# Least Cost Planning: Should Utilities Invest in Energy Efficiency Rather Than in New Supplies?

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# 1 INTRODUCTION

The essence of least cost planning is that in some circumstances it is more profitable for a utility to encourage its customers to use less electric power/water/gas than it is for the utility to sell a larger quantity of its product.

The two parameters that define the circumstances when this may occur are the price at which the utility can sell its service; and the cost of investing in new or additional plant to meet growing demand, as compared to the cost of conservation measures. Capital costs of new plant have increased very sharply over recent decades, while prices charged by utilities are normally regulated, and political pressures limit the extent to which they can be increased - especially if there is evidence that conservation could remove the need for such large increases. This unusual combination of circumstances has led to the unexpected situation of utilities investing on behalf of their customers in conservation.

"Least cost planning" is thus a very simple concept, but one which raises a number of practical problems in application. It implies a major change in the behaviour, and in the remit, of utilities, although it appears on the surface to make obvious financial sense. A number of pressure groups are strongly advocating it; and, as presented by these groups, one's immediate reaction is, why have utilities not always done this? This paper seeks to explore the concept; to review experience with least cost planning; and, most importantly, to separate the rhetoric on the subject from the reality. It is hoped that this will be helpful to the debate over the worth of least cost planning, and its applicability under different regimes of regulation and ownership of utilities.

It is important that it is made very clear that the concept of least cost planning applies to the utility as an entity, and not to society as a whole. This issue is discussed in detail in the next section, and will recur throughout the paper. The distinctive feature of least cost planning is not that it shows that conservation is good for the world; it is that it measures whether or not conservation is profitable for a specific utility. Given the role of politicians and regulators in influencing the pricing policy of utilities, their business strategies are never wholly market-led. But the aim of least cost planning is not to introduce a new business objective for utilities - conserving resources and saving the environment; it is rather to improve the economic performance of the utility. The conceptual separation of politicians' (possible) motives in introducing least cost planning from the underlying logic of the method is very important in order to avoid confusion, and ultimate failure of least cost planning programmes.

At the outset it should be noted that the US utilities with experience in this area prefer the term "integrated resource planning" to the popular description "least cost planning". This is because they, quite rightly, claim that they have always been motivated to plan their facilities at least cost. Although there can

always be argument over which sort of power station, for example, is the most economic in any given situation, utilities have always been able to provide costings to justify their choice of one facility over another.

What is new about "least cost planning" is that it requires utilities to look at the world in a completely unfamiliar way. Their traditional role has been to provide a service in response to demand: as demand has increased they have been responsible for satisfying it in the most economic way, and without making excess profits. Utilities have developed considerable expertise in forecasting demand profiles, and in providing efficient and reliable supplies.

In principle any utility with high capital costs could be made subject to least cost planning regulations. For example water authorities that face a constantly growing need for additional reservoirs and more sophisticated water treatment facilities; electric power companies which are faced with ever growing demand for electricity, necessitating new power stations and a larger distribution grid; and possibly gas companies. In some states of the USA gas and electric power are provided by the same utility, and it therefore makes sense to subject both fuels to a similar regulatory regime. Moreover, the first state to introduce least cost planning - California - was responding to physical curtailments of gas and oil supplies, which affected both power stations and customers who used natural gas as a fuel.

The discovery and development of natural gas is however closely related to oil market economics, and is therefore subject to open market forces in a way that construction of power stations or reservoirs is not. The influence of least cost planning on this end of the gas business would therefore be very complex. In many European countries there is also direct competition between separate gas and electric utilities, especially for the home-heating market: this also affects the modalities and economics of demand-side investments by either industry. This issue will be further discussed in the final section of this paper. For the sake of clarity and simplicity however the sections of this paper describing and analysing the nature of least cost planning will be restricted to the electricity industry. The focus will only be broadened in the final sections.

Under a least cost planning regime the demand for electric utilities' services is no longer taken as a given, to which they simply respond. Rather, utilities are expected to integrate into their approach a more sophisticated analysis of demand and of their customers' behaviour, and also of end-user technologies (in addition to their traditional fields of power generation and distribution). The premise is that, for a variety of reasons elaborated below, it is often cheaper for utilities to invest in end-user efficiency than it is to meet expanding demand.

Whereas electric utilities have traditionally measured their success in terms of their output of kilowatts, it being taken for granted that regulation ensured their economic operation, under least cost planning they become subject to the

"bottom line" economics of other businesses. The quantity of power that they sell becomes less important than the ultimate figure at the bottom of the balance sheet. Rather than being the purveyors of electric power, they are the suppliers of energy services: consumers typically have very little idea of how many kilowatts they use - they are interested in having adequate heat, light and motive power at the lowest feasible cost. Other things (and especially cost) being equal, consumers are indifferent whether they use inefficient appliances and a large amount of power, or efficient appliances and a small amount of power.

The immediate attraction of the concept of least cost planning is that it links energy efficiency to profit and loss economics. The efficiency lobbies have seen it as a way in from the cold fringes of environmental politics, to which they have often been consigned, to hard-headed business economics. Whereas their motives are grounded in environmental concerns and "green" politics, least cost planning appears to provide a bridge to an island, where they can speak a common language with traditional business concerns. It has been hoped that where environmentalists have disliked the construction of additional power stations on the grounds of pollution, utility managers will come to agree with them - albeit for entirely different reasons, those of profit and loss. The examples of some US utilities have been widely quoted in the European context as models for changing practices in Europe.

The UK seemed particularly fertile ground for such new ideas when its electricity industry was being privatised, and its regulatory systems thoroughly scrutinized as a result. The general shake-up of the industry should have provided numerous opportunities for introducing new ideas and practices. Moreover, privatization should have made "bottom-line economics" of prime concern to company managers with the new remit of satisfying private shareholders.

While the ideas of least cost planning have certainly gained more currency than heretofore, the general reaction has been far more lukewarm than the lobbyists might have hoped for. Some reactions have been understandable, if not very logical. There is suspicion of the motives of Greens; the business community is not used to receiving advice from this quarter on how to increase profits. There is also considerable reluctance to take on board new ideas. Corporate and individual inertia will always resist a completely new approach to business. This is especially the case where the very measure of business success is in question. Thus the UK Electricity Council dismissed the idea out of hand: privatized companies "would be less enthusiastic to encourage a reduction in sales ... they would be being asked to become the architects of their own decline". (Evidence to UK House of Lords, 1989, p.8) This quotation reflects a total misunderstanding of least cost planning; it also demonstrates the clinging on to notions of success as defined by quantities of electricity sold, as opposed to the bottom line of the balance sheet. Least cost planning does indeed fly in the face of traditional

"common sense" in the electricity industry, and persuading people to change their received ideas is never easy.

It can of course be argued that the proponents of least cost planning have understood it no better than its opponents. There is a school of thought that argues that the whole idea is the product of very specific market and regulatory conditions in the USA. Whereas it makes economic sense in that particular context, the ideas cannot be transposed onto completely different circumstances in other countries.

This paper will seek to tease out the general from the particular. It will review the experience in the USA, and the debate that has ensued over the exact application of least cost planning. It will then set the parameters of how useful the concept may be under different regimes. How would the relationship between the gas and electric supply industries be affected? Does least cost planning make any sense where these two suppliers are in direct competition?

Wide-ranging regulatory changes would be required for least cost planning to operate effectively: are these desirable? Or can the aims of the efficiency lobby be better met by other means than through the intermediary of utilities' profit and loss accounts - perhaps through direct government subsidy?

## 1.1 The Aims of Least Cost Planning

The environmental lobby has seized upon least cost planning, as suggested above. But it is not alone - a whole range of other potential benefits exist, and each brings its own supporters into the camp of least cost planning advocates. The following benefits are all claimed:

- lower pollution. The construction of fewer power stations and generation of less electricity than would otherwise be the case will mean fewer emissions into the atmosphere of carbon dioxide, nitrogen oxides, sulphur dioxide, etc. Air pollution, acid rain and the greenhouse effect will all be reduced.

- a way of including environmental externalities in the planning process. Least cost planning cannot solve the difficulties in costing environmental damage, but it does provide a mechanism for directly weighing putative costs against benefits.

