



Energy Efficiency Best Practice in Housing

Energy efficient refurbishment of existing housing – case studies



Contents

Aberdeen City Council	3
A major renovation scheme, including the application of fabric insulation measures to deck access flats and heating upgrades.	
Bedford City Council	5
Rehabilitation of houses in a conservation zone, including internal insulation and efficient heating systems.	
Fenland District Council	6
A complete loft and wall insulation programme for the Council's entire housing stock.	
Hull City Council	7
The overcladding of non traditional dwellings along with ventilation and heating improvements.	
Kirklees Metropolitan Council	8
The installation of solar hot water systems as part of a heating upgrade in Council owned housing.	
Leicester City Council	9
An integrated approach to private sector housing with a key focus on ventilation needs.	
Further reading	10
Acknowledgements	11

Introduction

The energy efficient refurbishment of the existing housing stock is a priority in reducing UK carbon dioxide (CO₂) emissions, improving comfort and providing affordable warmth. These case studies cover refurbishment works undertaken around the UK in recent years in which high standards of energy efficiency have been achieved. Detailed information on the current Best Practice refurbishment standards is given in Energy efficient refurbishment in existing housing (GPG 155).

Standards and building regulations

The energy efficiency measures which are the primary focus of the case studies meet the current Best Practice standards, and the building regulations in the relevant country in the UK at the time of publication. Several case studies include secondary energy efficiency measures, some of which may not reach these standards, but which represented Best Practice when the work was carried out. Measures marked with a † would not now meet the revised building regulations in that country.

Note

U-values quoted in these case studies have either been provided by the host organisation or calculated using default values for a stated construction. Consequently, seemingly identical improvements may have slightly different U-values quoted.

Aberdeen City Council

Aberdeen City Council manages one of the largest housing stocks in Scotland with approximately 26,350 houses. The Council's Housing Improvements Unit has the energy efficiency brief within the Community Services Directorate and acts as informed client to Environment and Infrastructure Services on housing improvement programmes. It also advises tenants on any housing improvement matters. Amongst these projects has been the upgrading of a number of open deck access blocks in the Torry area of the city.

The properties

Since 1992 the Council has renovated 164 flats and maisonettes built in the late 1960s, in 6 phases.

The properties had deck access, no insulation and electric storage heating. Although some works had been carried out over the years, the properties had deteriorated to a bad state of repair with minimal insulation, inadequate heating facilities, condensation and mould growth. In addition the general area was becoming undesirable. The security issues were high on the list of tenant priorities along with energy issues. NHER ratings of around 2 (and a SAP of 32) were the average for these flats. At sea level, and only 300 metres from the North Sea, the blocks are fully exposed to the worst coastal gales.



Figure 1: Flats before improvement



Figure 2: Flats after improvement

Programme of works

It was clear that single measures, whilst improving the properties in the short-term, would not be sufficient to provide decent housing and affordable warmth on a long-term basis. A list of measures specified in excess of Building Standards at that time were included in the works. Aberdeen City Council specified controls to Central Heating System Specifications (CHeSS) (2000) guidelines and from April 2003, following a number of test projects over the last two years, will be fitting condensing boilers as standard on all heating upgrades and refurbishments.

Tenants were moved to adjacent properties in the Torry area of the city and, as the phases progressed, into the previously refurbished properties.

The following refurbishment took place:

- deck access and balconies removed.
- new secure access stairs to four properties at a time.
- old balconies enclosed inside the property and external walls were given 100mm polystyrene insulation, as appropriate to the standards at the time, finished with dry dash render (U-value 0.3W/m²K)
- loft insulation to Building Standards of that period
- gas central heating with programmer, room thermostat and TRVs
- timber double glazed windows with 12mm air gap† and trickle vents
- extractor fans in kitchens and bathrooms
- rewiring and full replacement of internal fittings

The full complement of works has resulted in an average NHER of 8 for the properties, and a SAP of 76.

The average cost of improvements per property was £44,500 reflecting the upgrade to the general area as well as the energy components.

Funding

All works were funded by the City Council. Some Energy Efficiency Commitment (EEC) funds have been secured from Scottish Gas in the last phase which will include condensing boilers.

