Section 2.3: Eco-Renovation

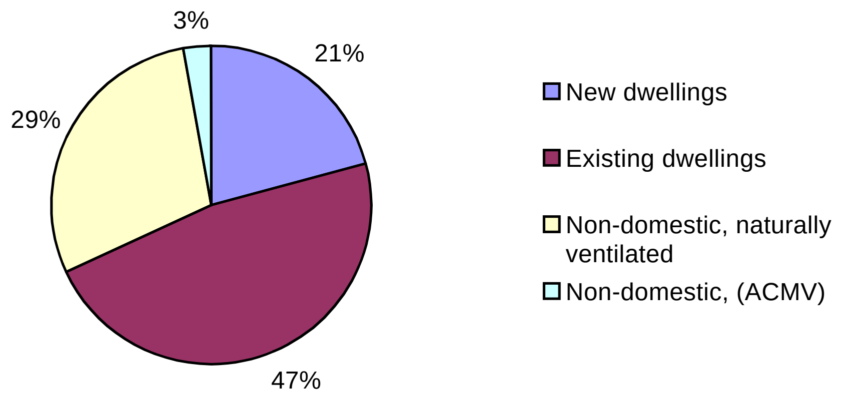
2.3.1 The Potential for Environmental Benefit

Eco-renovation and conversion can be seen as the ultimate in recycling - of whole buildings rather than just the components. This approach creates buildings with low energy requirements and running costs, enhances health and comfort, as well as being resource efficient, minimising waste and prolonging the life of the building. Ideally, all this will be achieved using low-energy, sustainably produced materials.

There are some 22 million dwellings in the UK and roughly 150,000 new homes are built each year. Simple arithmetic tells us that the time needed to replace the current stock at the current rate of build is 146 years. This does not take into account the 4 million new homes which are needed, according to the government, over the next 20 years. So even if all our new-build homes were built to best environmental standards, the benefit would take some decades to filter through, unless it was part of a strategy which also emphasised the importance of eco-renovation.

There are of course limits to what can be done with an existing building. For example, in most cases it would be impractical to attempt to alter the orientation. The benefits of eco-renovation are however mainly quantitative (small improvements to many buildings) rather than qualitative (a few zero-energy buildings). It has been estimated that the potential savings in heating energy by renovation is about 30 percent on average, whereas with newbuild it can be up to 92 percent [1]. Government analysts looked at the sources of predicted CO_2 savings anticipated from improving the thermal performance requirement of the Building Regulations. They concluded that the single biggest contributor (47 percent) would be existing dwellings (see Figure 1) [2].

Figure 1: CO_2 savings in England and Wales arising from proposed amendments (for 2002 and 2005) to Part L of the Building Regulations



The kind of environmental upgrade that can be incorporated into renovation works relates mainly to improving energy efficiency. This is because there are good returns to be made financially, environmentally and in terms of comfort/health. The work needed to achieve the upgrade can be done without unnecessary disruption, and is often incorporated into the renewal of building elements for functional reasons (e.g. roofs, windows and heating systems).

2.3.2 Energy Efficiency and Sustainability

Energy efficiency is poor throughout the whole of the UK housing stock. Half of our dwelling stock is more than 50 years old and was built to very different standards than today. While these dwellings will typically be robust structurally and built with low-impact materials, they are often difficult and expensive to heat adequately, which creates the problem of fuel poverty. This must be addressed for the achievement of both environmental and social progress.

The Government's Standard Assessment Procedure (SAP) rating is calculated on the basis of predicted fuel bills. While there is no minimum acceptable value, a score of 80-85 out of 100 can often be used to show compliance with the Building Regulations for new homes. Yet 96 percent of existing houses in the UK would score less than 60, and 15 percent would score below 25. The average SAP rating on our current housing stock is 42. The English House Condition Survey of 1996 showed that only 15 percent of owner occupied houses had the then current Building Regulations standard of 150mm or more of loft insulation.

