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Retrofit Integration Guidance Note

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Purpose of Retrofit Guidance Note

The Retrofit Guidance Note is designed to provide readers with an understanding of:

- Retrofit and potential retrofit measures
- The economics of retrofit
- The challenges of successful implementation and the public policy environment
- Potential funding solutions
- Retrofit "Bundling" considerations

Retrofit adoption to date has been limited in spite of multiple public policy interventions. In order to plan and implement retrofit programmes which will deliver long term adoption and positive outcomes going forward, it is necessary to understand what has and hasn't worked to date and the reasons for this, identify ongoing challenges and barriers to adoption and tailor solutions accordingly.

What is Retrofit?

Definition & Scope

Retrofit refers to the modification of existing buildings to improve energy efficiency, reduce greenhouse gas emissions, and enhance occupant comfort and resilience. It applies to the existing building stock and excludes new build development. Retrofit may be undertaken while buildings remain occupied and typically goes beyond routine repair or maintenance, although it may be delivered alongside planned maintenance cycles. It should be understood as a strategic intervention in long-lived assets, rather than a one-off project or isolated upgrade.

Types of Retrofit

Retrofit interventions are commonly described along a spectrum:

- Partial/Shallow retrofit: Single or limited measures delivered independently (for example loft insulation, boiler replacement, or glazing upgrades). These interventions are generally lower cost and quicker to deliver but risk locking buildings into sub-optimal performance and constraining future decarbonisation pathways.
- Deep/Whole-building retrofit: A coordinated package of measures addressing building fabric, energy systems, and controls together, often targeting very low operational energy demand and emissions. Deep retrofit requires greater upfront planning, funding, and disruption but reduces long-term risk, avoids stranded assets, and aligns more effectively with Net Zero objectives.1 Affordability is however a significant blocker to retrofit adoption and the benefits of deep/whole house retrofit need to weigh against what individuals and public funding can actually afford.2
- A rigid focus at either end of the spectrum risks creating underperformance / loss of confidence at one end and inertia / limited development at the other.

[1] **Domna Homes: Whole House Retrofit vs Partial Retrofit**

[2] **Santander: Tomorrows_Homes_report_2025**

Measures

Retrofit typically comprises three interdependent categories of intervention:

- Fabric measures: insulation, airtightness improvements, high-performance windows and doors, and mitigation of thermal bridging.
- Building systems: renewable energy generation (e.g. solar PV panels and battery storage systems) low-carbon heating (e.g. heat pumps), hot water systems, mechanical ventilation, and connections to heat networks.
- Controls and optimisation: zoning, smart controls, monitoring, and commissioning to ensure designed performance is realised in use.

Effective retrofit depends on integration across these categories. Isolated measures may undermine overall performance if poorly sequenced.3

Market

Scale

Retrofitting UK homes will be essential to meeting the UK's legally binding Net Zero 2050 target. 80% of the homes that will be occupied in 2050 are already built4, domestic heating and hot water account for around 20% of UK greenhouse gas emissions. Despite the UK Government's Warm Homes Plan and renewed investment in social housing retrofit, the current system is not delivering the scale, consistency, or multi-tenure coverage required. The National Retrofit Hub estimates that 14.3 million homes will need significant upgrades by 2035 to reach Energy Performance Certificate (EPC) C, rising to much deeper interventions for full heat decarbonisation.5 This translates to a need to retrofit 1.5 million homes per year; current delivery is around 250,000 "retrofits" per year, many of which are partial or shallow.

Public Policy

At least 10 separate national schemes have come and gone since 2013 alone.

The Green Deal (2013-2015):

Conceived as a "pay as you save" mechanism, the Green Deal was designed to let homeowners fund energy efficiency improvements through savings on their energy bills with repayments attached to the electricity meter rather than the individual. Targeting 14m retrofits by 2020 the scheme closed in 2015 with only 16 thousand households with Green Deal Plans in progress.6 The reasons for the failure have been cited as an over complicated administration process (homeowners were required to pay for a home assessment and then get quotes from three Green Deal providers), high interest rates on Green Deal finance, uncertainty around

[3] **Bre Group**

[4] **Retrofitting homes for net zero**

[5] **NRH-State-of-the-Nation-Review.pdf**

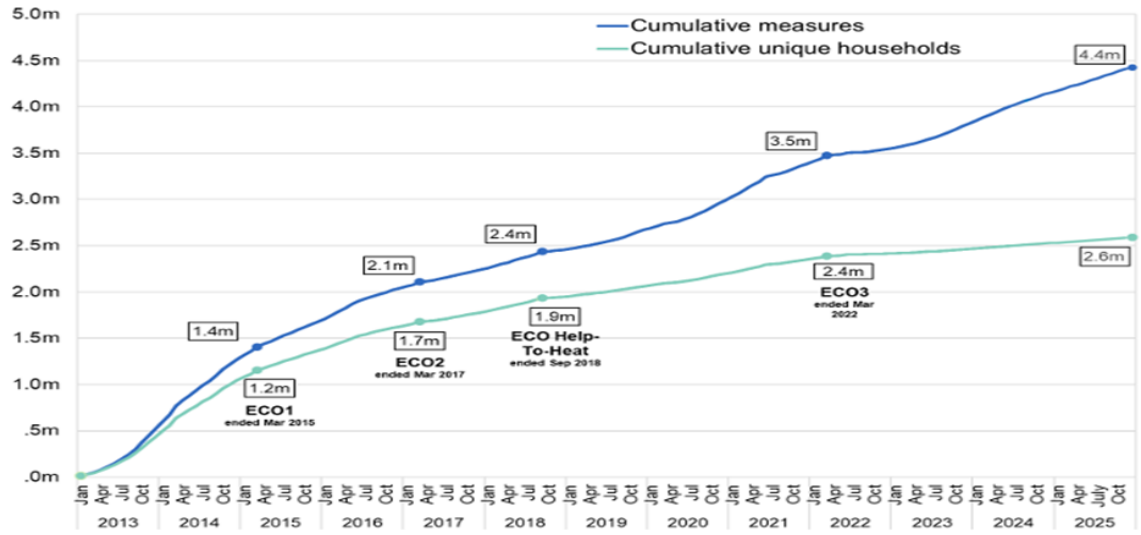
[6] **DECC Monthly Statistical Release GD ECO in GB July15**

projected savings on electricity bills exceeding repayment obligations and low public awareness of the scheme in general.7

The Energy Company Obligation (ECO) (2013-2026):

The Energy Company Obligation (ECO) is a UK Government scheme designed to improve energy efficiency of homes and to tackle fuel poverty. Under the scheme, energy suppliers are required to fund the installation of energy efficiency measures in qualifying households. ECO had four main phases with ECO4 closing in December 2026. The ECO was successful in meeting its own targets in terms of measures installed with millions of homes receiving insulation, boiler upgrades, and heating improvements. In total the scheme supported 4.4m measures across 2.6m households by December 2025.8

However, the scheme has been criticised for a stop-start policy design, a failure to reach the millions of poorly insulated homes in the UK over an extended time period, a pass-through of costs via energy bills in excess of the cost of improvements and structural flaws in supplier obligations which incentivised installers to "minimise costs to maximise profits"; a lack of adequate oversight led to a high number of poor-quality internal and external wall installations.