Tenant liaison

The Council are committed to giving tenants a greater say in the decisions that affect the houses and areas in which they live. In the case of these blocks initial tenant consultation showed that there was broad agreement between tenants and the Council on the solutions to the problems. The results have vastly improved tenants perceptions of the properties.

Benefits

A major motivating factor for the Council to carry out the improvements was to try and halt the deterioration of the flats and the area as a whole. Since the renovations have been carried out tenant turnover has reduced and there has been a small increase in income from rents. The removal of the stairwells during the improvements allowed 20 new flats to be created.

Before improvements to the flats the estimated annual fuel bills per flat were £540 per year or £10.38 per week. After the installation of measures the estimated annual fuel bill is £190 a year or £3.65 a week – a saving of £350 a year.

The future

Work is about to start on the specifications for the 7th and final phase and these will be the first major refurbishment works to be carried out since the changes to Part J of the Building Standards in Scotland. All the works will be reviewed to ensure they meet the more rigorous requirements of the new standards.



Figure 3: Flats before improvement



Figure 4: Flats after improvement

† See 'Standards and building regulations', page 3

Bedfordshire Pilgrim Housing Association Ltd

Bedfordshire Pilgrim Housing Association Ltd (BPHA) manages over 10,000 properties in the Bedfordshire area. Investment in the fabric of these properties and the energy efficiency of homes has been a priority for the Association since it was set up in 1990. Two large Georgian houses built in 1840 were completely refurbished and the work was finished in February 2003. The properties were empty, in a poor state of repair with rain penetration to the brickwork and major structural problems. They were also situated in a conservation area and the Association decided that there was good potential for architecturally sensitive improvements that would still incorporate energy efficiency measures and significantly reduce future running costs.

Costs and funding

Total costs for renovating the two properties was £100,000, most of which came from BPHA funds. The extent of the work meant that energy efficiency measures could be added at little additional cost. Some funds were provided through Bedford Borough Council's grant scheme for minor repair work and a similar amount was available through the EEC.

Programme of works

After repairing the structural problems the final energy efficiency specification was developed using Good Practice Guides, Local Authority programmes and extensive web based research. The specification included:

- loft insulation top-up to 250mm (U-value 0.16W/m²K)
- dry-lining with insulated plasterboard (approximate U-value of 0.45W/m²K)
- SEDBUK 'A' rated condensing boiler
- room thermostat, programmer and TRVs
- humidity controlled extractor to kitchen and bathroom
- PVC-u sash windows with low-e glass and trickle vents (U-value 2.0W/m²K), and insulated external doors

Tenant involvement

Although there were no tenants in the properties, tenants in neighbouring properties were consulted and encouraged to provide input, especially into the aesthetic qualities to the external works. In addition the consultation provided a channel to give energy efficiency advice to a group of people who may not have otherwise been exposed to such advice. As tenants moved into the properties face to face advice was given on the measures installed and on how to use the heating controls. Corresponding literature in several languages, including Punjabi and Urdu, has also been developed.

Improvements and benefits

The SAP scores for these two properties have increased from 40 to 80, with associated annual heating and hot water costs estimated to be £460 per property.

BPHA has benefited by adding value to their stock, from the good local publicity and from the fact that the renovation has been part of their strategy for reducing fuel poverty.

Lesson learnt

Difficulties with the conservation issue were highlighted by the need to ensure that Building Regulations were being met at all stages and the need for consultation with the Council, tenants and installers.



Figure 5: Front views before improvement



Figure 6: Front view after improvement

Fenland District Council

Fenland is a rural area with some 4,200 Council owned homes, the majority of which were built between 1945 and 1974. An energy policy was set by Fenland District Council in 1999 and the first capital programme for energy efficiency focused on the fabric of their stock. Since 1999, loft insulation and cavity wall insulation has been installed in all Council owned homes.

Motivation

The Council's motivation for improving the fabric of their stock comes from an energy policy that is 'Affordable Warmth for All' and from the fact that 75% of tenants are in receipt of one or more benefits.

Loft insulation and cavity wall insulation were jointly recognised as being the most cost effective measures for the Council to install in order to reduce tenant fuel bills and improve the level of comfort of the dwelling. The measures are also very quick and easy to install. This helped meet the Council's strategy of achieving the biggest savings in the shortest time, whilst minimising disruption to tenants.

