

Adam Smith Institute
Omega Report

ENERGY POLICY



Adam Smith Institute

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From research conducted
for the Adam Smith Institute

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FOREWORD

The Adam Smith Institute's **Omega Project** was conceived to fill a significant gap in the field of public policy research. Administrations entering office in democratic societies are often aware of the problems which they face, but lack a well-developed range of policy options. The process by which policy innovations are brought forward and examined is often wasteful of time, and uncondusive to creative thought.

The **Omega Project** was designed to create and develop new policy initiatives, to research and analyze these new ideas, and to bring them forward for public discussion in ways which overcame the conventional shortcomings.

Twenty working parties were established more than one year ago to cover each major area of government concern. Each of these groups was structured to include individuals with high academic qualification, those with business experience, those trained in economics, those with an expert knowledge of policy analysis, and those with knowledge of parliamentary or legislative procedures. The project as a whole has thus involved the work of more than one hundred specialists for over a year.

Each working party had secretarial, research and editorial assistance made available to it, and each began its work with a detailed report on the area of its concern. Each group has explored in a systematic way the opportunities for developing choice and enterprise within the particular area of its concern.

The reports of these working parties, containing, as they do, several hundred new policy options, constitute the **Omega File**. All of them are to be made available for public discussion. The **Omega Project** represents the most complete review of the activity of government ever undertaken in Britain. It presents the most comprehensive range of policy initiatives which has ever been researched under one programme.

The Adam Smith Institute hopes that the alternative possible solutions which emerge from this process will enhance the nation's ability to deal with many of the serious problems which face it. The addition of researched initiatives to policy debate could also serve to encourage both innovation and criticism in public policy.

Thanks are owed of all of those who participated in this venture. For this report in particular, thanks are due to Professor Duncan Burn, Algy Cluff, Ivan Fallon, Peter Lilley, Daniel Lux, and Atholl Robertson, amongst others. All **Omega Project** reports are the edited summaries of the work of many different individuals, who have made contributions of various sizes over a lengthy period, and as such their contents should not be regarded as the definitive views of any one author.

1. ENERGY SUPPLIES AND POLICY

Britain is fortunate in its possession of natural resources. Indeed, it has the largest resources of any country in the European Community. The approximate value of minerals produced in 1981 was £18,760 million, of which crude oil accounted for sixty-five per cent, coal twenty-four per cent and natural gas five per cent. The value of mineral production was forty-seven per cent higher at constant prices than in 1970, virtually all of the increase being accounted for by oil and gas.

In 1982, the UK's consumption of energy was valued at £30 billion - representing twelve per cent of gross national product and 312 million tonnes coal equivalent. This constitutes a slight decline over the years, as shown in Table 1 below.

Table 1

Inland energy consumption (primary sources)

million tonnes coal equivalent

| | 1972 | 1980 | 1981 | 1982 |
|-----------------|-------|-------|-------|-------|
| Oil | 162.2 | 121.4 | 110.9 | 111.1 |
| Coal | 122.4 | 120.8 | 118.2 | 110.7 |
| Natural gas | 40.9 | 71.1 | 71.2 | 71.7 |
| Nuclear energy | 10.6 | 13.4 | 13.7 | 16.0 |
| Hydro-electric | 1.8 | 2.0 | 2.3 | 2.4 |
| TOTAL (rounded) | 338.0 | 328.7 | 317.2 | 311.9 |

Source Department of Energy

British government control

Considering how economic activity is determined and influenced by energy supply, it is not surprising that many well-intentioned governments have become increasingly involved in 'the development of national policies in relation to all forms of energy'.¹

Government involvement in the energy industry began in 1850, when the Act for Inspection of Coal Mines was passed. Subsequent legislation increased state involvement, with the Mines Department being set up in 1920 as a Board of Trade subsidiary. The

1. Civil Service Yearbook 1984 (London: HMSO) p. 248.

Board also took on the responsibility for the gas industry. The electricity industry was transferred to the Ministry of Transport under the Electricity (Supply) Act 1919.

The decision to place all energy responsibilities under the remit of one minister of state led to the creation in 1942 of the first Minister of Fuel and Power, with 'overall responsibility for coal production, allocation of supplies of solid fuels, control of all energy prices, and petrol rationing'.² Since then, numerous changes of name and responsibility have occurred, but it was not until after the 1973 oil crisis that a separate Department of Energy was established in January 1974.

State ownership was drastically expanded after the second world war; in 1946 the National Coal Board was set up; in 1947 the Electricity Act nationalized the electricity supply industry; and the 1949 Gas Act did the same for the gas industry. The present situation regarding the relationship between private and public control has been aptly summarized:

'All minerals in Great Britain are privately owned, with the exception of gold, silver, oil, and natural gas (which are owned by the Crown), and coal and some minerals associated with coal. On the United Kingdom continental shelf, the right to exploit all minerals except coal is vested in the Crown. The exclusive right to extract coal, or license others to do so, both on land and under the sea, is vested in the National Coal Board. Normally, ownership of minerals runs with the ownership of the land surface, but in some areas, particularly where mining has taken place, these rights have become separated. Mining and quarrying, apart from coal, are usually carried out by privately owned companies.

'Privately owned companies predominate in offshore oil and gas production and oil refining, while publicly owned bodies are responsible for most coal production, gas distribution, and electricity generation and distribution. The publicly owned fuel and power industries in Britain employ in total some 500,000 people (some 2.5% of the working population); their annual turnover is about £25,000 million and capital investment £3,500 million. In Great Britain the Secretary of State for Energy is responsible for these industries, except for electricity in Scotland which is the responsibility of the Secretary of State for Scotland.'³

| | | |
|----------------------|------|------|
| Natural gas | 13.1 | 23.7 |
| Nuclear energy | 3.1 | 5.2 |
| Hydro-electric power | 0.5 | 5.8 |

² Guide to the Department of Energy (Department of Energy Training Section, April 1983).

³ Britain 1983 (London: HMSO), pp. 244-5

2. THE GAS INDUSTRY

HISTORY AND DEVELOPMENT

Following the introduction of privately owned gas supply in Westminster in the early nineteenth century, gas produced from coal became popular for lighting. Natural gas is now used for domestic cooking and heating, and for industrial purposes. Natural gas has now completely replaced town gas in the public supply system.

