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ENERGY EFFICIENCY

International attention has focused on ways of reducing or reversing the growth in carbon dioxide emissions[1], since CO_2 is a major contributor to the greenhouse effect. The Department of Energy forecasts however, that without special action, CO_2 emissions by the UK could increase by 13-42% from 1985 to 2005, and 19-100% by 2020. One response to resolving this conflict is through higher efficiency in the production and use of energy.

This briefing note looks at the potential for increasing energy efficiency in the UK, the barriers to progress, and reviews some of the options available for improvement.

ENERGY EFFICIENCY IN THE UK

How do we compare with other countries?

One way of comparing countries' energy efficiency is through the energy consumed for each unit of GDP. This 'energy intensity' is shown in Table 1 for several countries. In 1973, the UK's energy intensity was higher than in many other industrialised countries, but this has now improved to about the European average. Much of this improvement has been due to industrial changes and fuel substitution, triggered by higher energy prices in the 1970's, and only around 30% has been attributed to investments to improve efficiency.

Current trends and policies

The Department of Energy (DEn) estimate that energy demand will increase at an annual rate of around 1.7% over the next 30 years, assuming no change in relative prices and policy, and an economic growth rate of 2.25% per year. These forecasts assume continued modest improvements in the efficiency of both energy production and use, but would nevertheless lead to an increase in CO_2 emissions of 29-34% from 1985 to 2005.

Government action to improve energy efficiency is centred on the DEn's Energy Efficiency Office (EEO), set up in 1983 with the objective of improving energy efficiency by 20% within 10 to 15 years. Its budget of £21m in 1988/9 supported:

- R and D on energy efficient technology/ techniques, and better energy management in buildings, in industrial /commercial plant and processes (£5m).
- A Demonstration Projects Scheme which provided grants to selected host companies to help offset the risks of demonstrating new technology, techniques or new applications of existing technology (£7m).
- Publicity, exhibitions etc, as well as the Energy Efficiency Survey Scheme and Community Insulation Projects (£8m).

The EEO estimate that annual savings of £400m resulted from these programmes. EEO programmes have also been reviewed by the National Audit Office, who concluded that they were yielding annual savings well in excess(x5) of their annual cost.

The EEO's recent emphasis has shifted to the promotion of 'best practice' in buildings and industrial processes. The total budget of the EEO was reduced to £15m for 1989/90 and will be £15m for 1990/1 (this will rise to £26m if Parliament approves the proposed Home Energy Efficiency Scheme). Cuts from the 1988 budget fell particularly on television advertising, energy surveys, and on support for Energy Manager groups.

Table 1 : ENERGY INTENSITY AND CHANGES 1973 -1987

Country	Energy Intensity* 1973	1987	Average Annual Improvement 1973-1987(%)
Canada	0.77	0.64	1.3
Germany	0.53	0.42	1.6
Japan	0.39	0.26	2.8
Europe	0.52	0.43	1.3
Italy	0.42	0.33	1.7
Sweden	0.59	0.54	0.5
UK	0.57	0.43	2.0
US	0.59	0.44	2.1

* Total energy requirements (tonnes coal equivalent) per $1000 GDP

ENERGY - EFFICIENT TECHNOLOGIES

Technologies exist to improve efficiency in all sectors of the energy economy (Figure 1) - from production to use.

Combined Heat and Power (CHP)

In most fossil fuel power stations, only about one third of the energy in the fuel is converted to electricity, the balance being lost primarily as waste heat. Where waste heat can be used for process or space heating (eg for

1. As part of the 1989 Noordwijk agreement, most industrialised countries (including the UK) agreed that CO_2 emissions should be stabilised by the year 2000 .

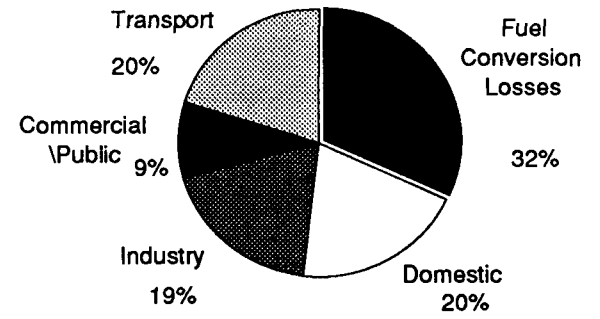

Figure 1 : UK Primary Fuel Use 1987

nearby housing), the resulting combined heat and power scheme can achieve overall efficiencies up to 80-85%.

Since the 1983 Energy Act, it has been possible for private CHP operators to export surplus electricity to the National Grid. This has given a boost to small-scale CHP schemes, which are already installed at 420 sites and account for 3% of UK electrical capacity. The greatest use of CHP is in Denmark, where most of the country's electricity is from CHP sources. The EEO promote CHP and estimate that there is potential for many more schemes in industry and commerce (e.g. in office blocks and hotels). There may also be scope for implementing city-wide CHP/district heating schemes on the lines of those widely used in Scandinavia and under consideration at Newcastle, Sheffield and London. Such schemes have the potential to reduce by 10% the UK energy demand over the next 20 years.