According to the 1996 EHCS, 13 percent of dwellings in England fell in the category of 'poor housing', which meant either unfit, in substantial disrepair or requiring essential modernisation [3]. Dampness, disrepair and unsatisfactory facilities for food preparation were major causes of concern. Another report, commissioned by the Joseph Rowntree Foundation and published in 1996 by the National Housing Forum, came to a sobering conclusion that was sensationalised in newspaper headlines: 'Thousands Die of "Home Sickness"- Bad Housing Kills'. Poor housing conditions were found to contribute to 'chronic chest disease, hypothermia, digestive problems, schizophrenia, even cancer'.

In addition to the poor state of repair and thermal inefficiency that characterises our housing stock, much of it is inappropriate for modern households in terms of its size, layout, and location. Recent demographic changes have shown a shift away from the conventional two parent family towards an increasing number of single parents and single people wanting independent accommodation. Issues of accessibility and flexibility, which could enable a building to respond to the changing need of its occupants, need to be addressed.

In working to create a more sustainable society, including economic and social progress as well as environmental improvement, the importance of improving the existing housing stock and reducing its impact is obvious. Yet eco-renovation remains the 'Cinderella' of sustainable construction. It is more difficult, less glamorous and without the plethora of books, magazines and free advice directed at new-build. There are of course a number of high-profile renovations of beautiful old civic buildings, full of character and irreplaceable details, whereby banks are converted into winebars, or churches into shopping centres [4]. Yet it remains the case that VAT is charged at the full rate on renovation works and extensions, but not on new-build, which creates a powerful economic argument for demolition and complete replacement, rather than repair and upgrading.

We need to reduce our overall consumption of all non-renewable resources and make best use of the resources already in use. Buildings encapsulate much of that in-use energy and resources. Demolition dissipates it, mostly to waste. There is potential for materials reuse, but many materials can only be downgraded, and recycling involves further energy use. From a strictly environmental point of view, it is almost always better to renovate and repair than to build new.

2.3.3 The Role of the Government

At the World Sustainable Development conference in Johannesburg in 2002, the World Wildlife Fund (WWF) issued a challenge to the UK government and regional assemblies, to commit themselves to developing one million sustainable homes in the next five years [5]. It was envisaged that this target would only be achieved by addressing renovation as well as new-build. WWF-UK would ultimately like to see a ‘kite mark’ or certification scheme for sustainable homes.

Minimum standards of energy efficiency are being improved, and one of the most significant modifications in the 2002 revision to Part L of the Building Regulations was to bring more renovation work within the scope of the Regulations. In many cases, the Regulations applied for the first time to existing dwellings, material alterations and change of use. For existing houses, it is thought that the most significant impact would be in the replacement of heating systems, doors and windows, as replacement boilers or glazing are required to be as efficient as for new-build.

General energy efficiency measures and renewable energy technologies are being promoted at all levels of national and regional government. Many Local Authorities, often working in conjunction with local energy providers, Energy Advice Centres and other NGOs, are setting up programmes to promote and support energy efficiency measures in their areas. They do of course have a legal obligation, under the Home Energy Conservation Act, 1995 (Section 3.1.2) to improve energy efficiency by 30 percent over 15 years. Different areas of the country will have different schemes, but in most areas grants are available to owner-occupiers for improving or installing insulation. In some cases, if the applicant is in receipt of a means tested benefit, these grants can be 100 percent. Other items can be made available at reduced cost, such as condensing boilers, compact fluorescent light bulbs, draught proofing and radiator foils.

In addition, many RSLs are taking advantage of an ‘Affordable Warmth’ strategy, offered in collaboration with Transco, to install gas central heating into 1 million homes in the social housing sector, in conjunction with other energy efficiency measures and advice [6].