The state assumed ownership in 1949 following the passing of the 1948 Gas Act. The nationalized industry replaced some 1,000 separate bodies, including many local authorities and around 700 companies. The British Gas Corporation, set up in 1973 under the Gas Act of 1972 to replace the Gas Council and area gas boards, is now the controlling agency for the industry.

The British Gas Corporation purchases natural gas from offshore producers (although BGC are now facing some competition from other buyers), treating it at its coastal terminals, and then distributing it through a national transmission system. Gas Council (Exploration) Ltd and Hydrocarbon Great Britain Ltd, both of which are wholly owned subsidiaries of BGC, have been involved in exploration for oil and gas in the Irish Sea, the English Channel, the Celtic Sea and, in partnership with oil companies, in the North Sea and onshore.⁴

The gas industry has been growing since the 1960s when cheap and convenient natural gas was discovered under the North Sea (see Table 2). Total gas sales have risen from 11,487 to 16,463

Table 2
Primary energy consumption (per cent)

| | 1972 | 1982 |
|----------------------|------|------|
| Oil | 48.0 | 35.6 |
| Coal | 36.2 | 35.5 |
| Natural gas | 12.1 | 23.0 |
| Nuclear energy | 3.1 | 5.1 |
| Hydro-electric power | 0.5 | 0.8 |

4. Natural gas is not yet available in Northern Ireland, where town gas produced from oil feedstocks is used instead, since the cost of the necessary pipelines was regarded as being prohibitive. However, an agreement has now been reached with the Irish government to supply natural gas to Northern Ireland in the near future.

million therms between 1973/4 and 1982/3 (an increase of 43%), and gas now has a 56% share of the domestic fuel market. Gas supplies approximately one-third of all the heat used by industry and business.

The BGC is therefore by no means a small concern. In 1982/83 it had a turnover of £5958m, it employed 103,300 people and had almost sixteen million customers. On top of this, the BGC made a profit of £188 million. In 1980 the BGC repaid £109m to the government to 'wipe the slate clean' of government loans, which had amounted to a debt at one time (in 1975) of over £1,650m. After doing this it became the first nationalized industry ever to lend money to the government.

Table 3
Gas industry statistics

| Year | Employees '000s | Profit/ loss £m | Gas sold and used (m therms) |
|---------|--------------------|-----------------------|------------------------------------|
| 1973-4 | 103.4 | - 41 | 11,487 |
| 1974-5 | 102.5 | - 31 | 12,932 |
| 1975-6 | 103.0 | + 25 | 13,454 |
| 1976-7 | 100.7 | + 32 | 13,837 |
| 1977-8 | 99.8 | +104 | 15,172 |
| 1978-9 | 101.8 | +172 | 15,934 |
| 1979-80 | 104.1 | +152 | 16,736 |
| 1980-1 | 106.2 | +156 | 16,386 |
| 1981-2 | 105.8 | +144 | 16,876 |
| 1982-3 | 103.3 | +188 | 16,463 |

Source: British Gas Corporation Annual Report and Accounts 1982-83

Recently, the government has implemented a number of reforms. For example, BGC's first-option buying rights for gas from UK waters has been removed and BGC has been obliged to carry gas for others, and to enlarge its provision of pipelines.

In addition to this, the Oil and Gas (Enterprise) Act 1982 conferred powers upon the Energy Secretary to order BGC to dispose of certain assets. Under such direction the BGC has set up subsidiary companies to hold assets represented by five off-shore fields, and (under the Gas Act 1972) it has sold its 50% interest in a petroleum production licence (PL089, which includes the Wytch Farm Oilfield). Under the same Act, the monopoly control of gas enjoyed by BGC was removed, and private competitors may now supply gas to industries using in excess of two million therms and to consumers using at least 25,000 therms a

year, with the Secretary of State's permission. The sale of Enterprise Oil, a new company formed out of the offshore oil-fields formerly owned by the BGC went ahead in June 1984. However, while all this is to be welcomed, much more needs to be done if serious commercial incentives are to be restored to the gas industry.

Although governments are not supposed to control energy prices directly, the evidence indicates otherwise. Recent examples include: the constraint of prices which mainly affected domestic prices during the period when the Price Commission operated (1973 to 1979); constraint of domestic prices in the autumn of 1979; the sequence of three real tariff increases of 10% per annum completed in 1982; and the freezes on industrial and commercial prices during the period since 1980/81.⁵

The need for gas pricing

Nationalization was designed to achieve political ends, and as such, the whole purpose of public ownership was to make the allocation of resources subject to political rather than economic forces. This results in a distortion of market forces and in low efficiency and poor service to the consumer. The gas industry is no exception.

There are three reasons why it is important to introduce competitive pricing, free from political constraints, into the gas industry.

Political manipulation. Uncertainty resulting from political constraints on pricing reduces the stability of energy supply and demand. This disrupts the efficient long-term exploration, production, distribution, and supply of energy and causes powerful swings in the pattern of demand. Controlled prices on any commodity, including gas, are difficult to raise because of political pressures to reduce the cost of living. Low prices increase consumer demand and add to the size of the group with a vested interest in lobbying to keep prices down. Elections and budgets can generate large and unforeseen fluctuations in price as governments balance the competing interests of taxpayers and users. If a government grasps the nettle and allows a substantial rise in prices, demand can go through sudden and disruptive shifts between alternative energy sources.

Pricing under political objectives generates gluts or shortages and, by its very nature, is a source of uncertainty. By allowing the free market to determine the price, gradual changes in consumer tastes or in the technical conditions of supply can be accommodated much more smoothly, and futures markets can smooth

⁵ Efficiency Study - British Gas Corporation (London: Deloitte, Haskins, and Sells, June 1983), p. 50.

out the uncertainties of future supply and demand conditions.

This general principle can be seen in terms of the supply and demand problems that have arisen in recent years.

Demand problems: rationing and waste. In the gas industry, prices have been kept artificially low for many years, so that gas has been typically cheaper than other energy forms. To a large extent, this policy was started (and continued) deliberately. After the war, the policy was 'cost-plus' price control, where the main objective was to ensure that as much gas as possible was made available as soon as possible and 'fairly' distributed. It was thought that such a move would help Britain's balance of payments by allowing home-produced gas to supplant the imported oil with which it competed. Also, the idea of producing gas within the limits set by cost and minimal producer profit, would prevent excessive profits (or 'rent') being obtained by gas suppliers.