The Green Homes Grant (2020-2021)

Under the Green Homes Grant Voucher scheme, homeowners could receive vouchers covering at least two-thirds of the cost of energy efficiency improvements up to £5,000 (£10,000 for low-income households). The scheme adopted a measures-based approach paying for individual interventions rather than whole house retrofit and targeted 600,000 homes but it was scrapped within nine months having reached just 10% of that target. A rushed implementation schedule, unprepared supply chain, poor promotion and a lack of public trust have been cited as reasons for the scheme's early closure and lack of impact.9

Local Authority Delivery (LAD) Scheme (2020-2022)

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[7] **What went wrong with the Green Deal? | The CPA**

[8] **Household Energy Efficiency Detailed Statistical Release March 2026**

[9] **PAC report: Green Homes Grant scheme**

The LAD scheme was launched in 2020 as part of the wider Green Homes Grant, with £500 million allocated to local authorities to improve the energy efficiency of homes belonging to low-income households, with the aim of reducing fuel poverty and phasing out high carbon fossil fuel heating. Delivered in three phases, it targeted homes with EPC ratings of E, F, or G and required households to have an income below £30,000. LAD Phases 1 and 2 together installed ~50,000 measures across ~38,000 households, with LAD 1 and LAD 2 improving 55% and 60% of treated homes to EPC C or higher respectively. The scheme had genuine successes in reaching some of the most fuel-poor households but fell short in terms of delivery targets meeting around three-quarters of estimated number of households upgraded (38,290 compared with estimated 55,000) and delivered just over a quarter of total expected measures (49,824, compared to an expected 191,000) with tight timelines, additional costs of PAS 2030/2035 and Trustmark certification, caps per property and supply chain capacity cited as major barriers to delivery.10

Home Upgrade Grant (HUG) (2022-2025)

HUG was introduced in 2022 as a successor scheme, focusing specifically on off-gas-grid properties, typically harder to treat and more expensive to heat. The scheme targeted homes with EPC ratings of D to G, aiming to improve the worst-performing homes to at least D and D-E homes to band C where possible, with the goal of taking households out of fuel poverty. The scheme ran in two phases: HUG 1 allocated £220 million, and HUG 2 allocated £630 million for delivery between September 2023 and March 2025. The HUG scheme made progress on the hardest segment of the housing stock; however, delivery was limited to just 28,300 measures across 15,800 homes for both HUG Phase 1 and Phase 2, with a complicated approval process, inflexible EPC band rules and difficulty in identifying eligible homes cited as restricting delivery.

The Great British Insulation Scheme (GBIS) (2023 -2026)

GBIS was launched in 2023 to reduce energy bills, improve home energy efficiency and cut carbon emissions through funding loft, cavity wall, solid wall, roof and floor insulation. Under the scheme, low-income and vulnerable households could get free insulation, and middle-income households with D-G EPC ratings or a lower council tax band were usually part-funded. The scheme can be regarded as a partial success, funding over 130,000 measures across 95,500 households to the end of January 2026, with over 53% of the measures going to low-income households, aligning with the scheme's core mission. However, the scale of the scheme fell short of a £1 billion programme and, like ECO4, investigations have found high levels of faulty insulation work.

The Social Housing Decarbonisation Fund (SHDF) (2021 – present)

The SHDF is designed to upgrade the UK's social housing stock below Energy Performance Standard (EPC) C. Under the scheme the government allocates funding in "waves" and councils, or housing associations apply for funding and organise the upgrades to the homes they manage. The government launched Wave 1 of the SHDF in August 2021 awarding around £179m of grant funding for delivery from 2022 to 2023 for energy performance improvements to up to 20,000 social housing properties. Successful projects within Wave 2.1 were announced in March 2023 with £778m of grant funding going to 104 projects delivering from 2023 to 2026. Wave 2.2 of the SHDF awarded a further £80m of grant funding from April 2024. To the end of January 2026 there were around 122,700 measures installed in 58,500 households across SHDF Wave 1, Wave 2.1 and Wave 2.2 with the majority of measures focused on insulation.11

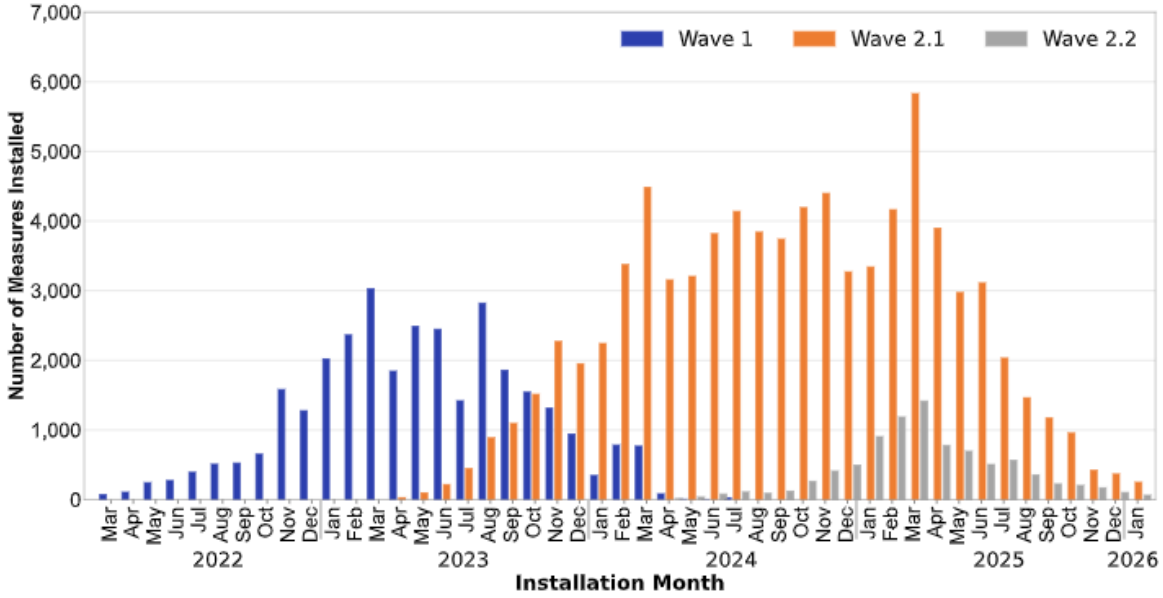
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[10] **DESNZ: Green Homes Grant Local Authority Delivery Schemes Phases 1 & 2: Dec 2024**

[11] **Summary of the Social Housing Decarbonisation Fund statistics: March 2026 - GOV.UK**