Funding

The Council employs an Energy Conservation Manager who was tasked with identifying as much external finance as possible. Energy Efficiency Standards of Performance (now EEC) funding from four private energy suppliers was used to supplement the capital fund available from the Council. The total cost to the Council of insulation works was approximately £400 per property.

Specification

The Council are committed to promoting and, supporting energy conservation, and aim to specify in excess of Building Regulation standards wherever possible. After considering the advice available on insulation from Good Practice Guides the following specification was used:

- loft insulation – cellulose fibre installed to a depth of 250mm (estimated U-value 0.14W/m²K). Any pipes in the loft space were insulated along with the loft hatch which was also draughtstripped. The installer was asked to ensure adequate ventilation in the roof space and this was checked, in a 10% random sample of properties, by the Council's surveyors
- cavity wall insulation – the construction of the properties is conventional brick with a 50mm cavity. Mineral wool was used to fill the cavities. The installers were BBA approved and a CIGA guarantee issued for each installation is held by the Council

Tenant participation

The District has a strong tenant forum representation which is fully consulted on all aspects of change. Tenant contact included:

- information in the Council's quarterly magazine
- access to the Energy Team at the Council, where all members of staff are qualified energy advisors and can make visits should the need arise
- literature, giving energy advice and demonstrating the benefits of both cavity wall and loft insulation was left with the householder on completion of the contract

Benefits

Increasing the thermal properties of these dwellings has increased the SAP by, on average, 18 points and estimated CO₂ savings are up to 1.7 tonnes per dwelling. Reductions in fuel bills of 25% means that tenants have more money to spend and the Council found that rent arrears decreased following the works. Tenants also noticed a considerable improvement in the internal comfort of the property. The maintenance department have had fewer occurrences of damp and mould growth to deal with since the insulation measures have been installed in the properties, so reducing their costs.

In addition, the general awareness of energy and environmental issues has increased with a recent survey suggesting that 60% of all households are aware of the energy efficiency works being carried out by the Council.

To be seen as a responsible landlord is of paramount importance to the Council. Benefits of energy efficiency are varied but include:

- social inclusion
- high quality housing
- equality
- anti-poverty strategy
- improving health of tenants
- happier tenants
- motivated staff
- achieving targets for HECA
- fuel poverty eradication



Figure 7: Insulation being blown into loft spaces

Hull City Council

Hull City Council is a major landlord in the city. With over 35,000 properties to maintain and manage, any properties with a poor thermal performance, high turnover, low occupancy and high maintenance costs are a major drain on resources. One such estate, at Bransholme, comprising 1,415 Wimpey No-Fines cast-in-situ concrete homes and 120 traditional properties, has benefited markedly from major refurbishment works carried out between 1995 and 2001.

Programme of works

With deteriorating render, rotting window frames and failing underfloor heating systems the average NHER of the 1,620 properties was just 1.9, with a SAP of 15. Influenced by their experiences from the Government's 1992 Greenhouse Programme, the City Council had set a target NHER of 8 for all refurbishments. Specific issues relating to non traditional construction were researched and considered in conjunction with Building Regulations requirements.

A pilot programme on three houses allowed a final specification to be developed and put out to competitive tender. The final energy efficiency measures included:

- mineral wool external wall insulation covered with an acrylic render (U-value of 0.33W/m²K)
- loft insulation top ups to 250 mm (U-value 0.15W/m²K)
- passive stack ventilation systems
- heating system upgrade including programmer, room thermostat, TRVs and boiler interlock

These measures contributed to give an improved average NHER of 8.1 and a SAP of 79.

Tenant participation

The City Council runs a tenant forum. Tenant groups were consulted on the plans for the properties and how they would be affected. On completion of the work the tenants were given training on the new controls and efficient use of the new systems. A nominated member of the maintenance and refurbishment team was made available to tenants to help solve any problems and to offer advice.

Benefits

The tenants were given a satisfaction questionnaire following completion of the works and the results are encouraging. Tenants have reported improved comfort, lower bills and fewer draughts. Simulations using BREDEM based software suggest a typical family's total energy bill has reduced from approximately £900 per year to £500.

The refurbishment of the properties has also shown huge benefits to the Council. Demand for properties on the estate has increased with voids and re-let times now well below the city average. Maintenance costs have also reduced significantly. Costs on the estate are below the city average.