Not surprisingly, the downward political pressure on gas prices called forth a rising demand from consumers - new customers who had switched from other forms of fuel, and existing customers who increased their gas use. The switch to gas, especially by ordinary domestic users, was particularly marked in the period after the OPEC price rises. The effects of the OPEC manipulation of oil prices adequately demonstrates the danger of removing the control of market forces.

Table 4

Relative fuel prices (January 1974 = 100)

| | RPI | Coal | Gas | Electricity |
|------|-------|-------|-------|-------------|
| 1974 | 108.5 | 105.7 | 103.7 | 114.5 |
| 1975 | 138.8 | 142.4 | 119.9 | 166.4 |
| 1976 | 157.1 | 176.2 | 146.5 | 207.2 |
| 1977 | 182.0 | 205.2 | 170.9 | 236.2 |
| 1978 | 197.1 | 228.6 | 176.1 | 260.1 |
| 1979 | 223.5 | 268.3 | 182.5 | 282.6 |
| 1980 | 263.7 | 342.7 | 212.8 | 359.5 |
| 1981 | 295.0 | 402.2 | 268.4 | 432.1 |
| 1982 | 320.4 | 432.4 | 334.4 | 474.4 |
| 1983 | 335.1 | 459.5 | 374.4 | 492.0 |

Source: Digest of UK Energy Statistics, 1984

An underpriced supply of energy, while a boon to users, encourages profligacy. Underpricing induces people to burn more fuel rather than to invest in insulation and conservation. Consumers who could quite easily use more plentiful sources of

energy are induced not do so by the low price; and those who would otherwise seek out new forms of energy have less incentive to develop alternatives because of the artificially low price. The net results are that gas resources are used up more quickly; that conservation measures are no longer cost-effective; and that new energy alternatives remain unexploited - all because of politically-determined underpricing.

If demand soars because of artificially low prices, other means of allocating scarce gas resources have to be found. Interestingly enough, gas officials have found such a mechanism in terms of rationing by bureaucratic decision. Thus, in the period when gas was a particularly cheap form of fuel, large energy users were invited to provide reasons **other than price** why they wished to switch to gas heating. The allocation of gas supply was then made on the basis of a bureaucratic judgement about the 'desirability' of these reasons. However, such judgements were often perverse. For example, conversion of light oil burners to gas firing was permissible in some areas, installations which used high-sulphur heavy fuel oil with its attendant pollution problems were not allowed to change. The 'justification' was usually dressed up in economic terms, to the effect that the financial advantage to the firm was insufficient to justify the conversion (although this is a judgement that is more appropriately made by a customer rather than a monopoly supplier). Such bureaucratic absurdity hardly seems an efficient or a just way of allocating a scarce resource.

Supply problems. An artificially low price of gas threatens the future supply of those who really need it, the so-called 'premium' customers, who use gas because of its particular qualities (such as being clean, easy to control, and supplied through pipes so that no storage space is needed). These consumers cannot readily use other fuels, have a very low elasticity of demand for gas, and therefore need a long-term supply. By attracting other customers who could easily use other sorts of energy (and would do so if gas were competitively priced) to use gas, the low-price policy makes the long-term supply to 'premium' customers more uncertain. Artificially low prices also reduce the potential rewards of any commercial involvement in the already risky work of exploration and production. This decreases the available gas supply.

The problem is compounded by the sudden shortage of future supplies that is expected to occur sometime during the early 1990s. With demand expected to be around 1.8 to 2 trillion cubic feet into the 1990s,⁶ the presently available reserves are running out, and current thinking appears to be stuck in a false dilemma: either **spend more money** on importing gas from Norway's Sliepner field; or **spend more money** on developing new British fields. The dilemma is false because there is a third possibility: the introduction of economic pricing to gas consumers and

Winter 1983/4, p. 5.

6. The Economist, April 7, 1984, p. 28.

the freeing of restrictions on producers to export gas to the continent. Unless it becomes more economical to take the risks of exploration (the average age of a gas field is seventeen years and none are younger than ten years old), this would suggest that there will be a swift gas shortage developing in the 1990s, despite the fact that gas will continue to lie beneath the seabed or will continue to be flared off as a by-product of other exploration rather than being harnessed and used as the valuable asset it is.

Until recently, indigenous offshore natural gas supplies were expected to be sufficient to meet the major part of British requirements into the twenty-first century. Now, the industry's view is that 'by 1990 overall gas demand will be between ten and twenty per cent greater than 1982', and while 'demand for gas looks fairly healthy... there still remains a large gap between (assumed) demand and contracted supplies in the late 'eighties and 'nineties'.⁷ By 1995,⁸ existing contracts will cover only about one-third of demand,⁸ and Norway might be a more effective supplier.

One factor that is continually ignored in such evaluations is price. Once prices are allowed to move freely then supply and demand will tend to adjust automatically. There will be incentives (if a competitive market is allowed to evolve) for more marginal fields to be used as the price of gas rises - and there will be incentives to use it more sparingly, to substitute an alternative fuel source, and to investigate new technology aimed at using less fuel or finding new fuel sources.

Because new sources will take time to develop, it is vital that the proper environment should exist to prevent any import gap occurring. It would therefore seem appropriate to introduce a relatively easy and minor reform, which would give greater rein to market forces, namely to permit producers to export gas to the continent. This would ensure that BGC would have to compete with other continental gas companies for supplies, and would, in one simple move, break BGC's monopsony power. Thus, a 'freedom to export policy' would complement, on an international scale, the albeit more complicated changes that need to be implemented in the domestic market.

Towards competitive pricing

A more liberal market structure, under which alternative suppliers can introduce gas at a competitive price into the transmission system, might originally lead to gas being supplied at considerably lower prices than the BGC's marginal cost, and

7. 'United Kingdom Energy Outlook', ESSO Magazine Supplement (Winter 1983/4), p. 5.

