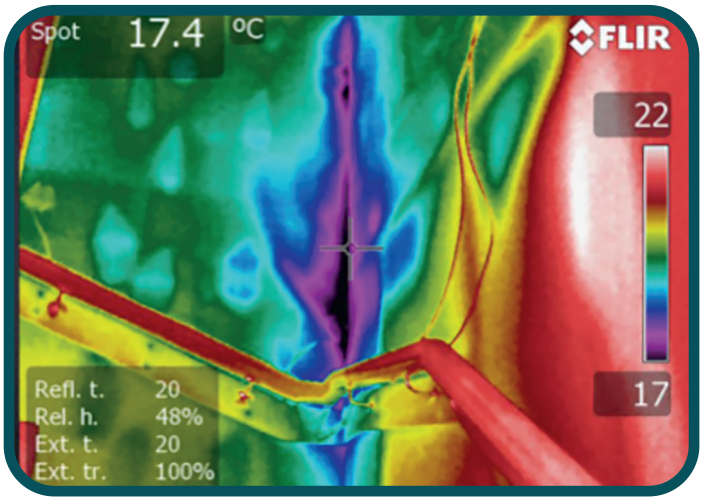
In numbers:



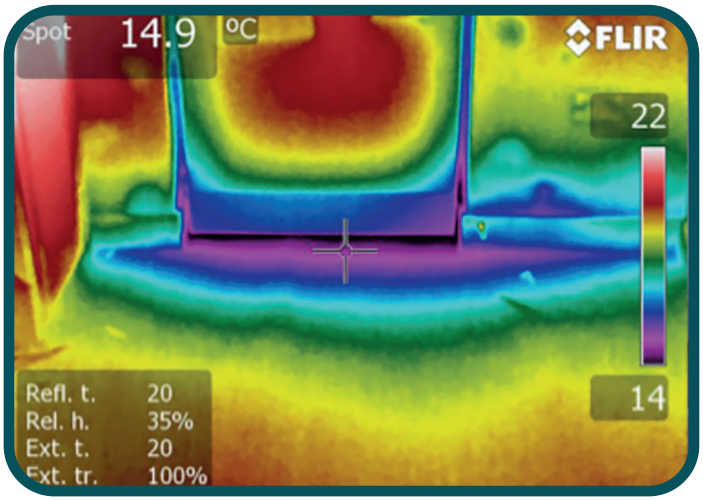
Credit: Building Performance Network

Why review Performance?

In pictures:



High heat loss in the corner of a stair well



High heat loss under a door

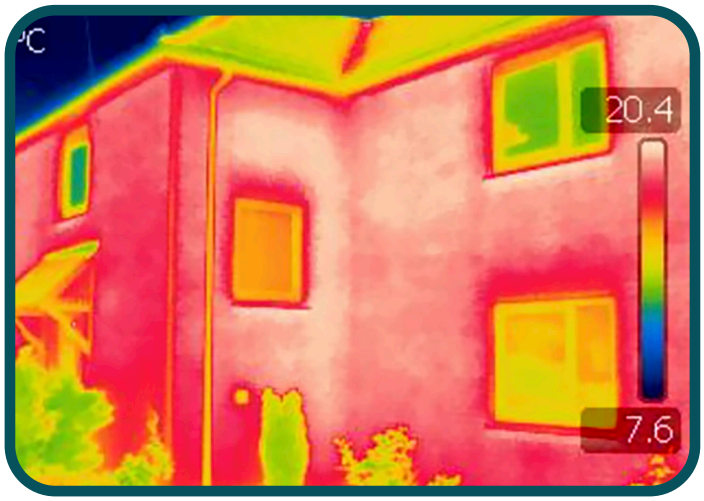
Credit: Building Performance Network “State of the nation” report.

What was found when the tiles were stripped - an insulated loft – really?

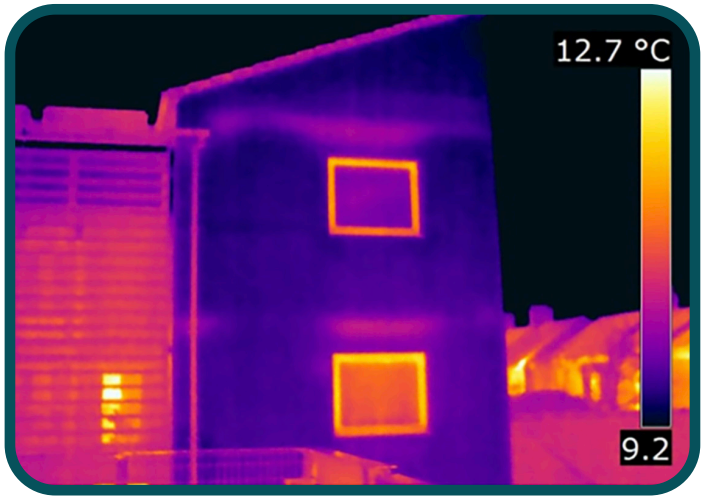
Original insulation installation within the timber frame panel – significant thermal by-pass

