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New directions for household energy efficiency: evidence from the UK

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Abstract

The market rarely delivers energy efficiency improvements spontaneously, as there is no market push. Consumers are not providing a pull towards energy efficiency, usually because they are ignorant of (or indifferent to) the range on the market, or the energy implications of their purchases. Whilst consumers are concerned about climate change and generally understand the causal role of fossil fuels, they believe either that they have done everything or that one person cannot make a difference. Without a positive design focus from manufacturers or a clear demand from consumers, no part of the market will deliver energy efficiency naturally: policy has to provide the drive. Within the UK, the opportunities to introduce policies based on higher energy prices are constrained by the impact these have on low-income households. This means that product policy (market transformation) has to be the main delivery mechanism for domestic energy efficiency in the UK. The policies adopted so far in the UK and EU have been successful, with existing products, but have not prevented the development of new, profligate equipment. This limited success demonstrates the need for European policy to be more forceful and for policy to involve engagement with manufacturers about the products they are planning to introduce. To motivate consumers, policy should focus on carbon and incorporate feedback. Without these developments, and considerably more activity by the European Commission and Member States, energy efficiency will not contribute its potential to the UK target of 60% reduction in carbon dioxide emissions by 2050.

Keywords: Energy efficiency; Product policy; Market transformation

1. Introduction

Major changes in domestic energy efficiency—and the resultant energy conservation—are being discussed (e.g. the UK Energy White Paper, DTI, 2003) in order to lower carbon dioxide emissions. These will be obtained, in summary, through a combination of:

- *products*: manufacturers producing more efficient equipment;
- *people*: consumer choosing whether to buy, what to buy and how it is used;
- *prices*: world energy prices;
- *policy*: Government policy on both prices and product standards.

Over the last 8 years, in the UK, most of the increase in energy efficiency has resulted from policy on product standards, set within an EU context. Neither the manufacturers nor consumers have been steering the market towards lower energy consumption. However, for future energy conservation, there will be a need for both to contribute, to supplement policy and ensure that change occurs more rapidly.

To provide a foundation for the debate, this paper, briefly, investigates the following components which collectively could provide for a virtuous circle leading towards sustainability:

- evidence about the energy efficiency of products, in the absence of policy;
- success of product policy;
- consumer attitudes to energy use and sustainability;
- ways in which to encourage greater consumer participation, for instance feedback;
- extent to which energy efficiency policy will be supplemented by either, or both, market pull and technology push.

In constructing this argument, most of the evidence provided comes into two categories. The first is to review what has been achieved through product policy

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in the last few years. This is strongly focused on the use of electricity in domestic lights and appliances and reflects considerable work undertaken by the Environmental Change Institute at the University of Oxford. Before 1994, this was a poorly understood and researched area and it is still the area of greatest growth in consumption in the domestic sector. With the growing debate on carbon reductions, the policy emphasis had to include a strong focus on electricity, the most polluting of the fuels in the UK: domestic lights and appliance use is responsible for 25% of all carbon emissions from the home.

The second concentration of evidence is a review of recent research into consumer attitudes, to try and establish how to incorporate citizens into future energy efficiency policy and to make sure that it reflects their wishes.

1.1. Background

The UK's Energy White Paper (DTI, 2003) places considerable emphasis on greater energy efficiency, together with the additional generation of electricity from renewable sources. The commitment is to reduce carbon dioxide emissions by 60% by 2050 from 1997 levels, but the next 5 years are particularly important in proving the case for the chosen 'route'—energy efficiency and renewables. Thus, energy efficiency is on trial. More details on how to achieve this reduction from energy efficiency are to be provided by the Government by February 2004, although increased regulation and co-operation across Europe have already been identified. It is therefore appropriate to review recent developments and assess some of the long-term challenges if energy efficiency is going to provide the support for climate change policy that is envisaged and warranted.

The Royal Commission on Environmental Pollution (RCEP, 2000) identified the 60% carbon reduction as an appropriate challenge in the face of the threat of climate change. They provided four scenarios for 2050 and showed that the first stage of energy decision making is to establish how low demand for energy can be taken, and then discuss the choices for how that demand can be met, for a low carbon future (Table 1). By 2050, the minimum aim is a stabilisation of energy demand at the 1998 level, across the whole of society, although even this represents a reduction of 33% below what it would have been on a 'business as usual' or reference case basis. This would be the minimum; in the other scenarios the reduction would be 50% below the reference case (scenarios 2 and 3) or, even more optimistically, by 66% in scenario 4. This demand is then met by varying combinations of fossil fuels, renewable sources and nuclear power. If demand is only reduced by the minimum, of a third, then nuclear power has a major role to play. With greater reductions in demand, nuclear power becomes less critical. To achieve climate mitigation, the UK, as all developed countries in the world, has to decide on the balance between reduced demand, renewable sources and nuclear power. Not only is it vital for the UK to demonstrate that a 60% reduction is achievable, but the Prime Minister has stated his intention to try and make this European policy as well (Press release, 25.2.03).

Table 1
Royal Commission on environmental pollution scenarios

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Change in demand	0	−36%	−36%	−47%
Total renewables	53 GW	45 GW	25 GW	20 GW
Nuclear/carbon recovery	52 GW	0	19 GW	0
Fossil fuels	106 GW	106 GW	106 GW	106 GW

Source: RCEP (2000, p. 173).

