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Housing and sustainability: demolition or refurbishment?

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The demolition or refurbishment of older housing has been an active policy area since the late 1880s in the UK, when the government first authorised the statutory demolition of unsanitary slums. The debate on demolition and new building has been intensified since 2003, with government proposals for large-scale clearance and new construction. This paper summarises the evidence and debate on whether demolition would reduce greenhouse gas emissions from buildings. It examines whether a more achievable and socially beneficial route to reducing energy use in the built environment exists, based on the fact that buildings account for half of the UK's carbon emissions. This paper argues that large-scale and accelerated demolition would neither help with meeting energy and climate change targets, nor would it address social needs. Refurbishment offers clear advantages in time, cost, community impact, prevention of building sprawl, reuse of existing infrastructure and protection of existing communities. It can also lead to significantly reduced energy use in buildings in both the short and long term.

1. INTRODUCTION

Housing demand and its environmental impact generate considerable debate. Housing is a troublesome issue for many reasons:

(*a*) the need for more affordable supply, due in part to household fragmentation
(*b*) the high cost of land and construction
(*c*) shortcomings in energy performance
(*d*) the need for basic repair and energy upgrading of millions of existing homes.

Since 2003, housing demolition has been adopted (with UK government support) as a tool for regeneration or 'restructuring housing markets' to suit modern conditions. Many argue that this is harmful to the environment, costly and damaging to the long-term community networks that grow slowly within housing areas (SDC, 2007). The demolition of houses, which are bulky and valuable material objects, should therefore be considered only as a last resort. It is usually only advocated to remove unsound or unwanted buildings. Additionally, demolition is invariably contentious and slow in delivering new replacement homes (Power, 1987; Power and Houghton, 2007). However, the idea of demolishing the poorest and oldest homes to improve environmental efficiency and reduce fuel poverty has found some appeal and has been used to justify the large-scale area demolition of Victorian terraced housing in many northern and Midlands cities and towns since 2003. Yet the evidence for and against such a contentious and potentially risky approach is unclear.

Ambitious government building targets of 240 000 additional homes a year in the UK are already resulting in greenfield building and a high environmental impact, in spite of aspirations for energy reductions (DCLG, 2008a). Each new home, however efficiently built, adds significantly to carbon emissions through embodied energy (Ireland, 2008). At the same time, serious political debate is lacking on how to drastically reduce (by 60% at least) the energy used in running existing buildings, although they are the biggest contributors to current carbon dioxide emissions (around 50%). Meanwhile, new building contributes at most 1% a year to the overall stock.

This paper aims to:

(*a*) assess whether demolition plans to remove the worst-performing stock contribute to the aims of energy efficiency and emissions reductions
(*b*) examine the social, environmental and economic potential of the existing built environment
(*c*) investigate whether refurbishment and upgrading of the physical environment and structure of existing communities would save energy
(*d*) explore alternatives for existing communities to ensure the supply of more affordable and more sustainable housing, taking environmental and land constraints into consideration.

The retention and upgrading of existing homes would help meet today's acute housing need and protect more vulnerable communities and the environment. Upgrading the energy performance of homes offers immediate benefits, particularly to disadvantaged communities, and reduces fuel poverty. It also expands the potential for providing additional homes in existing communities while saving energy, land and materials (Power, 2007b).

2. HOUSING REALITIES

As already suggested, there are many wider issues affecting the built environment that need to be taken into account in trying to make housing more sustainable.

2.1. Neighbourhood renewal and upgrading of existing homes

Around 80% of the UK population lives in urban areas, and over 99% of all homes are more than a year old (DCLG, 2007a). How we care for existing neighbourhoods and maintain their condition and services shapes the options for renovation or demolition. The role of incremental renewal and neighbourhood management is undervalued, or even ignored, in the debate about sustainability. Yet the sheer scale of existing neighbourhoods in need of renewal (Power, 2006b) and the concentration of housing, buildings and people within them make this essential and urgent. Existing areas contain virtually the entire supply of cheap affordable housing since new replacement homes are unaffordable for those on low incomes without large subsidies (Power and Houghton, 2007).

The 24 million homes in the UK contribute almost a third of all carbon emissions (Duncan, 2009; OCC, 2007a, 2007b). At least 87% of these homes (22 million) will still be standing in 2050 (Power, 2006b), even if we return to the previous demolition rate of 50 000 a year. An ambitious building rate of 200 000 per annum (the government aims to achieve 240 000 per annum by 2016, but does not currently look likely to achieve it) would add 9 million homes by 2050, meaning that 75% of the 2050 stock would comprise what has already been built today. It is therefore clear that improving the energy performance of existing homes is vital to achieving the target of an 80% reduction in carbon dioxide emissions by 2050 and should be a priority (HMT, 2007).

To planners, it may seem easier to demolish rather than renovate a rundown area. But areas of poor-quality housing accommodate many low-income communities (ODPM, 2003a) and hold considerable latent value for the people who depend on them for survival. They also have considerable potential market value if upgraded for new generations of 'urban pioneers' (Mumford and Power, 2003a). Pre-World War I property is often 'leaky' but is the easiest to renovate and make more efficient because it is built in simple, rudimentary form. It is also potentially the most attractive (Rogers and Power, 2000). So there is almost an inverse relationship between the scale of current decay, concentrated fuel poverty and the recycling potential of an area. Council estates and concrete blocks of flats can often also be renovated to higher environmental standards, as will be shown later in this paper (DCLG, 2006d). The Empty Homes Agency (EHA) has demonstrated the feasibility, cost effectiveness and energy gains of renovation (Ireland, 2005).

2.2. Demolition

Removing the worst property in the worst areas may seem an obvious choice since most homes were built before energy efficiency became an issue and their efficiency is very low (see Table 1). However, demolition is slow, costly and unpopular. It is often also opposed by the very people who are supposed to benefit, often because the same communities have already been displaced over long periods by earlier, slow-moving clearance programmes.