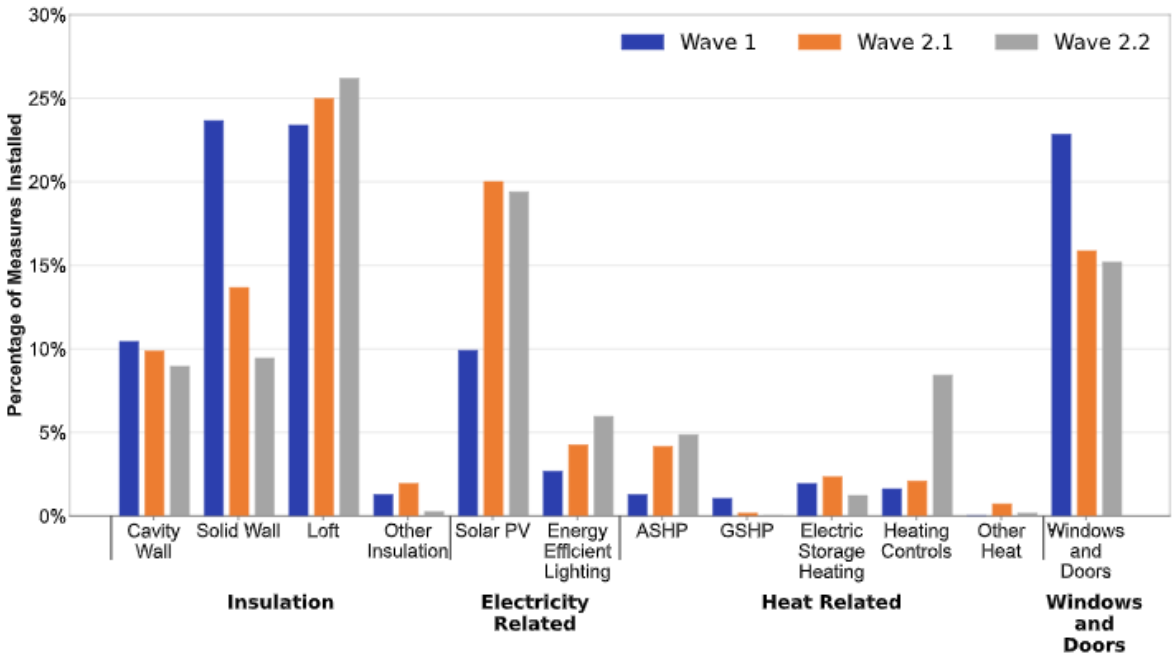
The scheme's wave approach has allowed learnings to be fed into later rounds and while the scheme has experienced delays in delivery due to supply chain shortages funding has helped scale up retrofit activity and an improvement in standards and customer satisfaction compared to earlier schemes with over 65% satisfied or very satisfied with the overall installation process.12

Figure 1: Number of Measures Installed by Installation Month under SHDF Wave 1, Wave 2.1 and Wave 2.2



[12] **Process Evaluation of the Social Housing Decarbonisation Fund (SHDF): Wave 1**

Figure 2: Percentage of Measures Installed by Measure Type under SHDF Wave 1, Wave 2.1 and Wave 2.2 (March 2022 to January 2026)



The Boiler Upgrade Scheme (BUS) and Great British Insulation Scheme (2022 – present)

Under the BUS homeowners can receive grants of up to £7,500 for air source and ground source heat pumps, £2,500 for air-to-air heat pumps (for residential properties only) and £5,000 for biomass boilers.13 The average cost to homeowners after grants is in the region of £4,500 for air source heat pumps14 and £18,000 for ground source heat pumps.15 Homeowners cannot apply directly for the grant instead they must work with certified installers who will apply on their behalf. By the end of 2025 over 100,000 applications had been submitted to the Boiler Upgrade Scheme with a total of 88,650 vouchers issued.16 While the scheme has been successful in stimulating demand for heat pumps with sales more than doubling since the scheme's launch, the Government's 2030 target of 450,000 installations is unlikely to be met with high upfront costs, limited public awareness and supply chain issues cited for the limited take up.17 18

The Warm Homes Plan (WHP) (2026 – Present)

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[13] **Ofgem: Boiler Upgrade Scheme (BUS)**

[14] **Octopus Energy**

[15] **BUS January 2026 Statistics**

[16] **Heat Pump Statistics 2026 (New Data) | Elite Renewables**

[17] **The Boiler Upgrade Scheme is failing to deliver, says Lords committee - Committees - UK Parliament**

[18] **The Warm Homes Plan: March 2026**

The WHP was launched in January 2026 to deliver £15 billion of public investment and roll out upgrades on up to 5 million homes.19 The WHP is an overarching government strategy bringing together multiple programmes and funding streams aimed at:

- **Cutting household energy bills** through improved insulation and efficient building
- **Reducing carbon emissions** from the UK's building stock
- **Deliver energy security** through reducing exposure to volatile fossil fuels
- **Tackling fuel poverty** by targeting support at low-income households
- **Upgrading Britain's housing stock** to make homes fit for a net zero future20

Funding under the WHP will be allocated across the Warm Homes Local Grant Scheme, Warm Homes Social Housing Fund, Boiler Upgrade Scheme, Warm Homes Fund and Heat Networks.

Warm Homes Local Grant (WH:LG) & Warm Homes Social Housing Fund (WH:SHF)

Low-income and fuel-poor households will benefit from around £5 billion of investment to 2030, with £4.4 billion in direct capital grants backed by an initial £0.6bn from the Warm Homes Fund. The WH:LG offers grants of up to £15,000 for low-income households to cover the cost of energy performance upgrades and low-carbon heating systems designed to help those living in privately owned homes with an Energy Performance Certificate of D, E, F or G and who earn £36,000 a year or less.

The WH:SHF provides support for social housing tenants to upgrade their homes with energy-efficient measures. It aims to ensure that all households regardless of income, have access to the benefits of home energy improvements.

The WH:LG and WH:SHF will be consolidated into a single scheme for low-income households from 2028/29.21

The Boiler Upgrade Scheme (BUS)

The BUS continues with £2.7 billion in funding with no means testing – making it universally available regardless of income. A new £2,500 grant for air-to-air heat pumps has also been introduced for the first time.

Warm Homes Fund (WHF)

A new measure worth £5.3 billion, comprising up to £1.7 billion allocated to low and zero-interest consumer loans (supported by £300m of capital investment) plus £0.6bn of low-income funding and £2.7 bn for investments in and loans to the home upgrade sector, expected to launch in April 2027.

Market Failures

A successful retrofit programme under the Warm Homes Plan will need to overcome well established market failures22:-

[19] **GOV.UK - News 20 January 2026**

[20] **The Warm Homes Plan January 2026**

[21] **Warm Homes Plan (HTML) - GOV.UK**

[22] **The Green Book 2026**

- Information asymmetry (Green Book category 4: Imperfect Information): households (where the onus of interventions have historically been focused), cannot assess retrofit value, insurability, or whole-life cost (the trade-off between high upfront costs and long-term forecast savings) and lack clarity over retrofit benefits and grant options23; installers cannot forecast demand or justify workforce investment; investors cannot see a credible pipeline. No actor has the full picture required to make efficient investment decisions.
- Coordination failure (Green Book category 2: Externalities): no single actor can internalise the system benefits of neighbourhood-scale delivery. Heat network developers, Distribution Network Operators (DNOs), housing providers and households each act independently, destroying value that coordinated action would create.
- Split incentives (Green Book category 2: Externalities): landlords bear cost while tenants receive benefit; lenders do not reflect retrofit value in mortgage assessments; energy suppliers benefit from efficiency improvements but bear none of the delivery cost. These misalignments systematically suppress investment.
- Thin and immature markets (Green Book category 3: Market Power, Green Book category 4 Imperfect Information): there are insufficient standardised, investment-ready projects to attract institutional capital on acceptable terms. The pipeline is too fragmented and too early-stage to close without upstream investment in project development.
- Risk concentration (Green Book category 1: Public Goods (partial), Green Book Category 2: Externalities, Green Book Category 4: Imperfect Information): individual households cannot bear the upfront cost, technology performance risk, or 25-year+ asset management responsibility of a whole-house retrofit programme. Public capital is needed to absorb and redistribute these risks to actors better placed to manage them.