- energy self-sufficiency. The smaller the amount of electricity generated the smaller the quantity of fuels required. Domestic supplies will last longer and/or fewer imports will be needed. This has both economic and political benefits, and is a powerful political lever in the USA in particular.

- the efficiency of the national economy. There is wide variation between countries in their energy intensity, the amount of energy consumed per unit of GNP produced, over and above structural differences in the economies. Since energy is a cost in production this makes the goods of energy inefficient countries relatively uncompetitive on world markets. For example the USA compares very poorly with Japan on this count. Achieving greater energy efficiency thus gains another group of supporters, and least cost planning is seen as an appropriate way of encouraging change in this direction.

- the economic efficiency of the utility itself. Investment in end-user energy efficiency obviates the need for long, expensive planning enquiries over the siting of new power stations. It requires less total capital, and can be carried out in smaller units than investment in major new power stations. It is flexible - programmes can be targeted to smaller or larger customer groups as required, and can be phased. The effects are rapid. They are also predictable. It is less risky than investing in extra generating capacity in advance of forecast demand growth.

I will argue that while all of these aims are laudable in themselves, they should be seen as red herrings - with the exception of the last, the economic efficiency of the utility itself. Much of the confusion in the debate over least cost planning has arisen because different groups are all trying to pursue different ends. Members of the industry are most likely to be persuaded if it can be shown that their business will benefit. Moreover, this is where the whole concept stands or falls. All the other effects are contingent upon the underlying assumption that it is indeed cheaper to invest in energy efficiency than in new power stations. If this is not the case then environmentalists and others would do better to concentrate on other methods of achieving their ends.

In the last resort it needs to be remembered that least cost planning is a *method* not a *solution*. It requires that the cost of reducing demand is compared to the cost of providing new supplies. It does not lay down in advance that new supplies are always a bad thing, nor that they are necessarily unprofitable.

## 1.2 "Least Cost" to Whom?

The question "least cost to whom?" is prompted by other confusions that can be found in the literature. There can be three distinct answers to the question, each carrying different implications. If these are not clearly distinguished from each other the waters become very muddied, and the whole concept loses its usefulness.

The first response may be to look at the welfare of the individual consumer. This is not however normally the perspective taken in the least cost debate - other than for a residual concern that individuals should not positively lose out as a

result of least cost planning. This is the context of the "no-losers" rule that will be discussed below. Broadly speaking however there is an assumption that least cost planning will benefit individuals to the extent that it encourages economic efficiency, and (importantly) this efficiency is reflected in electricity pricing.

At the other extreme, and more commonly, the debate centres around the putative benefits to the society as a whole of least cost planning. Is the most efficient use being made of scarce capital resources? Is the health and welfare of the population and the environment being protected? Is the national economy suffering as a result of inappropriate investment and over-costly power? This is the level at which many of the supposed aims of least cost planning described in the previous section are pitched. Again, I would argue that this is not what least cost planning is about, although it may carry such benefits as a side product.

These two perspectives are the traditional routes from which to approach questions of energy efficiency. It has been assumed that if energy efficiency is in the individual's economic interest then s/he will invest accordingly. Where there are clear societal benefits from efficiency investments that would be difficult for individual consumers to justify, then there have been calls for government investment programmes or subsidies. The distinctive feature of least cost planning is that it takes a third route, and looks at the benefits to utilities of investing in end-user efficiency for their own ends. The motivation for such investment is to be based on hard-headed economics, with no hint of subsidizing customers for the sake of any high-flown ideas.

Of course there is always room for argument over costs and benefits, as in any business decision, with some element of risk being attached to the investment. Arguably, the objective risk when investing in demand measures is considerably less than the customary risk taken by utilities when they invest in new facilities to meet forecast demand rises. This makes statements such as the following from the UK Department of Energy read very strangely: "In practice, the search for an optimal allocation of resources as between investment in energy conservation and energy supply has within it something akin to the quest of King Arthur's knights for the Holy Grail." (UK Dept of Energy, 1983, p.55) Unless the term "optimal" is interpreted in an extremely purist way, in which case no investment decision is ever rational, there is no reason at all why a rational judgement should not be made on this issue, just as on any other business decision.

One distinct advantage of treating energy efficiency investment in this way is that it becomes subject to "fair" economic assessment, on a discounted cashflow basis or in a full- blown cost-benefit analysis. This contrasts with the situation where energy consumers (including industrial concerns) normally rely solely on simple payback calculations in this context. (Even short paybacks commonly are not taken advantage of, for the reasons discussed below. In its recent assessment of the potential for electricity end-use efficiency the IEA used a criterion of a payback period less than three to five years - equivalent to a real rate of return

of 20-30 per cent or more. On this generous criterion they estimated there existed potential savings of 10-20 per cent on current electricity use in IEA countries, but these were unlikely to be taken up. (IEA, 1989, p.16))

As the UK Department of Energy has pointed out, using payback criteria for making investment decisions ignores some of the special features of energy efficiency investments, notably their long life, low risk and inflation-linked savings. "Using discounted cash flow techniques energy savings projects which would be rejected by many companies using payback period as a criterion can be shown to be highly attractive." (UK Dept of Energy, 1982, p.11) A utility making a direct comparison of investments in supply and demand management will of course use equivalent techniques for the two options.

An additional factor may also mean that energy efficiency investments are seen in a more favourable light by utilities than by other potential investors. Namely that public sector investment appraisals often require a payback of seven to nine years (equivalent to a discount rate of 5-10 per cent). (IEA, 1989, p.48) Where electric utilities are privately owned this criterion may not be quite so generous; but nevertheless regulators tend to stipulate somewhat less rigorous requirements than are found in the broader commercial world, if only because the enormous up-front investments required for new power stations and distribution systems can rarely satisfy stricter financial criteria.

End-user energy efficiency investments may thus seem more favourable when assessed by electric utilities than by the users themselves, because different criteria are used. The investment comparison also differs: both domestic and commercial consumers and many industrial electricity users have quite limited access to funds, and energy efficiency bears quite lightly on their major interests and concerns. Electric utilities can often command capital with greater ease; and investment in energy efficiency can *directly* reduce the need for much larger investments in new generating capacity. In other words it is central to their main business concern, and not a peripheral issue. At least in theory, the motivation to consider efficiency investments should therefore be very strong for utilities.

## 2 WHAT IS THE SCOPE FOR ELECTRICITY EFFICIENCY?

Before reviewing the practice of least cost planning in the USA, it may be useful to give a brief summary of the scope for improved electricity efficiency, its location (i.e. which consumer groups and which applications), and why it has not already been exploited.

A 1989 IEA review looked at the six major electricity end-uses, representing between 65 and 71 per cent of total electricity use, in six IEA countries that represented a range of climatic, economic and electricity sector characteristics. The six countries were: the USA (accounting for almost 50 per cent of total IEA electricity demand), Japan, Germany, the UK, Italy and Sweden. The largest end-use, industrial motors (27 per cent of total final consumption) was judged to have only low to medium scope for energy savings, and market/institutional barriers to these savings being made were assessed as few. But in the other five major end-uses - lighting (16.7 per cent), commercial space heating (9.9 per cent), residential refrigeration (6.8 per cent), residential water heating (5.4 per cent) and residential space heating (4.7 per cent) - possible savings were estimated as medium through to very high (in the case of lighting), and existing market/institutional barriers as many. If these barriers could be overcome however, as much as 10-20 per cent savings on current use could be made - and from the point of view of economic efficiency *should* be made. These conclusions are in broad agreement with many other studies carried out for specific sectors and in individual countries. [see IEA, Annex B for a summary of studies in Denmark, Germany, Italy, Sweden, Switzerland, the UK, USA and the EEC as a whole; also work by the Lawrence Berkeley Laboratory, UK Dept of Energy 1982, etc.]

The market and institutional barriers to energy efficiency measures are several. The most fundamental is lack of information about efficient technologies. Domestic goods are labelled with energy consumption rates in only a handful of countries, with the most efficient appliances unavailable in most places. Manufacturing industries in which energy is not a major input, commercial and service industries rarely have energy managers, or anyone with direct responsibility for monitoring energy consumption and new technologies that might reduce expenditure on energy.

