

Energy Conservation

This is one of a series of briefings prepared by SONE, in consultation with scientists and engineers, on energy topics for which exaggerated claims are made. Energy conservation is one of these.

Like renewable sources of energy or alternative ways of supplying it, energy conservation has great **theoretical potential**. It is even seen by “Greens” as a means of eliminating the need for new conventional power stations and especially nuclear plants. The problem lies in realising its potential.

Definition

What do we mean by energy conservation?

Essentially the term covers two aims:

1. to improve the efficiency with which energy is used in machines, appliances, buildings and motor vehicles; and
2. to cut out the wasteful use of energy.

In other words, conservation (saving) can be seen in two ways: in the positive sense of promoting the more efficient use of energy (using less to achieve more); and in the negative sense of deliberately restricting usage by exhortation (“Switch off Something”), by pricing, including taxation (making it too expensive to waste), or by rationing (compulsion).

Because of the unpopularity of higher prices and compulsion, exaggerated expectations are now placed on energy efficiency, even though, as we shall show, historically greater efficiency has led to greater energy use.

In short, promoting energy conservation is a complex business. It is not simply a matter of applying technology; it also involves persuading people not only to use the available technology but also to change their behaviour when they prize the convenience and comfort brought by higher energy usage.

Complication

It is made more complex because energy conservation is seen as a means to other ends:

- reducing greenhouse gas emissions to combat global warming
- reducing the use of fossil fuels, thereby contributing both to carbon emissions reduction and domestic energy security
- helping those living in what is described as fuel poverty by reducing energy consumption generally by means of better insulation, controls, draught proofing etc;
- eliminating the need for replacement power stations.

History shows that none of these “secondary” objectives is likely to be achieved through energy efficiency – only by actual reductions in energy use brought about by exhortation, pricing or compulsion.

In spite of all this, the **realisable potential** of energy conservation deserves serious examination. It never makes sense to waste anything and the modern world is a very wasteful one. This note explores what is possible and concentrates on the two – positive and negative – aims.

Energy efficiency

Ever since man began to use energy in his daily life he has sought to get more useful work out of it. Scientists, engineers and technologists are constantly employed on improving the efficiency with which machines, appliances, buildings and vehicles use energy and have been spectacularly successful, though squeezing more out of existing technology gets harder with every improvement.

Like other Western nations, Britain is a much more energy-efficient nation than 40 years ago. Since 1970 GDP – the Gross Domestic Product or national income – has doubled but energy consumption has risen by only 12 per cent. This improvement has been maintained over the past 10 years since GDP has risen by 21 per cent since 1997 but energy consumption by only two percent.

That is pretty spectacular progress by any standards, though some of it will have resulted from the decline of heavy industry. BUT... electricity demand has continued to rise by an average of 1-1.5 per cent a year, though the annual figure varies with the level of economic activity.

In other words, improved energy efficiency does not necessarily reduce energy consumption.

Cutting out waste

There is no doubt that man is extremely profligate in his use of energy. There is a vast opportunity – at least theoretically – to reduce consumption by cutting out waste.

It is certainly possible to slash its use in emergencies – e.g. the three day week in 1974 – through restrictions, but it is difficult to sustain the savings. In a democratic society voters get very restive if their comfort and convenience are interfered with. It follows that savings achieved during a crisis are strictly short-term and never maintained.

As a tool for reducing demand, energy conservation has to be something more than a brief response to national difficulties. It requires a change of attitude and behaviour towards the use of energy. That is unlikely to be secured if energy prices are falling in real terms – as they have done for much of the past 50 years until recently.

But high energy prices are politically unpopular. High petrol and diesel prices have brought insistent press and public criticism about the level of Government fuel duties and oil company profits, though it must be said that sales of gas-guzzling vehicles have latterly fallen dramatically. Nonetheless, governments, whatever their political complexion, are likely to find it politically difficult to apply sustained price pressure on people to reduce consumption. In other words, we cannot rely on prices and taxes to encourage consumers consistently to economise.