The first task is to clarify the difference between energy efficiency and energy conservation as these terms have significantly different meanings in this paper. Energy efficiency is the level of service provided by a unit of energy, but it can also be the level of service provided by a unit of expenditure. The emphasis of EU product policy is normally on energy efficiency, rather than on energy conservation. Thus, for instance, most labels identify the most efficient appliances, based on consumption per unit of service. This is kWh/l of internal space for cold appliances, kWh/kg of wash load for washing machines. The result has been a move towards more volume or larger appliances—a trend that could be reversed if the label were based on absolute consumption. This, in practice, is what is happening with European car labels in many countries: the ranking results from the l/100 km only, not related to engine size, body shadow (m^2) or other scale. This has been driven by a policy to promote downsizing of new car purchases in some countries, for instance Denmark.

Over time, more efficient products form a growing part of the stock of equipment in society as they replace old, inefficient models and, if nothing else changes, will result in a lower level of demand for energy—energy conservation. Normally, there are changes, such as more households or bigger appliances (providing more service), which reduce the level of energy conservation achieved. For climate change mitigation, it is the degree to which energy efficiency policy results in energy conservation, and lower carbon emissions, that matters.

2. Manufacturers and energy efficiency

The market will autonomously deliver energy efficiency improvements only under certain conditions:

when it is in the interests of the manufacturers or where the customer is particularly strong (Table 2). In all other circumstances, energy-efficient products are brought to market as a result of policy—this is certainly true for the majority of appliances bought by householders. In a minority of cases, such as cavity wall or loft insulation, the product itself is designed solely or mainly for energy efficiency, but even here the market does not always deliver: most cavity wall insulation is installed, either with the help of a grant (Shorrock, pers. comm.) or because of the requirements of the Building Regulations.

Manufacturers are assumed to be able to interpret the latent wishes of consumers, but, in reality, they may be misjudging both the environmental concerns of many of the population and the extent to which these would be reflected in the products bought. For instance, when householders are informed about the level of electricity they are wasting through standby power, they can be quite angry about being misled by manufacturers and retailers:

> Standby consumption is energy consumed by appliances whilst not performing their primary function, or ostensibly switched off. …this subsidiary, and often wasted, use of electricity may represent over 6% of total domestic sector [electricity] consumption. Contrary to popular belief, [there are] strong indications that the levels of standby consumption currently experienced within the UK, are not predominantly the result of a prevalent 'standby culture of convenience'. Rather, … a substantial proportion of householders are not aware of, and in fact opposed to, the levels of standby consumption within their home. Heightened awareness among householders is shown to provoke substantial behavioural-induced reductions in standby levels. However, the potential for further reductions is constrained by technological limitations, particularly the unavailability of power switches on appliances, and the need to retain programmed settings. (Vowles, 2000, abstract)

Table 2
Drivers for energy efficiency

Driver	Examples
Reducing load	Laptops (smaller batteries) Ocean liners, steam engines (less coal)
Improves product performance and durability	Audio/visual equipment
In own production equipment, as industry pays the fuel bill	Coke-based iron making
Where it is driven by lower resource usage	Lighter cars Smaller radios

Some of these technical problems are being solved in the next generation of traditional appliances, but most manufacturers have still not accepted that low energy consumption is a design priority. As a result, consumers are being offered, and are buying, an ever increasing range of products that use unnecessarily large amounts of energy. It takes policy some time to catch up with new additions to the market, so policy is always operating retrospectively. It would be better if manufacturers chose not to research and develop energy-inefficient or energy-extravagant appliances (such as the plasma TV, which uses 450 W instead of the 75 W of the average TV it is replacing). However, this is not the way that most manufacturers plan—there are some honourable exceptions—unless there is some policy clearly pending. The net result of new products coming onto the market, such as digital decoders and consumer electronics, is that overall electricity consumption per household is still increasing. Most broadband connections are sold as 'on all the time', which further increases electricity consumption, mainly for the convenience of the service providers.

If manufacturers continue to produce energy-profligate equipment, which unnecessarily increases domestic energy demand, policy-makers may need to consider whether there should be an approach that requires 'permission to manufacture'. At the moment, years of careful policy-making to lower energy consumption can be offset by new devices which provide higher levels of energy service (useful or spurious) without regard for energy efficiency. The freedom of the market place is working to the detriment of the climate.

Where there is no policy pending, the role of the market has been to encourage us to consume, not to conserve, energy: there is not technology push towards sustainability. We cannot rely on manufacturers to promote higher standards of living that result in lower energy use and carbon emissions. This part of the virtuous circle is not, yet, in existence.

The public could only begin to provide a counterweight and demand lower carbon products if they know that the products are inefficient and can identify the ones that are efficient. That requires policy to identify the efficiency of the products, and awareness and motivation on the part of the consumer.

3. Policy packages

In summary, the toolkit of energy efficiency policies represents a package of two sets of measures: economic instruments and product policy (Boardman et al., 1999). The latter is itself a compendium of initiatives, frequently called market transformation—a strategic

approach to making energy efficient products available.[1] The components of market transformation (described below) include policies on information and education (e.g. labels), regulation (minimum standards, such as Building Regulations). The links between the two strands of the package are:

- Product policy targets the energy-using equipment, whereas economic instruments mainly affect the running costs. These are two quite separate routes towards energy efficiency: product policy has a direct effect, whereas economic instruments work indirectly on energy efficiency.
- Some economic policies can be applied to products, for instance through variable value added tax (VAT).
- Economic instruments are usually applied to fuel prices and these have an impact on everyone from the moment they are introduced and are immediately regressive for low-income households. For those with tight budgets, a price rise results in less consumption—people are colder (i.e. they 'enjoy' lower levels of energy service). This is because low-income households are generally not able to afford to invest in improved efficiency to achieve the same level of service for less energy input and keep the same energy expenditure.
- More efficient products have to be available and identifiable, if people are to respond to price signals effectively. They provide a solution to the problems incurred by higher prices, for those with capital to spend.
- Product policy is effective at the rate of stock turnover (10 years for a car; 15 years for a fridge) and causes no direct hardship to the poor. The poor may be relatively disadvantaged in the longer term if prices rise, as the rich are better able to afford to upgrade their equipment. The poorest people are not affected for some time, if they buy second-hand, not new equipment.
- Whether or not there has been a price rise, for those who are fuel poor and without capital, there have to be policies to help them become more energy efficient. These programmes can be funded through general taxation (e.g. Warm Front) or through electricity and gas prices (Energy Efficiency Commitment—EEC). The latter is less progressive than the former as many of the poorest households do not pay income tax, whereas all of them consume energy.