While the information gap could be bridged relatively easily and cheaply, a deeper problem lies in the fact that energy consumption is of relatively peripheral interest to all these consumers. Use of energy is very much taken for granted, and constitutes only a very small fraction of total expenditure. It therefore comes a long way down in any list of investment priorities where capital is scarce, even when payback periods are three years or less. This is intuitively true for many household applications, and has also been found in surveys of industrial energy use.

Energy savings in industry are often allocated to the category of "discretionary investments", which as the name implies, are given low priority by managers. The latter are typically more interested in investments of strategic significance to their firm, and especially in securing a market share in growing markets, and in improving productivity levels. Cost-saving exercises are allocated residual sums of money, and are expected to meet much more stringent financial tests (typically a two to three year payback) than the much larger strategic investments. (UK Dept of Energy, 1982, pp.43-45) This behaviour is of course quite rational from the point of view of the individual firm, but it has constituted a major barrier to uptake of energy efficiency measures.

The wastage of energy involved, and particularly the financial penalty incurred, only become apparent when one looks at the problem from a wider perspective. The sum total of energy that is unnecessarily consumed is very large - 20 per cent of IEA final electricity consumption in 1986 amounted to 965 TWh. (IEA, 1989, p.13) The bodies that should take the wide perspective, in the sense that this defines their very business, are of course the utilities. They are involved in meeting aggregate demand, and it is not peripheral to their interests.

These statistics imply that there already exists a much larger installed base of power stations than is technically required. This represents an enormous capital investment by IEA electric utilities which would not have been required in an ideal world. Table 1 shows estimates made by some IEA countries in 1987 of additional generating capacity that they would need by the year 2000. The capital investments implied by such plans are truly enormous, and clearly demand an answer to the suggestion that demand management might prove a cheaper option.

Table 1: Forecast Additional Generating Capacity by 2000

| Country | New capacity authorized or planned (GW) | Estimate of further capacity that may be required (GW) |
|---|---|---|
| Germany | 2.6 | 10.1 |
| Italy | 15.5 | 7.4 |
| Japan | 37.6 | 15.6 |
| Sweden | 4.7 | ? |
| UK | 8.5 | 5.6 |
| USA | 83.8 | 124.9 |

Estimated further capacity for Sweden is subject to changes in energy policy now under discussion.

Source: IEA, 1989, p.128

# 3 EXPERIENCE OF LEAST COST PLANNING

The widest experience with least cost planning has been gained in the USA, although some utilities in other countries have also introduced similar programmes. (For example, the Oslo Light and Power Company in Norway is aiming to reduce electricity consumption in its area by 15 per cent by 2000 through use of a least cost planning programme introduced in 1982.) By the end of 1987 at least ten US states had adopted least cost planning, six others had major portions in place, and eight others were actively considering it. (Williams, 1989, pp. 837-8) This of course implies that the majority of states still have no such programmes; but nevertheless a fund of experience has been built up in a variety of sized utilities, which can be drawn upon elsewhere.

It is valuable to look at why programmes were introduced in these particular states and not others; what programmes have consisted of; and how successful they have been. Hopefully this will make clear whether or not such programmes are more widely applicable, or are artefacts of a particular time and place, with specific regulatory structures.

The novelty of least cost planning has also prompted a wide debate within the USA over the most effective and equitable means of implementing programmes. Whereas early trials were relatively crude in design, much more sophisticated tools are now in use. The major discussion points will be reviewed in the next section, while this present section is more descriptive of who, why and how.

## 3.1 Why Was Least Cost Planning Introduced?

There is no doubt that the original programmes were a response to the particular conditions and circumstances in the states concerned. The first state to introduce such measures was California, where quite aggressively interventionist policies were adopted by the utility commission as early as 1975. The power utilities in California had experienced special problems because they relied largely on oil and gas-fired power stations, and both fuels became subject to curtailment in the 1970s as a result of the Arab oil embargo and natural gas shortages. This introduced a new awareness that a constantly growing demand for energy could not automatically be met.

Furthermore, the economies of scale which had allowed enormous expansion in the previous decade at relatively low cost had reached their limit. Additional power stations were likely to be expensive. This fact, plus the sudden rise in fuel costs, seemed to be leading towards highly unpopular increases in electricity prices. "But interventionism was not an inevitable response for a state utility commission to make, even in such an environment." (Barkovich, 1987, p.32)

On the contrary, such a response represented a complete reversal of tradition.

> ... it was still widely believed, even in the early 1970s [sic], that utilities had natural incentives to act efficiently (which was ultimately in the interest of ratepayers). Historically, lower costs resulting from expansion or efficiency improvements meant higher profits and either stable or lower rates for customers ... Intervention in the interest of efficiency had not been seen to be necessary ... As long as rates were "cost-based" they were generally considered to be just and reasonable. (Barkovich, 1987, p.35)

What swung the balance in favour of an innovative policy was the conjunction of political and economic interests. November 1974 saw the election of Jerry Brown as Governor of California - a politician personally interested in alternative energy and conservation. This election itself reflected a growing public awareness of environmental problems in California. Jerry Brown appointed two new utility commissioners in early 1975 who were both knowledgeable about the industry and committed to consumer interests. It has been argued persuasively by Barkovich that these appointments acted as the catalysts that turned round the California power industry.

These new activist regulators believed that "utility managers did not see that it was in their best interest to [promote conservation and alternative energy] themselves and were not focusing enough on efficiency and innovation." (Barkovich, 1987, pp.130-131) Consequently they took it upon themselves to require a variety of interventionist measures of the utilities in order to limit the need for construction of new power stations. These ranged from free energy audits for customers, through the provision of low interest loans for energy conservation measures, to cost-free "weatherization" for low income households.

Other areas of the USA did not suffer as badly from direct curtailment of fuels. They were however subject to rapidly rising costs, both of fuels (especially following the oil price crises) and construction. Growing environmental awareness also led to difficulties in finding suitable sites for new power stations and long delays before permission was given for construction. Such delays were especially severe in the case of nuclear power stations, with the Three Mile Island accident and then Chernobyl accentuating the problem. Delays cost money in themselves, and a number of nuclear power stations that had been built were never commissioned, causing heavy losses to utilities. Cleaner air ordinances also increased the capital cost of coal and oil-fired power stations, as extra filters and scrubbing equipment were required. The capital investment programmes of utilities thus began to grow at an alarming rate.

Utility commissions in a number of states were unwilling to see electricity prices rise as rapidly as capital costs seemed to be. Furthermore, utilities met a barrier in trying to raise the capital sums involved. First, the regulators always insist that any utility expenditure which will increase prices to consumers must

be shown to be absolutely necessary. The mishaps over wasted capital on nuclear power stations that were never opened, and escalating costs caused by long planning delays led to a quirk peculiar to the US regulatory system. It became common practice that utilities were not allowed to include the costs of plant that was not yet operational when calculating electricity prices or rates. This of course massively increased the financial burden of delays in commissioning plant, and especially that of unused nuclear stations with their enormous up-front costs.

[This same element of supervision by the regulators of utility capital investments has been the mechanism that has allowed their "interference" in the cause of efficiency. Commissions may require that investments are shown to be (a) unavoidable and (b) the best possible way of producing new electricity, before a rate (consumer price) rise is approved. "Unavoidable" can then be easily interpreted to include the question of whether the utility might have spent less money on demand-management measures to the same effect as building a new power station.]

This regulatory practice also adds considerably to the risk involved in investment decisions based on demand forecasts. There is a relatively long lead-time required for any large new power station to be built; and no utility can afford over- optimistic forecasts if this leads to new plant standing idle and representing a constant drain on finances. It therefore became essential that all new plant should become operational as fast as possible in order that its capital costs might be recouped through the electricity rates.