8. The Economist, April 7, 1984, p. 28.

will probably require BGC to cut costs. It will only be in the longer run, however, that the full effects of a free market will be really seen, when all producers offering gas in the marketplace will equate marginal costs. This will inevitably generate structural problems and changes within the Corporation which must be anticipated. Faced with such competition, the Corporation would have to price competitively in the short run, but might eventually need to withdraw from unprofitable markets and from expensive sources of supply to reduce its marginal costs to levels which will be covered by market prices. All such decisions should be taken within the framework of a well-developed market strategy. This strategy will need to take into account the appropriate timing for price increases, recognizing the needs of the market place and the economic circumstances facing BGC's customers.⁹

Disruption to consumers. The different supply and demand conditions prevailing in various parts of the market will thus make the effect of competitive pricing somewhat unpredictable at first. New supplies may help to keep prices down initially, but rises in prices are most likely in the medium and long term. Additionally, if the BGC starts having to pay international market prices, then some of their supply costs from UK sources will rise. It is, of course, open to question as to what extent total costs may go up, but the failure to pay market prices to UK producers means that less UK gas will be produced and imports (costing more because of the pressure of UK demand) will have to be substituted. However, the spur of competition has been largely ignored in this argument, and will undoubtedly act to reduce costs when a more open market structure is introduced. Fears of rapidly rising costs are therefore pure supposition: only actual practice can settle the question. In the short term, positive steps should be taken to raise the price of gas in real terms with a view to reducing the shock of an economic pricing policy. (The alternative to not starting an adjustment process would, of course, be worse; a growing supply deficit and the need for non-market ways of rationing supplies, imposing overall an even higher cost of energy.)

Welfare issues. Arguments that economic gas prices would impose a burden on elderly or poorer domestic users are partly undermined by the fact that such groups actually use comparatively little gas, cheap as it is. Even so, artificially low fuel prices for everyone is a very inefficient mechanism for channeling aid towards needy individuals, since the low prices benefit rich and poor alike and act against conservationist strategies. It is far better to put extra financial benefits where they are needed at the same time that the gas price is raised for all consumers. Some part of the increased revenue arising from the higher gas prices could be earmarked for this cause. For example, low-income households could be given a 'grey

9. Efficiency Study - British Gas Corporation (London: Deloitte, Haskins, and Sells, June 1983), p. 50.

meter' which supplies gas or electricity at a lower tariff, or better, could be given direct income supplements to spend as they choose.

However, simply raising the gas price by official fiat is only a temporary measure, and must not be misinterpreted as a solution to the problem. As long as the effective pricing power remains in political control, the problems of government failure will continue.

IMPROVING COMPETITIVENESS

The structural nature of gas distribution means that the privatization of the industry in Britain will take a number of years to complete. Certain key policy changes (for example, the freedom to export, a new financial framework for the BGC, and the introduction of market pricing for consumers) could be introduced quite quickly. In addition to a restructuring of existing assets, there is a need to allow new competition to grow before we can reap the benefits. While most steps could begin immediately, others would be more long term, and might require interim measures as a means of smoothing over the transition from a state to an independent and competitive gas industry.

Competing transmission and distribution

To privatize the BGC as a single unit would not be particularly desirable. Transferring ownership would replace a state monopoly with a private one, and little would improve.

However, competitive supply is easy enough to ensure, and this objective suggests that the UK should continue to encourage competition among potential buyers through Section 9 of the 1962 Continental Shelf Act, which permits a direct supply of North Sea gas to buyers other than BGC. Examples of such direct supply would include the transmission of gas in large containers (or other new methods), major industrial or commercial users (or groups) for which the provision of a special pipeline would prove economical, or a new, competing gas transmission company.

Competition in transmission. Just as railways, roads, and airlines compete in the distribution of freight, it is possible that the different types of gas available could be transmitted by competing networks.

Natural gas has a totally different composition to manufactured gas and, moreover, has differing calorific values and needs different fuel/air ratios depending on the manufacturing process used. Gas is most cheaply generated from low-grade coal as low BTU gas which, as its name implies, has a low calorific value - about 25% of that of natural gas. However, on a heat-for-heat basis, it can be generated at 85% efficiency from raw coal and, assuming low-grade imported coal were used, would be as little as

half the present price of gas. It obviously could not be distributed through the same pipes or meters, or burned in the same combustors as natural gas. Substitute natural gas can also be generated from coal, but oxygen enrichment is needed which complicates the generation apparatus and thus adds to the capital costs. Coal gas is the product of the coke manufacturing process and is what used to be 'town gas'. It also requires different burners and equipment.

Of course there is no reason why locally-generated low BTU gas should not be distributed to consumers through its own pipeline or even used as the basis of small factory combined heat and power schemes. It would seem wise not to foreclose any such innovations, even including the prospect of a new and competing natural gas transmission system, by leaving any vestige of monopoly powers over gas transmission.

Privatizing transmission, given the most likely event that at first there will be only one transmission company, would be problematic, since it could be a very powerful monopoly. The solution is to limit the rights of a transmission company to making a throughput charge only, and not to purchasing and selling gas - to act solely as a 'common carrier'. Sales would be made between producers and large customers or to the distribution companies which it is proposed will operate regionally (see below). The price would therefore be competitively determined. A regulatory body would have to monitor tariffs, and it would be important for there to be a minimum of restrictions on allowing new transmission companies to set up and new pipelines to be laid.

Alternatively, it may be possible for the transmission network to be divided between regional monopolies which acted under franchises of limited duration, allocated by the regulatory agency.

Competition in distribution. The present monolithic structure, with the integration of all of the transmission and distribution, enables the Corporation to avoid revealing its transfer costs. In broad terms BGC buys gas at the coast for about 12p per therm (plus gas levy) and sells it to customers at around 30p per therm. There is no real yardstick to measure its precise efficiency or performance, because there is no real competition.

This suggests that at the very least, the privatization of the BGC's supply function should involve it being split up into regions, and argues for the encouragement of the setting up of competing reticulation systems since different types of gas cannot be standardized.

Privatization by region, though an imperfect way of fostering competition, would overcome some of the problems of monopoly in two ways. First, although the new private companies would inherit the existing gas regions or subdivisions of them, they need not be constrained by any geographical limit. Initially,

there would only be competition between companies along their borders, as those in these areas were, for the first time, given a choice in who supplies their gas. It is quite likely that the small (household) user would not be the first to be given this choice - more likely that boundaries between firms would move, as for example, one industrial user switched allegiances between different gas-supply enterprises. Over time, the more successful suppliers (those who provided the customer with the better overall service) would expand at the expense of the competition that failed to satisfy consumers. Competition of this nature would probably be a slow process and would be imperfect, but nevertheless, competition in any guise would bring benefits.