Economics of Retrofit

The Cost of Retrofit and the Funding Gap

The gross cost of whole house retrofit varies significantly by property archetype, construction type, and the depth of intervention required. For a typical pre-1980 semi-detached home, indicative costs range from approximately £20,000–40,000 for a comprehensive package combining fabric improvements, heat pump installation, and complementary low-carbon and generation technologies.24 Current grant support — combining the Boiler Upgrade Scheme, Warm Homes: Social Housing Fund, and Warm Homes: Local Grant where applicable — covers a meaningful share of this cost for eligible properties, but leaves a substantial residual financing requirement for the majority of the housing stock. This gap does not close of its own accord. It narrows as delivery scales, supply chains mature, and financing structures improve — but 'financial innovation' remains necessary to bridge it, particularly in the early stages of a national demonstration.

[23] **Uswitch: 2025**

[24] Living Places

Monetary Benefits

Retrofit generates several categories of benefit that are, in principle, convertible into revenue streams capable of supporting a financing model:

- Energy bill savings accruing to households, which can be partially monetised through a service charge or 'comfort pricing' model. The Warm Homes Plan notes that heat pumps in combination with battery and solar can reduce household energy bills by up to £1,000 per year. These savings provide a basis for a partial repayment mechanism, though the conversion of savings into service charge income requires careful consumer design and testing — particularly in fuel-poor areas where improvements may result in a 'comfort upgrade' rather than a bill reduction.
- Grid flexibility and demand response income may provide meaningful upside, accessible through aggregated smart assets, batteries, smart heat pumps, thermal stores, operating at a neighbourhood scale. This revenue stream, generated through Distribution System Operator (DSO) demand response and smart tariff arbitrage, is not fully accessible to individual households acting alone, but becomes material at the scale of a neighbourhood Special Purpose Vehicle (SPV) and is being piloted by National Grid Electricity Distribution.

These monetary benefits are real and significant, but they are insufficient on their own to close the financing gap without concessional public capital. They serve to reduce the size of the gap and, in the upside case, to generate returns that can reward equity investors and attract private debt.

Wider Economic Benefits

Retrofit generates a wider range of economic and social benefits that justify public investment and grant support, but which cannot be monetised by the private sector:

- Health outcomes: reduced cold-related illness, respiratory conditions, and mortality from underheating; reduced incidence of damp, mould, and associated respiratory and cardiovascular disease; reduced internal and external air pollution and associated respiratory disease; and reduced overheating risk, which is an increasing concern as summer temperatures rise. The National Health Service cost savings associated with warmer, drier, better-ventilated homes are substantial but difficult to direct into an SPV revenue stream. 25 26
- Productivity: warmer, healthier homes reduce days lost to cold-related and respiratory conditions, with measurable economic benefits. 27 28
- Local economic activity: supply chain employment, skills development, and local multiplier effects from sustained programme spending.

These benefits provide strong public interest justification for the grant component of the capital stack but sit outside the direct financing model.

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[25] **Retrofitting home insulation reduces incidence and severity of chronic respiratory disease - PMC**

[26] **Science Direct: Health implications of housing retrofits**

[27] **Home advantage: Unlocking the benefits of energy efficiency**

[28] **Health inequalities: Cold or damp homes - House of Commons Library**

The True Cost Problem

The current retail market for retrofit systematically overprices relative to what is achievable at programmatic scale. The average Air Source Heat Pump installation under the Boiler Upgrade Scheme costs approximately £12,000.29 The market average after the grant is approximately £4,500.30

At-scale, vertically integrated operators demonstrate materially lower costs. Octopus Energy — the UK's largest heat pump installer — reports a typical installed price post-grant of £3,818, compared with a market average of £5,29531: a differential of approximately 28%. The company's CEO has stated publicly that manufacturing investment reduced hardware costs from approximately £3,000 to £1,500 per unit.

Academic evidence from the UK Energy Research Centre (UKERC) and the Universities of Edinburgh and Imperial (2024) confirms that costs in the UK have not materially reduced over the past decade32, attributing this primarily to fragmented, low-volume demand that gives the supply chain no incentive to invest in efficiency improvements. The same research identifies that non-equipment costs — labour, installation practices, surveying and commissioning — offer the greatest scope for reduction through scaled, streamlined delivery. Countries that have successfully expanded their heat pump markets have seen supply chains respond with meaningful cost reductions; the UK has not yet created the demand conditions to trigger this response, an illustration of information asymmetry market failure.

A further component of current retail cost that is rarely discussed is customer acquisition. Individual installers bear a high cost per sale when marketing to one household at a time: surveys, consultations, bespoke designs, and the significant proportion of marketing spend that does not convert.

High Level Model

At current levels of grant deep retrofit does not generate sufficient returns to stimulate large scale deployment.

Assuming total capital spend on a range of circa £35,000, an average grant contribution of £10,500, average annual maintenance costs of £300 and annual energy bill savings of £1,250 the real IRR on investment is ~ 2% based on a 40-year life.33

This level of return, which includes an average grant contribution of £10,500 has been insufficient in stimulating significant individual householder investment or in attracting institutional investment when stacked with the lack of a proven charging mechanism, confidence in scalability and appetite for exposure to individual retail risk.

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[29] **Boiler Upgrade Scheme statistics: February 2026 - GOV.UK**

[30] **Nesta: how-to-make-heat-pumps-more-affordable**

[31] **Octopus Energy: Heat pumps explained: cost, benefits, and how they work**

[32] **Reducing heat pump installed costs: Reviewing historic trends and assessing future prospects (2024)**

[33] Living Places

Deep Retrofit Estimated Net Cash Flow and IRR

	Real	Timing
Capital Spend	(£35,000)	Upfront
Average Grant	£10,500	Upfront
Net Capital Spend	(£25,500)	Upfront
Maintenance Spend	(£300)	Annual x 40 years
Annual Energy Saving	£1,250	Annual x 40 years
Net Cash Flow over 40 yrs (Cumulative, undiscounted)	£12,500	Over 40 years
IRR	2.1%	