The policy debate is about the timing of these two strands: with fuel poverty,[2] the decision has been made to improve the efficiency of the low-income housing stock rather than increase the price of domestic fuel through policy. It is sometimes suggested that the money should be raised first through increased prices and then spent on the capital investments. The disadvantage is that considerable hardship is created, immediately, from the price rise, whereas the compensatory energy efficiency improvements can take decades to deliver. It is also essential for the efficient products to be there to purchase and to be identifiable, so product policy is always necessary, first, whether or not it is then followed by price increases.

4. Fuel pricing

Fuel prices can rise as a result of world markets, or as a direct or indirect effect of policy. There are several UK policies that will have the effect, or are already, of raising fuel prices, though this was not the primary intention: the EEC whereby the energy utilities are required to spend money on energy efficiency improvements. The extent to which they pass this on to customers is a company decision. The renewables obligation—requiring a certain proportion of electricity consumption to come from renewable sources of energy—is another stimulant. And, finally, the EU emissions trading scheme for carbon dioxide, effective from 2005, will put further upward pressure on domestic prices. Domestic gas and electricity price rises have recently been announced by major companies such as PowerGen and British Gas.

Fuel price rises are assumed to have a dual effect. The first is to reduce wasteful behaviour. This assumes both that the wasteful behaviour exists and that the individual is prepared and able to change it. The second effect is to lever people into making different (more energy efficient) equipment purchases as a result of rational economic judgements. There is little evidence that ordinary consumers compare the additional costs of a more efficient product with its lower running costs, through a life-cycle assessment—this may be an approach that exists in economic text books rather than householders' minds. Some slightly supportive evidence was found in a survey of consumer responses to the energy label on refrigeration products. The 'elder thrifties' represent about a quarter of the sample and they are:

> prepared to pay to protect the environment…and attempt to save energy because they do not like the idea of waste and wish to save money rather than attempting to save energy for environmental reasons. (Boardman et al., 1997, p. 37)

This behaviour has been enabled by the mandatory EU energy label and demonstrates some people's

[1] Defined on the market transformation website (mtprog.com) as: '…to bring forward products, systems and services which do less harm to the environment, using less energy, water and other resources'.

[2] Fuel poverty occurs when a household has to spend more than 10% of income to provide an adequate standard of warmth and other energy services (Boardman, 1991).

understanding of the 'spend now, save later' concept. Sensible, planned responses to the cost, and potential future cost, of energy, like this, are excellent and very different from the panic reactions required by those on a fixed income when there is a sudden price rise.

In 1993, householders themselves stated that they prefer incentives to taxation, as a way of stimulating investment in energy efficiency (Taylor, 1997, p. 123) and the success of the rebate on lead-free petrol demonstrates the truth of this observation, for environmental policy. Undoubtedly, it is better psychology to offer an incentive than to impose a penalty—we all like what appears to be a bargain. VAT is levied at 5% on domestic fuel in the UK, whereas most purchases carry a VAT rate of 17.5%, so that the cost of trying to save energy is more expensive than the cost of using energy. In the domestic sector, the principle of reduced VAT has been introduced, for instance, where a contractor is installing insulation and heating controls, to encourage energy efficiency investments. There is no widespread acceptance of the wisdom of comparable tax rates on consumption and investment for the domestic sector, so it costs more to save energy than to use it. There is no domestic equivalent to the enhanced capital allowances scheme available to commercial organisations, which substantially reduces the cost of the investment by offsetting capital expenditure against tax liabilities (Chesshire, pers. comm.). For householders, the tax system provides perverse signals if they want to achieve greater energy efficiency.

4.1. Fuel poverty

Since 1997, it has been official Government policy to tackle fuel poverty, but meanwhile the presence of several million low-income families, who are unable to afford adequate warmth and other energy services, means that the price of domestic fuel has to be kept as low as possible. The legal requirement is for fuel poverty to be eradicated by 2016 (Warm Homes and Energy Conservation Act, 2000), so that the failure to deal with fuel poverty has imposed considerable and continuing constraints on energy policy. The design of the climate change levy and the UK emissions trading scheme were both affected by the need to avoid raising domestic sector fuel prices. The level of investment in fuel poverty elimination has recently been deemed to be inadequate and should be increased by at least 50% in England (FPAG, 2003); however, for the second year running, the Government has reduced the funds to fight fuel poverty (ENDS, 2003, p. 16). According to the Government, most of the recent reductions in fuel poverty since 1991 have resulted from higher incomes or lower fuel prices, rather than greater energy efficiency (DTI, 2003). However, the fuel poor are those least likely to have benefited from the drop in UK fuel prices from 1995 onwards (Boardman and Fawcett, 2002). Any price rises will reverse some of the progress on eradicating fuel poverty. The ongoing failure to improve significantly the energy efficiency of low-income homes in the UK continues to create considerable hardship for the occupants and to limit economic policy options.

4.2. Fuel pricing summary

For the period 1990–2002, at the household level, electricity demand has risen inexorably—the 1996 and 1997 data probably suffered from bureaucratic confusion with liberalisation (Fig. 1). The dotted line is external temperature variation turned upside down, with 1996 being a particularly cold year; there is no correlation between electricity use and external temperature. For gas, consumption is significantly (at the 95% level) correlated with temperature, but otherwise does not show a trend. For neither fuel is policy reducing consumption at the household level, though it is preventing a rise in demand.