Second, even if a customer in, say, Cornwall had effectively no choice as to his supplier, he could determine whether his gas was more expensive than that supplied in Yorkshire and whether the service there was better or worse. This pressure from customers, added to the pressure from shareholders, would have its effect on management. There would be a tendency for the best companies to 'pull up' the worst.

Whatever larger structural changes are contemplated, one useful reform could proceed immediately. The recent provision that private competitors may supply gas only to industries using in excess of two million therms and to other consumers using at least 25,000 therms - although a welcome step in the direction of competition - is arbitrarily restrictive and should be removed as part of an overall liberalization strategy.

Sale of assets

The sale of BGC assets should be continued and accelerated where possible, as they can be under the powers conferred upon the Energy Secretary in the 1982 Act. Where such assets lie within a particular region and are directly relevant to that particular supplier (gas showrooms, for example), they should form part of the 'regional package'. The principal subsidiaries of BGC (referred to in its accounts) can be sold separately.

The role for government in the long term would be purely regulatory, in that it would set minimum quality standards for private operators in the gas industry, and through a government-controlled agency the regional firms could be kept in line and prevented from abusing any monopoly power that may still exist. The agency would be charged with monitoring the firm controlling transmission, and auctioning licences to explore and develop gas fields. The functions of this agency should be contracted out, as a further move to maintain quality and also get value for money.

To avoid introducing each change separately, the least cumbersome procedure might be to introduce a single enabling measure, giving the appropriate Secretary of State the power to privatize by ordering the nationalized industry to form and dispose of

subsidiary companies for the activities to be privatized. Whatever happens, the main aim should be to encourage smaller organizational structures, competition, and flexibility in gas production and distribution.

October 1973, a new economic weapon of enormous potential was discovered. That weapon was oil.

In effect, it was discovered that because oil had an inelastic demand (at least in the short term), it was therefore a powerful economic weapon to wield. The West's dependence on oil and the almost casual acceptance that it would last indefinitely contributed to this inelasticity. However, determined actions by the Western nations succeeded in reducing oil dependence remarkably over the succeeding years, once its strategic power had come to be understood.

The situation in the years preceding the first oil crisis, where world demand increased at an annual rate of around eight per cent between 1960 and 1973, is unlikely to recur. At that time, relative price stability was maintained by a roughly equal rise in supply, but the events of 1973 changed all that. As if to remind the world, 1979 saw the price of oil rise from \$13 to \$35 a barrel, following the Iranian cut in output by over fifty per cent after the fall of the Shah.

Table 5
The world price of oil

| Year | Nominal Price (\$ per barrel) | Real Price (1973 = 100) |
|------|----------------------------------|----------------------------|
| 1973 | 3.5 | 100 |
| 1974 | 9.6 | 228 |
| 1975 | 10.7 | 225 |
| 1976 | 11.6 | 243 |
| 1977 | 12.5 | 241 |
| 1978 | 12.7 | 215 |
| 1979 | 18.8 | 282 |
| 1980 | 31.2 | 419 |
| 1981 | 34.3 | 488 |
| 1982 | 33.8 | 491 |

THE ECONOMIC CONSIDERATIONS

The discovery of oil in the North Sea (mainly around the Orkney and Shetland Islands) came as a considerable benefit to the United Kingdom, faced with this supply restriction. The value of the assets in the North Sea can be appreciated when it is recognized that:

'Only fourteen years ago, no oil had been discovered in the

3. NORTH SEA OIL

In October 1973, a new economic weapon of enormous potential was discovered. That weapon was oil.

In effect, it was discovered that because oil had an inelastic demand (at least in the short term), it was therefore a powerful economic weapon to wield. The West's dependence on oil and the almost casual acceptance that it would last indefinitely contributed to this inelasticity. However, determined actions by the Western nations succeeded in reducing oil dependence remarkably over the succeeding years, once its strategic power had come to be understood.

The situation in the years preceding the first oil crisis, where world demand increased at an annual rate of around eight per cent between 1960 and 1973, is unlikely to recur. At that time, relative price stability was maintained by a roughly equal rise in supply, but the events of 1973 changed all that. As if to remind the world, 1979 saw the price of oil rise from \$13 to \$25 a barrel, following the Iranian cut in output by over fifty per cent after the fall of the Shah.

Table 5
The world price of oil

| Year | Nominal Price (\$ per barrel) | Real Price (1973 = 100) |
|------|----------------------------------|----------------------------|
| 1973 | 3.5 | 100 |
| 1974 | 9.6 | 228 |
| 1975 | 10.7 | 225 |
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THE ECONOMIC CONSIDERATIONS

The discovery of oil in the North Sea (mainly around the Orkney and Shetland Islands) came as a considerable benefit to the United Kingdom, faced with this supply restriction. The value of the assets in the North Sea can be appreciated when it is recognized that:

'Only fourteen years ago, no oil had been discovered in the

North Sea. In 1980, only six years after the first oil was produced, the United Kingdom became self-sufficient in oil and by 1982 was the world's fifth largest producer of oil and a major exporter.

'Today there are thirty-one oil and nine gas fields in production or under development in one of the world's most hostile operating environments... Development of the North Sea has meant the construction and installation of more than sixty fixed platforms and the creation of a safe working environment for up to ten thousand people... The development of the North Sea has so far cost more than £30,000 million and would have been impossible but for the financial and technical resources of the oil companies.'¹⁰

'After taking account of cumulative oil production to the end of 1983 - 572 million tonnes - the remaining recoverable reserves in present and future discoveries are now estimated to be in the range 1410-5280 million tonnes.'¹¹ On this basis it is believed that 'the UK could well remain self-sufficient beyond the end of the century'¹². In fact, more recently, John Raisman, Chairman and Chief Executive of Shell UK 'estimated that Britain could still be producing 1.2 million barrels of oil a day, or 60 million tonnes per year, by the end of the century', and that 'while North Sea output was nearing a peak, where it would remain for two to three years before declining, it was a mistake to assume that the fall in output would be as rapid as the rise. In fact, production will be sustained at a significant level into the 1990s and probably well into the next century'.¹³ The problem is that while North Sea output now represents around 5% of Britain's GDP, estimates of 'pumpable reserves' still vary quite widely because high margins of error are accepted. Probably the best guess, because it is the most recent, is:

'Proven plus probable reserves in existing discoveries now total around 1.4 billion tonnes, enough for around 12 years of output at the present rate of extraction. Adding these to the most optimistic guess of undiscovered reserves gives Britain another 50 years as a major oil producer.