The Council has increased income following the scheme as the rents have been increased by a small percentage, to reflect the benefits of the central heating, increased energy efficiency and other environmental improvements. The percentage of tenants in rent arrears has also fallen by over 10% so further reducing Council costs.



Figure 8: Houses before refurbishment



Figure 9: Houses after refurbishment

The first port of call for the energy element of any works are the relevant Good Practice Guides.

John Bell, Hull

Kirklees Metropolitan Council

In January 2002, Kirklees Metropolitan Council installed solar hot water heating systems as part of a heating system upgrade in 19 properties. The refurbishment was part-funded by a Government scheme which aimed to reduce the effects of pit closures and to reduce CO₂ emissions.

The properties were 2/3 bedroom brick built family homes built in 1946. Each property had a gas fire in the lounge (one had coal) and at least a wall heater upstairs. The properties had previously been upgraded with loft insulation, cavity wall insulation and double glazing. However the SAPs were still below the national average at 35 – an adequate heating system was necessary.

Costs and funding

The cost of the scheme was £100,000; this included design costs through Kirklees Council Estates, Property and Market Services. The project was jointly funded with central Government and Kirklees Council Energy Unit's Warm Homes budget.

Product specification

After taking advice from manufacturers and installers, 3m² or 4m² (depending on the property) solar collectors, were fitted to south facing properties. A new insulated hot water tank, insulated pipework and a gas fired condensing boiler with integrated heating controls were all part of the heating upgrade.

The specification required a boiler with a minimum SEDBUK rating 'B' and an arrangement with the manufacturer to supply an after sales service.

Tenant involvement

The Council realised that the co-operation of their tenants was important and tenants were given the choice of having the works done or not. After agreeing to the works they were consulted in detail at every stage.

After installation tenants were given face to face advice on how to use the new system and they were also left contact details where help could be reached at Kirklees Energy Unit.

Improvements and benefits

Tenants report considerable savings on energy bills. Annual fuel costs associated with hot water alone have been estimated to be £70 lower per household after fitting the new condensing boiler and solar panels.

Improvements to the properties have given a SAP increase from an average of 35 to 76 with corresponding savings in CO₂ emissions of 1.4 tonnes per year per property.

This scheme has been a success in the area and Kirklees Neighbourhood Housing, formerly Kirklees Housing Services, has since installed more solar panels on an adjoining estate.



Figure 10: Properties with solar hot water systems installed



Figure 11: Control panel on the new solar systems

Installation and consultation have gone well with a high level of tenant satisfaction. Based on this success we are planning more installations in the future.

Richard Garner, Kirklees

Leicester City Council

Leicester City Council was able to improve over 2,500 properties as part of their City Challenge programme. Certain properties, predominately late 19th century/early 20th century terraces (owner occupier and council properties) with an average SAP of 28, had been identified as being in need of regeneration. Householders were sent a questionnaire and individual properties were targeted based on the results. These refurbishments would provide affordable warmth, improved comfort and healthier homes and would also continue Leicester's environmental improvements as Britain's first Environment City.

Costs and funding

Core funding came through the City Challenge fund but monies were also levered in from householders and the Home Energy Efficiency Scheme (now called Warm Front). Owners, landlords and occupiers made a contribution to the works, based on an ability to pay, through two year interest free loans.

Programme of works

Improvements were based on the 'Leicester list' developed by the Leicester Energy Group which prioritised installations in terms of improved efficiency and payback. This ensured that energy efficiency measures were completed in the correct order and that the issue of internal air quality was also addressed.

- Insulation – 250mm loft insulation, cavity wall insulation (where applicable), full draughtstripping and, finally, PVC-u double glazing (U-value 2.7W/m²K†).
- Heating – if new heating systems were required, SEDBUK 'A' rated condensing boilers with a full control package were installed. The heating controller, which could be lifted off the wall and carried around, proved invaluable. Residents took them into the council offices or the local advice centre for help with programming. Storage heaters with intelligent controls were fitted in properties where gas was not an option.
- Ventilation – cavity wall insulation and draughtstripping improve the airtightness of a property and a fan pressurisation test carried out in one particular house in the scheme showed a reduction from 33ach@50pa to 11ach@50pa – close to the national average. As airtightness improves, controlled ventilation becomes more important. The Leicester team recognised this important issue and heat recovery ventilation fans were fitted in many of the properties. These fans had continuous humidity sensors to stop, start and control the speed of the units.