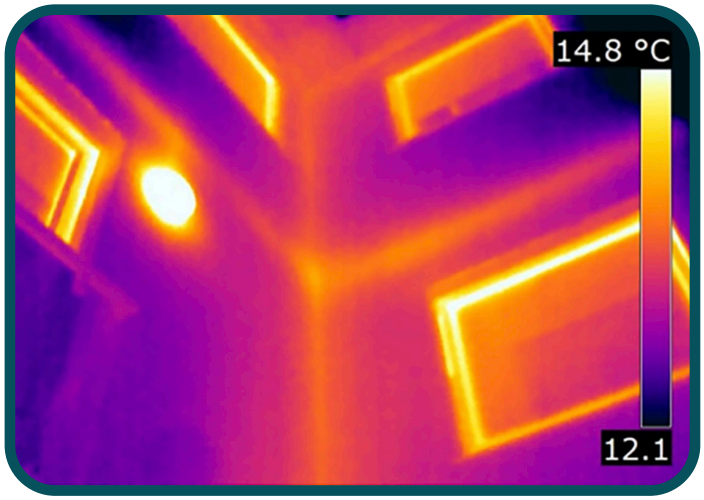
Credit: Melius Homes

An undercroft soffit, below a kitchen - no insulation when built.



Cavity wall insulation – areas of high heat loss suggesting areas of insulation missed





Lines of high heat loss identifying thermal bridges

Why is there underperformance?

In short, clients historically don't procure outcomes.

Typically:

- For new homes, clients procure homes that 'comply' with regulations (and regulations primarily require a theoretical performance)
- For retrofit, clients procure the 'installation of measures'.

For both, historically there has been an emphasis on price, so the culture has become delivery of compliant homes or installed measures at the lowest cost. This culture is compounded because underperformance is often not immediately obvious, and responsibilities are confused.

The 'actual performance' became an institutionalised blind spot.

What is clear is clients aren't getting what they assumed they would and, residents are getting less benefit than they might.

> **"If you always do what you've always done you'll always get what you've always got"**
>
> Henry Ford
>
> RETROFIT ACADEMY CIC

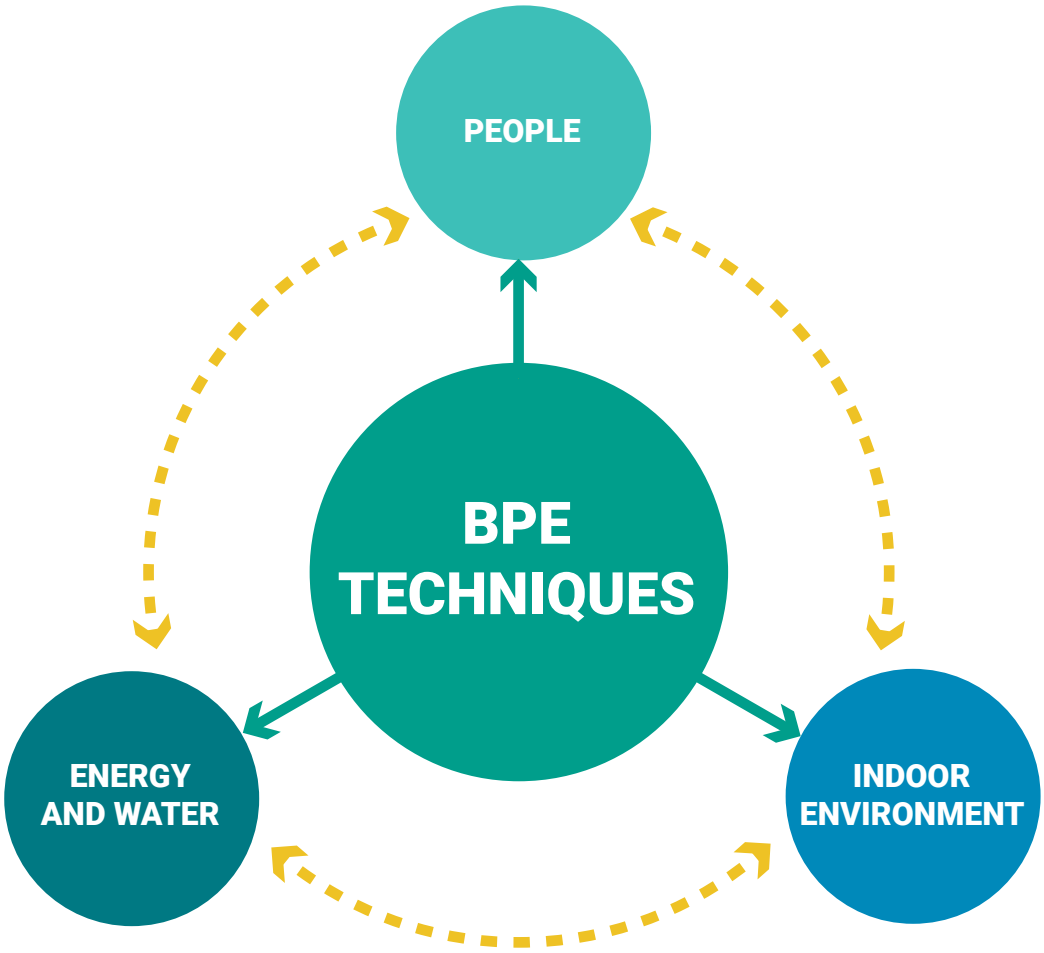
To change the outcome, we need to change the question and then check the result.