'Most of this oil may never be profitable to extract, unless world oil prices rise steeply.'¹⁴

10. George Uthlaut, 'United Kingdom Energy Outlook', ESSO Magazine Supplement (Winter 1983/4).

11. 'Development of the Oil and Gas Resources of the United Kingdom', (Department of Energy, 1984).

12. George Uthlaut, 'United Kingdom Energy Outlook'.

13. Daily Telegraph, Wednesday 18 April, 1984.

14. The Economist, June 9, 1984, p. 15.

ORGANIZATION OF THE INDUSTRY

The main British private involvement is through British Petroleum (BP) and Shell Transport and Trading. Direct state involvement is through a public corporation, the British National Oil Corporation (BNOC).

British National Oil Corporation

The BNOC was set up on 1st January 1976 as an arm of government to perform its regulatory work in accordance with the Petroleum and Submarine Pipelines Act 1975. It was part of the then government's promise (as outlined in its October 1974 Manifesto), to 'take majority participation in all future oil licences and negotiate to achieve majority state participating agreements with the oil companies', which mostly involved working through the UK Offshore Operators Association.

The original role of BNOC was twofold. On the one hand 'it was to hold equity interests in UK continental shelf exploration and production licences in partnership with private sector companies and thus directly contribute to the development of the UK continental shelf and share in the profits earned'. On the other hand, it was empowered to buy and sell roughly 60% of the UK continental shelf production - an option that it usually exercises - with a view to 'contributing to the government's objective of securing greater national control over the disposition of the UK's oil production'.¹⁵

Recent changes. Since 1979, a number of changes have been made in an attempt to commercialize BNOC, but by far the most significant move was the passing of the Oil and Gas (Enterprise) Act 1982. It abolished the National Oil Account and transferred BNOC's activities of exploration and production of oil to a newly created subsidiary - Britoil. Subsequently, 51% of Britoil's shares were sold, giving it greater independence and an opportunity to utilize the private capital markets. However, what the BNOC calls its trading and marketing activities, 'which are largely carried out on behalf of the government and cover approximately 60% of all oil produced from the UK continental shelf, remain with the Corporation, which will continue to be owned 100% by the government'.¹⁶ BNOC now aims 'through participation, to secure and dispose of UK continental shelf petroleum in a way which contributes to national security of supply and, through effective trading and marketing to ensure that the UK economy receives the maximum benefit from the Corporation's access to such petroleum'.¹⁷

15. BNOC Annual Report and Accounts, 1982.

16. BNOC Annual Report and Accounts, 1981.

17. BNOC Annual Report and Accounts, 1982.

These changes appears to have done a considerable amount of good for both Britoil and BNOC - even though the latter has not been privatized. The former announced a rise in net profits of almost 35% (from £102.7 to £143.3 million) in its first year as a private concern, and even BNOC ended its first year after the sale of its producing assets with a pre-tax profit of £800,000. In the light of these results, there is a need to do more than just sit back and say that 'Britoil has now been successfully privatized'.¹⁸ The government still has a 49% shareholding, and there is clearly an interest in Britoil by private investors - more so after its recent results. Therefore, it would make sense for the government to satisfy the demand and at the next available opportunity reduce its holdings in Britoil, with a view to eventually selling all its shares over, say, a two-year period. While this is being done the state's remaining shares in BP could also be sold.

Unnecessary powers. It is argued that BNOC is needed to buy (and then sell) North Sea oil to secure the supply of oil should any crisis occur. This 'security of supply' argument, however, does not justify this sizeable agency.

If there is a major shortfall in supply (defined as 7% or over), then the International Energy Authority has powers to take action (see relevant section). But if there is only a minor shortfall, then powers exist in the 1976 Energy Act to deal with it. There are also further emergency powers under the Treaty of Rome.

Even ignoring all this, there is no reason for BNOC's persistent purchase of around 60% of the oil. At a time when a major shortfall is classified as a mere 7%, the strategic justification for 60% purchase disappears. At the most, using this logic, there would be a case for a figure of 5-10%, but no more. Indeed, strategic stockpiles could easily be laid down against a crisis, involving even lower purchases on an annual basis.

Finally, BNOC is instructed to go about its work and buy at 'the market price'. Unfortunately, this is not precisely defined (it could be short term, long term, contracts or even the spot price). The possibilities for disruptive policy changes in the marketplace is therefore considerable.

BNOC appears to be a largely redundant organization performing tasks which are detrimental to the proper operation of the market and unable to fulfill its only important task - that of filling a supply gap. We suggest that it should therefore be run down over a year. Any assets could be sold, while at the same time a staggered withdrawal from the market would minimize any adverse effects. This would involve BNOC gradually buying less and less oil from one month to the next, so by the end of, for example, a pre-determined twelve-month period it would no longer be in the

18. Nigel Lawson MP, Hansard, 22nd November 1982, C.596.

market.

Strategic oil stockpiles, where necessary, would be bought by the Ministry of Defence. (Many countries operate such stockpiling systems. In South Africa oil is stored in disused mines.)

OWNERSHIP AND ALLOCATION OF EXPLORATION RIGHTS

Since 1969 the assumption has prevailed that the state owned the North Sea. The natural extension of this view has been to permit the government to allocate licences for the exploitation of the resources in the sea such as oil and gas.

Initially, taxation was kept down in order to encourage North Sea production. As time has passed, however, this has been translated into a much stricter government policy: away from the situation where no production controls operated and only Corporation Tax applied, and towards a policy aimed at 'reaping some of the benefits' of the North Sea oil 'bonanza'. In economic terms, governments have intended to extract the 'economic rent' from the oil fields.