Delivery Capacity

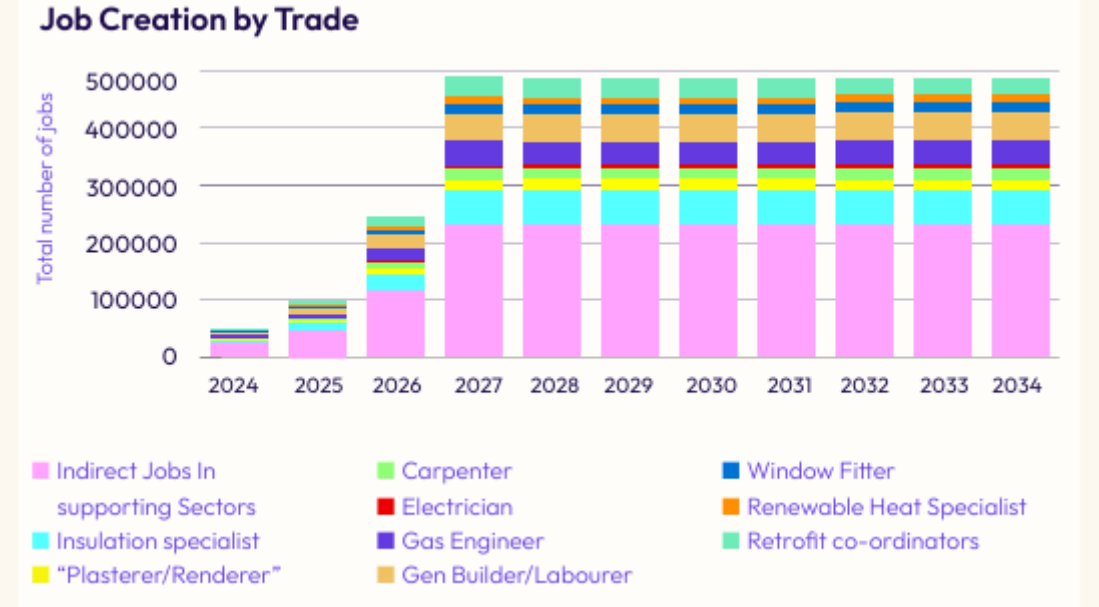
With approximately 29 million homes in the UK with most requiring some degree of energy efficiency upgrades to meet the 2050 net zero target34 and the Government's Warm Homes Plan committing £15 billion to retrofit around five million homes by 2030 (only equivalent to £3,000 per home), the capacity to deliver at scale will be fundamental to achieving a successful retrofit delivery mechanism.

Skills and Workforce

Scale of Workforce Gap

The UK has a skills shortage and currently lacks sufficient capacity to undertake the full scale of the retrofit programme. Forecasts estimate that 250,000 new construction-related roles are required for retrofit by 2035, retraining many of the 223,000 existing workforce, and the creation of a further 230,000 jobs across retrofit-related supply chains. Three key trades — insulation specialists, general builders and gas engineers — make up approximately 72 per cent of this projected workforce requirement.

[34] **UKGBC: Retrofit**



Retrofit Coordinators and Designers

Beyond installation trades, the PAS 2035 quality standard — now mandatory across government-funded schemes35 — has created demand for a new class of qualified professionals: Retrofit Coordinators, Retrofit Assessors and Retrofit Designers. These roles sit at the front end of any compliant project, yet their supply represents one of the most acute bottlenecks in the market. Industry studies identify shortages of retrofit designers and yet without sufficient design capacity, projects cannot be programmed, costed or delivered, creating a structural blockage even before ground-level trades are engaged. 36

The problem is compounded by a lack of clear career pathways and insufficient provision from further education colleges. The Warm Homes Skills Programme is providing £8m of funding (running until July 2026) and aims to train up to 9,000 installers and retrofit professionals, and the government has pledged to train a total of 18,000 people through a combination of this programme and the Heat Training Grant extension. However, forecasts indicate that the requirement for retrofit co-ordinators alone is likely to exceed these targets.

Quality and Assurance Concerns

Accelerating training volumes risks compromising installation quality if oversight does not keep pace. Audit reviews and case studies have highlighted instances of poor-quality installations — particularly in external wall insulation — where work was rushed under scheme time pressure, leading to damp, mould, and remediation costs. In 2025, nearly 40 insulation firms were struck off following poor workmanship.37 Ongoing quality failures, if widespread, risk undermining public confidence in retrofit and damaging the market's long-term prospects.

[35] **Riseretrofit: Understanding PAS2035**

[36] **Retrofitacademy: the future of retrofit**

[37] **Building: news January 2025**

Supply Chain Capacity and Structure

Fragmentation and SME Dominance

The UK's retrofit supply chain is characterised by its fragmentation. The overwhelming majority of installers and contractors are small and medium-sized enterprises (SMEs) that build their businesses on local reputation, repeat work with architects, and long-standing client relationships. 38 This model has significant strengths in terms of local knowledge and responsiveness, but it creates structural barriers to scaling delivery, accessing government schemes, and achieving the consistency required by PAS 2035.

Procurement & PAS 2035 Compliance

The adoption of PAS 2035 as the mandatory quality framework for government-funded retrofit has been broadly welcomed by the sector, but its administrative demands impose significant burdens on supply chain participants.39 Compliance costs include retrofit assessment, measure design, coordination and lodgement of data with TrustMark — and the 2023 version of the standard (PAS 2035/2030:2023), which came into full effect in March 2025, has further increased these requirements. 40 While the standard ensures a whole-house approach to retrofitting — addressing assessment, design, installation and post-installation monitoring — the cost and complexity of compliance risks excluding smaller operators.

Funding Models

Funding Gap

The expected cost of upgrading a UK home from EPC C to D is £6,000 rising to £12,000 for an EPC E home and £17,000 for those with an EPC rating of F-G41, around 65% of the UK's housing stock is below EPC C42 implying a minimum funding requirement of well over £100 billion just to reach this target.

The gross cost of whole-house retrofit varies significantly by property archetype, construction type and depth of intervention. For a typical pre-1980 semi-detached home, costs range from £20,000–£40,000 for a comprehensive package combining fabric improvements, heat pump installation and complementary low-carbon technologies. Current grant support, combining the Boiler Upgrade Scheme, Warm Homes: Social Housing Fund and Warm Homes: Local Grant where applicable, covers a meaningful share of this cost for eligible properties, but leaves a substantial residual financing requirement for the majority of the housing stock. This gap will not close of its own accord. Even as delivery scales, supply chains mature and financing structures improve, it may not narrow given the scale of the work within a shortening window of time.

[38] **DESNZ: Domestic energy efficiency retrofit supply chain: final report**

[39] **SHDF Wave 1 Thematic Case Study**

[40] **A guide to PAS 2035/2030:2023 standards**

[41] **CBRE: Insights March 2025**

[42] **Move-nest: March 2026**

It is clear that even with £15 billion committed under the Warm Homes Plan that private sector investment in retrofit needs to be stimulated in a manner not previously achieved under past policy interventions.

Private Sector Funding

The limited take up of retrofit measures in the UK to date indicate that private sector incentives focused on individual homeowners are not sufficient to generate the required long-term growth in the UK's retrofit sector where there remains a significant upfront cost for the resident to fund or where the cost of loan finance is insufficiently below the expected energy savings from the retrofit.

Grant Funding and Concessional Finance

Grant funding and concessional finance is needed but there is a limit to the impact it can achieve on its own. Funding must be utilised to continue to develop the market, market confidence, skills gap and supply chain but it must also be used to develop a mechanism for leveraging its impact over the long term.