Therefore, there is a limited role for planned fuel price rises in the UK domestic sector, largely because of the problem of fuel poverty and public disquiet. The expectation that prices are rising, as an indirect result of other policies or world markets, means that plans to increase domestic prices directly, such as carbon taxes, should be low on the political agenda. Even if higher prices occur, consumers can only purchase more energy efficient equipment if it exists and can be identified. That requires an effective product policy.

5. Product policy experience

Market transformation incorporates a range of policies, including regulation (or minimum standards), rebates, education and procurement policy. The recognition that these interact in a synergistic way is relatively new, but the individual policies have been around for some time.

Regulation is one of the most powerful policy tools and the Building Regulations have defined the minimum standard of efficiency for new homes in the UK since 1965 (Boardman, 1991). Another example is the minimum standard that came into effect in September 1999, when the only domestic fridges and freezers that could be sold were those in categories A–C on the EU energy label (except for chest freezers which could be A–D). This resulted, in the UK, in a 15% improvement in the energy efficiency of these appliances in 15 months, with a substantial price reduction (Schiellerup, 2002; Boardman, in press). With these 'cold' appliances, the introduction of the mandatory EU energy label in 1995 brought about a 7% drop in the energy consumption of the products bought (Boardman et al., 1997,

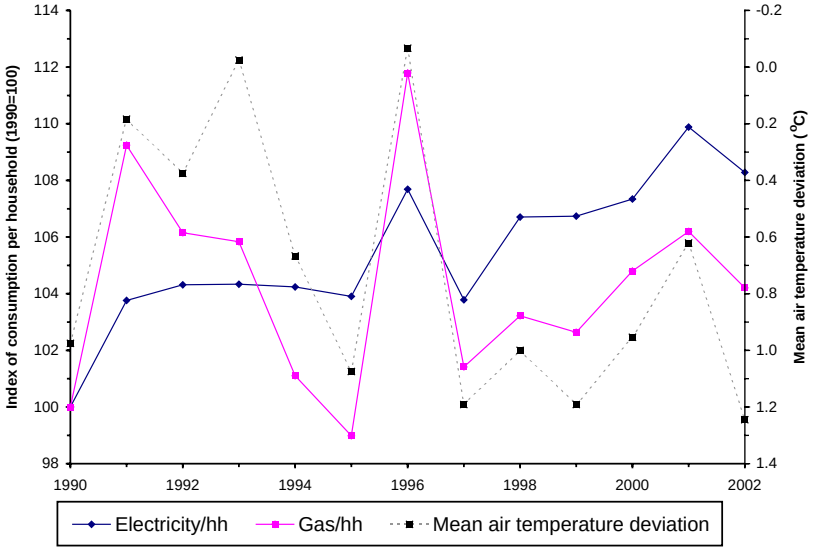

Fig. 1. Household gas and electricity demand, and external temperature. *Note*: The temperature scale is inverted: the coldest temperatures are at the top and demonstrate the deviation from a 30-year mean (1961–1990).

Table 3
Energy efficiency improvements, by policy 1974–1991 (%)

	Roof insulation	Double glazing	Wall	Draught-proofing[a]
Regulatory (new building only)	33	Minimal	17	0
Grant aided	39	1	0	100
Landlord installed	12	10	26	0
Private initiative	16	89	57	0
Total number (million properties)	9.3	8.3	2.8	0.8
Annual value (millions)	£60	£1400	£37	£0.4

Source: Boardman (1993, p. 326).
[a] Only those installations deemed still to be effective.

p. viii). Regulations on information, such as labels, provide information for consumers and is the necessary precursor to most other market transformation policies.

The lesson from Australia is that federal energy efficiency policy focuses on regulation, because it is cheap and guaranteed and industry is content with this approach, provided they are given enough notice:

> industry is no longer a begrudging participant in standards debates but a leader in translating standards from other nations and creating equivalent or better standards for Australia. (Holt and Harrington, 2003, p. 25)

Another important policy is grants or rebates and these have also been responsible for a large part of the enhanced energy efficiency that has been achieved since the first oil crisis in 1973–1974. During the first 15 years, grants were responsible for the greater uptake of roof insulation and draught-proofing, whereas the minimum standards required in the Building Regulations for new buildings ensured installation of both roof and wall insulation (Table 3). Social landlords took an active role in upgrading their properties, especially cavity wall insulation and the importance of private finance was most visible with double-glazing, where large sums of money were invested. The increase in double-glazing is partly due to the fact that it was heavily marketed, with door-to-door salesmen calling 'cold' and partly because it was advocated for a number of reasons, for instance keeping out street noise and low maintenance frames. It is also the most visible of the measures and, therefore, proves that the householder has been upgrading the property—it allows a public statement of action and investment. The information in Table 3 provides evidence that the most effective combination of policies and market mechanisms depends upon the measure being promoted, a concept that has been confirmed since through market transformation studies (Palmer and Boardman, 1998; Winward et al., 1998).

The changing interaction that occurs between political focus and activity on an individual measure is demonstrated through cavity wall insulation. The level of support has risen, so that 75% of acquisitions in existing homes are now subsidised, either through Warm Front

(for low-income households) or through the energy efficiency commitment (utility spending) (Shorrock, pers. comm.). The rate of installation has not increased dramatically since 1974–1991, perhaps by a third, so that some of these grants are going to free-riders and not transforming the market as much as they should be.