Building Performance Evaluation (BPE) – An Overview

BPE should be a holistic assessment of performance: the occupants' experience, the quality of the indoor environment and the energy/water use.

All aspects are important. Great to measure energy but, it is not the whole picture.

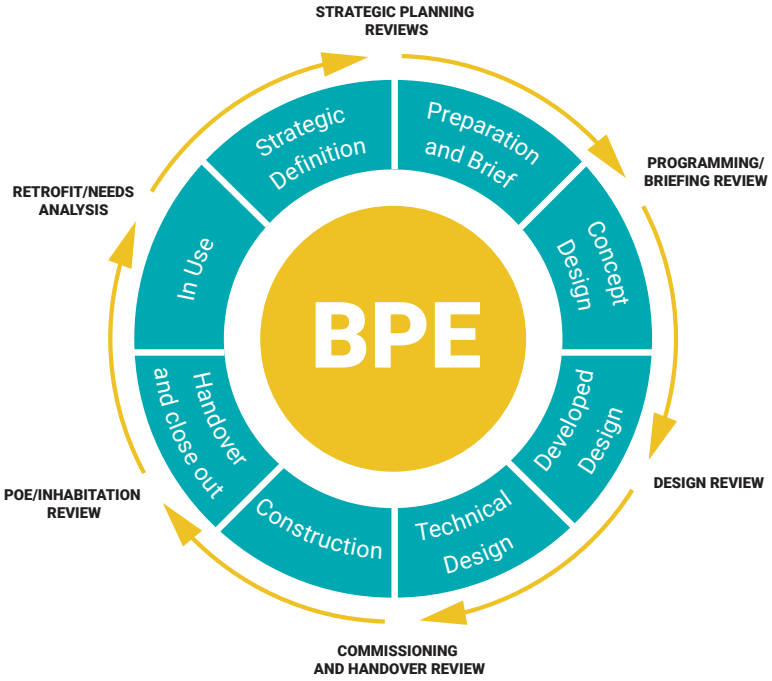
What?



Credit: Building Performance Evaluation Toolkit and Guide (WoodKnowledge Wales)

When?

For maximum benefit, BPE should be integral to the project process from the initial proposal through to your in-use performance evaluation.



Credit: Building Performance Network: Whole Lifecycle of the Home

That's said, PAS 2035 performance 'review' is currently focused on post-construction / in-use.

The Core Element of a Retrofit BPE

The stages

1. Project proposal
2. Tender development
3. Design review
4. During installation
5. Post-installation handover & in-use

In short, building performance should be embedded and reviewed during every project stage to help identify problems and remediation/mitigation as the project progresses, not simply picking them up at the end when rectification is typically much more expensive and potentially disruptive.

It is not rocket science!

Mostly looking, questioning, listening, and 'feeling'.

If it doesn't feel right, then it probably isn't.

1. Project proposal review

Including:

- What outcome(s) are intended / desired?
- Do they align with the organizations vision?
- Are performance objectives set? How do they compare with regulatory minima and best practice?
- Is it clear how the project outcome will be measured?
- Have the risks been identified and strategies for mitigation?

Useful resource: Woodknowledge Wales BPE Guide prompt - Client Sheet

2. Tender requirements

Including:

- Are performance objectives incorporated?
- Is building performance risk assessment reporting required?
- Are design and calculation reviews required?
- Is there a BPE requirement BPE at each project stage?
- Are there meaningful requirements for taking users into account?
- Are clear process laid out to describe how BPE outcomes will be reviewed and consequences of underperformance?
- Is tender scoring is aligned to performance objectives?

3. Design and documentation review

Such as:

- *Project briefs – are performance objectives embedded for energy/carbon, people & indoor environment*
- *Confirming key drawings, thermal bridging, energy calcs etc.?*
- *Checking there is a clear plan for in-construction BPE with resources allocated and necessary training*
- *Ensuring high-risk performance items are identified and suitable mitigation plans are in place?*

Useful resources Woodknowledge Wales BPE Guide prompt sheets:

- *Design and documentation review*
- *Overheating analysis*
- *Energy strategy review*
- *Thermal bridging & moisture review*

4. During installation

Such as:

- Are the team aware of the performance objectives and how they will be demonstrated?
- Do the appointments and the program reflect the BPE requirements?
- Are there sufficient BPE spot check site inspections scheduled?
- Is there sufficient commissioning time? (Noting: far too often commissioning time is cut if the programme slips)
- Are arrangements made for adequate handover?