To optimise the impact of grant funding, the economics of retrofit need to be improved through a change in approach.

A Regional Strategy

The economics of retrofit are not currently attractive enough to attract private investment at scale either from individual residents or institutional private capital. Significant capital savings are achievable through large scale procurement, the capital cost of solar installs in the UK is around 3 x higher for domestic installations than large scale projects. 43 44 45 A large scale solar procurement policy, if it achieved 50% of the cost differential between large scale and domestic installs would save approximately £2k per property on solar alone large scale procurement savings may also be achievable on battery storage systems, potentially reducing the total cost of a deep retrofit by more than 10%.46

Similarly, with regard to heat pumps, vertically integrated operators demonstrate materially lower costs. Octopus Energy, the UK's largest heat pump installer, reports a typical installed price post grant of £4,459, compared with a market average of £5,931; a differential of approximately 25%.47

Academic evidence from UKERC and the Universities of Edinburgh and Imperial confirms that costs in the UK have not materially reduced over the past decade, attributing this primarily to fragmented, low-volume demand that gives the supply chain no incentive to invest in efficiency improvements. The same research identifies that non-equipment costs, labour installation practices, surveying and commissioning, offer the greatest scope for reduction through scaled, streamlined delivery. Countries that have successfully expanded their heat pump

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[43] **DESNZ Arup: Renewable Energy Generation Cost and Technical Assumptions – Onshore Wind and Solar PV: Cost of Electricity Report Update 2024**

[44] **Solar panels: costs, savings and benefits explained - Energy Saving Trust**

[45] **The Renewable Energy Hub**

[46] Living Places

[47] **Octopus Energy: How much does a heat pump cost? May 2026**

markets have seen supply chains respond with meaningful cost reductions; the UK has not yet created the demand conditions to trigger this response.

A Place Based Approach

While the strategic approach to retrofit needs to think regionally and nationally, applying the strategy to place could not only bring further economies of scale but also unlock additional benefits.

Economies of Scale

Customer acquisition cost can be transformed under a place-based approach. Individual installers face a high cost per sale when marketing to one household a time, with significant survey, consultation, and design costs incurred even for proposals that do not convert. Neighbourhood-wide marketing and engagement replaces this with a single structured programme, dramatically reducing cost per installation.

Installation costs could be significantly reduced. Scaffolding costs can account for approximately 20% of the total solar cost on a standalone domestic property basis.[48] An area-based approach will reduce transport and mobilisation costs, site set up and permitting per household, set up timeline (and hence cost) reducing the overall cost per property.

A further dimension is shared asset design. Rather than installing the same equipment 1,000 times across the individual homes, neighbourhood-scale design enables shared infrastructure where this improves the economics, a community battery serving 200 homes instead of 200 individual batteries, shared thermal stores; networked ground source heat pump ground loops. The same if not greater outcomes are achieved at materially lower per unit capital costs.

Engagement

Trusted, place-based delivery models should demonstrate higher uptake rates than individual grant programmes with peer influence within communities accelerating adoption.[49] Residents are more likely to participate when their neighbours have done so, when they can see working installations nearby, and when trusted local organisation is delivering the programme. Neighbourhood delivery creates the social conditions for uptake that individual marketing cannot replicate. The pioneering Brockmoor, Dudley Net Zero Neighbourhood developed by West Midlands Combined Authority, Dudley Metropolitan Borough Council and Equans, successfully combined education programmes, workshops and shared ownership to improve engagement and increase intervention uptake through community participation in Net Zero Neighbourhood interventions.[50]

System Integration and Revenue Optimisation

Combining retrofit, heat, generation and storage at neighbourhood scale creates smart local energy systems capable of optimising revenue streams beyond what is achievable on an individual household basis. Multiple properties should be able to aggregate their demand under a single power purchase agreement to sell locally at higher rates than exporting direct to the grid, the complexities of cost associated with doing this on an individual

[48] Living Places

[49] **House of Commons: Retrofitting homes for net zero**

[50] **Equans: case-studies/net-zero-neighbourhood-brockmoor-dudley**

basis are likely to prohibit peer to peer selling beyond signing up to a peer-to-peer platform where any upside will be shared with the platform in addition to the counterparty. The redevelopment of the urban district of Nordhavn in Copenhagen has been designed to integrate electricity, heating, buildings into an intelligent. A large scale flexible heating system, operational since 2018 supplies district heating to ship terminals and warehouses, battery storage and electric vehicles increase local energy efficiency and surplus heat is captured from local heating systems for use in the district network, illustrating what can be achieved with a place-based design.51

Demand Aggregation

Individual retrofit projects are too small and too heterogeneous to attract large scale firms which has led to the structural barriers to scaling delivery, accessing government schemes and achieving the consistency required by PAS 2035. Demand aggregation at a place-based level enables larger contracts and larger suppliers to enter the market alleviating some of the structural blockages which have hampered retrofit delivery to date. In the Bel Air district in Saint-Priest, near Lyon, 930 social housing homes were renovated in just 20 months, due to the scale of the contract around 40% of the facades could be manufactured off site using prefabricated timber-frame panels, reducing costs and allowing residents to remain in their homes while works were carried out.52 Similarly in Nottingham, Nottingham City Council, Melius Homes and Energiesprong retrofitted over 150 homes in an aggregated scheme in three targeted areas, lowering costs and reducing installation times.53

Considerations

Place based retrofit programmes will however bring with them added complexity and delivery considerations which will impact the area selected and the potential benefits of the programme.

Tenure and consent

Neighbourhoods are rarely tenure-uniform. Owner occupiers, private renters and social tenants will often occupy the same street and a place-based engagement process will have to reach different groups with different financial and social circumstances and objectives.

Housing stock

Individual properties differ in construction, orientation, extensions, past alterations and condition. The benefits of place-based programmes are best realised in areas of homogenous housing stock potentially limiting area selection or achievable benefits where delivery boundaries are widened.

Disruption Concentration

A place-based approach is likely to lead to concentrated disruption, including scaffolding, noise, dust and traffic over a number of months, and the needs of elderly or vulnerable residents will need to be identified and considered in any proposed programme.

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[51] **State of Green: Urban area of the future**

[52] **Energiesprong: Off site renovation and collective purchasing**

[53] **Festival of place - Nottingham City Council - Energiesprong - Melius Homes**

Equity

The choice of area selection creates an obvious fairness question. Deprivation scores, housing stock type, retrofit readiness and commercial optimisation are unlikely to map neatly creating potentially conflicting delivery options between commercial and social optimisation.

Optimal Asset Bundling

Alongside a place-based approach to delivery, retrofit measures need to be

- Optimally "bundled" to maximise energy efficiency, lower overall costs and maximise deployment
- Affordable to enhance take up
- Sequenced correctly to properly realise benefits
- Quality checked to maintain an upward curve of trust and take up

The Optimal Bundle

It is widely documented that a fabric first, multiple measure, whole house retrofit approach can deliver enhanced energy savings and lower overall costs.