Product policy has grown in momentum across Europe since 1995, when the first EU energy label became mandatory. There has been a range of policies on domestic lights and appliances, combining those initiated by the European Commission (labels, minimum standards and, often, voluntary agreements) and those that are the responsibility of the Member State (procurement, rebates and education). Where there has been a coherent approach (refrigeration equipment and washing machines) the result has been a drop in overall energy consumption, despite rising ownership and household numbers (Lane and Boardman, 2001). Where there has been a piecemeal approach, the net effects have been less successful and expensive. With low-energy light bulbs, the over-riding UK policy has been to subsidise—and often distribute—them through the electricity industry; a substantial proportion of the compact fluorescent lights (CFLs) that are found in British homes have been obtained in this way. The failure to take a comprehensive approach across the whole market has meant that 'these subsidies may paradoxically destroy the retail market for CFLs because the sales of subsidised CFLs go through non-retail channels' (Schiellerup and Fawcett, 2001). Thus reinforcing the continuing use of subsidies, whereas it should be possible to phase them out in a mature market with a clear transformation strategy.

The subsidies for CFLs have occurred as, since 1994, the UK utilities have been required, by the Regulator and latterly by Government, to invest in reducing demand, primarily in the domestic sector. This first applied to the electricity companies and now includes gas as well. By 2005, this is expected to have resulted in a total expenditure of nearly £750 m (Schiellerup and Fawcett, 2001). The greatest emphasis, in terms of numbers of measures, has been on efficient lighting; programmes that focus on efficient appliances have proved difficult to make cost-effective and have had relatively little impact on the market so far. Other countries—notably the Netherlands, Belgium and Denmark—have provided substantial rebates on A-rated appliances, but this has been a minor focus in the UK.

Market transformation policy recognises that the market has to be pushed towards more efficient products and will rarely deliver low-consuming products otherwise. The careful design and timetabling of policies is required to achieve the maximum effect, but the result can be major improvements in energy efficiency, at no cost to the Government, the manufacturer, or even the consumer. There has been a lot of policy, but with total demand still growing, what are the lessons we must learn if we are to reduce absolute demand?

5.1. Future market transformation

The first point to reflect upon is that there is still a considerable potential to realise: the most efficient prototype refrigerator uses only 12% of the electricity used by an average, existing refrigerator of the same size in someone's home. This 88% saving would be achieved without any sacrifice in the standard of service being offered. There are similar examples with many other products (e.g. cars and light bulbs) and certainly with houses, where a factor of 10 can be found between dwellings of the same size, under identical operating conditions. The manufacturers can develop the technology when given the challenge.

Secondly, on the positive side, the energy efficiency measures that are introduced today continue to produce savings for several years as the resulting more efficient stock is used. The length of time depends upon the rate of turnover in the stock: 15 years for fridge–freezers and slightly quicker for washing machines. So the minimum standard for domestic refrigeration equipment (cold appliances) that was introduced in 1999, will still be providing benefits for another 11 years, until the stock of cold appliances has been replaced with more efficient ones. There are, therefore, considerable savings in the pipeline that are not yet in evidence. There are similar effects from mandatory standards on light bulb ballasts and boilers. The Policy and Innovation Unit (PIU, 2002) estimated that a 20% increase in energy efficiency over a decade would result in a 10% saving in energy, with the remainder being taken as extra standards of energy service, because of the combined offset from rising levels of ownership and the purchase of larger equipment. Recent analysis at the ECI on the effect of the minimum standard of efficiency on cold appliances indicates that this is approximately correct: by 2020 the saving will be 60% of the energy efficiency improvement (Boardman, in press). But this was a reasonably tough, mandatory target set well in advance. It is not always easy to obtain such a level of certainty and the philosophy in Brussels is to move towards voluntary agreements proposed by the industries themselves. These are, inevitably, weaker and slower to achieve significant savings, partly because they are often based on a company average, rather than a minimum standard.

The UK Energy White Paper expects considerable progress on appliance efficiency standards, but it may be that this is not justified, based on the slow rate of progress of many policies emanating from Brussels. The EU energy label for cold appliances was due to be revised in 2000, to reflect the effect of the 1999 minimum standard, as the models on the market are 'bunched' in

the top categories. After considerable delay, the revised label will be introduced from January 2004 and merely reflects a minor adjustment: the top, A category, now includes two additional groups A+ and A++. There has been no reconfiguration of the whole label, so that it still contains the redundant D–G categories.[3] This is confusing, if not irritating, to consumers. The Commission is not producing the strong, clear policies on domestic appliances that the Energy White Paper is relying on and certainly not quickly enough.

Another new and beneficial addition to the market transformation toolbox is the policy of co-operative procurement: an independent agency interacts with manufacturers who are producing super-efficient equipment and lists their products (Boardman and Attali, in press). This list is made available to participating retailers, and vice versa. The process of identifying willing producers and purchasers is facilitated. This has resulted in a growth of super-efficient, domestic cold appliances from two models in 1999 to well over 600 in 2003. Thus, when the new labels come into operation, there will already be a large number of models that qualify for the A+ category and the market can take over. This demonstrates the synergy that can be achieved when policies are combined in a market transformation approach. The higher, A++ category, will remain as a significant target for manufacturers.

One of the disadvantages of minimum standards is that major changes can be brought about without the consumer having any involvement or being aware of the effects: this is what occurred with the minimum standard on cold appliances in September 1999. The opportunity was lost—there was no major publicity campaign to identify the benefits of strong policy and to educate consumers about the savings they were achieving. Others policies, such as labels, are dependent upon the choices that consumers make, so the motivation of the general public is important (Winward et al., 1998, p. 88).

Consumer involvement will become ever more important if energy consumption is to be reduced—product policy can be powerful, but is delivering too few savings, too slowly. Informed, concerned, active consumers are needed if the market is going to be pulled towards greater energy efficiency and away from the production of unnecessary or inefficient equipment.