Useful resource: Woodknowledge Wales BPE Guide prompt sheets:

- *Site visit*

5. Post installation handover and in-use

Such as:

- Have commissioning test results been recorded and compared with original objectives?
- Is seasonal commissioning scheduled?
- Are agreements in place with occupants for any in-use monitoring?
- Has the householder had a formal handover and was the handover information complete?
- Is the plan in place for in-use monitoring?

Useful resource: Woodknowledge Wales BPE Guide prompt sheets:

- *Completion and handover*
- *In use*

Post-installation and in-use BPE

Having said BPE isn't rocket science when it comes to 'as-built' or 'in-use' performance some techniques are quite technical and specialist support will be required.

Measured performance, combined with the occupant feedback, is the day of reconning. The purpose of all the preceding, mostly non-technical BPE, is to ensure that the outcome is a success and the process of measurement is verifying this success.

Should the project performance objectives not be met, then untangling what has gone wrong, and how it can be rectified, is necessary but often not straightforward. Far better to ensure that it is 'right first time' by appropriate BPE throughout the project.

Each BPE technique provides information on one aspect of performance and needs to be interpreted in context, and in conjunction, with other techniques to give a rounded view otherwise results may be misinterpreted.

Two examples to illustrate how simply looking at measured data can give completely the wrong impression:

High energy use needn't necessarily mean poor dwelling performance – the householder may be leaving inefficient electrical appliances running? Still, a concern but requires a completely different approach to address.

The data may suggest a home has very good, monitored CO2 levels, for example, However, the householder may be reporting the home is stuffy - requiring them to keep windows open.

Triage

A structured approach to understanding the actual performance of a home ensures that scarce resources are used efficiently. Initially, this is simply getting a good, but high level, understanding of the performance - a basic BPE. Subject to what this shows, escalating to more in-depth analysis only as required.

Steps of in-use BPE:

1. Basic BPE
2. Intermediate BPE
3. Advanced BPE

PAS 2035 requires monitoring and evaluation of all homes and follows this triage approach.

PAS 2035 Monitoring and Evaluation

Basic BPE

Every project is subject to monitoring and evaluation to determine whether the intended outcomes of the retrofit project have been realized, and to identify any project-specific or systematic problems with the following criteria:

- The retrofit design
- The installation of energy efficiency measures
- Commissioning
- Handover of installed measures
- The retrofit dwelling assessment
- Retrofit risk assessment

Undertaken and reported in the first 3 months after handover

Types of questions:

- Have the agreed intended outcomes of the project have been achieved?
- Are the clients and occupants are satisfied with:
- Outcomes?
- Process (assessment, design, installation, testing, commissioning, handover)?

- Specific points of:
- dissatisfaction
- elements not working as expected

- Other comments

The basic BPE can be performed by the retrofit coordinator

Intermediate BPE

This shall be undertaken (in full) where Basic monitoring and evaluation indicates:

- Project outcomes are significantly different from those agreed / intended
- There are unintended consequences of the retrofit work

Notes:

- The consent is required of the client and occupant
- Performed by a Retrofit Evaluator independent of the project team
- Completed and reported within the first 6 months of a basic performance evaluation (or as soon as conditions allow)
- Utilises a range of BPE techniques

Advanced BPE

Advanced monitoring and evaluation **shall** be undertaken where Intermediate M&E indicates:

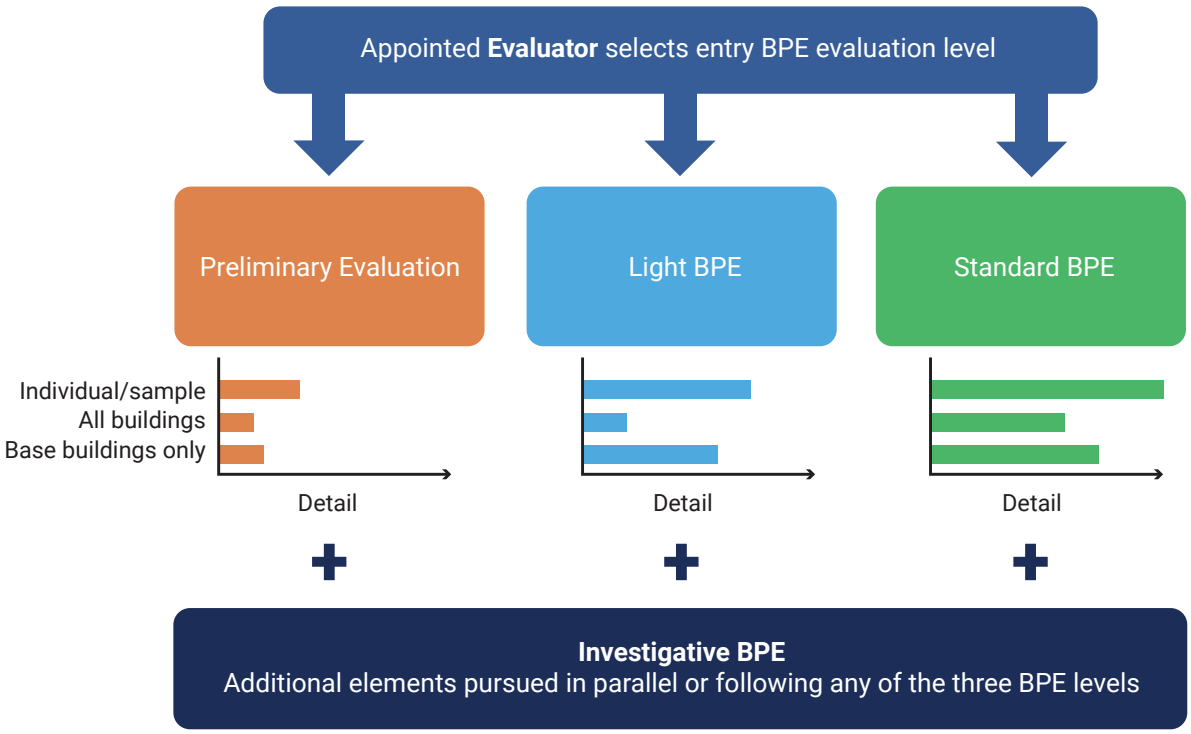
- Further investigation is required to understand and resolve any discrepancy between predicted and outcome performance

Notes:

- The consent is required of the client and occupant
- Performed by a Retrofit Evaluator independent of the project team
- Completed and reported within 2 years of a basic performance evaluation
- Utilises a range of BPE techniques as appropriate

BS 40101 – Building performance evaluation of occupied and operational buildings

The new BS standard for Building Performance Evaluation differs a little from the PAS 2035 Monitoring & Evaluation although the intent is the same there is a greater focus on performance measurement and document review.



Credit: British Standards Institution, BS40101 January 2022

BS40101 Key elements are:

- BPE Occupant questionnaire for 100% of homes

- Measurement within 10% of homes:
  - Overall energy use
  - CO_2 levels
  - Temperature inside and out
  - Humidity
  - Water use
  - Commissioning document review
  - Airtightness test review
  - Original design targets v actual performance

Common Post-construction / in Use BPE Techniques

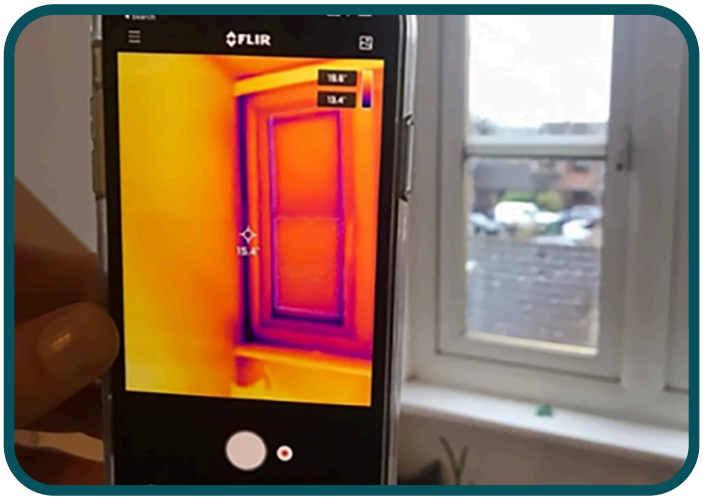
There are a range of different techniques available to verify if a retrofit project is meeting its objectives. Some of these are briefly introduced below.

Occupant feedback

You can measure energy use, temperature, CO2 but without the context, without understanding how the occupants use their homes, what they think and feel you only have half the information and risk drawing incorrect conclusions more often than not. Be it a chat on the doorstep, a tick box questionnaire, a fully structured interview, a text response etc will depend on circumstance, resource, time and budget.

Thermography

Thermography presents a ‘picture’ of the surface temperatures. It can detect gaps in insulation, cold bridges, air infiltration and damp. Whilst it is best carried out by an experienced professional to interpret results correctly, but it can be useful as a ‘spot check’ by a generalist. Infrared cameras have dropped significantly in price, although the best is still very expensive, some plug into a smartphone.