Taxation policies

The year 1975 saw the introduction of a 45% Petroleum Revenue Tax (PRT) and marked the end of a simple tax system for the earnings of the oil companies. Before PRT, a 12.5% royalty was placed on the value of oil produced (this was regardless of whether a profit was made or not) and Corporation Tax up to a ceiling of 52% was applied, as with other businesses, on profits. However, using a tactic not unknown on the mainland, a firm could start investing in other fields once a profit began to show itself, with the result expenditure it could be offset against tax. The Oil Taxation Act of 1975, which gave birth to PRT, further complicated the situation. On the one hand, it included a 'safeguard' provision for PRT, (which effectively represented a minimum registration level similar to the £18,000 turnover below which small firms do not have to pay VAT) and exempted a company from paying any PRT if its gross profits in any one year were less than 30% of capital expenditure. On the other hand, a 'tapering' provision limited PRT to a maximum of anything over the safeguard limit, i.e. only 80% of the difference between gross profits and the 30% of capital spending could be paid as PRT. IN 1981, the rate of PRT rose from 45% to its present 70% while the capital allowance went down from 1.75 to 1.35. The most significant reform was the application of a tax 'fence' around oil production which prevented profits from oil revenues being offset against losses in mainland activities.

As if this were not enough, the 1981 budget saw the introduction of the 'windfall tax', as it was called. More correctly, it was the Supplementary Petroleum Duty (SPD), which was a 20% tax on gross revenue from oil after deducting an allowance equal

to the value of one million tonnes of oil per field per year and was to run for only eighteenth months, until June 1982. A more recent development has been the abolition of the royalty tax. The aim of SPD was to both bring in funds to the government, and to fit in with a policy encouraging slower depletion. The 1982 budget extended SPD to 31 December 1982, but PRT was increased from 70% to 75%. Then in the 1983 Budget, an £800 million programme of tax encouragement for North Sea Oil companies was announced, but it was to be spread over the four successive years. Changes in the last budget include:

'Corporation Tax restrictions on post-Budget day 'farmouts' (sales of interest in oil fields). Capital gains on 'farmouts' brought within North Sea Corporation Tax ring fence. Amendment of current legislation on repayment of Advance Corporate Tax to oil companies.'

It seems that policy has switched slightly, from attempting to reduce the depletion of oil, in 1981, to actively encouraging both the 'appraisal and exploration of marginal fields, in 1983. And there is a fine example of the problem of the North Sea tax regime: an excessive number of charges, and therefore a lack of confidence that government will not use the 'excuse' of any favourable development to raise the tax take to an excessive level. The tax system should be initially simplified and then be accompanied with a policy announcement that it will not be tampered with in the future. In this way the oil firms in the North Sea can attempt to plan with greater certainty their future activities.

Folly of present policy. Plainly, the present tax policy is a disruptive mechanism for extracting the 'economic rent' enjoyed by the oil exploration companies as a result of the state's monopoly in licensing exploration and development rights in particular areas of the North Sea.

The ability of governments to impose arbitrary taxes when they feel the industry can bear them, and to alter the rates and exemptions on the various taxes presently levied on the companies, is a source of considerable uncertainty in exploration plans. It also raises the cost of oil production once a discovery has been made. To raise the price of oil in an erratic way through taxation may be a sound conservation measure; but the uncertainty of the tax environment imposes additional and unnecessary costs and cuts into producers' profits.

The disruptive and depressive effect of this arbitrary taxation policy may take many years to become evident, due to the length of time which it takes to commit new resources to exploration. The result is nevertheless a tendency to produce shortages in the

19. 'The Budget', Politics Today, No. 6 (London: Conservative Research Department, April 2, 1984).

future that will be persistent until the instruments, and the intentions, of arbitrary tax interference have been put aside. In addition, such shortages may be erroneously ascribed to spurious factors.

In our judgement, the optimal policy would be to renounce all arbitrary taxes on oil exploration and treat those firms, where possible, just like any other British firm. The 'economic rent' of new North Sea oilfields can be extracted by the more predictable and less arbitrary system of exploration rights auctioning, as practised in the United States.

Auctioning North Sea oil licences

Prompted by an international agreement in 1958, Parliament passed an Act in 1964, which extended to the continental shelf the Crown's right to licence exploration and production as originally set out in the Petroleum (Production) Act 1934. While this does not clearly imply that the state should own the North Sea (and in turn the assets underneath it), it encouraged the assumption to this effect.

However, journalists have extended this to the point that many people believe North Sea Oil to be 'our' oil. The truth is that once the extraction rights have been distributed not only is the oil **not** owned in any way by the British people, but it is owned by the oil companies and their shareholders, who as a result of the prevailing distributive system, were given it free. While not acceptable, it is perhaps understandable that governments have resorted to subsequent and arbitrary taxation methods in order to put a cost on this unwittingly generous free gift. (The exceptions to this have been in 1971 when the government sold licences to fifteen blocks and raised £37 million and the 'award of licences for seven blocks for which successful cash tender bids were made' in 1983.²⁰)

In this way, government policy in Britain has allocated licences by bureaucratic judgement rather than competitive auctioning, meaning that the economic rent (or revenue) is not collected by the initial licence allocation, but at a later date through the complex range of taxes levied on the earnings of the oil companies. This method of allocation was further used as an arm of government conservation policy in that it assisted in the control of offshore development to prevent rapid depletion.

The problem is therefore a twofold one. Firstly, how should the state obtain the 'economic rent' in the most efficient manner possible? And secondly, to what extent should the granting of licences be used to slow down the exhaustion of North Sea oil fields?

20. Development of Oil and Gas Resources in the UK (London: HMSO, Department of Energy Brown Book, 1984).

In the United States, Canada, and many other countries, however, a price is put on the asset being conferred to the oil explorers when licences are auctioned to the highest bidder. The bids are normally made in terms of a one-off payment or, as in the case of the United States, 'royalty bidding' (which involves companies bidding in terms of the percentage of net profits on any production). In the latter case, there is a double-edged advantage to the government, in that if a company buys an area of very low yield the government will not lose out by the initial payment. If however, there is a high return, the government will get a larger royalty. Although overhead costs mean that there may be little or no reward in starting up production in marginal fields if a flat rate of royalty has been agreed, a variable royalty, depending on the return, has successfully overcome this problem.

In Britain, the question of how the state should extract the maximum economic rent has normally been restricted to proposing alternative structures of tax on the oil companies, while still accepting that licences should be given away via administrative patronage rather than through the market. One unwelcome side-effect of discretionary licencing is that it has discriminated against the small companies because government officials are reluctant to allocate licences to 'non-established' concerns. But more important is that it has also proved impossible to extract the whole of the economic rent through the tax system without inflicting heavy and arbitrary taxes and thereby discouraging exploration. This is because economic rent depends on the subjective assessments of the investors, which can never be precisely known to those settling the tax rate; it also varies over time.