It is possible to help consumers to economise through such things as loft and cavity wall insulation, double glazing, draught proofing and lighting and central heating controls. They make for the more efficient use of energy, provided, of course, people do not use windows or doors as a form of air conditioning and allow their heating systems to warm the birds. Often, however, increased efficiency encourages people to turn up their thermostats to enjoy more comfort at the same cost.

It is also possible to reduce consumption by more efficient technology, regulation and tax pressure as with hybrid cars, operational standards, building regulations and preferential tax rates for more economical systems.

But all these things have been tried to a greater or lesser extent over the years and still energy demand has increased.

Waste heat

“Green” campaigners insist that large power stations are a problem and aspire to a nation where every householder generates his own electricity through what is called micro-generation – i.e. wind turbines, solar panels etc. This brings many problems (see SONE briefing on micro-generation).

It is true that large power stations may be only 40 per cent efficient because their operation necessitates the dumping of large quantities of low-grade heat (50-100°C) and that in Northern Europe this hot water is often used for district heating.

Britain’s temperate climate may partly explain the low usage of power station heat or smaller combined heat and power (CHP) systems. But since World War II the UK’s policy has also been deliberately to site large power stations away from cities and close to coalfields, ports or the coast to simplify refuelling and reduce housing blight. The waste heat from them would have to be pumped 10-20 miles to the nearest centre of population and then distributed around the town or city. That would create massive disturbance, not to mention the cost, which has so far been regarded as prohibitive, of piping it into existing buildings. Heat requirements also vary across the day and year and are minimal during the summer, though electricity is still required.

Designing the use of waste power station heat into new buildings may be more attractive but it would be a mistake to believe that there is a perfect alternative to allowing low-grade power station heat to go to waste.

Rebound and multiplier factors

There are two socio-economic effects that make energy conservation such an uncertain moderator of demand – the rebound and multiplier factors.

Only the most committed environmentalists, determined to save the planet by their own actions, save energy for energy’s sake – or more precisely to reduce their fossil fuel consumption. Most people see energy conservation, in so far as they give it a thought, as a means of saving money.

Having economised and with more money in their pockets, they are prone to spend it on additional appliances which use energy, especially in this age of DVD, computer games and digital appliances. This is the **rebound** effect.

The **multiplier** effect takes it a stage further. Take, for example, a Government scheme to encourage investment in loft insulation as part of counter-recessionary measures. This will give insulation manufacturers a boost, which could be reflected in dividends paid to shareholders. Insulation installers will take on more staff who will have more to spend to the benefit of shopkeepers. All these and other ripples from the stone the Government has cast into the pond in the form of an insulation incentive raise economic activity, as intended, and indirectly energy consumption.

Ignoring history

In spite of all these factors, environmental campaigners, the Sustainable Development Commission, which advises the Government, and “Green” politicians maintain that energy conservation and more specifically energy efficiency can help to avoid the need for new power stations – and especially nuclear power stations, which they regard as taboo even though they emit next to no carbon.

They ignore the evidence of history. Stanley Jevons, the logician and economist, noted in the 19thC that increased efficiency leads to higher consumption. In his book *“On the Coal Question”* (1865) he recorded the efficiency of early steam engines in terms of “the number of pounds of water raised one foot high by the expenditure of a bushel (84lbs) of coal”. Summarising his tables, which showed a successive improvement, he wrote: “In less than 100 years, the efficiency of the engine has been increased ten or 15-fold”. This was the foundation of the Industrial Revolution. He concluded: “It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to a diminished consumption. The very contrary is the truth”.

Jevons' early work evolved into the Khazzoom-Brookes postulate after work by two economists in 1979-80. A House of Lords' inquiry in 2004-5 into energy efficiency also noted that there appeared to be no example of a developed society that had succeeded in combining sustained reductions in energy consumption with economic growth.