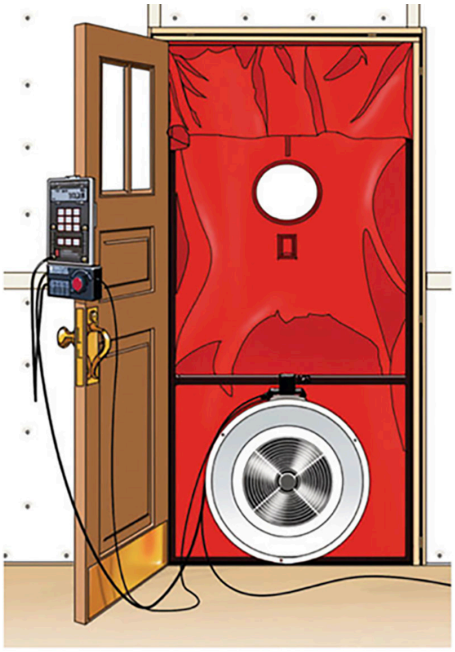


The draft under a back door and an under-insulated en-suite floor above an entrance porch.

Air Permeability

Over recent years correct ventilation of a home has increased in recognition and is important for occupant health and prevent degradation of the fabric.

Reduced air leakage may be an intended outcome of a retrofit measures or a by-product. The traditional approach has been to pressurise or depressurise the home with a 'blower door' and measure the airflow. A typical test on a home may take 1 to 2 hours.



An alternative approach is now available which provided a 'pulse' of air and detect the pressure decay. Both give a measure of the air leakage of the home which can be compared to the original objective.

Credit: Build Test Solutions

Ventilation

To work efficiently mechanical ventilation must be correctly commissioned.

During commissioning, airflow rates are measured and adjusted to balance the system.

Element U Value Measurement

Thermography provides a picture of heat loss, but it doesn't quantify this loss. A few techniques are available which provide a measure of the thermal performance of an element.

Heat flux plates can be temporarily fixed to a wall, for example, and the heat flow measured directly. As heat flow is dynamic as the internal and external temperatures change and the element itself heats up and cools down, tests typically take circa 1 week.

Infrared U-value Measurement

An alternative approach has been developed which utilises a thermal camera and is able to provide a U-value result in circa 1 hour.

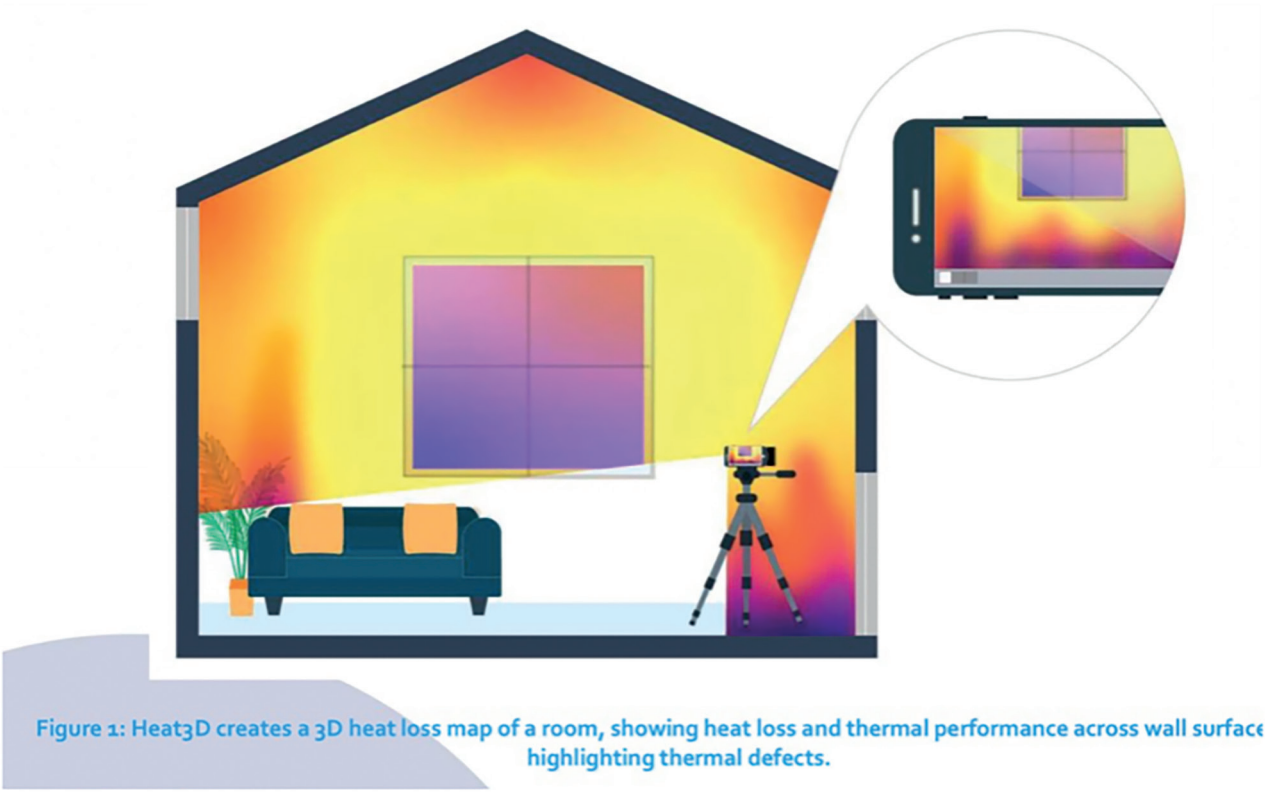


Figure 1: Heat3D creates a 3D heat loss map of a room, showing heat loss and thermal performance across wall surface highlighting thermal defects.