- Insulation reduces the heat loss through walls, floor and ceiling and keeps homes warmer for longer. This in turn means a heat pump operates more efficiently as it needs to work less.54
- Draught proofing and improved glazing reduce infiltration losses, which amplify the savings from any heating upgrade.55
- Mechanical ventilation with heat recovery provides controlled fresh air exchange, helps avoid uncontrolled heat loss and should help avoid costly damp and condensation issues.
- Smart controls (often included in boiler upgrade or heat pump grants) optimise the timing of delivery which only produces meaningful savings if the fabric retains heat well enough to make pre heating viable.56
- Reduced mobilisation and labour costs: Fixed costs such as scaffolding, site preparation, specialist surveys and trade call-out charges are incurred each time a contractor visits; combining measures can collapse several of these into a single visit.
- Reduced capital and running costs: A heat pump installed in a poorly insulated home must be larger and more powerful than one installed after fabric works, increasing both capital cost and running costs.57

However, a multiple measure approach also needs to be formulated in the context of what is feasible and affordable.

[54] **Heat pump installation: a step-by-step guide - Energy Saving Trust**

[55] **The Importance of Draught Proofing in Energy Efficiency**

[56] **Energy Systems Catapult: Heat Pump Optimisation Report December 2024**

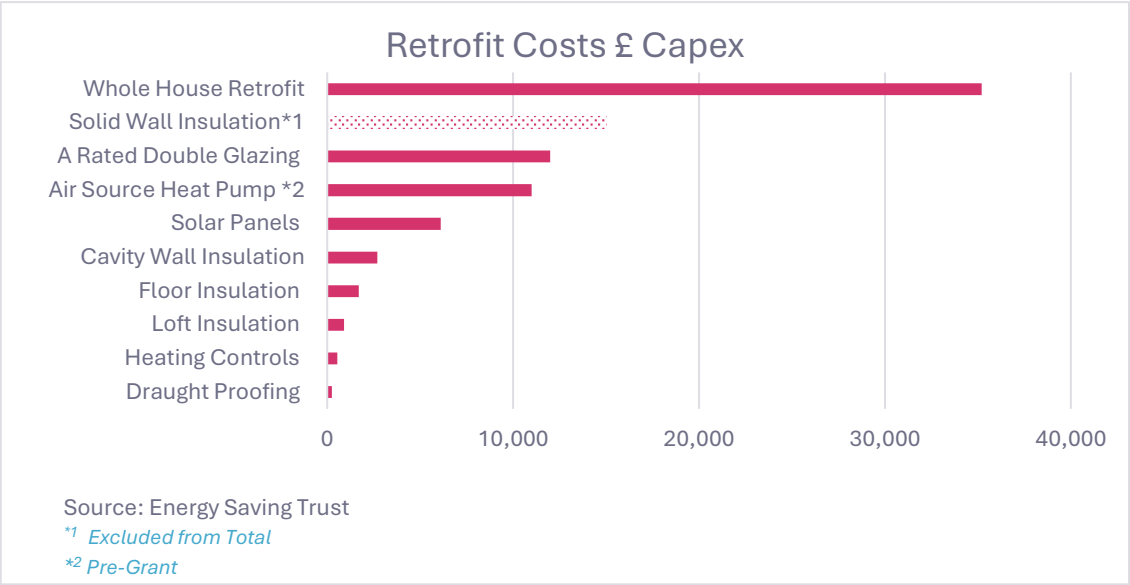
[57] **English Housing Survey 2022 to 2023: energy report - GOV.UK**

One of the most significant barriers to retrofit in the UK is the high upfront cost. The total sum for whole house retrofit is beyond the affordability of most UK households. Recent surveys from Santander and Uswitch highlight upfront costs as the main barrier to installing energy efficiency upgrades.58 59

The Affordable Bundle

An optimal bundle should not only consider energy efficiency and overall costs but also affordability. An affordable retrofit bundle will accelerate take up, which over the long term will be the key driver in improving the supply chain and delivery quality which in turn should drive further cost reductions.

The Energy Saving Trust estimate that the cost of a whole house retrofit could be in the region of £30,000-£40,000.60

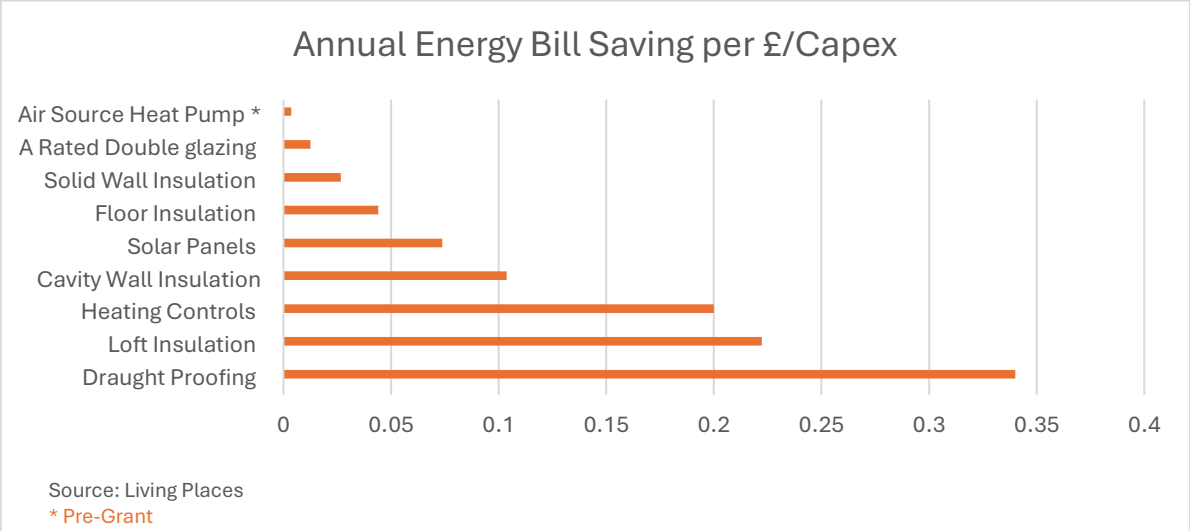


A combined measure approach focusing on the most cost-effective measures, draught proofing, loft insulation, cavity wall insulation, heating controls and renewable generation could significantly reduce the upfront cost and still deliver significant energy efficiency improvements and bills savings.

[58] **Santander: Tomorrows_Homes_report_2025**

[59] **Egi Energy: High Costs Deterring UK Homeowners from Retrofitting**

[60] **Retrofit explained - Energy Saving Trust**



Combining the more cost-effective retrofit measures could reduce the payback period to ~ 15 years from ~ 30 years for whole house retrofit.61

Sequencing of Measures

Proper sequencing of a retrofit bundle is central to realising the benefits of a multiple measure approach. Multiple measure retrofit delivery to date has been hampered by limited installer capacity which has led to measures being installed by different trades with no overarching coordination often leading to significant quality assurance failures.