A demolition rate of 80 000 homes per annum, which was reached for a few years during the late 1960s, was the highest rate in the government-driven mass clearance era (Mumford and Power, 2002). The slum clearance programme, which ran from 1930 to 1980 but was interrupted by World War II, removed two million formally designated 'slums' in large concentrated areas of Britain's inner cities. Overriding acquisition powers by public authorities coupled with open-ended subsidies made such a programme possible in a way that is unthinkable today. Constituting the 'largest clearance programme in the Western world' (Power, 1993), it caused serious human and social damage from which inner cities have barely recovered. The ensuing strength of opposition to demolition as a tool for area renewal or for improving housing conditions has meant that it is not practicable to attempt again anything like the previous scale of demolition (Power, 1993).

Dwelling age	Average SAP rating	Fraction of total housing stock in 2005: %
Pre-1919	39	58
1919–1944	43	
1945–1964	48	
1965–1980	51	23
Post-1980	61	19

Table 1. SAP rating of homes by age (DCLG, 2007a)

2.3. Housing density

In order to support a regular bus service, shops and schools, a home density of at least 50 homes (around 110 people) per hectare approximately must be reached (Power *et al*., 2004). However, the current minimum planning requirement is only 30 homes/ha. As households become smaller, so population density falls. At 30 homes/ha, there are simply not enough people to make public transport a viable alternative to cars, yet this is the minimum guideline density set by the UK government. This unsustainable density is already posing serious transport problems (Power *et al*., 2004; TGUDC, 2008).

Existing areas of terraced housing and blocks of flats normally far exceed this density, often reaching 100 or more houses per hectare, reducing energy use in transport, encouraging local shopping, making provision of good public transport more viable and offering easier conditions for high-efficiency renovation (Newman and Kenworthy, 1999). Higher density also helps social integration and reduces isolation by supporting mixed uses and better services (Appleyard, 1980; Appleyard and Gerson, 1981; Rogers and Power, 2000). Suburbs of cities and towns, however, have 35 homes/ha or less. Based on the arguments above, they could be made more environmentally sustainable through re-conversion of larger properties and some infill building (Power and Houghton, 2007).

2.4. Housing supply and demand

The UK government projects an increase in household numbers of around 230 000 per annum. The current rate of house construction is far less than this, at around 160 000–180 000 per annum (DCLG, 2008b). However, 70% of newly formed households are single people living alone who cannot pay the economic rent because of low income (DCLG, 2007b). Smaller households occupy in general more space per person, use proportionately more energy and therefore have a greater environmental impact (OCC, 2007a, 2007b). This demographic is unlikely to continue in linear form as it is socially isolating and environmentally unsustainable. The environmental consequences of new building to meet this type of household multiplication are extremely serious, pushing up space per person and associated energy costs (Table 2).

The distribution of space is highly unequal. Young couples and low-income families with children are often the hardest hit by the lack of suitable affordable homes (Hills, 2007). We have at least 18 million existing family-sized homes (far more than the actual number of families) and we have more larger older homes in the UK than elsewhere in Europe (Whitehead and Scanlon, 2007) even though new building in the UK produces smaller than average homes (Parkinson *et al*., 2009).

2.5. How and where do we build?

The building process and the materials used are both highly energy intensive. Most of the building materials in new buildings are newly produced and processed, so new homes use up to eight times more resources than an equivalent refurbishment (Ireland, 2008; Yates, 2006). This is because most of the building mass and structural elements in an existing property are already there and only rarely need replacing. This constant requirement for new materials, regardless of the long-term energy efficiency of the building, has a major environmental impact. The building process itself wastes also about 30% of the new materials, and demolition waste goes mostly to landfill or for building hardcore (SDC, 2006). Additionally, the exhaustion of available landfill sites has serious implications for the scale of building waste.

New build raises other environmental issues such as:

(*a*) the transport impact of large-scale demolition and building (owing to the sheer volumes of material being moved)
(*b*) the use of toxic and energy-intensive materials such as UPVC, chipboard, glues, cement and aggregates
(*c*) the resulting particulate pollution.

Building standards are frequently reduced to keep up the pace of building and to avoid pushing up costs, causing quality to suffer. Funding is also usually reduced during large building programmes because of cost over-runs and the end product is usually far from the original proposal. These arguments apply far less to refurbishment since the scale of operation, materials input, waste, transport and other elements are on a far smaller scale (Ireland, 2005).

2.6. Community impact

Cheap housebuilding on a large scale over accelerated time periods tends to produce 'lowest common denominator estates' outside existing communities (Power *et al*., 2004; Rogers and Power, 2000). Essential infrastructure often arrives after development and sometimes not at all. The UK has experienced this problem with the earlier generation of new towns and large outlying estates, which have become self-sufficient in only rare cases (DCLG, 2006b).

Planning based primarily on supply and demand calculations – while excluding considerations of the social and economic roles of housing – risks ignoring the links between housing, family, facilities, schools, transport and jobs. New estates on the edge of existing areas do not offer the proximity, familiar landmarks, neighbourhood identity or local culture of established areas. Proximity to urban centres is increasingly important not only for access to employment and services but also to reduce the environmental impact of transport (UTF, 1999).

2.7. The vital role of infill building alongside renovation

The overwhelming majority of builders are small firms with invaluable experience of repair, upgrading and small-scale development (DECC, 2009; FMB, 2009). An incremental approach to renovating existing homes, adding housing units on small unused sites and within existing buildings, would rely on the 50 000 small building firms that operate on a local scale. This would fit with land constraints and environmental and social conditions. It would use local labour and would revitalise rundown communities. The capacity of small (under 1 ha) sites officially not counted and therefore not registered in land assessments exceeds the projected household growth and need for land within all urban conurbations including London (LDR, 2005). However, it is crucial that green spaces, play areas and outdoor recreation are protected in these dense neighbourhoods. Therefore, while arguing that infill capacity, which is currently ignored in official plans and targets, should be explored and prioritised, more careful environmental planning and social planning will be vital to the success of this approach (Power, 2009a).

3. THE DEMOLITION DEBATE

3.1. The 40% house

The Environmental Change Institute (ECI) report *The 40% House* sets out to reduce domestic carbon dioxide emissions from homes by 60% by 2050 (Boardman *et al*., 2005). To achieve this, it proposes the demolition of three million 'leaky' homes by 2050, clearing 80 000 a year, which is four times the current rate (DCLG, 2008c). However, the following omitted considerations weaken *The 40% House* proposition.

(*a*) The political, social and environmental impact of quadrupling the rate of demolition.