A £10m campaign has been set up to encourage homeowners, schools and communities to install their own renewable energy schemes. Funded by the DTI and managed by the BRE, the 'Clear Skies' initiative is a vital component of the Government's renewables strategy, and offers the following suggestions for local projects [7]:

- A 'solar street' where water heating panels are fitted to the roof of every house in a street
- A small-scale hydropower project in a school
- Installing a wind turbine to provide electricity to a hospital
- Using energy crops, such as willow or poplar, to provide heat for a community farm

Grants of between £400 and £5000 are available to householders, while not-for-profit community organisations can apply for up to £100,000.

This is in addition to the £20m PV Demonstration Programme, launched in 2002, which provides part funding (40-60 percent) to householders, businesses or social housing groups for solar PV installations of 0.5kWp to 100kWp [8].

2.3.4 National Case Studies

District CHP Scheme

An £11 million community heating scheme in Manchester, serving six 1960s high-rise blocks of flats, was the first energy services PFI initiative in the Local Authority sector. It replaced old and inefficient warm air and electric storage heating schemes, with new radiator systems incorporating individual controls, metering and smart card prepayment technology. Two new CHP (combined heat and power) units were installed, each rated at 150 kWe.

The PFI scheme was judged to be a more cost effective model than the traditional Council procurement method. The scheme has been popular with tenants, 91 percent of whom expressed satisfaction as a result. Occupancy levels in the flats have risen over the years that the scheme has been operating.

Inner City Estate

Faced with refurbishing a block on a large estate in South London, Lambeth Council was persuaded by the tenants to adopt an eco-friendly approach. The Angell Estate had been built in the early 1970s, when central heating was becoming standard but before the oil crisis. There was no insulation in the fabric, the flats were cold and draughty, and condensation problems were exacerbated by the use of mobile oil heaters.

The first step was to install insulation in walls, roofs and ceilings, new timber frame windows with double glazed low-E units, and insulated render on exposed concrete slabs. Full height metal windows were replaced with timber panelling and ‘breathing’ construction. In consultation with the residents, the architects (Anne Thorne Architects) removed individual, hidden, dogleg stairs between the first and second storeys, which were seen as a major safety problem. Condensing boilers and passive stack ventilation systems have increased comfort and reduced utility bills.

Subsequent monitoring found that temperatures in the renovated flats were on average 1ºC higher than in the original flats, but the heating energy consumption had been reduced by about 50 percent. Over the three-month monitoring period, CO_2 emissions were reduced by an estimated 500kg per flat. Damp, draughts and cold floors were no longer cited as problems. Overall, it was felt that this scheme represents what should be achieved as a matter of course in public housing refurbishment [9].

Figure 2: Angell Estate before refurbishment

Figure 3: Angell Estate after renovation works

An Urban Terrace

A refurbishment of four inner-terraced houses, built around 1900, was carried out by Arches Housing Association, Sheffield in 1999. Three of the four were improved to very high standards of energy efficiency, with environmentally friendly materials. The Housing Corporation required the fourth to be a 'control', and it had only minimum energy efficiency carried out. Before improvement, the houses had an average SAP of 46 and an NHER score of 4.4. The aim was to reduce residents' heating bills by £300/yr.

Roof insulation was increased to 200mm, external walls were dry-lined, and 150mm of underfloor insulation was installed. Other measures fitted included low-E double glazing, thermostatic radiator valves, energy efficient light bulbs and gas condensing boilers. The fully refurbished houses achieved a SAP of 94 and annual savings of £420, while the 'control' had a SAP of 68 and annual savings of £300.

Table 1: Summary of energy efficiency improvements, costs and resident savings [10]

Feature	SAP	NHER	Cost (£)	Saving per yr (£)
Double glazed Low-E	48	4.7	70-100 *	33
Condensing Boiler	60	5.8	200-300 *	30
Insulation	94	9.4	1,600	310
Thermostatic Radiator Valves			50 **	7
Low energy light bulbs			24-40	13