These problems revolving around investment costs and capital availability were indeed severe. To put the issue in perspective it is worth recollecting that during the late 1970s and early 1980s the utilities were responsible for nearly 15 per cent of all investment in new plant and equipment in the USA. The utilities thus absorbed more capital than any sector of the US economy other than real estate. (Chandler et al, 1988, p.35)

However severe these problems may have been, they did not in themselves cause widespread revaluation by the utilities of their role. Specifically, they did not spontaneously launch themselves onto the road of proselytizing for energy conservation. While a few utilities saw some public relations benefit to be gained from conservation initiatives, most complied somewhat reluctantly with the demands of the regulators.

The main interest of the utilities was that of attempting to shed risk. The easiest way of doing this was not to become involved in demand-management, but simply to leave others to invest in the risky and expensive base-load power plants. For example in his 1984 Annual Report the President of San Diego Gas and Electric said: "SDG&E is not going to build any more large, central station generating plants. We are, however, encouraging others to help us meet future demand." (quoted in Joskow, 1986, p.IV-13) They were paradoxically aided in this

strategy by federal efforts to open up competition to cogenerators through legislation such as the Public Utility Regulatory Policies Act (PURPA) of 1978. Far from shying away from new competition the utilities positively welcomed it. "Competitive entry of competing suppliers is viewed as a potentially important step [by the utilities] to ensure that adequate supplies are forthcoming." (Joskow, 1986, p.IV-3) [Perhaps a similar motivation of risk- shedding can be perceived in the enthusiasm of the UK government for privatization of the electricity sector - albeit dressed up once again in terms of the ideology of competition.]

These growing financial pressures on utilities coincided with several political influences on the regulatory commissions. Ever-increasing environmental awareness among the electorate made new power stations unpopular and difficult to site. A powerful political argument also revolved around the need for "energy security". US politicians developed a new awareness of the country's growing dependence on imported energy sources, especially Middle Eastern oil. Growth in energy demand changed from an index of increasing well-being of the population to one of ever-growing vulnerability. The particular situation of California in 1975 thus became much more widespread during the 1980s, and led to regulators requiring a number of utilities to introduce similar programmes.

By 1988 it was estimated that the conservation programmes of six of the largest utilities had eliminated the need for 7240 MW of generating plant, at less than one-fifth the cost of building such capacity. (Flavin and Durning, 1988, p.52) Capital expenditure by the utilities had fallen from $50 billion in 1982 to an expected $17 billion per year by 1990. (Chandler et al, 1988, p.35) [This latter of course could be due at least in part to simple displacement of the investment to competitive suppliers.]

Many of the factors that led the regulators to intervene in the USA in the cause of efficiency are at least echoed in Europe. It is important at this point to reiterate however that although similar motives may (or may not) exist amongst policy-makers, the case for least cost planning stands or falls on its own merits. Various political motives may enable its introduction against inertia in the industry. The important question remains: is it the most appropriate means of improving the viability of the power industry? Or is deregulation and increasing competition perhaps a more efficient path to follow? Or direct government intervention on energy efficiency?

### 3.2 What Measures Have Formed Part of Least Cost Planning in the USA?

The underlying goal of least cost planning from the utilities' point of view is to save money. They wish to avoid the need to build additional power stations by encouraging more efficient use of electricity, with as little outlay of cash as possible. Or more accurately, they may be prepared to invest relatively large cash sums in efficiency programmes, providing a large and measurable reduction in

demand results, removing the need for much larger investments in additional capacity. This requires careful targeting of the markets for different kinds of energy conservation measures.

The need to target programmes is accentuated by utilities' over-riding interest in limiting growth for peak electricity demand. Over the long term there is of course room to control and minimize growth in baseload demand; there is no reason to assume that savings cannot be made in this area. But the economic reward for avoiding construction of new plant that will only meet peak demand is far more immediate, since the costs per kWh generated are normally much greater than in the case of baseload electricity. [This straightforward economic motivation may be overlaid by regulators' concerns for social equity, etc. This will be discussed under the "no losers" debate below.]

The cheapest method of encouraging energy efficiency is by simply ensuring that the requisite information is available to consumers. This will have some impact - perhaps persuading householders to draught-proof their doors and windows, where a tiny capital outlay brings a rapid payback (as well as increased comfort). Similarly, the labelling of electric appliances with their energy efficiency will have a minor impact over a relatively long period of time. But such programmes do not in themselves constitute least cost planning, since they leave intact most of the market and institutional barriers to change. This is reflected in the large remaining capacity for efficiency improvement in countries that have run occasional information campaigns - such as the Monergy campaign in the UK in 1988.

The first more interventionist strategy tends to be the provision of energy audits at no cost to the consumer. A federal ordinance in the USA (the National Energy Conservation Policy Act) has required since 1978 that residential customers be offered such a service. Such widespread detailed assessments of where energy is wasted in households can be useful - not least, it can identify unexpected problem areas, such as the "attic bypasses" that were the cause of 10 per cent of energy use in US houses, and could be easily and cheaply remedied. (Dutt & Fels, 1989, p.358)

Unfortunately however, a programme limited to energy audits is unlikely to have a major impact. "A rather disappointing 5 per cent response rate is typical. Moreover, energy audit participants do not generally follow all the audit recommendations." (Berkman, et al, 1986, p.28) On an intuitive level this is not very surprising. It is safe to assume that most householders will have some idea of the possible improvements in their homes. An audit might provide a clearer investment hierarchy, but of course it does not provide the funds with which to make the improvements. At best, energy audits are likely to increase awareness of energy efficiency (or lack of it) and perhaps hasten the day when improvements are made - they are most unlikely to cause any rapid increase in efficiency.

Numerous studies of energy efficiency have repeatedly shown that the major impediment to efficiency in the commercial, industrial and domestic sectors is lack of cash - both in absolute terms and in cases where a large upfront investment will result in long-term savings.

When utilities address this problem directly, and start to invest on behalf of their customers then least cost planning proper is in operation.

One of the most widespread measures has been the provision of *rebates* on energy efficient equipment. Where the efficient option costs more than the inefficient item (e.g. German fridges compared to British ones in the UK) rebates can eliminate the cost advantage of the inefficient choice. Alternatively they can of course make them positively cheaper than their competitors. In 1986-87 as many as fifty-nine US utilities were offering rebates on energy efficient equipment - mostly payable direct to the purchaser, but in some cases to the retailer. They concentrated especially on domestic air conditioners and heat pumps, since the utilities were keen to reduce peak demand. It has been calculated that six of the largest programmes in 1986 achieved average peak demand savings of 62 MW per year, or 0.69 per cent per annum reduction in peak demand. (Geller, 1989, pp.744-9) The American Council for an Energy Efficient Economy showed that utilities with rebate programmes were typically paying $200-300 per kW of avoided peak demand, roughly one-tenth to one-half the cost of new generating capacity. "A large majority of utilities are satisfied with their rebate programmes and very few programmes are being stopped." (Geller, 1989, p.746)

There is now considerable empirical evidence in the USA that rebate programmes encourage energy efficiency where the simple provision of information fails. For example a survey was carried out of sales data from appliance dealers in New York State. Sales of efficient fridges increased by 22.7 per cent with adverts alone; by 35.5 per cent with $35 rebates; and by as much as 40.9 per cent with a $50 rebate. (Williams, 1989, p.839) Similarly, the Bonneville Power Administration found that "sales increased by an order of magnitude as incentives were increased from low to high, for both low and high promotional efforts." (ibid)

The use of rebates need not be restricted to the residential sector. For example Pacific Gas and Electric carried out market research on its rebate programme for the commercial and industrial sector; and found that it was indeed accelerating investment in energy efficiency. In particular it provided

> ... a vehicle for energy managers to convince upper management to make investments (e.g. if we act now we can get the rebate, which may not last). PG&E feels that the rebates brought payback periods into an acceptable range and gave credibility to their [energy] auditors' recommendations ... 81 per cent of the program's participants said that their decision to invest in conservation measures was influenced by the existence of PG&E's programme (of the 81 per cent, 37 per cent said they would not have made

any changes without the program and 44 per cent said their actions were accelerated by the program). Only 19 per cent said they would have made the investments anyway. (Barkovich, 1987, p.229)

In the light of the UK Department of Energy's evidence on the low priority normally given to energy efficiency improvements in UK commerce and industry, this finding is of some interest.