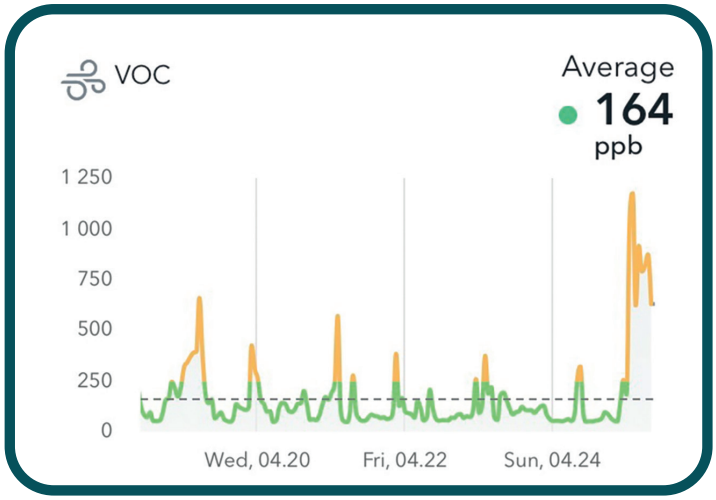
Credit: Build Test Solutions

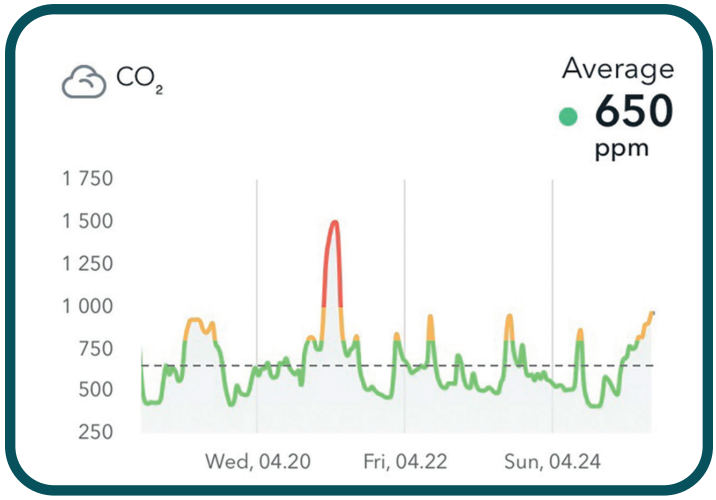
In-door Air Quality

Measuring the indoor air quality used to be the preserve of the universities but the cost of is falling fast making it more accessible to those with smaller budgets.

The results can be revealing. With the increased attention to appropriate ventilation in particular, CO_2 measurement provides important performance data.

Pictured, an Airthings indoor air quality sensor, web connected measuring Radon, VOC's, CO_2, Temperature, Humidity. A host of manufacturers produce combined and single measurement devices.





Energy Metering

Understanding the energy use over a period and comparing it with the expected energy use provides a general check on performance. Data from smart meters allows more granular analysis although can be complicated to get access to.

Temperature and Humidity

Whilst it can be useful to simply note the internal temperature of a home when visiting it more granular information is helpful. Small low-cost temperature and humidity sensors are available which log results for downloading and analysis when the sensor is collected again from the property.

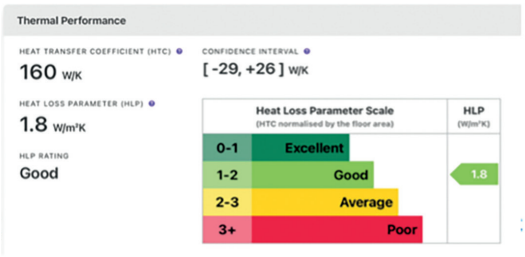
Helpful in its own right to understand over or under heating, they can also be used in conjunction with the metered energy data to understand more accurately the energy performance of a retrofit.

Whole House Heat Loss Management

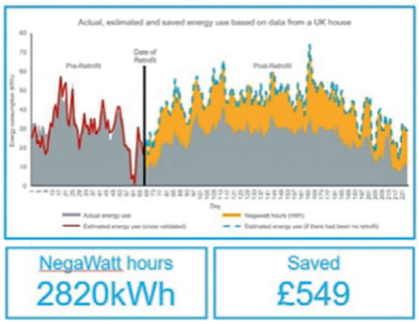
Techniques are now available which allow the measurement of whole house heat loss. There is a range of approaches.

