Parliamentary Office of Science and Technology

postnote

October 2005 Number 249

HOUSEHOLD ENERGY EFFICIENCY

Household energy use accounts for more than a quarter of all energy used in the UK, but the typical household wastes around a third of that energy each year. The Government's 2003 Energy White Paper placed energy efficiency centre stage for achieving its energy targets. It identified potential carbon savings amounting to ~20 million tonnes a year (Mt/yr) across the economy over the next 15 years[1], with 5 Mt/yr coming from the household sector by 2010. But critics question whether current policies will deliver these predicted savings. This POSTnote examines these concerns and explores the barriers to improving household energy efficiency.

Background

The UK faces four tough energy challenges:

- Ensuring the reliability of future energy supplies. North Sea oil and gas supplies are dwindling: the UK is now a net importer of gas and will become a net importer of oil by 2010.
- Curbing climate change. The Government plans to cut fossil fuel use and reduce carbon dioxide (CO_2) emissions by 60% by about 2050.
- Maintaining competitive energy markets to keep energy affordable and the UK economy moving.
- Providing affordable heat for all. 'Fuel poverty', where a household would need to spend more than 10% of its income on fuels for adequate heat and lighting, affects ~2 million UK households.

The Government's long-term energy strategy for addressing these four key energy challenges is set out in the Energy White Paper (2003). The Paper describes energy efficiency as "the cheapest, cleanest and safest way of addressing our energy policy objectives", but these objectives can be difficult to reconcile. For example, reducing CO_2 emissions broadly means reducing energy use, but competitive energy markets can increase energy consumption, as they often make energy cheaper.

Privatisation of UK energy companies in the 1980s increased competition and reduced prices. In 1970 the typical family spent 6.3% of its income on energy; in 2001 this fell to 2.9%. We now spend more on alcohol than we do on energy, and energy use continues to rise.

The key issue, however, is that energy efficiency alone as a mechanism for reducing energy use is not always effective. Decreases in householders' attention to budgeting and the cheapness of energy coupled with, ironically, energy efficiency improvements mean energy is now used in ways not previously considered. Research shows energy efficiency does not necessarily equate to reduced consumption: additional strategies that reduce energy demand are required[2].

The policy context

Currently, there is no single over-arching minister or department responsible for delivering all aspects of energy policy. There are more than 15 pieces of European Union (EU) and national legislation as well as numerous policies that aim to improve energy efficiency. The Department of Environment, Food and Rural Affairs (Defra) leads on energy efficiency work but responsibility for delivery is shared by the Office of the Deputy Prime Minister (ODPM), the Treasury, the Department of Trade and Industry (DTI) and the devolved administrations. The Sustainable Energy Policy Network, an *ad hoc* ministerial group, aims to address this fragmentation of policy and has a broad remit to deliver on energy commitments.

Energy Efficiency: The Government's Plan for Action[3] details how the energy strategy will be implemented. The Energy Efficiency Commitment (EEC) is Defra's principal policy delivery mechanism within the *Plan for Action* for increasing energy efficiency in the household sector. It requires energy suppliers to achieve targets for customer efficiency improvements (Box 1).

Box 1. Key energy efficiency policies/measures

Most policy focuses on the fabric of the housing stock, as this is where the most effective improvements lie.

Home-focused energy saving policies

- *Energy Efficiency Commitment (EEC):* energy suppliers must achieve targets for promoting improvements in domestic energy efficiency by helping householders make energy savings through installing cavity wall and loft insulation, energy efficient boilers and so on. Phase 1 (EEC1) is now complete, with all targets met. EEC2 runs from 2005 to 2011.
- *Home Energy Conservation Act (HECA) (1995):* local authority 'HECA' officers are working on delivering by 2010 a 30% improvement in energy efficiency over 1996 levels. Although not mandatory, a 12% improvement has been reported so far.
- *Part L Building Regulations:* set out the legal requirements for energy use in buildings and have recently been updated. Changes that will apply from April 2006 should see extra carbon savings of ~1 Mt/yr by 2010.
- *Directive on Energy Performance of Buildings (2002/91/EC):* applies minimum standards for energy performance in new buildings and refurbishments of existing larger buildings. To be implemented in the UK in 2007 partly through Home Information Packs: these will require energy efficiency information to be presented to home buyers.
- *Decent Homes:* alongside other goals, requires local authority housing to provide a "reasonable degree of thermal comfort".