* Additional costs
** DIY costs

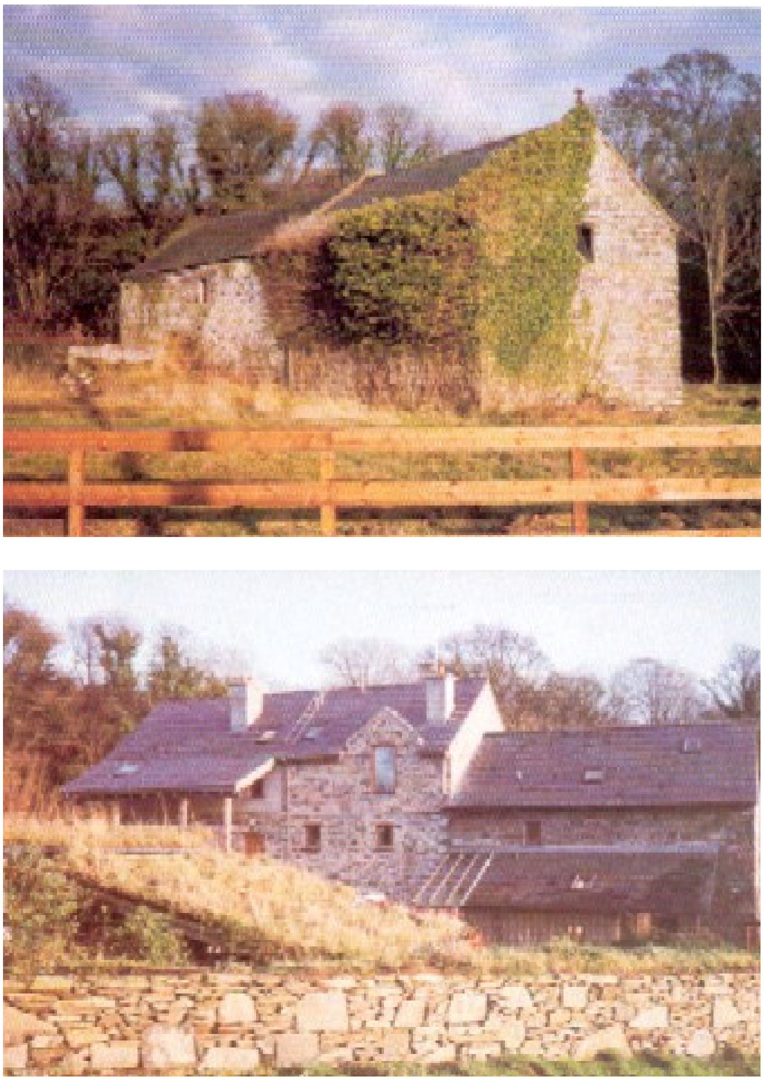
Barn Conversion in Northern Ireland

In their eco-conversion of an old stone barn, architects Tom Woolley and Rachel Beaven have adopted a strategy of 'minimal intervention', "…taking advantage of what the existing structure has to offer in terms of existing openings (some of which may be hidden) and allowing the plan to work within the constraints of the existing form" [11]. This meant keeping the design approach flexible, and careful dismantling or removal of old plasters. They also wanted to keep in mind the original function of the building, and not expect an inappropriate level of performance. For example, the current fashion for exposed stonework may not be appropriate for walls originally rendered to keep out draughts.

The familiar problem of how best to insulate old stone walls was solved in this instance by internal dry lining, 75mm deep, filled with recycled polystyrene and ventilated through the stonework. Although this approach preserved the external appearance, it did mean that energy efficiency was compromised by poor air-tightness, where services penetrated the plasterboard skin. In addition, cold bridging occurred where internal cross walls were tied into the external stone walls. Given that they had to completely replace the roof, an alternative approach would have been to construct an entirely independent timber frame within the stone walls, as they acknowledge.

Other goals on this project were to use as many reclaimed and recycled materials as possible, and in fact reclaimed slate, stone, timber and insulation were used. Their aim to avoid the use of environmentally damaging materials such as uPVC was only partially successful; electric cables and drainage were uPVC.

Figure 4: Before and after pictures of eco-barn conversion, N. Ireland



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