The original approach was known as a Co-heat test which took circa 3 weeks with a home unoccupied. Since a range of approaches has been developed.

Rapid overnight tests such as QUB (Saint Gobain) and Veritherm which involve measuring the warming up and cooling down of an unoccupied home. Others, such as Smart HTC (Build Test Solutions) run over a longer time period and measure energy use and temperatures of an occupied home to measure performance. Others again, measure a range of parameters and use machine learning to determine a home's performance such as by Knauf Energy Solutions.



Credit: Build Test Solutions, Smart HTC



Credit: Knauf Energy Solutions

Co-heating test equipment

Evaluate and Review Template

Your Objective:

KEY POINTS

e.g Highlight the key successes/lessons learned

KEY DOCUMENTS

e.g Where will the information be used/reports etc.

BEFORE RETROFIT

Best Practice - Policy - Cost Savings - Cash/Carbon/kWh/Peoplevalues - VfM

DURING RETROFIT

Impact/value of measures - level of engagement ladder - methods of data collection

POST RETROFIT

Analysis of behaviour change - VfM - Training available/ongoing needs

INFORMATION SOURCE

COE/links added here

KEY CONTACT

e.g Who do you need to inform, where do you need to get the data from

Evaluate and Review Template

Your Objective:

KEY POINTS

KEY DOCUMENTS

BEFORE RETROFIT

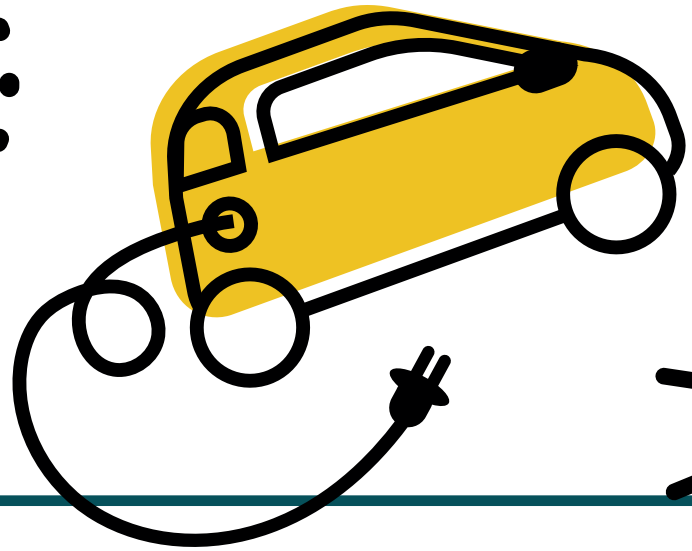
DURING RETROFIT

POST RETROFIT

INFORMATION SOURCE

KEY CONTACT

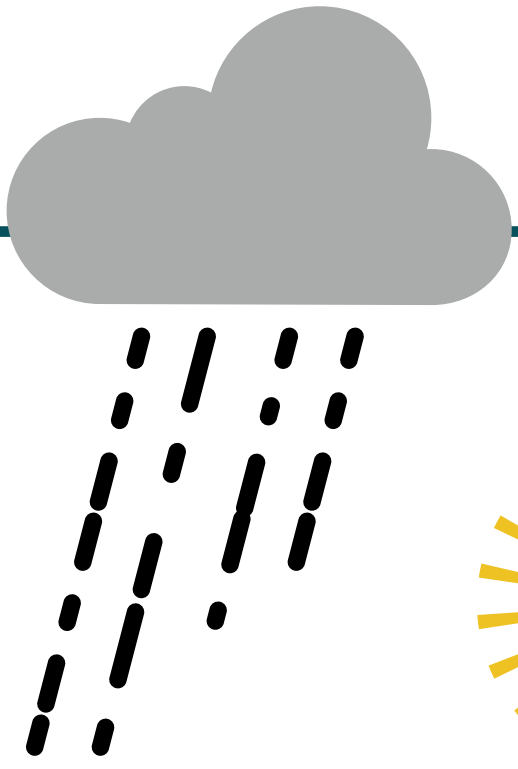
Notes:



EVALUATE AND REVIEW

It's fine to celebrate success but it is more important to heed the lessons of failure

Bill Gates



RETROFIT ACADEMY CIC

Essex County Council

T: 0330 0557 629

E: info@retrofitacademy.org

W: www.retrofitacademy.org

A: Barn 4, Dunston Business Village, Stafford Road, Stafford, ST18 9AB

HM Government

This project is fully funded by the UK Government through the UK Community Renewal Fund. The UK Community Renewal Fund is a UK Government programme for 2021/22. This aims to support people and communities most in need across the UK to pilot programmes and new approaches to prepare for the UK Shared Prosperity Fund. It invests in skills, community and place, local business, and supporting people into employment.

For more information, visit https://www.gov.uk/government/publications/uk-community-renewal-fundprospectus

March 2022