Here are three examples of greater efficiency leading to greater use of energy:

1. **The Industrial Revolution:** The first steam-powered pumping plants built over 200 years ago were barely one per cent efficient, measured as useful work divided by thermal energy input. Improvements in design by Watt and Trevithick raised efficiency to 3-4 per cent. This cut the amount of coal used by the pumping machines and the cost of pumping water out of coal mines and in turn encouraged the exploitation of previously uneconomic coal seams. The result: an increase in the amount of energy used to mine coal and a reduction in the price of coal at the pithead, leading to its greater use.
2. **The motor car:** Forty years ago most cars had a one-litre engine that gave 30mpg. Since then energy efficiency has greatly increased so that engines can give 50mpg and even more. The improvement in efficiency enabled motorists to buy more comfortable cars with larger engines requiring only the previous amount of fuel. Far from reducing fuel consumption, energy efficiency has increased demand. Indeed, it has doubled over 30 years.
3. **Electricity consumption:** Over the decades electrical equipment has become more energy efficient and cheaper to operate but electricity consumption has not fallen. Some of the savings have been invested in technological advances leading to the phenomenal growth in the ownership of computers and electrical gadgetry. The result: electricity consumption has risen by 65 per cent since 1960 and by 44 per cent since 1980 and continues to rise by an average of 1-1.5 per cent a year.

What is possible?

We can certainly reduce energy consumption in an emergency but the gains are likely to be short-lived. Securing sustained economies is an entirely different matter and unlikely without fierce and politically difficult price pressure or restrictions. Over and above that, it requires a change of attitude towards energy and its use that certainly cannot be engineered over the short-term. Latterly we have not seen a vigorous national campaign to promote a change in behaviour such as the "Save It" campaign that was instituted after the oil crisis of 1973-74.

It may make eminently good sense to cut out waste, especially when we are faced with such finite major sources of energy and carbon emissions as fossil fuels. But there is no sign yet of that wartime spirit – that national determination – which raised the question "Is your journey really necessary?"

So, as things stand, we should be very cautious about regarding energy conservation as "the fifth fuel" – as it was described in the 1970s' "Save It" campaign.

No substitute for nuclear

Perhaps the most we can expect of energy conservation in its several forms is to shave an increase in demand. There is no evidence whatsoever that the "Green" dream of powering Britain with renewable and alternative sources of energy, aided by energy conservation, to the exclusion of fossil fuel and nuclear power stations, is remotely achievable.

The Government has made energy conservation a plank in its energy policy but in practice does little visibly to promote it compared with its heavy investment in renewable sources of energy, or more precisely wind. Its advocacy thus appears to be mere window dressing.

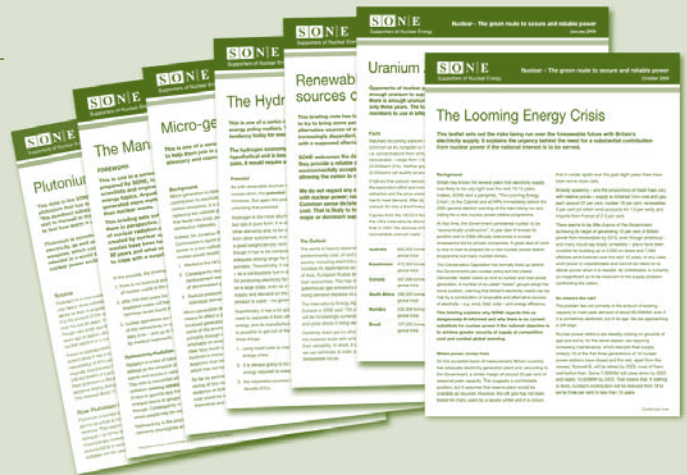
One thing is clear: continued reliance on renewables and energy conservation as a substantial element of policy will produce substantial savings of energy only through blackouts. That is not what energy conservation is about.

With the best will in the world, energy efficiency is unlikely to render a single nuclear power station redundant. Only major reductions in use brought about by exhortation, pricing or compulsion could achieve that – and that is extremely difficult outside short-term crises.

Energy conservation is clearly not – and never will be – a substitute for nuclear power.

If you want to read more about nuclear issues or different aspects of energy policy you can download the following briefing notes from SONE's website at www.sone.org.uk:

- Carbon Cull
- The Looming Energy Crisis (update)
- Uranium Availability
- Renewable and alternative sources of electricity
- The Hydrogen Economy
- Micro-generation Briefing Note
- The Management of Nuclear Waste
- Plutonium in Perspective
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