[Of course this raises the question: why subsidize the 20 plus per cent who would have made the efficient choice even without a financial incentive? Are the incentives simply accelerating by a few years a process that would occur in any case, as some critics have suggested ? (Berkman et al, 1986, p.III-28) The answer lies in the required *speed* of demand reductions. The "natural process" of increasing efficiency over time, as appliances are replaced and housing stock replenished is extremely slow, and is likely to slow still further in periods of low energy prices. There are already many more power stations in operation than are technically necessary to meet the demand for energy services (as opposed to demand for kW). If it is indeed cheaper to promote efficiency than to build yet more power stations then there is every reason to implement such a programme immediately, before yet more capital is wasted. The speed with which efficiency is achieved is also of course important to those concerned about dwindling fuel resources, and to those worried about the environmental impact of unnecessary burning of fuels. Every little bit may help in at least postponing the worst consequences of the greenhouse effect.]

An alternative to direct cash rebates is the provision of low or zero interest *loans* to customers, in order to reduce the first-cost barrier of investment in energy efficient equipment. Such programmes have also proved effective, in the sense that there is more investment in efficient equipment than would otherwise be the case. Utilities have devoted considerable resources to such programmes: for example the Tennessee Valley Authority has spent more than $250 million on zero interest weatherization loans. (Berkman et al, 1986, p.III-16) US experience has however been that customers prefer simple cash rebates; and utilities are burdened with high administrative costs and debt-service expenses. (Geller, 1989, p.750) Where low or zero interest loans already form a standard promotional gimmick, as in the UK, there is however clear scope for targeting such programmes to energy efficient appliances at the expense of less efficient equipment. [It should be noted that all such programmes aimed at directing consumer purchases will ultimately have an impact on the overall standard of goods on sale, since manufacturers will be motivated to improve their products in order to match the competition.]

In some instances US utilities have calculated that the most cost-effective way of encouraging energy efficiency has been to institute efficiency programmes that are *cost-free* to customers. For example by 1988 Southern California Edison had already given away 450,000 compact fluorescent lightbulbs to low income

customers, displacing 8MW of generating capacity. The cost per saved kWh was less than the marginal operating cost of the nuclear power plant at San Onofre. (Flavin & Durning, 1988, pp.21-2) Such lightbulbs are a classic case where the energy efficient option calls for a much higher front-end investment than traditional incandescent lightbulbs, and brings savings to the consumer only over a relatively long period, on an expenditure that is in any case hardly noticed by most consumers. Given the "very high" potential for savings in electric lighting identified by the IEA such programmes could be of very widespread benefit to utilities, at minimal administrative cost and inconvenience.

More comprehensive programmes of *direct installation*, especially of weather-proofing, by utilities on the premises of low income customers have also occurred. This can often be a means for gaining access to "hard to reach" consumer sectors. For example rental housing always tends to be badly insulated and inefficiently heated, since the landlord would need to make the necessary investment, while the tenant would benefit from lower bills. Since a sizeable proportion of the population in most countries lives in rented accommodation, the aggregate wasted energy is considerable. Direct installation has also been used to circumvent a straightforward lack of cash amongst low income consumers. [Brenda Boardman has shown that it is the poorest households in the UK that are both least well insulated and use the most inefficient forms of heating - on-peak electric fires and heaters, since this requires the smallest capital investment. (Memorandum to UK House of Lords, 1989, p.100)]

Barkovich in her study (1987) traces an interesting development in this type of programme in California, where least cost planning gave way to broader social aims. This demonstrates the somewhat "slippery slope" between criteria of utility efficiency (least cost planning) and those of the good of society as a whole.

The regulatory commission in California first required the somewhat reluctant utilities to offer low interest loans for "weatherization" of homes. This was in an effort to reach the 50 per cent of dwellings that were un- or underinsulated. A second phase of the programme brought in zero interest loans, and a third phase introduced free "weatherization" for low income households. Whereas the first two phases of the programmes were predicated on standard least cost planning principles - that the cost of efficiency investments was less than the marginal cost of new energy supplies - the final phase was not. Rather, it was designed to meet a number of persistent political problems revolving around the "fairness" of the first two phases, since low income customers had been effectively excluded from the earlier programmes. "This is clearly a case where a combination of concern about fairness and political attractiveness outweighed the objective of economic efficiency." (Barkovich, 1987, pp.211-2)

# 4 POLICY DEBATES ARISING FROM LEAST COST PLANNING

This "slippery slope" from hard-headed business economics to subsidizing low income groups for social and political purposes does seem to be endemic to least cost planning, and is epitomized by the so-called "no-losers test" that has been developed by some US regulators. The underlying conflict is that of regulators seeking to achieve both efficiency and equity simultaneously. Whereas least cost planning is concerned primarily with efficiency, regulators have tried to overlay it with a gloss of equity - whereas the latter aim might more appropriately have been met by other means.

## 4.1 The No Losers Test

The apparent unfairness of selective investment in end-user efficiency by utilities has been levelled against least cost planning since its earliest days. Those consumers who have already upgraded their homes and appliances, and new industries with all the latest energy-saving equipment, will have missed out on the grants or low-interest finance made available to their more laggardly neighbours. This may in itself seem unjust, and indeed led to some complaints to regulators in US states that were implementing least cost planning regimes. From a hard-headed business point of view these consumers are merely unlucky rather than unfairly treated however. It could equally have been the case that a technological breakthrough would have brought onto the market appliances that used only half as much energy just after they had thought they were purchasing state-of-the-art equipment.

Moreover in the long term they will share in the benefits accruing to all the utility customers. Namely, the avoided investment in new generating plant will mean that the utility has lower overall costs, which can be reflected in lower prices than would otherwise have been the case. Paradoxically of course, if prices were to be very considerably lower than had been expected, the consumer who had invested in energy-saving equipment at her/his own expense would find the payback period on that investment lengthening. The only consolation might be an improved living environment thanks to lower pollution from power stations! Least cost planning is designed to benefit the utility, the society as a whole, and perhaps each individual consumer, in that order.

A further element of unfairness may appear in the short term however for customers who do not respond to utility efficiency programmes - for whatever reason. If a utility succeeds in reducing demand for kWh by a significant amount then it will be faced with a situation where its fixed historical costs need to be spread over a smaller market base. Although future costs may be lower than expected, repayment of existing loans etc will mean that the price for each kWh will temporarily need to be increased.

If the group of consumers most likely to be left out by utility programmes consists of low income households, as seems probable, then this effect is a double blow upon this already disadvantaged group, since their consumption will not fall and they will be faced with a higher cost per unit. Where regulators have a duty to consider equity as well as efficiency, then the justification for cost-free programmes of the type introduced in California and described in the previous section becomes clear. There is perhaps a case for arguing that the costs of such programmes should fall directly on the government, as subsidy; rather than falling on the utility and being called a "least cost" option.

The Public Service Commission of Wisconsin took this problem plainly on board in 1986, and decided in favour of economic efficiency over equity:

> Demand-side options will have an impact on electric rates because they reduce the number of billing units over which some fixed costs are spread. Higher near-term rates will increase bills for non-participating customers. In the long-run, demand-side programs reduce the need for new expensive facilities and thus will reduce the long-run combined average bills for participating and non- participating customers. Some individual non-participating customers' bills may increase in the long-run. The commission finds that the negative impacts of short-run higher rates (commonly referred to as the "non-participant" or "no-losers" test) should not be used to restrict development of demand-side programmes. Rather the negative impact should be minimized to the extent practicable by offering a broad range of programs to each customer sector. All customers should have the opportunity to receive lower utility bills even though rates may increase in the near term. (quoted in Williams, 1989, p.842)

Discussions about the "no losers" test in the literature can sometimes seem to merge misleadingly into a more generalized debate over the merits of least cost planning under different pricing regimes. For example it seems that the Oregon utilities adopted a so-called "no losers test" for investments in residential heating conservation, whereby they were allowed to include such investment in their rate base providing it was less than the difference between the cost of new electric supply and the average cost or price of electricity (i.e. electricity prices would go up no more than if an equivalent amount of supply had been added to the system). (ibid, p.840) This should more appropriately be seen as a measure of whether or not the programme is economically viable, than of distributive effects amongst customers. The fact that there would be "no losers" is not the most salient factor in the equation.