Fuel poverty policies

- *Warm Front:* the main programme for tackling fuel poverty in England. It aims to bring homes up to a satisfactory Standard Assessment Procedure (SAP) rating of 65[4]; the national stock average is currently 51.

Appliance-focused energy saving policies

- *EU energy label scheme:* compulsory energy labels on a variety of goods sometimes coupled to minimum energy efficiency standards. (See page 3.)
- *Market Transformation Programme:* a Defra scheme to develop policy strategies to improve resource efficiency for goods and services. Aims to remove the least efficient and encourage the most efficient products.

Overarching measures

- *The Energy Saving Trust (EST):* created in 1992 by the Government to promote sustainable and efficient energy use in several sectors including the household sector.

Energy use in the home is split between heating and hot water (~77%) and powering appliances/lights (~23%). Reflecting this, household energy efficiency policy has two key aims: improving housing stock so homes can be heated more effectively with, ideally, less energy; and promoting energy efficient technologies. Barriers to energy efficiency have two main sources: technology and behaviour (for example, Box 2). A raft of measures is in place to address the issues these barriers raise (Box 1).

Housing

The UK's housing stock is some of the least efficient in Europe. Space heating accounts for, on average, ~60% of household energy demands. In 2003, of 25 million UK homes, ~2 million were classed as fuel poor.

Barriers to efficiency: new homes

The technology already exists to create buildings with low or zero space heating demands: one UK example is the Beddington Zero Energy Development in Surrey (Box 3). However, such homes are rare in the UK. Despite research showing that 84% of buyers say they are prepared to pay an extra 2% on the purchase price for an "eco home" with, among other assets, "improved levels of energy efficiency"[5], the construction industry remains conservative. For example, a recent select committee inquiry on energy efficiency reported that in Woking a developer chose to install electrical heating in a new development instead of taking heat from the local Council-run district combined heat and power (CHP) plant[6]. Compounding this, compliance with Building Regulations is low. A 2004 Buildings Research Establishment survey found one-third of new homes did not achieve the required energy efficiency standard.

Box 2. The conservatory paradox

Originally, conservatories were thought likely to reduce household energy consumption. In theory, this 'buffer space' should passively collect solar energy, pre-heating the house and reducing the need for additional central heating. However, this theory relied on the conservatory being used during warmer months only, rather than all year round as part of the main house. A survey done in 1993 found the reality is quite different. Of 1800 respondents, 91% said they heat their conservatories and 50% of those said they do so regularly. A recent update of this work shows trends towards year-round conservatory use and the installation of heating and now also cooling systems is increasing. The irony is that such spaces lose heat at ten times the rate of conventional insulated rooms, even when double-glazed. Thus conservatories substantially increase energy usage by some households rather than delivering the 10% reduction in overall household energy usage originally predicted[7].

Barriers to efficiency: existing homes

Because new homes add <1% to the housing stock each year, existing homes represent the greatest opportunity for efficiency improvements. Lack of consumer awareness and knowledge along with lack of capital and the 'hassle factor' are some of the major barriers to making such improvements. For example, cavity wall and loft insulation are cheap and effective measures for improving efficiency, but uptake is low. By 2003, only 6 million of a possible 17 million homes had cavity wall insulation. In addition, although most homes with a loft space have loft insulation, at least 44% have less than the recommended 300 mm-thickness of insulation material.

Box 3. The BedZed project

Designed as a zero carbon development and built in 2002, BedZed is an energy-efficient live-work space. It consists of 82 dwellings and employs a 'passive building' design technique so that the homes require no mechanical heating or cooling. The houses face south and have double-glazed 'sun spaces' that maximise solar heat gain. The super-insulation applied to roofs, walls and floors keeps in the warmth. It reduces loss of heat generated by human activity, lights, appliances and hot water to the point where conventional central heating systems are no longer essential.

A CHP plant generates electricity to power lights and appliances and distributes hot water around BedZed via insulated pipes. Oversized hot water cylinders that store water in each home are centrally positioned and double up as radiators, should they be needed, during cold weather.

Further energy savings could be achieved with draught-proofing, triple glazing and so on. If such measures were introduced throughout the UK housing stock to raise the average SAP rating from 51 to 70, it would reduce UK housing CO_2 emissions by ~35%[8]. The Association for the Conservation of Energy (ACE) points out, however, that wall insulation for the UK's ~8 million solid wall homes is currently not cost-effective.