	Average floor space: m^2/person					
	1 person	2 people	3 people	4 people	5+ people	All
Owner-occupied	77	48	33	27	21	46
Registered social landlord	54	31	24	19	15	36
Couple + dependent child/children	—	—	31	26	20	26
Couple aged 60+ years	—	48	34	27	20	46
1 person under 60 years	65	—	—	—	—	65
1 person aged 60+ years	71	—	—	—	—	71
All	69	44	31	25	20	44

Table 2. Average floor space by household size and category, England, 2001 (ODPM, 2003a)

(*b*) The embodied carbon in the 250 000 additional new homes per annum constructed to meet household growth. (The government's current building target is 240 000 per annum (DCLG, 2008c); the ECI proposes 250 000. Neither target includes making up for extra homes lost through higher rates of demolition (Boardman *et al*., 2005).)
(*c*) The embodied carbon in the three million replacement homes.
(*d*) The policy and financial tools required for such extensive removal of privately owned property.
(*e*) The waste of resources, social damage and blight of such large-scale demolition, and the social and health impacts on the elderly of demolition and forced re-homing (Power, 1987, 1993; Mumford and Power, 2002).
(*f*) The disintegration of most building materials during demolition, particularly slates, bricks and timber.

There are also some unsupported assumptions in the proposal. For example, the study assumes an extremely high energy performance of all new homes. Those built since 1996 are assumed to use less than a quarter of the energy of renovated pre-1996 properties. All new-build homes from 1996 are predicted to perform far beyond current standards. *The 40% House* assumes low standards in the upgrading of existing homes even though repair and energy efficiency standards are likely to rise significantly. However, the embodied energy in new building is ignored, as is the fact that building waste constitutes one third of landfill (SDC, 2006). The infrastructure required for new building carries significant energy costs itself, but that is also overlooked (Ireland, 2008).

The study does not reflect the durability of materials and structures, given the need for repair, maintenance and weather-proofing, particularly for older structural materials that have survived to date. Rather, it argues that demolition is necessary in order to reduce the apparent average length of time properties would have to last at current rates of demolition – over 1000 years. This ignores the incremental, small-scale nature of ongoing repair, which gradually makes good or replaces the main building elements as needed, effectively renewing the building stock in a constant reinvestment process. The large majority of current building spending is dedicated to repair (Power, 2006a).

Fuel poverty is offered as a further justification for demolition. However, levels of fuel poverty are much lower in social rented housing than elsewhere as a result of higher standards of energy efficiency and insulation, in spite of social housing disproportionately accommodating poor households in modest-quality homes (Hills, 2007). Many older people live in over-large un-modernised properties they cannot afford to heat. They often own their own homes, but cannot afford or cope with adequate repairs, relying on expensive, outdated electric heating, which is the most carbon-intensive source. These older, larger and more expensive to heat properties are also the easiest and most attractive to renovate and insulate (Ireland, 2005). They are often family-size homes more suitable for younger age groups. Demolition of such properties is rarely justified whereas subsidised upgrading is (Killip, 2008).

There are thus many critical factors to take into account before reaching a conclusion.

3.2. The urban environment

In assessing the energy impact of the built environment, a Royal Commission on Environmental Pollution report (RCEP, 2007) shows that if homes are refurbished to the basic standard suggested in *The 40% House* (which is below the achievable level when known efficiency measures are adopted), refurbished older homes can perform as well as new homes built to current standards over a 60-year period. In fact, over a period of just 10 years, renovation saves more in carbon dioxide emissions.

However, new homes with high embodied but low in-use energy ('zero carbon homes') may, over a 50-year period, eventually outperform refurbished existing property (Ireland, 2005). Nevertheless, behaviour change in adopting better energy practices, incremental improvements through renovation, demand management, increased incentives for higher quality renovation and fast-evolving efficiency measures would help renovation achieve much higher levels of efficiency. This study also flags up the social and environmental problems of demolition and argues for extensive renovation.

3.3. The sustainable communities plan

In 2003, the UK government's sustainable communities plan proposed an increase in house building targets to meet a shortage of housing and large-scale clearance of older, poor-quality property in former industrial areas. Energy efficiency, viable density, infrastructure support, public transport links and other services required for 'sustainable' communities were not addressed (SDC, 2007). Neither rapid growth nor clearance was justified environmentally, socially or financially.

The 10 000 demolitions a year taking place have proven costly and, in many places, deeply unpopular (Shelter, 2009). The demolition plans cover whole areas rather than single properties, thus taking out already renovated and well-maintained properties alongside those that are inadequate or derelict (Neild, 2007; Power and Houghton, 2007). The 'scalpel' approach to demolition advocated in earlier work (Mumford and Power, 2002; Power and Mumford, 1999) would only remove the most derelict and unusable (usually unoccupied) properties. It is a laborious process for planners and builders even though it is quicker and less disruptive than demolition and it aids community regeneration. Yet even in the most unpopular, rundown, older areas proposed for demolition, on average over 70% of homes are occupied (EEL, 2004; NAO, 2007; Nevin, 2001).

As a result, the only concerted attempt at systematic demolition in recent decades has proved to be extremely difficult to implement, damaging to communities and expensive. The plans have caused larger scale blight, accelerated depopulation and loss of services in potentially attractive inner areas (Power 2003b). However, rising property values in these areas, the success of renovation occurring in housing market renewal (HMR) areas and the difficulty of displacing communities is causing a rethink in government. Meanwhile, renovation and upgrading of the existing stock is a matter of urgency since it accounts for over a quarter of all carbon dioxide emissions and will continue to make up the vast majority of all homes far beyond 2050 (DECC, 2009). HMR is the latest government regeneration programme that aims to tackle low-demand housing in the north and the midlands and over a 15-year period (2003–2018). As part of the programme, nine pathfinder areas were established in 2002 and received their first substantial funding allocations in 2003 and 2004. The pathfinders are sub-regional partnerships and are unique in that they operate at a geographic level targeted at weak housing market areas rather than overall local authority or small-area levels.

3.4. Flood risk and newer properties

Driven by the ambition to build many new homes, building on flood plains is a conspicuous environmental problem and at least two million recently built homes are at risk of flooding (Power, 2008). Many modern homes, unlike more robust older homes, are unsuitable for the new climatic conditions we face. Over the last 20 years, high winds, heavy prolonged rain and serious flooding have damaged several million properties (Mootoosamy and Baker, 1998; Parry, 2000).