6. Consumer knowledge of climate change, fossil fuels and energy efficiency

How close are consumers to being able to pull the market towards more efficient products by their choices and purchases? For this to occur, people have to understand that it is their use of energy, that is causing the carbon dioxide emissions, that results in climate change. There is a direct link between our energy-related behaviour and climate change, that may not be obvious to most citizens. There are additional factors about the extent to which, having understood this link, people are prepared to either change their lifestyle or spend additional money, in order to protect the environment. Whatever is the state of public knowledge, it is increasingly clear that major carbon reductions cannot be achieved without active support and positive actions by the residents of the developed countries. Consumers want to help the environment in a general sense and the proportion of the British public who are very worried about climate change specifically has increased (DEFRA, 2002, pp. 62, 116):

- thirty-five percent were very worried in 1996/1997,
- forty-six percent in 2001.

Thus, concern about the climate is affecting a growing proportion of people in the UK—the educational message is getting through. In addition, by 2001 (DEFRA, 2002, pp. 63–64, 113, 118):

- virtually all UK respondents had heard of climate change, global warming, or the greenhouse effect;
- most people were at least fairly convinced that climate change is happening;
- eight-four percent thought that climate change was a very important or fairly important headline quality of life issue;
- climate change, or one of its potential effects, was the second most common environmental concern for the future.

Similarly, there is understanding of the role of anthropogenic contributions to enhancing climate change, with seven out of 10 respondents thinking that climate change is due to human activities (DEFRA, 2002, p. 7).

There is a firm link in people's minds between the use of fossil fuels and climate change. The knowledge is remarkably consistent across Europe and over time in the UK with four out of five people accepting that this is either definitely or probably true (Fig. 2). These figures are also reinforced by a survey which found that 75% of respondents in the EU are of the opinion that the use of fossil fuels contributes significantly to climate change (Eurobarometer, 2001) and in the UK, 73% of the public already associate some sort of fossil-fuel burning power station with an increased risk of climate change (RSPB, 2001, p. 5).

Thus, people do understand the main links between climate change and energy use, and they are worried about climate change. There is a good foundation of knowledge and concern, but this may not directly translate into an understanding of the importance of

[3] Only chest freezers can still be rated D; models in other groups have to be C or better.

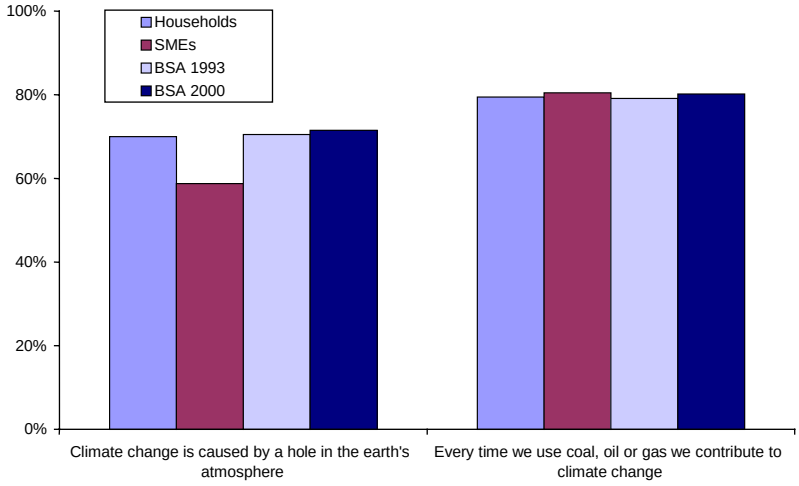

Fig. 2. Knowledge of climate change: percentage of respondents who agree—domestic customers and SMEs. *Note*: BSA is households only, in the UK; other figures are for 10 European countries; SMEs are small and medium-sized enterprises. *Sources*: Palmer (2003), Jowell et al. (1993) and BSA (pers. comm.).

energy efficiency and energy conservation. Is this why demand is still growing?

6.1. Consumers and energy efficiency

Undoubtedly, for many people, energy (and energy efficiency) will always be a subsidiary issue. The success of the energy label on washing machine is that it includes an A–G rating for both wash performance and spin speed: it is possible to buy an AAA machine. People have chosen to buy machines that wash well and are energy efficient, which is entirely logical and sensible. The energy efficiency gain is, perhaps, only serendipitous, for washing machines, whereas it has been more of a positive choice with the cold appliances (Boardman et al., 1997). These beneficial side effects are similar to the principle discussed earlier, that for many manufacturers a gain in energy efficiency may be the indirect result of some other positive decision. It is commonplace for the use of less energy to combine well with the use of other resources—materials, water, etc.—and to provide a higher standard of service. Perhaps this should be highlighted more often. However, the converse is not true: a higher level of service does not have to be accompanied by greater energy efficiency.

Another explanation is that many British people believe they 'cannot use less'. This was the most common reason given for those that do not regularly cutting down on electricity, gas or water and for not cutting down use of the car for short journeys (DEFRA, 2002, p. 8). This was cited as the reason by 60% of the respondents and the older the respondent, the more likely they were to give this response (DEFRA, 2002, p. 42). This may be consistent with the general attitude of the older generation, as normally the 'elder thrifties' are the most resource-careful: "they seem to care a lot about saving energy and other resources" (Boardman et al., 1997, p. 45). If they are already careful, they cannot consume less. Alternatively, it could demonstrate the diminishing proportion of the population for whom the WWII was an abiding influence and represents a shift towards careless resource use amongst the older population. Based on a small UK sample, only 15% agreed that they had done all they could to reduce global warming and 30% thought that 'it is too difficult for someone like me to do much about global warming'. However, from the same sample, 75% of people believed that 'homes like mine' contribute less than 10% to global warming in Britain. Industry was seen as more likely to be the major contributor (Doust, pers. comm.). Is this because they are not prepared to compromise on their lifestyle—they have come to expect a certain standard of living and believe that a lower level of energy use would have to be accompanied by a lower level of energy service. Certainly, a lot of the media coverage and advice has focused on the need for lower levels of service—turning the lights off or temperature down—on the assumption that we are blithely wasting energy and money. This is sometimes true, but perhaps less often than is implied and may have created the unfortunate mental link that energy efficiency is equivalent to a lower standard of living.