### 4.2 Pricing

The discussions over pricing do however highlight another complication that arises when calculating whether or not it is economic for a utility to pay incentives to its customers (rebates) or to give away lightbulbs free, etc. Utilities cannot afford to

cover the entire cost of efficiency improvements up to a level equivalent to the cost of marginal supply. This is because in addition to its capital outlay on efficiency the utility will incur a cost from lost revenue, due to the kW it will no longer sell. The exact point at which benefits outweigh costs to the utility is heavily dependent on the pricing regime in operation. When the full economic cost of conservation exceeds the marginal cost of producing electricity then of course it is by definition uneconomic. But in other circumstances it depends on the costs relative to prices charged to customers. (For a full discussion see Berkman et al, 1986) Consequently pricing regimes may be seen as the "joker in the pack". The rate of return on any investment (such as a power station) depends partly on the price at which the goods produced (electricity) are sold. But even where the electricity industry is privately- owned, consumer prices are universally subject to regulation. A purely "commercial" decision over utility investments is therefore a theoretical chimera.

### 4.3 Regulation and Competition

Some of the problems raised by least cost planning go to the heart of regulation *per se*. How extensive should the role of government be in the utility sector, when its component parts are privately owned? Even where regulation is kept to an absolute minimum as in the new UK model, there is government "interference" over pricing: on the one hand the government has pledged that electricity prices will not increase by more than the rate of inflation before 1992, and on the other hand it has ruled that a nuclear surcharge of 10 per cent or more may be levied on consumers' bills in order to cover the uneconomic nuclear power programme. By definition any government influence over pricing must affect the potential profitability of an industry, and hence interferes with market mechanisms. Taking least cost planning into consideration when setting price levels might paradoxically help to anchor prices more closely to true market conditions.

For this reason, least cost planning can never be introduced as if into a policy vacuum. Whatever its economic merits, regulators need to be aware of the knock-on effect of such a shift in perspective. Electric lighting is one market sector that is relatively isolated, and can be treated as such. But in many markets electricity is in competition with other fuels - the home heating market being a prime example. Electric space heating is in competition with natural gas (usually regulated), heating oil (unregulated) and in some places with firewood (unregulated and sometimes cost-free, but inconvenient to the consumer). In a competitive market such as this it is difficult to stipulate that, for example, either the electricity or the gas utility ought to invest in home insulation, since the net effect on demand for that utility's services is unclear. The straight equation - insulating x number of homes will displace demand for y amount of electricity, saving z amount of capital costs - becomes much more complicated.

Interestingly, in one of the areas in the USA that has seen extensive least cost planning exercises by the electric utility, including investment in home insulation, heating by wood stoves is widespread. The utility - Bonneville Power Administration - has commissioned studies of the impact of its programme, and these have indeed shown a complex market mechanism at work. In the short term enhanced insulation tends to actually increase electricity demand, since the fact that less electricity is required to heat a well-insulated home means that low income households that previously collected firewood at little or no cost can afford the more convenient electric heating. This is not an entirely negative result from BPA's point of view however, because the utility always needed to have generating capacity in reserve for these households, since they were all connected to the grid, and could switch very rapidly to electricity if for instance woodfuel became suddenly scarce or expensive. Demand profiles for electricity therefore become more stable; and the utility has discovered a new market to exploit in times of surplus capacity. The effect is nevertheless not what would be predicted from a least cost planning exercise, and the study concluded that "From BPA's perspective, money may have been better spent elsewhere."

Nevertheless, the authors continue: "the investments to save energy may have net regional benefits because regional energy planners have broader goals, such as lowering regional energy costs, conserving forest resources and preventing air pollution." (Tonn & White, 1990, p.290)

This is another classic case of the "slippery slope", where least cost planning principles, predicated on the economic benefits to the utility itself have been elided into wider benefits to the society as a whole. Tonn and White may well be absolutely correct in saying that preserving the forests is important; but it is far from clear why the electric utility should be required to fund this worthy cause. It would seem to be a case where the state government should directly fund home insulation if it considers the outcome important enough.

It is therefore extremely important that regulators are clear about their own function, and that extraneous political debates do not become subtly entwined in the economic affairs of the regulated utility. Where clear political priorities are set for the regulators then these should be recognized as such, and not disguised as profit-maximizing policies.

Competition between electricity and gas for the home heating market can serve as another example of how such confusion may arise. Requiring both utilities to invest in home insulation as part of a least cost planning exercise is unlikely to be very successful. The gas utility in particular will baulk at such a demand, since the end effect may well be that more of its customers switch to electric space heating. (The better insulated a building, the greater the chance that electric heating will be economic, since the up-front costs of electric heaters are less than for a gas-fired central heating system.)

One might therefore argue that the electric utility would be highly motivated to introduce a home insulation programme, not only in the interests of least cost planning, but because it would also increase its competitive edge against natural gas. The chances are that such an outcome would throw interesting light on the motivations of regulators. The logic of least cost planning might lead to electricity displacing natural gas in the home heating market. But the chances are high that a least cost planning regime is introduced in the hope that it will encourage energy conservation for environmental reasons. This particular outcome would fly in the face of such wishes.

The production and transmission of electricity is inherently inefficient as compared to direct use of natural gas: each kWh of electricity delivered has been produced by about 3 kWh of primary energy input - with all the attendant atmospheric pollution involved in using that much extra fuel. Furthermore the off-peak electricity heavily marketed to the home heating sector tends to emanate from the least environmentally acceptable power stations - coal or nuclear-fired, that need to be kept in constant operation in order to be economic, and cannot be easily switched in and out of the grid like gas-fired stations.

Regulators, or politicians, who wish to take these factors on board, need to do so at a broad level of energy policy, and not hope to achieve the "right" outcome as a result of a mechanism such as least cost planning. The latter is likely to produce somewhat unpredictable results in the environmental sphere, since its primary aim has nothing to do with environmental policy. Furthermore, the relationship *between* utilities for gas and electricity is not a matter for each to decide on its own - it requires a broader political judgement.

### 4.4 Environmental Externalities

The debate over least cost planning, regulation and pricing also links to another topical issue - that of costing social and environmental externalities. The same is true to some extent in this case, although it is defensible on the grounds that traditional energy pricing has always been biased in favour of energy use as against conservation. In general it is true to say that energy efficiency causes less damage to the environment than does energy consumption. Historically pricing of energy has completely ignored all such externalities, and has therefore arguably been much lower than it should have been. Allocating such costs to energy sources is of course a difficult task that has not yet been satisfactorily solved. But least cost planning does afford an opportunity to make some allowance for these costs when making investment decisions, even if at an arbitrary level. For example the North West Power Planning Council in the Pacific North West of the USA has required planners to grant a 10 per cent economic bonus to conservation options to reflect the environmental and social benefits of conservation as opposed to energy use. (Geller, 1989, p.755) This is still a rare example; but such a

strategy is not inherently anti-market: it is rather a more accurate reflection of true costs and benefits.

### 4.5 Energy Services

An alternative approach to the problem of equity is to argue that those consumers who do install energy efficient equipment need not necessarily benefit in terms of lower electricity bills in the short term (in the long term the bills would of course be lower than they would otherwise have been, due to avoided capital investment by the utility). At best customers might benefit from a slight reduction in order to compensate them for the inconvenience involved in new equipment being installed etc. Indeed there is no obvious reason why customers should expect their electricity bills to go down if for example their new lightbulbs are supplied free, or their new fridge is cheaper than a straight replacement for their previous model (thanks to a rebate) - always provided that the utility is not seen to be getting windfall gains.

Electric utilities are accustomed to selling kWhs, and their pricing regimes are designed accordingly. Consumers normally have very little (if any) awareness of how many kWhs they consume, despite the fact that bills always contain this information. Consumers are, rather, aware of how *much* they pay in total and what *services* they receive - how many appliances they use and how often, what temperature they heat the house to for how many hours a day, and so on. Of course consumers will always welcome a reduction in bills; but expectations are normally that bills will constantly rise. If a new, efficient, appliance allows a consumer to receive the same service (clean clothes or cold food) for the same price as previously, then few will complain.