An examination of insurance claims over 20 years reveals that properties built since 1970, with poorer materials, are less resilient than older buildings (Black *et al*., 2006; Clark *et al*., 2002; Crichton, 2005; Mootoosamy and Baker, 1998). Additionally, large-scale building since 1970 is frequently in flood-prone areas and future storms might affect many more properties than the three million old homes with very low standard assessment procedure (SAP) ratings (Parry, 2000). (The SAP is the government's recommended system for energy rating of dwellings. Used to calculate annual energy costs and carbon dioxide emissions associated with space and water heating, it is used to fulfil the requirements of building regulations to notify and display an energy rating in new dwellings.)

Much more work is needed to proof newer buildings against climate damage (Crichton, 2005; Roaf *et al*., 2005). The environmental challenges thus go far beyond demolition and new building.

4. HOW MUCH CAN RENOVATION HELP?

4.1. The German experience

Evidence on the viability of renovation for energy-reduction purposes is growing. Prior to 2005, a number of housing carbon dioxide reduction programmes were carried out in Germany, including:

(*a*) 1996–2005 Kreditanstallt fur Wiederaufbau (KfW, the German government-owned development bank) carbon dioxide reduction programme (685 000 dwellings)
(*b*) 2001–2005 KfW carbon dioxide building rehabilitation programme (196 000 dwellings)
(*c*) 2003–2005 existing low-energy houses programme (part of the Zukunft Haus umbrella campaign) (2230 dwellings).

These programmes have demonstrated the potential to reduce energy consumption of homes with the worst performance (existing low-energy houses programme (FMTBUD, 2010)) by 80%, and exceed new-build standards. So clear was the evidence and so enthusiastic the uptake for these programmes that the German government re-launched the KfW carbon dioxide building rehabilitation programme in 2006. It now aims to bring all pre-1984 dwellings up to current German new-build standard by 2020. It was further extended to all building types in 2007.

The Zukunft Haus pilot programme 2003–2005 involved the upgrading and installation of energy efficiency measures in 915 homes in 34 (mainly rented and mostly built before 1978) blocks of flats across eastern and western Germany. The blocks were generally in poor condition and relatively hard to let. The main measures adopted in the pilot were:

(*a*) insulation, including external and internal walls, under-floor and roof cladding
(*b*) high-quality glazing
(*c*) efficient heating and energy systems
(*d*) solar collectors for hot water
(*e*) heat recovery ventilation mechanisms
(*f*) where possible, the addition of south-facing balconies and door porches.

Through these measures, energy consumption was reduced by over 80% and the renovated homes became more than twice as energy efficient as the current German new-build standard, even though German building standards are much higher and more strictly enforced than those in the UK (Figure 1) (DENA, 2005).

In 2007, a programme to bring all pre-1984 properties up to this standard by 2020 through a system of loans, grants and tax incentives was announced (BMVBS, 2007). This programme covers 17 million blocks of pre-1984 buildings (about 30 million dwellings) and includes schools, public offices and other buildings. This building upgrade programme will make a major contribution to Germany's ambition to reduce overall carbon dioxide emissions by 40% by 2020 and is inspiring similar ambitions in other European countries, including the UK (SDC, 2007).

4.2. The Empty Homes Agency

The EHA has assessed the embodied energy and energy in-use of new and existing buildings using three recent new-build and three renovation exemplars. The existing buildings were renovated to varied energy efficiency standards and the new ones were developed by major builders to 2002 or higher building standards (Ireland, 2008). The research compared the two types of property over 50 years, and included measures of the embodied energy and infrastructure costs for new build, which were an additional input compared with refurbishment (which mainly reused existing infrastructure).

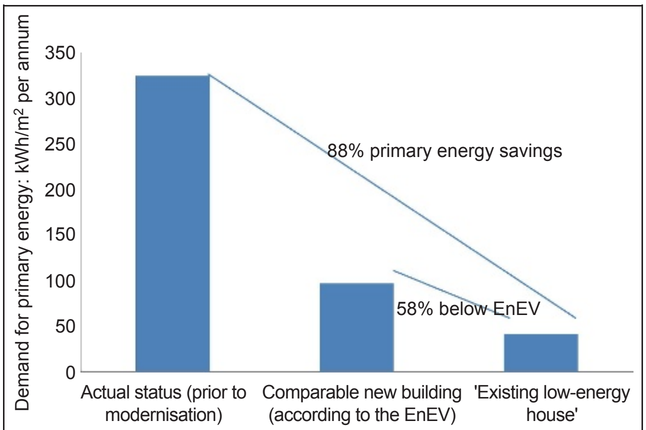

Figure 1. Evidence of energy reductions in German Zukunft Haus programme (DENA, 2005)

The research shows that, for new properties, embodied energy constitutes 35% of the total carbon dioxide emitted over the estimated 50-year lifetime; for renovated properties, the embodied energy is 7% of the total energy over this period. The in-use carbon dioxide for the two renovated Victorian properties in the sample was 20% higher than for the new build, whereas the 1950s renovated property performed considerably less well, which made the average in-use emissions for the three renovated properties 40% higher than for the new-build property (Figure 2(a)).

Taking the full energy inputs (embodied and in-use) over 50 years, the average new-build lifetime emissions totalled 174 t of carbon dioxide and the refurbished average was 194 t per home (10% more) (Ireland, 2008). Allowing for equivalent space, the renovated properties performed as well as the new builds over the whole 50-year period (Figure 2(b)).

The worst-performing refurbished property performed better for 28 years than the average new build before its cumulative impact became comparatively worse. (Note that these calculations do not allow for the risks attached to future gains in reduced emissions by comparison with the certainty of the initial carbon costs of new building.) This finding does not support the ECI's assumption that refurbished homes use 60% of the energy of an average un-modernised home, or that pre-1996 properties use four times the energy of post-1996 homes (Boardman *et al.*, 2005). The EHA study demonstrates that older refurbished properties can perform significantly better than the ECI assumption allows for.