Lighting

Around 15% of total electricity usage is for lighting. The latest compact fluorescent lighting is much more efficient than conventional incandescent bulbs; reflectors and high frequency fluorescent tubes also increase the efficiency of strip lights. Savings in the amounts of energy used for lighting of over 75% are technically available. Capital costs are higher, but the DEn estimates that the cost to the average British household of replacing its lighting would be recouped by savings within 1 to 5 years. Further gains in efficiency are expected over the next decade as technology develops.

Electric Motors

Over half of industry's electrical consumption arises from motors. Advances in motor and controller design offer consumption savings of up to 10%, but energy efficient motors have made little headway in the UK. The industry has contrasted this with the much higher (30%) share held by such motors in the USA, where tax credits were available for energy efficient equipment.

Appliances

Electrical appliances consume around half of domestic electricity demand. Appliances using better thermal insulation and motor technology, and with energy consumption of up to 65% below the UK average, are currently available in the European market (although not widely found in UK shops). Prototype technology has achieved further savings.

Space and Water Heating

Space and water heating accounts for the dominant(82%) use of energy in households, whether electricity, gas or solid fuel. There is scope for saving, both by reducing heat losses and through improving the efficiency of heat production. Better insulation and draughtproofing can reduce heat losses by as much as 60%. The latest design of gas condensing boiler is around 10-20% more efficient than conventional designs, while modern controls direct the heat to the places and at the times when it is needed. DEn estimates that the cost to the average household of cavity wall insulation would be recouped by savings within 4 to 7 years, and of improved boilers and controls within around 3-5 years. Loft insulation pays for itself in 2 -4 years. Double glazing is less cost effective (paybacks 8-30 years) but has other benefits such as noise reduction and security.

In practice, the full potential of these savings will not be realised because householders will take some of the improvement as raised comfort levels. Nevertheless, even allowing for this, bringing all UK housing up to the best current practice could reduce domestic energy consumption by around one quarter.

BARRIERS TO IMPROVED EFFICIENCY

The DEn estimates that the potential savings throughout the economy that could be achieved now on standard economic criteria are:

- 10% for "good housekeeping" and better management,
- 10% for "retrofit" investments paying back in 2 years,
- 10% for investments with a 5-year payback.

Looking ahead to when plant and buildings are replaced, the potential exists for another 10% savings by incorporating modern cost-effective energy efficiency techniques, and for a further 10% if the most energy efficient technology were to be used (regardless of cost). If the state of the art itself improves then another 10% saving may be achieved. Although these savings may not all be additive, **the total savings potential could exceed 50% of current energy consumption.**

The fact that opportunities to reduce energy waste are not taken up, despite attractive rates of return on capital invested, raises questions concerning the operation of

the markets for energy. Various studies have identified several perceived obstacles to implementing efficiency measures, including:

- Lack of time, manpower or skills, and, in the public sector, of finance.
- Uncertainty over fuel prices.
- Unwillingness to take risks in investments not directly related to production.
- Lack of awareness. Smaller businesses and domestic users, are often unaware of how much energy they use, and of what measures they could take at what cost to reduce consumption;
- Rate of return. Investments in energy efficiency are typically required to pay back their costs in two or less years - much less than with other investments.
- Separation of costs and benefits. Often the one who must pay for better efficiency (e.g. the landlord) does not reap the benefit; this is common in the commercial and public or institutional sectors.
- Many cost-effective opportunities are limited by the slow turnover of equipment and buildings.

OPTIONS TO IMPROVE EFFICIENCY

Much of the potential for energy efficiency could be realised with existing cost-effective technologies, but progress depends to a large extent on individual decisions by large numbers of individual energy consumers. A number of policies and measures for improving energy efficiency have thus been suggested by many organisations, which particularly aim to correct perceived market imperfections or raise public awareness.

Responsibilities of Energy Suppliers

During 1989, much discussion took place in Parliament on the duty to be placed on electricity suppliers to promote energy efficiency. Some cited experience in the USA and Norway where some Public Utilities have applied the principles of "least cost planning", requiring the lowest-cost investment in order to meet anticipated demand. Some utilities have found that rather than construct a new power plant, it may be cheaper to encourage energy efficiency through publicity, free energy surveys, and rebate or loan schemes on efficient equipment. Some US States have allowed Utilities to earn a higher rate of return on capital if they operate an effective energy efficiency programme.

A duty on the electrical supply industry now arises from condition 22 of the Public Electricity Supply Licence, which requires a code of practice on the information to be provided to customers on efficient use of electricity. The Director-General of Electricity Supply (DGES) is in the process of reviewing a draft code with suppliers to be applied from July 1990. In addition, the DGES is consulting on possible actions under Sect. 41 of the Electricity Act concerning performance standards to promote the efficient use of electricity by consumers.

The Director-General of the Office of Gas Supply (OFGAS) has observed that his powers under the Gas Act 1986 are weaker than those of the DGES, and has raised the possibility of requesting additional powers if satisfactory progress on energy efficiency cannot be achieved by agreement. OFGAS is also concerned to ensure the maximum use of gas generated by landfill sites on both energy efficiency and environmental grounds (see POST Briefing Note 3).