Barriers to efficiency: social housing
Between them, local authorities and housing associations own ~25% of the UK's housing stock. Impetus Consulting (energy specialists who, on behalf of the EST, offer a free sustainable energy advisory service to local authorities and housing providers) say that while some housing providers are implementing efficiency strategies, others provide little internal support for their officers. Often whether gains are made or not is down to a HECA Officer's will to "champion" energy efficiency.

Overcoming the inefficiency of our homes
Before efficiency standards for new buildings can be raised, the EST believes that enforcement of and compliance with existing Building Regulations must be urgently improved. Recent changes to the Part L Building Regulations will see the introduction in 2006 of mandatory air pressure leakage testing (a rough proxy for energy efficiency testing) and the development of self-certification schemes to improve compliance with the regulations. For existing buildings, the EST and others believe that initiatives undertaken at a local and/or regional level have a key role to play in actively engaging individuals with energy efficiency. For example, local authority championing of loft insulation in the 1970s saw a significant uptake of this option

Most energy efficiency messages focus on saving money. Impetus Consulting believe that this does not appeal to more affluent members of society. They think that a raft of messages focusing on the "smart" and the "right" thing to do coupled with regulation and fiscal incentives will be more effective. The fiscal incentives currently proposed by the EST and others include council tax and stamp duty rebates in return for installed efficiency measures. British Gas is currently trialling a pilot project with the local authority in Braintree, Essex offering £100 council tax rebates once cavity wall insulation is installed. Initial results indicate it is proving very successful.

Improvements in heating both new and existing homes can be achieved with condensing boilers (now mandated in the Part L Building Regulations). These boilers contain an extra heat exchanger that helps convert up to 97% of the energy consumed into heating and hot water compared to the 60–75% efficiency rate of conventional boilers. They can be complemented by a range of optimising programmers. These optimisers can be set to monitor room temperatures throughout the home, running the boiler at the lowest temperature possible to maintain heat demand to each room as required.
ACE and others are also calling for the introduction of smart meters. Used in Italy and currently undergoing a small UK trial organised by the EST, these meters track the energy used at any particular time and its costs. Advocates believe these meters coupled with graphics on energy bills that show how a householder's monthly energy usage compares to average use along with ideas for further efficiency improvements could encourage greater energy savings. Although popular with Defra and DTI officials, energy suppliers argue they are too expensive. Finally, Impetus Consulting and others believe that Home Information Packs, which will introduce energy labelling for homes, may help push the housing market towards greater efficiency, as the public become more informed on energy issues.

Appliances and lighting

Appliances and lighting represent the biggest residential energy use growth area: since the 1970s consumption has been increasing at ~2% per year. Improvements in the efficiency of appliances and lighting have, to date, been driven mainly by European policy that introduced energy labels and minimum standards. Such policies provide clear signals to manufacturers, incentivizing the development of products with improved energy efficiency. However, as outlined in Box 4, subsequent changes to the labelling system have introduced some confusion.

Box 4. Appliance labelling
A label will be effective only if it is clear, understandable trusted, eye-catching and displayed at the point of sale on every appliance. In 1995 the EU energy label was introduced. It had a simple A–G energy efficiency rating and was easy to use: A was the most efficient and G the least. It also provided information of annual energy consumption. This enabled consumers to see the substantial variation in efficiency that exists even between similar-sized models. In 1999 minimum energy efficiency standards for cold appliances (fridges and freezers) were introduced. These standards removed the most inefficient models (rated D or E and below, depending on the product) from the market and improved the energy efficiency of the average cold appliance by 15% within 15 months. However, instead of recalibrating the energy label to reflect these changes, two new categories A+ and A++ were introduced. This has reduced the effectiveness of the label because there are now appear to be three 'good' categories.

The lack of clarity is compounded further because the energy efficiency grading system is based on 'relative' not 'absolute' energy use. The efficiency is measured in terms of the kilowatthours of energy used per litre of space cooled; size is not factored in. So, although a large A-rated appliance may use more energy each year to keep cool than a smaller B-rated one, it is the larger one that appears to conserve the most energy[8].

Despite such advances in energy efficiency, gains are being offset by the increasing sizes of new appliance and by the proliferation new and unregulated consumer electronics. For example, fridge and freezer sizes increased 15% during 1995–2001, and the introduction of labour-saving devices has given us more leisure time and is one of the factors driving the proliferation of appliances designed to entertain (see the illustration overleaf). Of these, the new generation of plasma TVs, for example, use almost five times as much electricity as conventional TVs.