Property improvement

The average cost to the council was £200 per property. Improvements to properties were assessed in terms of fuel bills, SAP and CO₂ emissions using the BREDEM based software and the average SAP for the area has improved from 28 to 62. Associated annual savings in fuel bills averaged £200 per property and on average, four tonnes of CO₂ are being saved per year per household.

Householder involvement

Householders were initially contacted by post and encouraged to fill out a home energy questionnaire. Those responding were then sent a detailed energy report on their property based on the questionnaire. Over 5,000 reports were sent out and, after follow up visits, over 2,500 properties were improved. Advice was also available at the local Energy Efficiency Advice Centre, where staff were fully aware of the programme, and from the council's Energy Management Team.

Benefits

Householders are experiencing lower fuel bills, a reduction in condensation, a reduction in draughts and increased comfort. They also have an improved awareness of the energy use in their home and how this affects the environment. The council has benefited by reducing fuel poverty, meeting environmental targets and the transformation of a previously run down district into a vibrant and desirable area. The council are pleased with the scheme and believe that a key factor in its success was the development of good working relationships with the householders, manufacturers and suppliers.

Costs and results

- £500,000 core funding
- 2,500 properties
- 34 SAP points average improvement
- 4 tonnes CO₂ saved per property

The 'Leicester list' priority of measures

- 1 Insulation (loft and wall)
- 2 Heat recovery ventilation fans
- 3 Low energy light bulbs
- 4 Draughtstripping
- 5 Thermostatic radiator valves (TRVs)
- 6 Condensing boilers
- 7 'Intelligent' heating controls
- 8 Double glazing



Figure 12: Council property in Leicester

† See 'Standards and building regulations', page 3

Further reading

Energy Efficiency Best Practice in Housing publications

These publications can be obtained free of charge by telephoning the

Helpline on **0845 120 7799** or by visiting the website at

www.est.org.uk/bestpractice

Good Practice Guides (GPG)

GPG 26: Cavity wall insulation in existing housing

GPG 138: Internal wall insulation in existing housing – a guide for specifiers and contractors

GPG 171: Domestic energy efficiency primer

GPG 199: Energy efficient lighting – a guide for installers

GPG 208: Providing energy advice to householders – a guide for local authorities and housing associations

GPG 224: Improving airtightness in existing homes

GPG 268: Energy efficient ventilation in housing. A guide for specifiers on the requirements and options for ventilation.

GPG 284: Domestic central heating and hot water: systems with gas and oil-fired boilers – guidance for installers and specifiers

GPG 293: External insulation systems for walls of dwellings

GPG 294: Refurbishment site guidance for solid walled houses – ground floors

GPG 295: Refurbishment site guidance for solid walled houses – windows and doors

GPG 296: Refurbishment site guidance for solid walled houses – roofs

GPG 297: Refurbishment site guidance for solid walled houses – walls

GPG 301: Domestic heating and hot water – guidance for installers and specifiers

GPG 302: Controls for domestic central heating and hot water

General Information Leaflets (GIL)

GIL 23: Cavity wall insulation: unlocking the potential in existing dwellings

GIL 59: Central Heating System Specifications (CHeSS)

GIL 70: The effect of Building Regulations (Part L1 2002) on existing dwellings

GIL 74: Domestic Condensing Boilers – the benefits and the myths

General Information Reports (GIR)

GIR 64: Post-construction testing – a professional's guide to testing housing for energy efficiency

GIR 72: Heat pumps in the UK – a monitoring report

GIR 88: Solar hot water systems in new housing – a monitoring report

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Further information on the funding sources mentioned in these case studies

For information on EEC contact:
Ofgem on 0845 906 0708 or www.ofgem.gov.uk or fuel suppliers.

For information on Warm Front contact:
EAGA on 0800 316 6011 or www.eaga.co.uk, Powergen on 0800 952 1555 or www.powergen-warmfront.co.uk

Information on City Challenge Funding (Leicester case study) is no longer available.

Good
Practice
Case Study
418

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