Energy Pricing

It has been widely suggested that energy prices should reflect the full environmental costs of energy use, particularly the generation of carbon dioxide. Such a tax (e.g. a carbon tax) could encourage energy efficiency by raising the price of energy. However, it has been pointed out that serious distortions could result from such an approach unless it were applied internationally, since energy is a primary cost in any industrial country.

Regulation and Standards

Some support the use of regulations to specify new standards or tighten existing ones on energy efficiency. For example, although stricter insulation standards for new buildings will apply in the UK from April 1990, they will remain behind best European practice. The new standards will also affect only new buildings (~1% of the building stock each year).

Supporters of tighter standards point to experience in Denmark where energy surveys are required of houses for sale, and are encouraged through subsidy in existing housing. A high proportion of all housing has now been brought to the standards for new housing. In Milton Keynes, higher minimum standards are applied to new housing which has reduced heating bills by 40% at only marginally higher (1%) building costs. The National Energy Foundation has recently set up an accredition scheme to allow builders to provide an energy cost index for new houses.

In the transport sector, the average UK car produces nearly 4 times its own weight of CO_2 each year and the DTp forecasts that vehicle mileage could rise by 83-142% by 2025, increasing the relative importance of transport as a source of CO_2. There are no UK regulations on fuel efficiency. In the USA, Federal law required manufacturers to achieve a doubling in the average consumption of all vehicles over a period of about 10 years (though from a relatively low base). Vehicle taxes in some EC states promote the use of smaller, and thus more economical cars. In the UK, recent surveys have shown that the higher incidence of

company cars encourages extra use of larger and less efficient cars. In the 15 years to 1985, average fuel consumption fell only 7% in the UK, while in France and Belgium it fell 25%, in Italy 40%, and in the USA 15%.

Appliance Standards and Labelling

Some argue that domestic appliances should be required to meet minimum standards of efficiency, and should be labelled to show their energy consumption. There are no UK standards of energy efficiency or requirements for labelling, nor are there binding EEC standards. By contrast, the clear labelling of appliances to show their energy consumption has been required for nearly ten years in the USA, and was supplemented by mandatory efficiency standards under the 1987 Energy Conservation Act. Some local schemes in Britain were promoted by the EEO but have now mostly lapsed, reportedly due to limited public interest. Manufacturers have opposed efficiency labelling on the grounds that efficiency was only one of several factors affecting a customer's purchasing decision. Although efficiency information is now routinely collected and included in the appliance documentation, primary legislation would be required to compel manufacturers to display this in a common format.

The Lords' Select Committee on the European Community and others have argued that mandatory standards of efficiency should be applied across the Community.

Publicity and Practice

Energy engineers are concerned that investments with very rapid paybacks are not being made, which emphasises the need for more publicity of best practice, support for energy audits, monitoring and targeting, and for energy management. The reduction in EEO activities has been criticised as sending a wrong signal that the need for energy efficiency has declined. Cutbacks in publicity campaigns by the EEO have also been contrasted with the frequent finding that efficiency measures are held back in part by users' lack of information. Calls have been made for the reinstatement and expansion of earlier initiatives. For instance, increased support for energy managers has been suggested as a cost-effective way of encouraging continued action, while the withdrawal of the EEO's Energy Efficiency Survey Scheme has been contrasted with continued DTI support of 50% funded consultancies for other business activities (in marketing, design etc.).

Within the public sector, a programme has been started to promote energy efficiency. Departments now have energy managers, responsible for achieving a target 15% reduction in consumption over 5 years. Investments of up to 10% of the energy bill are encouraged, and a league table of departmental performance will be compiled and published.

Incentives

Against the background of recent falls in investment in most forms of building insulation, there have been calls for financial incentives to be introduced. A wide range of such incentives have been considered and applied in some countries, including grants (such as the discontinued Homes Insulation Scheme for loft insulation), low-interest loans for efficiency measures (as used by some American energy utilities), and tax incentives, as recommended by the Commons' Select Committee on Energy. Some suggest that tax relief for insulation work by homeowners, or for industries to invest in efficiency, would be beneficial. They point to the inconsistency of charging VAT on efficiency improvements while the energy supply is not taxed.

Others (including the DEn) oppose such incentives on the grounds that the actions they encourage are already cost-effective. However, the Home Energy Efficiency Scheme, if authorised by Parliament, will encourage insulation projects for low-income households.

Action by the EEC

Many of the above actions to promote energy efficiency could interfere with the free movement of goods in the Common Market and would thus need to be part of an EEC programme.

In 1988, the Commission drafted a proposal for a Community Action Programme to improve electricity efficiency which included the following elements:

~ consumer information and technical advice;
~ standards of appliance and equipment efficiencies;
~ financial incentives;
~ demonstration and R&D

This was considered by the Lords' Select Committee on the European Community which supported the aims of the Programme, but felt its scope should cover all issues concerning energy efficiency. Since then, little progress has been reported on this proposal.

FURTHER READING

Additional details and background information are available from POST, 2 Little Smith St., Westminster, SW1P 3DL. Tel 01-222-3912.