PAS 2035 was introduced in response to widespread quality assurance issues in the retrofit industry. A PAS 2035 retrofit involves a comprehensive assessment of the building, followed by the design and implementation of appropriate energy efficiency measures. 62 The process includes:

- Evaluating the building's current condition
- Identifying retrofit measures
- A risk assessment to check the measure compatibility and suitability
- A medium-term improvement plan or Whole House Retrofit Plan
- Ensuring that these measures are installed correctly

PAS 2035 also lays out a logical sequencing of retrofit measures known as "fabric first" which prioritises improvements in five stages and aligns with the aforementioned 'affordable bundle approach'.63

i) Bring the building fabric into good repair by dealing with defects that inhibit energy efficiency. Deal with water penetration and damp (so that the building fabric is properly dried out) and with structural defects (e.g. cracks) and poor pointing of masonry.

ii) Implement measures that are low-cost and easy to install, e.g. energy-efficient lighting, basic heating controls and better control settings.

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[61] Living Places

[62] **PAS 2035 and PAS 2030: retrofit, accreditation and certification**

[63] **PAS2035_2023.pdf**

iii) Improve the building fabric by means of insulation and airtightness measures, and by minimising thermal bridging, to reduce heat losses and reduce the demand for heat and the required capacity of the heating system. When the insulation and airtightness of the building fabric are improved, adequate ventilation should be maintained.

iv) Satisfy the remaining heat demand as efficiently as possible using efficient heating technology and responsive, intelligent or smart controls.

v) Use LZC "renewable" energy technologies to reduce emissions further and "top up" the performance of the dwelling to the target level.

Quality Assurance

In spite of PAS 2035, quality assurance issues worsened throughout ECO4 and the Great British Insulation Scheme, and the National Audit Office reported in 2025 that 98% of homes with external wall insulation and 29% of homes with internal wall insulation installed under ECO4 and GBIS had major issues requiring remediation, and that 23% of additional measures (such as heat pumps, solar panels and cavity wall insulation) had major issues affecting performance.

Major issues of recent retrofit quality have been attributed to64:

- Poor scheme design incentivising cost cutting by installers and fragmented oversight from certification bodies and scheme providers, DESNZ, Ofgem, Trustmark and UKAS
- Lack of governmental oversight and accountability
- Insufficient auditing and monitoring
- Poor workforce skills
- Subcontracting to non-competent or appropriately registered bodies

Successful future retrofit programmes will have to adopt the lessons learned from these failings in order to create the foundations of consumer trust and successful implementation necessary to kick start the retrofit industry in the UK.

Glossary

Carbon Credits: Carbon credits are tradable instruments that convey a claim to avoided Green House Gas (GHG) emissions or to the enhanced removal of GHG from the atmosphere. Credits allow claims to be transferred from an entity that generated the avoided emissions or enhanced removals to a buyer. The buyer of a carbon credit can then "retire" it to count the avoided emissions or enhanced removals towards a climate change mitigation goal or as a contribution to global mitigation efforts. Carbon credits are certified by either governments or independent certification bodies.[65]

[64] **Energy efficiency installations under the Energy Company Obligation**

[65] **Carbon Offset Guide**

Concessional Finance: Concessional finance is below market rate finance provided by financial institutions. The most common financial products used to deliver concessional finance come in the form of loans, grants and, to some extent, equity investment.[66]

DESNZ: Department for Energy Security and Net Zero (DESNZ) is a ministerial department responsible for UK energy security, protecting billpayers and reaching net zero.

DNO: A Distribution Network Operator (DNO) is a company licensed to own, operate and maintain the local electricity distribution network: the towers, poles, cables and meters that deliver power to homes and businesses.

DSO: A Distribution System Operator (DSO) focuses on maintaining grid stability and optimising energy flows, as well as coordinating the integration of distributed energy resources (DERs).[67]

EPC: An Energy Performance Certificate (EPC) indicates the energy efficiency of a building. The assessments are banded from A to G, where A (or A+ for non-domestic properties) is the most efficient in terms of likely fuel costs and carbon dioxide emissions. An EPC is required when a building is newly constructed, sold or let. The purpose of an EPC is to show prospective tenants or buyers the energy efficiency of the building. The requirement for EPCs was introduced in phases and fully implemented for domestic properties by autumn 2008. EPCs are valid for 10 years. **Grant Funding**: Grant funding is non-repayable financial assistance awarded by governments, foundations or organisations to individuals, non-profits or businesses for projects that provide public, social or environmental benefits. Unlike loans, these funds do not have to be paid back, though they are often restricted to specific uses.

Green Book: The Green Book is the UK government's guidance on appraisal, the process of assessing the costs, benefits and risks of different options for achieving government objectives. The Green Book does not set these objectives or make policy decisions. It provides a structured framework for developing evidence-based, objective and impartial advice for decision-makers on the best way of achieving their objectives. It is supported by detailed guidance on developing business cases based on the Five Case Model, as well as supplementary guidance on specific appraisal topics.

IRR: Internal Rate of Return (IRR) is a metric used in financial analysis to estimate the profitability of potential investments. IRR is a discount rate that makes the net present value (NPV) of all cash flows equal to zero in a discounted cash flow analysis. In practical terms the IRR indicates the annualised rate of return a project is expected to generate.

Ofgem: Ofgem is the energy regulator for Great Britain. Ofgem works to protect energy consumers by ensuring they are treated fairly and benefit from a cleaner, greener environment.

PAS: A PAS, or Publicly Available Specification is a document that defines good practice for a product, service or process. The object of a PAS is to speed up standardisation, and they are often produced in response to an urgent market need.[68]

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[66] **World Bank Group: Concessional Finance**

[67] **Electron.: dnos-developing-dso-capabilities**

[68] **National Energy Foundation: an-introduction-to-pas-2035**

PAS 2035: PAS 2035 is a specification for whole house (or whole home) retrofit. PAS 2035 is a comprehensive standard introduced in 2019 as part of the UK government's commitment to improving energy efficiency in buildings.[69]

PAS 2030: PAS 2030 specifically focuses on the installation process within retrofit projects. It was introduced to ensure that all installations, particularly of energy efficiency measures, are performed to a high standard.[70]

SPV: A Special Purpose Vehicle (SPV) is a separate legal entity created by an organisation. The SPV is a distinct company with its own assets and liabilities, as well as its own legal status. Usually, they are created for a specific objective, often to isolate financial risk.[71]

Trustmark: Trustmark are the only UK Government-Endorsed Quality Scheme for work carried out in and around the home. It is operated by an industry-governed body and accredits scheme operators across 90+ trades – building, decorating, gardening, glazing, heating, roofing and more. A TrustMark registered trader has agreed to a code of conduct, a customer-charter, and complies with technical standards set by the relevant accreditation body. Trustmark requires Insurance-Backed Guarantees (IBGs) for any deposit-protected work, meaning the warranty services even if the trader ceases trading.[72]

UKAS: United Kingdom Accreditation Service (UKAS) is the National Accreditation Body for the United Kingdom. They are appointed by government, to assess and accredit organisations that provide services including certification, testing, inspection, calibration, validation and verification.[73]

[69] **National Energy Foundation: an-introduction-to-pas-2035**

[70] **National Energy Foundation: an-introduction-to-pas-2035**

[71] **Corporate Finance Institute: Special Purpose Vehicle (SPV) - Guide**

[72] **TrustMark (TrustMark) Explained — UK Guide 2026 | TradeMatch | TradeMatch UK**

[73] **UKAS**

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