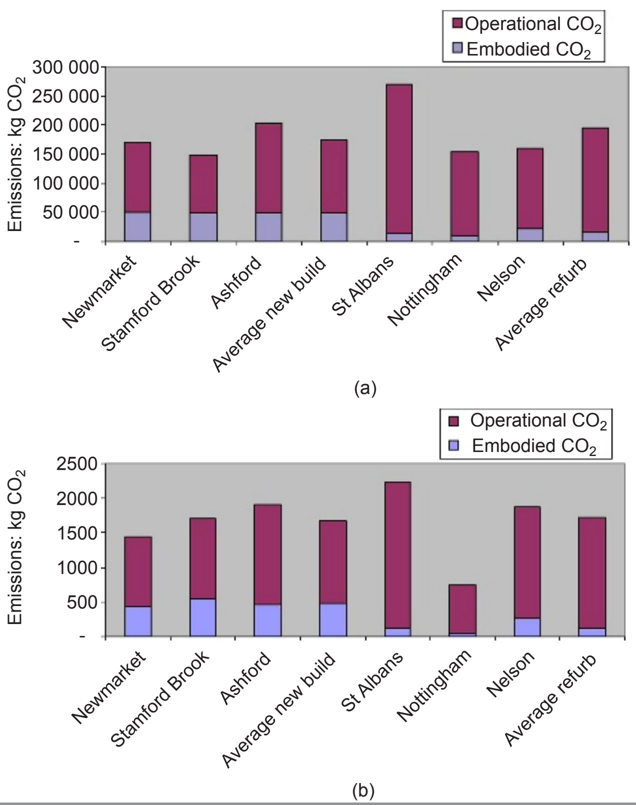

Figure 2. (a) Carbon dioxide emissions (total) from new build and refurbished homes. (b) Carbon dioxide emissions (per square metre) from new build and refurbished homes. Note: Nelson and Nottingham are both nineteenth century properties and compare favourably with average new build in total carbon dioxide emissions (Ireland, 2008)

4.3. Revaluing terraced housing through English Heritage

Work by English Heritage (EH) on the upgrading potential of older buildings has helped overcome the criticism that many of its older properties are poorly insulated due to the inherent physical character of listed buildings. The organisation became involved in protecting traditional streets and homes as part of its wider role in preserving built heritage (EH, 2006). Its work showed that terraced housing was relatively cheap to restore and cheaper to maintain than current new build, requiring considerably less material input (and therefore representing less embodied energy) through conserving bricks, beams and other structural elements. Such materials last far longer than those in new homes and the repair costs of renovated property are therefore lower. Once upgraded, older restored housing is more valued on the market than equivalent modern houses. High insulation standards lead to much lower energy in-use for terraces than standard modern homes because long party walls are shared and frontages are narrow. The internal insulation of solid external walls is achievable in terraced housing since these tend to be narrow and end of terrace and back external walls can usually be externally insulated (EH, 2006).

4.4. Technical measures show plummeting SAP ratings

The Building Research Establishment (BRE) carried out an energy audit for the Prince's Foundation on the impact of energy-efficient renovation on SAP ratings. It shows that a 60% reduction in energy use was achieved in tenements through insulation to roofs and external walls (internally applied), double glazed windows, draft-sealing doors and modern gas central heating and hot water (replacing inefficient gas and electricity). The levels of insulation were far below those recommended today, yet SAP ratings still rose from 23 to 57 in one case and from 50 to 86 in another (Yates, 2006). The current average SAP rating for all homes is 51 (DCLG, 2006a). The BRE also argues that wider neighbourhood renewal plays a significant part in overall improved environmental performance. This occurs chiefly through better management of the urban environment, which leads to greater investment in repair and renovation and encourages energy upgrading. Property upgrading also plays a wider role in urban renewal, neighbourhood management, brownfield and infill reclamation, as well as direct energy efficiency.

4.5. 'Stock take'

The Sustainable Development Commission (SDC), of which the author is a commissioner, has demonstrated the feasibility of upgrading existing building stock to a high energy performance standard by addressing the use of energy, water and construction materials and the treatment of waste products (SDC, 2006). The fact that over two thirds of homes that will exist in 2050 and beyond have already been built (Foresight, 2008), presents a powerful case for upgrading in the most cost-effective ways to the highest possible level. The findings of the SDC coincide with the German experience, showing that roofs, outer walls, under floors, windows, doors and heating systems are the most important and basic elements for saving energy to achieve maximum efficiency. Carbon dioxide emissions reductions, as a result of energy saving, are also greatest from tried and tested measures applied to these parts of the house (Figure 3).

If these known efficiency measures are applied to all the main structural elements and to space and water heating, then