The realization that consumers are more interested in energy services obtained than in electricity *per se*, has opened the way to some completely new ways of marketing energy efficiency. Rather than the onus falling entirely on the utility to calculate whether investments in energy efficiency are cost effective, space is created for a new competitive energy services industry - where third parties enter the picture. Energy service companies grew up in the USA during the period of high energy prices in the 1970s and early 1980s, largely as a means of providing third- party finance to large commercial and industrial concerns for energy efficiency investments. More recently however the advent of microprocessor-based control technology has spawned a new generation of hi-tech energy service companies, with expertise that the utilities simply cannot match. (Williams, 1989, p.844)

Under an "energy services" regime the utility becomes involved as well as the third-party company, because it sees a potential advantage to its own finances. The utility continues to charge consumers the same total amount as before (i.e. the customer pays for the service provided - heat/light/refrigeration, etc); meanwhile an energy service company has installed new equipment on the customer's

premises, or insulated the customer's house, with the effect that less electricity is consumed; the utility then pays the energy service company for the electricity that has been saved, at a price determined by competitive bidding between energy service companies. (The energy service company would probably pass on part of this payment to the consumer as an incentive to compensate for the inconvenience caused.) [This schema corresponds to the model developed by Cicchetti and Hogan, 1988. Some of the early examples of competitive bidding in the USA consisted simply in the utility paying the energy services company for the saved energy, with customers then paying reduced bills as they used fewer units of electricity.]

### 4.6 Competitive Bidding

The survival of the third party will of course depend on the energy savings scheme being economic. Ideally, the utility would be open to competitive bids from both energy service companies and independent power producers and cogenerators when a shortage of supply was forseen. For example in early 1988 the privately-owned Central Maine Power Company solicited bids for either conservation or electricity supply projects. It received thirteen conservation project proposals, totalling 36 MW of potential saved electricity at an average requested price of 3.5 cents/kWh of savings. When the conservation projects were ranked against the supply projects on price, reliability, environmental impact, etc, conservation projects took twelve out of the fifteen top-ranked schemes. (Geller, 1989, p.750)

In all cases, competitive bidding of this type will lead to the least cost solution for both the utility and for society as a whole. Moreover, the problems of equity between customers are minimized, since electricity bills are not reduced for those customers who benefit from the new efficient technologies - or at most they participate in the "shared savings" with the energy service company and the utility itself. Such a system has been described by Robert Wiliams as "an elegant market-oriented approach to implementing least cost planning." (Williams, 1989, p.849) Indeed it is highly favoured by advocates of competitive markets in place of over-regulation of the electricity industry.

> If utilities increasingly compete for market share in energy service markets ... they will begin to move away from their historical position of a regulated utility to a more competitive market. The resulting competition will provide more choice, better quality, and lower costs to consumers. The possibilities for competition arise from the likelihood that increased investment in the use of energy service systems will likely be larger than for new fuel supplies. That is not because of anyone's moral or ethical ideas on what the world ought to be but rather because that's the direction in which economic self-interest is pushing us. (Sant, 1984, p.28)

The major problem with relying on market-led competitive bidding is that it would tend to capture only those efficiency investments available from large industrial and commercial users of electricity. This is due to the need for accurate

measurement of electricity savings achieved, since the utility pays the energy service company for savings, and the administrative economies of scale for the energy service companies in dealing with a few large clients. Entry of third-party energy services companies into the disparate and scattered residential and small commercial sectors remains problematic. The network of customer contacts already possessed by the utility in these sectors is likely to always make it considerably easier for efficiency initiatives to come direct from the utility in these sectors.

### 4.7 Over-investment in Efficiency

The operation of efficiency schemes by third parties should however help to avoid the situation where a utility-led conservation programme gains such momentum that it outstrips that which is economically efficient for the utility. [Extremely high levels of conservation may be desirable from the environmental standpoint; but if they are not of economic benefit to the utility then they ought not to be achieved through least cost planning. Benefits that accrue to the society as a whole and not to the utility should perhaps receive direct government subsidy, but channelling such subsidy through the utility will merely serve to confuse the picture.] "Competitive bidding would weed out superficial or unreliable efficiency measures and ensure that the efficiency industry has the necessary skills, equipment, and professional standards to perform effective, high-quality retrofits." (Flavin & Durning, 1988, p.53) This might avoid situations such as those quoted by Berkman et al (1986, p.30) where four of the major US conservation programmes are said to be uneconomic because the utility concerned already has - or soon expects - a glut of generating capacity. They quote California, which is forecasting a glut in the 1990s; Northeast Utilities which already has excess capacity; Bonneville Power, where prices for electricity are above its marginal cost; and East Wisconsin Utilities where the marginal costs of energy savings implemented exceed the cost of producing electricity.

## 5 HOW APPLICABLE IS LEAST COST PLANNING OUTSIDE THE USA?

As discussed above there is considerable potential for improving electricity end-use efficiency throughout Europe (IEA, 1989). The European Commission has argued that even a 10 per cent improvement by 2000 would reduce the EEC's primary energy requirements by 45 mtoe (4 per cent of the current total), avoiding investment in over 40,000 MW of new capacity. [Also avoiding emissions of 125,000 tons/year of sulphur dioxide, 200,000 tons/year of nitrous oxides and 160 million tons/year of carbon dioxide, on the assumption that half of the new plant would be coal-burning.] (Memorandum by ACE to UK House of Lords, 1989, p.33) The question is whether least cost planning is the best way of working towards this end?

In principle there is every reason why least cost planning should be adopted everywhere in the interest of economic efficiency and optimal use of capital. As an evaluation method it makes no assumption about what is least cost: it simply requires that the costs of restraining demand are compared on an equal footing to the costs of providing new supplies. Clearly, where there is no need for additional (or replacement) power stations then there is no call for carrying out such an exercise. Electric utilities with existing surplus capacity need not worry about it, since they have no need to make any investment at all, on either the supply or demand side.

Few utilities are in this position for very long however. As shown in Table 1 most IEA countries forecast a need for expansion of power capacity in the next ten years. Electricity demand in the developing world is forecast to soar well beyond the capacities of governments to meet. The question seems less whether least cost planning *should* be applied, than whether the regulatory system and decision-making process encourage it to be applied, or indeed allow for it at all. Since the concept is relatively new and unfamiliar, it is possible to overlook provisions that could be of great value to the utility and to society as a whole even where utilities are being completely reorganized, as in the UK. The case of the UK will be described here in some detail, in order to illustrate some of these missed opportunities.

The electricity industry in the UK has historically shown very little interest in encouraging end-user efficiency. Rather, it has indulged in quite aggressive advertising campaigns to encourage more widespread use of electricity. In 1982 a Department of Energy study on energy conservation investment in industry recommended that the Department "should use its powers of persuasion to attempt to have changed the consumer marketing activities of the Electricity Boards and of British Gas, which are seen by many to be contrary to the government's energy conservation policy". (UK Dept of Energy, 1982, p.53) No noticeable change has occurred however. Although loans are available for

insulating homes these are at extremely high interest rates (an APR of 38 per cent is quoted in the 1989 UK House of Lords Committee's conclusions, p.17)

The major corporate objective of the electricity industry has been to sell as much electricity as possible. Two factors have served to emphasize this bias. First, generating boards did not have to earn open market returns on money invested in new plant; and secondly, any residual responsibility for promoting conservation and energy efficiency rested with the Electricity Council and the Area Boards. The Area Boards were responsible solely for distributing and selling electricity and therefore had no incentive to limit the number of new power stations required to meet perceived demand.

In 1989 the CEGB projected that peak demand for electricity in the UK would reach 70,000 MW by 2040 - a 60 per cent increase on existing capacity, that would require construction of forty-five large power stations. (Friends of the Earth, 1989, p.69) They expected two-thirds of these additional power stations to be coal-fired and the remaining one-third nuclear. As the debate over privatizing the power industry has moved on, it has become clear at least that gas-fired power stations will play a much larger role than had been envisaged by the CEGB. A large number of proposals and planning applications for gas-fired stations have already surfaced from a wide variety of potential investors. What has not been heard in the debate have been any competitive bids from energy service companies to restrain demand growth. Why is this?