It is difficult to understand when incorrect knowledge matters or to decipher the motivations behind levels of action or inaction: "there is a distinct lack of green activity undertaken by the younger generation. Despite being future guardians of the planet, 15–24 year olds are less likely to purchase environmentally friendly products than older age groups and 39% of them don't have time to be green. 15–24 year olds are also less motivated to 'do their bit' for the environment—one million (15%) think one person can't make a difference" (MORI,

2002). Only a limited number of this age group have responsibility for their own energy bills, which could be part of the explanation. It could be unwise to think of this as political apathy. The anti-war demonstrations, particularly in London in February 2003, demonstrated that the young, and many other age groups, do believe that one person can make a difference and are prepared to join a march when they are concerned about the subject enough. If the young are to act to reduce climate change, we need to understand what motivates them and we are not good at that.

"If you are professional and middle class you are more likely to be environmentally aware and more likely, or able, to take action" (MORI, 2002). Is this because we have been so poor at communicating the science of climate change, that it is only the professional and middle classes that have been able to clarify the messages for themselves? Early research on the effectiveness of the energy label found that the group most likely to use it to buy a more efficient appliance was the 'concerned professional', for whom there was often a moral imperative, they are:

> the greenest, most knowledgeable and the most successful of the groups. They seem to care about the environment and have the money to pay the extra cost that this sometimes entails. Accordingly, they are quite likely to take account of ethical or green issues when making purchases. (Boardman et al., 1997, p. 36)

6.2. Carbon awareness

Energy policy is gradually moving to a focus on carbon, with energy efficiency and renewables as the two main components, supported by carbon emissions trading. The shift in policies will have to be matched by a growth in consumer awareness of the importance of carbon (Fawcett et al., 2002). The change in public priorities will be helped by policies that are already being introduced. Carbon emissions are shown on the label on each new car as a result of EU Directive 99/94. This Directive allows each member state to introduce its own design of the label and several countries have chosen to base this on the colourful A–G appliance energy label to maximise recognition. The UK draft label, that is only just being piloted, uses the same approach, as proposed in earlier research (Boardman et al., 2000). In the UK, carbon-related vehicle excise duty and company car taxation are already in operation. The car label states that carbon dioxide contributes to climate change, so gradually, consumers should have this confirmed for them: "Carbon dioxide is the main greenhouse gas responsible for global warming".

Another major initiative, that could have powerful ramifications, is the disclosure rule under the revised European Liberalisation Directive (2003/54/CE). The legislation has to be implemented by the individual Member States by July 2004, so at some point after that each consumer, whether householder, business or large industry, will receive information with their electricity bill about the sources of electricity generation being used to supply him/her. The proportion that comes from gas, coal, nuclear, renewables, and so forth, will have to be identified, together with the resultant level of carbon dioxide emissions and nuclear waste (though these latter two, separately, may only be provided on a website). With imaginative supporting policies, for instance catalogues, the data will enable consumers to compare company products and, therefore, as a result of liberalisation, to switch on the basis of environmental information, rather than mainly price (Boardman and Palmer, 2003). This will involve the end users in determining the electricity generation mix that they want—it is the extension of democracy to the energy supply world and, together with household-level renewables, is part of the process of decentralising energy decision-making.

Consumers are predicting that they will use disclosure to switch to renewables (Boardman and Palmer, 2003). However, in the UK, relatively few households are purchasing green electricity—about 50,000—so there has not been great enthusiasm for renewable electricity so far. This reflects, partly, a low level of advertising and promotion by the utilities, as a third of British consumers have switched companies on the basis of price (Boardman and Fawcett, 2002). Therefore, consumers are prepared to switch and it remains to be seen whether they will also switch in order to reduce their carbon emissions.

7. Helping consumers—the importance of feedback

Whatever the gap in people's comprehension, there is a general appreciation that consumers could be doing more to pull the market towards greater energy efficiency. There is little evidence of people proactively complaining about inefficient products or of demanding that retailers and manufacturers help them reduce the threat of climate change. How could they, when they do not realise there is an alternative? One way of closing this gap, of helping people to understand more clearly the link between their individual actions and greater emissions of carbon dioxide, would be through personal information and feedback mechanisms.

At the simplest level, feedback about the rate at which the household is consuming electricity and gas, with the resultant carbon dioxide emissions, could be provided in the home. This information could be provided through an interactive meter, as in parts of Northern Ireland where the KeyPad can be interrogated about levels of

consumption and expenditure. Other measures include putting the information on the normal electricity or gas bill, as a barchart that shows consumption over time, or in other formats. A review of 38 feedback studies carried out over a period of 25 years showed savings ranging from 5% to 20% (Boardman and Darby, 2000, p. 97). In many cases, the householders were not given additional energy efficiency advice—they became interested and knew what to do to conserve. The lesson may be that we just need to be motivated, to be reminded to change our habits, to put energy efficiency higher up the agenda and then we will act. Energy is invisible, so it is not possible to 'see' the wastage that is occurring, as you can with a dripping tap.