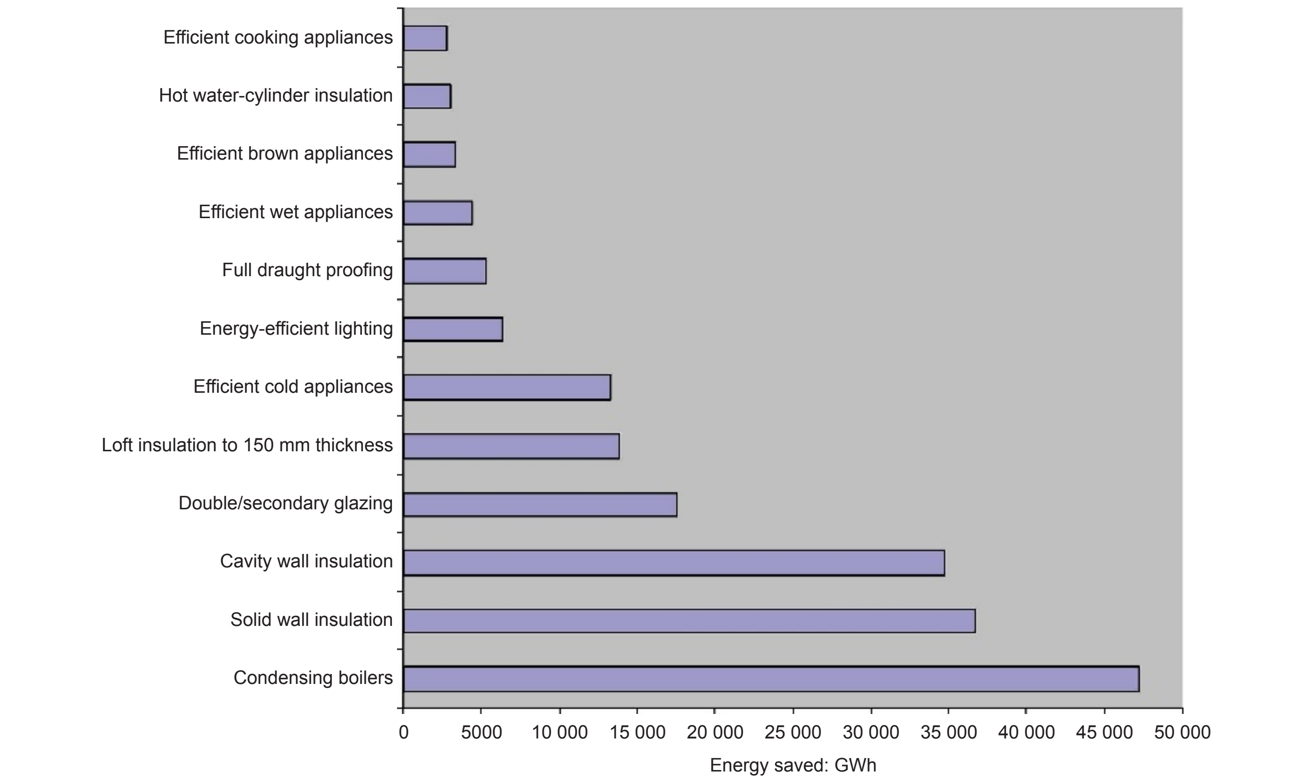

Figure 3. Average energy saved, an indication of average carbon dioxide savings from different energy efficiency measures (SDC, 2006: p. 33)

renovation can outperform current new build in the short and long term. Even solid wall insulation, the most complicated of the basic measures, shows a positive return after 14 years. The government has recently proposed a funding mechanism to encourage this type of investment (HM Government, 2009). Figure 4 shows the distribution of energy leakage from a home.

The SDC has also collected case studies of individual house renovation projects to demonstrate the gains that can be made from upgrading. Existing pre-World War I homes with the worst energy performance achieve energy in-use reductions of 60–80% (SDC, 2010).

Reinforcing this message, a major international Stockholm-based utilities company (Vattenfall, 2009) has confirmed that the overall economic cost of insulation in buildings in order to reduce their carbon emissions is in fact negative (Figure 5). The energy savings resulting from insulation measures have demonstrable payback times within the lifetime of the products, even without economic subsidy. The biggest energy efficiency gains come from added insulation, better heating efficiency and public transport, which is directly connected with existing urban structures, density and accessibility (DfT, 2007). This evidence has been used by the Office of Climate Change (OCC, 2007a, 2007b) to push for more household advice and incentives on cost-effective measures.

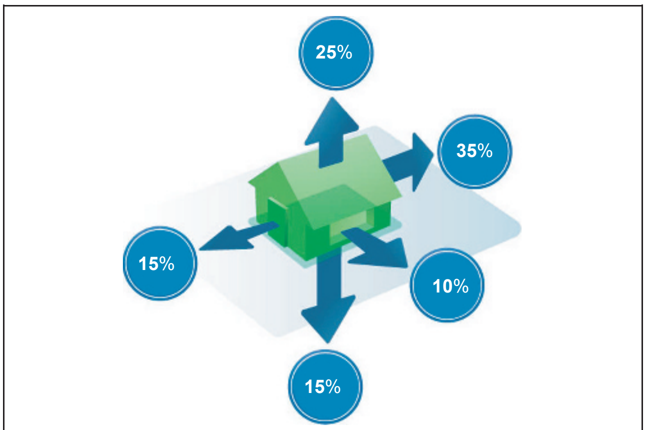

Figure 4. Main building elements showing the percentage of energy lost without high insulation (Parity Projects, 2010)

All of the studies mentioned have illustrated the potential to upgrade existing stock while reducing carbon dioxide emissions and the environmental impact of new construction.

5. DEMOLITION AND RENOVATION OF EXISTING AREAS

5.1. The impact of demolition

The available evidence suggests that renovation is not only feasible, but it is essential for the regeneration of older areas. While demolition is a common tool in regeneration, it imposes severe costs both on the communities that are targeted for regeneration and on the wider urban environment (Power, 1997; Power and Houghton, 2007).

The compensation offered to owners in demolition areas rarely covers the property's use or replacement value (SDC, 2007). This is a major factor in the intense unpopularity of demolition in occupied areas, even in areas with many empty properties. Meanwhile, housing capacity is reduced by the process of demolition and rebuilding because of the time it takes, including the slow legal processes involved in expropriating properties for demolition. It takes several years to agree precise demolition plans and acquire properties (AC, 2006). Re-housing existing