IMAGE REMOVED

"Labour-saving and entertainment devices can increase energy demand, reduce personal interaction and can damage health."[10]

Overcoming appliance/lighting inefficiency

Major opportunities for efficiency improvements exist because of the relatively quick turnover rates of products.

- Additional vacuum-insulated panels for cold appliances could reduce energy consumption by ~80%. The technology has been available for many years but is out-competed by cheaper and less efficient options.
- Light-emitting diodes (LEDs) are already used for some vehicles and traffic lights and can perform even better than existing low energy light bulbs. Although still in development for household use, they replicate the quality of regular light bulbs but use 80% less energy.
- Appliances left on standby use ~10% of the electricity consumed at home; a PC monitor on standby overnight wastes enough energy to microwave six meals. Turning appliances off could save 1 Mt/yr of carbon[9].

The UK is now at risk of becoming an international dumping ground for energy inefficient goods such as air conditioners because minimum standards are low or absent altogether: the most efficient products are sold in the USA and Japan, where standards are higher[8]. Some academics have called for the Government to outlaw energy-wasting products by introducing minimum standards for efficiency across the full range of appliances and lighting. Defra and the EST state that such measures, while desirable, can be slow to introduce, as extensive testing is required and measures must be introduced on an EU-wide scale.

Delivering energy demand reductions

Rebound effect: will energy efficiency work?

The rebound effect occurs when energy efficiency measures do not deliver the expected fall (and may even lead to a rise) in energy use. It occurs because the cheaper a good becomes, the more we tend to buy of it. Energy efficiency measures effectively make energy services cheaper: through efficiency improvements, more energy services can be delivered for the same price. Thus, home insulation generally results in higher internal temperatures. For the fuel poor, this is a desirable outcome, but it conflicts with energy saving goals.

Opinion is divided but many academics and others believe absolute demand reductions will be delivered only if energy efficiency is coupled with measures that encourage consumers to limit their overall energy use[2]. Mooted increased fuel taxes to curb energy demand are criticised by some because they disproportionately affect the poor. Alternatives include progressive electricity tariffs that provide a 'lifeline' amount of electricity at a base price but progressively increase the price for higher consumption rates. In Japan such tariffs resulted in people either choosing the most efficient appliances available or none at all. Personal carbon allowances are also a possibility. These compulsory and tradable carbon quotas could be allocated on an equal basis, with allocations decreased on an annual basis to encourage greater energy efficiency and demand reduction.

Political leadership and public engagement

Some academics have criticised the Government for a lack of clear and coherent messages on how energy efficiency can help reduce carbon emissions. Although Defra is making progress with energy efficiency improvements, other Government departments appear to be slowing further improvement opportunities. ACE has described recent revisions to the Part L Building Regulations – which expect to deliver a 20% increase (rather than the pledged 25% increase) in the efficiency of new UK homes by 2010 – as a "lost opportunity".

Overview

- Energy consumption in the UK is increasing.
- Around one-third of energy used in the home is wasted through inefficiency.
- Household energy efficiency measures could deliver 5 Mt/yr of carbon savings – half the UK's 2010 target.
- Behavioural and technological factors both contribute to inefficient use of energy in the home.
- Opportunities for making significant energy savings on heating requirements exist but uptake is poor because of low public interest.
- Significant opportunities for reducing the energy demands of lighting and appliances exist but are not being implemented.

Endnotes

1 DTI (2003) *Our Energy Future: Creating a Low Carbon Economy.*
2 For example, see Wilhite, H. & Norgard, J. (2004) Equating efficiency with reduction: a self-deception in energy policy. *Energy Env.* **15**, 991–1009.
3 Defra (2004) *Energy Efficiency: The Government's Plan for Action*.
4 Rates the energy efficiency of buildings on a scale of 0–120 based on thermal performance, heating system and energy prices.
5 SDC (2005) *Sustainable Buildings: The Challenge of Existing Stock.* Technical working paper.
6 House of Lords Science and Technology Committee, First report of session 2005–2006, *Energy Efficiency.* HL 21-I, para 8.15.
7 Oreszczyn,T. (1993) The energy duality of conservatory use. *Proceedings of the 3rd European Conference on Architecture* 17–21.
8 Boardman, B. *et al.* (2005) *40% House.* ECI, Oxford.
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