One clear reason is that the privatized electricity supply industry has been split into separate generating, transmission and distribution companies. This means that the incentive felt by the integrated regional utilities in the USA to hold down capital expenditure is extremely diluted in the UK, if it exists at all (even without gas/electricity competition). It is not impossible to devise a system where unnecessarily high capital costs reflect directly on the distribution company's profits, but the regulatory system does not in fact achieve this. [Friends of the Earth suggested that investment to reduce peak demand would result under the following conditions: if generating companies charge the transmission companies higher rates for peak demand, to reflect the relatively high cost of maintaining this capacity; the transmission company passes on this higher charge to the area utilities plus an additional charge for maintaining transmission equipment to cope with peak demand; and area utilities are not allowed to pass on these extra costs to customers. FoE, 1988, pp.31-2]

The assumption seems to be that if energy efficiency investments are economically worthwhile then the workings of the free market in a privatized industry will ensure a place for it. The utility will spontaneously adopt least cost planning principles, seeing it to be in its own interest. In an ideal world this would of course be true. Indeed, some privately-owned US utilities that have used least cost planning have seen their bond ratings rise on Wall Street. The Wisconsin Electric Company which has followed an active demand-management

programme was the highest-rated electricity company in the USA in 1989. It was also the most profitable on most criteria, including returns on assets. (ACE evidence to UK House of Lords, 1989, p.48) The fast-growing interest in ethical investment might give a further boost to the standing of companies that displayed an active interest in encouraging energy efficiency. Such an outcome of course runs counter to suggestions that least cost planning would sign the death warrant of a privatized electricity industry - as suggested by the Electricity Council in the quotation given early in this paper, or a (Labour) MP during a House of Commons debate on the subject: "People will not be interested in a private company which has a statutory duty to encourage its customers not to use the product it is trying to sell them." (*Independent*, 21/7/89)

Unfortunately market forces are not sufficient in themselves however. The power of inertia and resistance to new ideas is always great. Moreover, the industry is in any case subject to regulation and therefore not freely led by market forces. And finally, some of those regulations may actually work against an unbiased assessment of efficiency investments.

One area affected in this way is that of pricing. There is no provision for utilities to recoup the costs of efficiency programmes through consumer prices - whereas the cost of investing in new power stations can be passed on to consumers. (FoE evidence to UK House of Lords, 1989, p.85) Although it would be an innovation to allow such costs to be passed on, there is no logical reason why they should not be. Quite the contrary, as argued in this paper. Only then can a rational comparison between the two options be made. (It is not necessary to simultaneously prevent the costs of power stations under construction being included in the rate base, as occurred in the USA.)

A second major problem may lie in concrete restrictions on where utilities invest. For example investing in energy efficient equipment on behalf of customers, i.e. in customers' as opposed to the utility's property, may be interpreted as improper. An Electricity Council spokesman responded to a suggestion from the UK House of Lords Committee (1989, p.10) that incentives might be offered to improve efficiency with: "... handouts to industry so that they use electricity more efficiently? ... I think that that is virtually impossible." His chief concerns seemed to be (a) on the grounds of equity, and (b) over statutory rights of the electricity industry to introduce such a policy. Free gifts and interest-free loans however do seem to fall within the scope of many retailers' behaviour in the UK. [It has been calculated that replacing the UK's more heavily-used domestic and commercial sector incandescent lightbulbs with their energy efficient equivalents would save on average 1 GW of electricity at the point of use. This would predominantly displace winter peak electricity use, and after allowing for transmission losses etc this would lead to a likely saving of 3 GW of installed generating plant. FoE, 1989, p.68]

Certainly the House of Lords Committee concluded that "Clearer statutory guidance should be given to the electricity supply industry to ensure efficient electricity use. The Electricity Bill as currently drafted is inadequate to ensure this and a clearer statutory duty to promote energy conservation should be placed on the Secretary of State, the Director General of Electricity Supply and the licensees." (UK House of Lords, 1989, p.19)

As Friends of the Earth have pointed out: "The Government was restructuring an electricity industry and had the opportunity to create an electricity service company. It failed and left the RECs [Regional Electricity Companies] at financial risk from any public action to reduce electricity demand. FoE firmly believes that it could have made reducing electricity demand its most profitable option by using imaginative (though not burdensome) regulation of prices and rates of return on investments and contract transactions." (FoE, 1990, p. 26).

The IEA has made a similar plea: "In addition to setting tariffs at appropriate levels, governments should remove the barriers which are preventing or discouraging utilities from pursuing activities other than electricity generation and distribution, if such efforts improve the efficiency of the utility system as a whole." (IEA, 1989, p.125)

# 6 CONCLUSION

There is therefore reason to believe that utilities may miss opportunities for sensible and economic investment in demand- management measures, because the regulatory system fails to take account of such potential. From any standpoint this is a wasteful and absurd situation. It is also ironic that such an opportunity to increase market competition should be missed by legislators who profess an over-riding interest in free market economics. Competitive bidding between generators and energy service companies ought to be very attractive to a newly privatizing industry and to its regulators.

In practice conservation policies have often won against bids for new plant when competitive bidding has been invited in the USA. But the precise economics will of course depend on varying costs and opportunities in each specific case, including the price of fuels and the tariffs charged for electricity. Least cost planning demands only that the utility weigh up each option in an unbiased fashion. It does not require that conservation be favoured in any way.

If least cost planning is misunderstood, and taken to be a means of *favouring* energy efficiency over other solutions, then perhaps the reluctance to take it on board is more understandable. As this paper has shown, there is in fact a "slippery slope" that has often entered into least cost planning programmes and which seems to derive from the somewhat conflicting aims of regulators to pursue both efficiency and equity. Where least cost planning is introduced in the interests of economic efficiency, complaints about its inequitable results have lead to modifications and additions which may be far from efficient (from the utility's point of view).

There seems to be a need to distinguish the two concepts of efficiency and equity very clearly, and to allocate responsibility somewhat differently. If, for example, rebates on efficient equipment make sound business sense from the utility's point of view, leading to large avoided investment, then such a scheme should quite rightly be financed by the utility. It is clearly in the utility's interest and a legitimate part of its business. If, on the other hand, it is felt that certain groups of the population are disadvantaged - perhaps low income households - then this is not strictly the utility's field of interest. Political and moral arguments may require subsidies to be paid to these groups; but such subsidies should be provided by the government rather than by the utility.

Given the complexities of competition between different fuels for the home heating market there may also be a case for specifying home insulation as a target that is better met by direct government finance rather than utility loans and grants. Any such programme should also take its place within a broader, politically defined energy (and environmental) policy, which contains clear guidelines for the preferred fuels for different purposes. These priorities can then

be interpreted by the regulators of the various utilities when determining consumer prices - one of the major factors that determines the viability of different utility investments.

The "slippery slope" may also be somewhat pernicious due to the realities of everyday politics. It is reasonable to suggest that a major sea-change in utility practice such as that represented by least cost planning will only be accepted when it receives strong political support and encouragement. An unusual amount of energy is needed to overcome the natural inertia of regulators and utilities. In California this was provided by the election of Jerry Brown in 1975. Now there is a strong impetus from the environmental movement. The difficulty lies in separating the political impetus that can enable a new initiative to be adopted, from the way in which that new programme is operated.

If the environmental movement succeeds in spreading the use of least cost planning then it is to be applauded. If, in the process, it comes to be assumed that least cost planning will always lead to the most favourable environmental outcome - and especially if regulations are framed in order to achieve this - then what remains is a travesty of the original idea.

At best least cost planning may provide one tool for increasing energy efficiency in some spheres and for some fuels; it should not replace other government programmes or government funding for energy efficiency, but should rather be an addition. In particular, utilities should not find themselves being required to act as intermediaries for the government for social welfare programmes. Least cost planning should be seen as a business proposition, measuring costs and benefits *to the utility* of various investment strategies. It is neither more nor less than this.

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