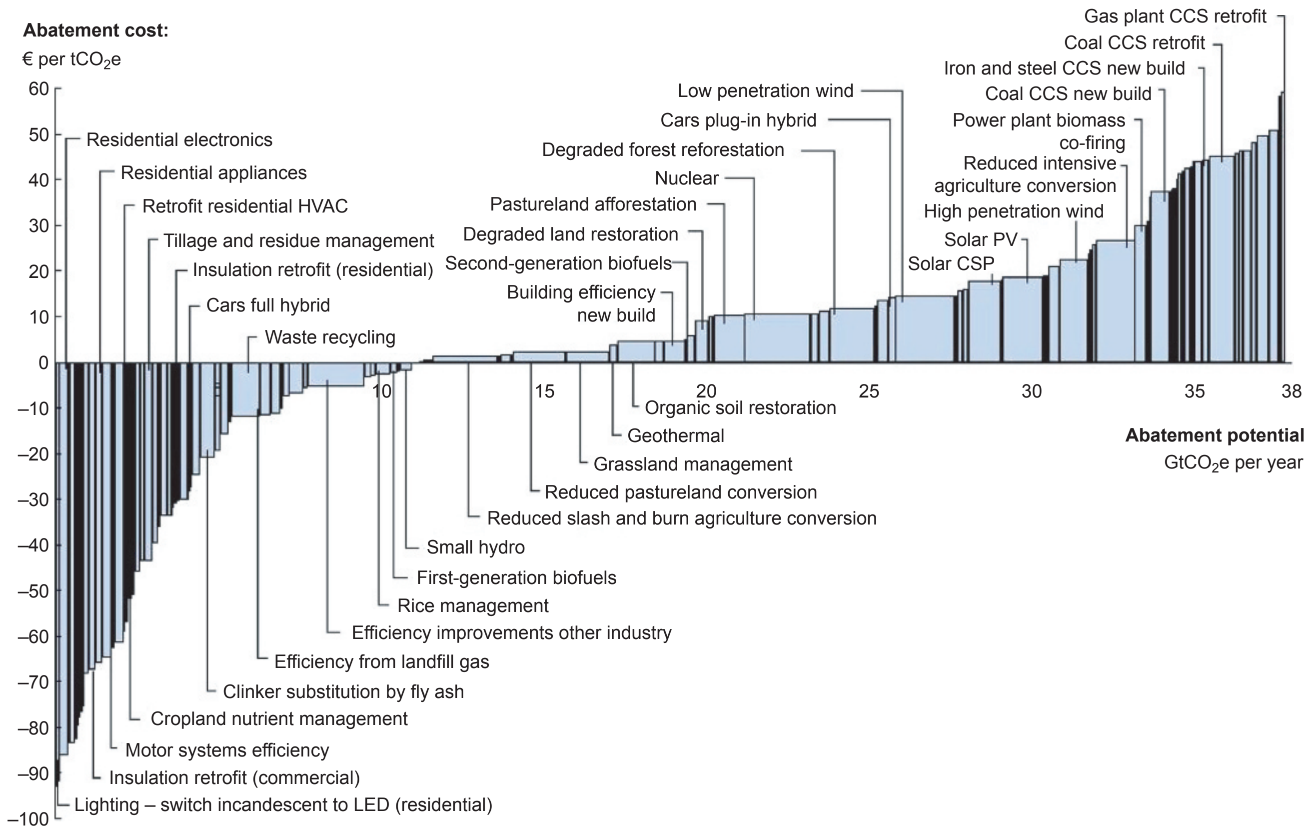

Figure 5. Negative cost of energy efficiency measures

residents delays demolition and creates extra housing demand with high costs attached (Dunleavy, 1981; Power, 2002).

Demolition causes damage to neighbouring properties through disrepair and decay because homes proposed for demolition do not attract any investment, even for essential maintenance. This can lead to water penetration, increased vandalism and arson, break-ins and other damage to neighbouring homes. Adjacent properties lose value and there can be a domino effect on local conditions. The problems of demolition blight can be made worse by the loss of essential social infrastructure and social capital, which take decades to build up again. Facilities and meeting places are costly to reinstate once they have been lost, and young people can become very disorientated as demolition advances (Power, 1997; 2007a).

Demolition plans have major knock-on effects on schools, shops, health provision, banks and other local services, most of which leave an area long before it is demolished and do not return till long after rebuilding, if at all (Power and Mumford, 1999). This causes hardship to residents, particularly the elderly, and can have negative consequences on health (Konttinen, 1985). Ugly spaces often remain so for decades due to the withdrawal of investment and the collapse of an area during demolition. Such sites become refuse-strewn and unsightly, affecting local businesses over a far wider area.

Rebuilding timescales are slowed by the need to renew infrastructure after demolition. It is rare for a demolition plan to deliver replacement housing in less than 10 years, even with strong government backing and funding. It often takes far longer, up to 20 years (Turcu, 2007). This slow planning blight on poorer neighbourhoods drives sprawl demand for housing outside existing areas. The bigger the demolition plans, the wider the damaging effects and the greater the urban exodus (Rogers and Power, 2000).

Demolition is costly – from £17 000 to £35 000 per home – not even counting actual replacement costs (Roger Tym & Partners, 2005). If we add the cost of delays in reusing the land, the loss of housing capacity and the infrastructure cost of new housing, then demolition is almost never justified in total cost terms.

Finally, costs to the local environmental are visible, with unsightly boarding up, accumulated rubbish, increased dumping, overgrown gardens, decayed streets and reduced maintenance. The wider environmental costs are even more serious:

(*a*) loss of valuable and increasingly scarce materials
(*b*) impact on landfill sites
(*c*) transport of materials to and from demolition sites
(*d*) particulate pollution in the process of demolition and transportation of waste
(*e*) loss of housing, creating the need for new housing with its high embodied energy.

It would be possible to conclude that only extreme physical dereliction justifies such high social, economic and environmental costs (Power, 2009b).

5.2. The consequences of refurbishment

In all but the cases where *de facto* rebuilding would be required, refurbishment is both cheaper and less damaging to the local and wider environment than demolition or new build. Refurbishment offers many clear benefits: it preserves the basic structure of a property and reuses existing infrastructure. This makes it a far quicker process than demolition. While existing infrastructure may sometimes need upgrading, this is far less costly and less energy intensive than the building of new infrastructure (Power, 2003a). It also involves a shorter and more continuous building process since most of the work can happen under cover in weatherproof conditions. New build involves many months of exposure to all weathers while building the foundations and main structure.

The renewal of a single house has a positive externality effect on neighbouring properties. It gives a clear signal that the neighbourhood is worth investing in, contributing to the long-term value of an area. If an area's homes are renewed, many other existing underused buildings become potential sources of additional homes and services. This applies to unwanted office buildings, disused shops, storeys over shops, old schools, warehouses, workshops, pubs, churches and other buildings.

Renovation is far less disruptive to residents because even where major work is undertaken, unless a dangerous structure is involved residents can usually stay and area services continue to operate. If residents have to move out temporarily, it is usually for weeks or months rather than years.

Older existing neighbourhoods and homes require constant upgrading due to wear and tear as well as gradual decay. Renovation, through adding value and improving the attractiveness of the area, has a positive effect on street conditions, social mixing, service quality, local transport and schools.

Successful and prosperous towns and cities have shown how continuous renewal happens. For example, demolition is rarely proposed for terraced streets or council estates in places like Durham or Chester, showing that renovation is feasible and viable for older properties. Often, poorer communities are gradually 'gentrified' but the process is more mixed and less harsh than wholesale clearance, as demonstrated by many community programmes. Lack of renovation in itself can eventually lead to wholesale demolition and displacement, while 'low-level gentrification' retains and attracts working households to sustain an area (Butler, 2007).