One powerful option for the 25 members of the EU through electricity disclosure (Boardman and Palmer, 2003) would be to link the emission factor for that particular company with the actual consumption of the individual and provide a statement on the bill:

> This year your electricity use has resulted in the emission of 1.2 tonnes of carbon dioxide, for further information see the accompanying leaflet.

Another possible route is to have a personal carbon allowance, for each individual, to cover all direct consumption of fuel—gas, electricity and petrol (Fawcett, 2003). This would provide a powerful feedback mechanism and incorporate all personal consumption under one heading. Households are responsible for 50% of all UK energy use, through their activities in the home and for personal transport. The remaining energy is used by householders indirectly, through the provision of services, such as street lighting, manufactured products, banking and so forth. A personal carbon allowance, though not an immediate policy solution, would provide a link between our international commitments and our activities as consumers.

A final form of feedback might be provided through the installation of supply options within the home. Decentralised technologies, such as domestic combined heat and power, solar thermal heating of hot water or photovoltaic generation of electricity can all be incorporated into the private dwelling. These may encourage people to live within the supply they generate themselves, thus the form of supply and taking responsibility for it could make people conserve energy. New research at the ECI is collecting the evidence, but studies of users of standalone photovoltaic systems demonstrate the principle (Fraunhofer, 2000, p. 10):

> Before watching TV the children look at the charge gauge. We respect the rules: Turn off light, no standby of appliances, make use of the daylight. For our part we are convinced that our solar adventure is a big success.
>
> A user from Catalonia

The feedback would depend on an informative monitor clearly and frequently visible to the user. This is similar to the beneficial effect from cars that show the driver the efficiency with which they are driving, as the result has been more efficient driving habits. It has been demonstrated that the occupants of super-efficient, passive homes so enjoy the experience that they try and find homes of a comparable standard when they move (Schnieders, pers. comm.). This represents the best form of market pull.

The British public believe that the Government should force people (53%) and industry (82%) to protect the environment, even if it interferes with their rights to make their own decisions (Christie and Jarvis, 2001, p. 144). These results for 2000 are virtually unchanged since 1993. If policy requires the manufacturers to produce low carbon technologies and if we help people by giving them good, clear information on the products that they buy and their impact, this would be the basis for a sane, sensible sustainable energy policy.

8. Conclusions

There is a great deal of potential for energy efficiency improvements and these could result in real reductions in energy use. In reality, the savings are less than optimal, because of growth in the numbers of households—which cannot be altered by policy—and the emphasis on efficiency rather than conservation is facilitating the development of larger appliances, cars and houses. European market transformation policy is progressing too slowly and needs revitalising: for instance the decisions on the new energy label are weak and very late. The most effective policy—minimum standards—is being replaced with the much weaker industry-promoted voluntary agreements. Working with industry is good, but not if it is at the expense of the environment. The UK Energy White Paper's confidence in European policy is misplaced unless the UK can shift the EC into a new gear.

Any energy saved is also offset by the introduction of an increasing number of energy-profligate pieces of equipment. New developments are welcome (for instance the digital revolution), but manufacturers do not focus sufficiently on making this equipment low-energy. Thus, the expectation is that electricity use in consumer electronics could completely wipe out the gains made with white goods. What is needed is for manufacturers to implement more responsible research strategies, otherwise governments may need to consider a 'permission to manufacture' approach. Once a product is on the market and heavily advertised, it takes policy several years to limit its consumption, by which time much of the harm has already been done. If the EU is making slow progress, then the member states may have to

consider working with manufacturers directly, as a second-best option. However, the opportunities for an individual country to reach an agreement with an international manufacturer, without breaching European legislation, are limited.

The primary focus should be strongly on more efficient products, whether appliances, houses or cars, as these are a prerequisite before prices are increased: consumers have to be able to identify the equipment that will save them money. In the UK, policy will continue to be constrained because of the continuing problem of fuel poverty—a problem that will continue at least until 2016, as the government has reduced the budget despite the fact that its advisory committee is asking for a 50% increase in funds. Until the homes of the disadvantaged are more energy efficient, then price increases (whether from world markets or policy) would be harshly regressive.

Consumers are concerned about climate change, know that fossil fuels are the major problem and would like to purchase cleaner, non-nuclear sources of electricity. Despite these concerns, consumers are rarely proactive and could undertake many more improvements to the efficiency of their homes. Somewhere, there is a missing link in people's chain of reasoning—it is likely that most people believe that they have done everything, or that what they are doing, for instance recycling, is sufficient. Another concern is that the efforts of one person cannot make a difference. The first of these, at least, could be overcome by policies to provide feedback to consumers. These initiatives are not common, in the UK, but could be the next most promising direction for promoting energy efficiency. Innovative feedback mechanisms, such as carbon quotas for the supply industries (as is happening with the EU emissions trading scheme) and for consumers individually could be particularly powerful, with adequate preparation. Easier forms of feedback, for instance through more information on the bill, could be a useful first step and have been found to reduce consumption by about 10%.

One of the benefits of working in carbon, rather than energy efficiency, could be that it has more meaning to people and reinforces the link with climate change, although the meaning may be synonymous with dirt and soot. Another benefit is that it brings demand and supply into the same carbon equation—it is possible to compare directly the cost and size of reductions from more renewables or more efficiency. Finally, of course, it is carbon that we want to save if we are to limit the risk of climate change.

The virtuous circle that would come from concerned consumers pulling the market towards sustainability, coupled with environmentally friendly products from like-minded manufacturers, does not exist. The focus of policy on energy efficiency, at least for households, should be to try and establish the circumstances whereby the circle operates strongly and well. Meanwhile, policy has both to make the links and to offset the negative effects of our profligate tendencies. This is an uphill task. The sooner we can utilise consumer pressure in favour of the environment, the better, and it should not be too difficult given their level of concern.

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