5.3. Wider benefits of renovation to neighbourhood renewal

There are four gains from a renovation approach to poor-quality housing. First, upgrading existing property sets in train a virtuous circle of reinvestment and revaluing unused buildings and land while encouraging much higher quality and better energy-efficiency standards (DCLG, 2006c; Power and Mumford, 2003). Most underused buildings can be brought back into beneficial use, whether as housing or for community or commercial use. This can reduce the need for large new building sites. Renovation of larger existing homes encourages families to stay within existing communities and combats fuel poverty. Conversion into smaller, more manageable units allows elderly people to remain in this community, alongside younger, smaller households, offering support and more manageable accommodation.

Second, renewal gives a new lease of life to infill spaces. These small gaps in existing areas, as a result of change of use, earlier demolition or bad land use planning, are complicated to develop because of their small size (under a hectare and often under half an acre). They are not officially counted in planning documents or in brownfield land registers. They could provide virtually all the extra land needed for additional building for at least 30 years (Power, 2006b). Many are in rundown areas and are vacant because of the perceived investment risk, the low value of the land, the complexities of planning for new building within existing areas and the priority given to wider scale renewal (Power *et al.*, 2004). This infill reuse requires intensive neighbourhood management. Areas previously written-off as requiring demolition are recovering through neighbourhood management and reinvestment approaches (LSE/CASE, 2007a).

Third, density is increasingly important because the halving of household size since World War II has led to increased demand for homes and the loss of a critical mass of people in a given area to support local services including buses, shops and local schools. This is shown to have led directly to neighbourhood decline (RCEP, 2007). Conversion of larger homes, empty buildings and infill building increases density in the face of falling household size and a shrinking population density. Low density encourages scaling up of provision, which in turns leads to the withdrawal of front line services, reduced supervision, more cars, more traffic and more anti-social behaviour (LSE/CASE, 2007a).

A fourth benefit of renovation and infill building as opposed to large-scale demolition and new build is local economic development, involving reinvestment in declining neighbourhoods using small locally based building firms usually hiring local workers. In a context of high rates of economic inactivity in urban areas, despite low official unemployment, this development can generate new jobs, skills and motivation within demoralised communities (BMVBS, 2007; Winkler, 2007).

5.4. What would help?

Renovation, repair and upgrading will remain by far the most significant contributors to affordable housing and to progress in energy efficiency and environmental protection for the foreseeable future (Hills, 2007). Incentives for renewal and energy efficiency are essential, yet current incentives favour demolition and new building. For example, new build is currently free from value added tax (VAT), whereas most repair and reinvestment is subject to 15–17·5% VAT, falling to 5% for property that has been empty for more than three years. Even in government-targeted regeneration areas, the VAT rule applies, offering a perverse incentive for demolition (CABE, 2010; Power, 2006a).

Meanwhile, demolition costs in area renewal programmes are invariably met by government, as is the cost of infrastructure for new-build homes. These add £17 000–35 000 per home for demolition and £35 000–65 000 for infrastructure for new development (Power *et al.*, 2004) (estimates based on feasibility studies on growth areas by Roger Tym and Partners (2005) and on a study of infrastructure implications of house building in Kent Thameside (KCC, 2005)). This adds around £75 000 to the cost of building a home, falling to £50 000 per property without prior demolition. If these indirect subsidies were redeployed on refurbishment, then most older poorly insulated homes could be upgraded. VAT should be the same for new build as repair. Demolition costs and environmental impact should be the responsibility of the developer with an infrastructure charge on new build (UTF, 1999, 2005) (Milton Keynes has in fact proposed a 'roof tax' of £20 000 on all new-build homes as a contribution to infrastructure costs). However, these subsidies, incentives, taxes and charges require a level of integration that does not yet exist (Power, 2006a).

There are some obvious steps that would help. Established refurbishment measures need to be turned into a standard upgrading package. Challenging issues such as under-floor and solid wall insulation need stronger government support and development of better techniques and practices. But generally, there are tried and tested ways of delivering a much more energy-efficient home without knocking it down.

Highly selective demolition – a 'scalpel' approach to existing areas – can remove the small numbers of dangerous and un-saveable properties, providing small infill potential and upgrading incentives (Mumford and Power, 2002). While both wider arguments and concrete evidence support a focus on renovation rather than large-scale demolition, higher incentives through policy reform could reduce energy use within a short time-frame and could achieve a significant reduction of carbon dioxide emissions from buildings by 2020.

An upgrading programme would require an enforceable code for sustainable existing homes, equivalent to the recent new-build *Code for Sustainable Homes* (DCLG, 2008a). Energy improvements complying with a tough enforceable building code for existing homes could attract a sliding scale of subsidy for improvements, depending on the degree to which they reduce carbon dioxide emissions.

Incentives to reuse infill sites and empty buildings, as proposed by Barker (2006), would encourage new supply and upgrading within neighbourhood renewal areas. As urban densities rise to more sustainable levels through these measures, there would be beneficial knock-on effects, particularly on transport and car use but also on local services, thus further reducing energy use (Satterthwaite, 1999). To support this reinvestment in dense built-up mixed-use and low-income areas, responsibility for the long-term maintenance of older areas to underpin the attractions of the existing built environment must be ascribed, reducing pressures on people to escape 'bad neighbourhoods into sprawl housing' (Power, 2004b).

5.5. The way forward

The timescale for increasing the energy efficiency of buildings is short and the task is huge and urgent. While the very best new build will deliver energy gains on a significant scale in the long term, from about 2045 onwards each un-renovated existing home will incur large energy debts in the short term. Since the case for demolition on energy grounds is not clear cut, higher refurbishment standards for existing homes using known methods (including under-floor and solid wall insulation) offer better value and potentially greater gains more quickly and cheaply than demolition and replacement building.

An approach grounded in the realities of our complex built environment seems more hopeful than a theoretical, long-term and largely uncosted plan to demolish and build on unprecedented scales within a seriously constrained context. This argues for an organic approach, combining incrementally at a local scale the valid and sensitive measures across renewal areas that will be needed in a crowded and environmentally constrained country. Planning plays a critical role in facilitating this neighbourhood renewal based on area improvement plans, a neighbourhood management approach and an even playing field. This has worked before in earlier periods of recession and previous work leading to 'jigsaw cities' sets out how it can be done again (Power and Houghton, 2007). A more conserving approach that recycles buildings as well as other 'redundant' products could lead to more sustainable urban environments and better protected Greenfield areas.

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