'Economic rent' is generally accepted to be the difference between the expected return (i.e. weighted by the probability of success) earned in exploring and developing in the block, less the return which could be earned in alternative investment opportunities of similar riskiness (allowing for the pooling of risk). In other words the 'economic rent' is the excess profit over and above that needed to attract adequate capital into oil exploration. The only way to even approach the extraction of 100% of the 'economic rent' while at the same time removing uncertainty and leaving adequate incentives for expeditious and efficient exploration and development, is by the auctioning of leases. Auction prices would reflect the net present value of any anticipated economic rent not likely to be taken in tax.

Conserving resources. Conservation is itself a complicated subject, deserving greater investigation. However, the idea that the government is in the best position to conserve resources (whether that be oil or anything else) is wrong. Private organizations generally show a greater efficiency in the production process, thus avoiding the increased waste associated with state operation, and helping to conserve valuable resources. Even if it is accepted that the state could conserve oil production, why should it? Why should the government postpone the use of

resources, which involves sacrificing the needs of the present generation for those of future ones? How can a government possibly know what a future generation will want or need, or what new sources of supply and new alternatives will be brought into production by increasing prices as existing supplies become scarcer?

These questions raise serious doubts over the wisdom of state conservationist intentions. The best rationale that exists for the short to medium term is based on strategic issues. Doubts exist about economic and political stability in the Middle East which could affect oil supplies. There is even the possibility of Soviet action, direct or indirect, which might attempt to disturb, interrupt, or even cut off the passage of oil to the West. This may be sufficient justification for some state intervention; but strategic stockpiles seem more useful than attempts to freeze technology in its present pattern.

Clearly, an assessment of the strategic reasons for state-implemented conservation is required; and where these differ from the present policies, then they need to change. (For example, control over foreign companies being involved in oil production should be different for friendly and established firms compared to those from or influenced by anti-Western governments.)

Arguments against the auctioning of licences

There are a number of specious arguments often cited to justify the status quo, with the extensive level of government intervention in oil extraction that it entails. Four might be cited here.

(a) 'Oil extraction entails certain defence considerations which justify government ownership'.

At best this can support limited conservation measures, some strategic stockpiles, and possibly even discrimination against dubious foreign business involvement. Acceptance of this argument does not require rejection of licence auctioning; since it can easily be achieved by either regulating the sale of licences, or by accepting only certain bids.

(b) 'Oil extraction is a process taking a few years in most cases, and in that time the 'price' paid for the licence can underestimate the true value of the oilfields - especially when the price of oil is expected to move upwards'.

Competitive auctioning will provide the incentive for firms to obtain the best information available about what they are buying. Even if such a price does not represent the value of the extracted oil this will only be found out in the future, for if that information were available at the time of the auction there would have been the incentive for someone to bid that little bit higher, since the return would have been worth it. The argument

also ignores that it is equally possible to **overestimate** the value of an area and thereby pay too much for it. Significantly, the US evidence²¹ shows that there is a 'close correlation between the price paid and the success of subsequent drilling'.

(c) 'Auctions would permit technically and financially incompetent companies to acquire leases'.

At the moment it is perfectly feasible for the government to reject tenders from applicants lacking necessary technical resources, or for any other reason. This power was retained by the Department of Energy during the UK Fourth Round auction experiment in 1971. In any case, it is not clear what lasting harm would result from the occasional licensee who goes bankrupt because of operational mistakes (although the fact that a firm has had to pay for its licence is presumably a good reason for it to be careful, and a sound disincentive against those firms which are unsure of their expertise). So while it is doubtful whether there needs to be any examination of firms to assess their competence, it would be a simple matter to implement a pre-selection procedure while auctioning the licences.

(d) 'Auctions would result in larger (or foreign) companies taking a disproportionate share'.

There is no reason to have a preference for British firms, since the winner of the auction pays for what he gets. The fact is that for the first four rounds of licence allocation, 72% of the total acreage went to foreign companies - in the competitive auction it was only slightly more (80%), but they did pay for what they got.

Present bureaucratic allocation methods already discriminate in favour of larger, established companies. Under the auction system, it is likely that the small companies will pick up the less promising acreage, but it is also possible that on occasion a small company (or group) will 'strike lucky' and become a big company. Small companies can also raise large backing from capital investors, if needed, to bid for licences. In the 1971 experimental auction, the average number of different companies per block allocated among successful consortia bidders was 2.5, whereas in the simultaneous discretionary round the ratio was only 1.8 companies per licence. So, contrary to accepted wisdom, it is the discretionary system that favours the larger companies.

Future policy

The Brown Book, Development of Oil and Gas Resources of the UK (1979) estimated that the already-licenced areas contained sixty per cent or more of the recoverable reserves in place in the

21. Peter Lilley, The Case for Auctioning North Sea Oil Licences (London: The Bow Group).

whole UK sector. Therefore, for this area, a change in policy towards the sale of licences will make no difference whatsoever.

Estimates of the value of the remainder conflict. A fair appraisal would suggest something between \$3 and \$5.7 billion at 1980 prices. This may be disputed, but whatever the estimate, it is a sizeable amount which the government could expect to receive in bids for licences.

The introduction of an auctioning mechanism would lead to a dual system operating for a time: those that have been given a free licence and those who have had to pay the market rate for the right to development. In terms of equity, it would be sensible to proceed by exempting all successful new bidders from PRT and SPD, and subjecting them only to the standard rate of Corporation Tax; then to investigate and overhaul the tax system applicable to oil companies on existing licenses. Perhaps the most equitable solution here would be to calculate the notional remaining 'economic rent' in each field on the basis of the bids entered for new licenses, and to impose a flat rate of tax which was an annual equivalent to the remaining rent divided by the expected lifetime of the field. Being simple, this tax is unlikely to be subjected to further political manipulation. However, there is clearly a need to research alternative payment systems that are also likely to remain, or are deliberately placed, outside political control.

THE ROLE OF THE INTERNATIONAL ENERGY AGENCY

The understandable anxiety of the early 1970s undoubtedly led to the birth of the International Energy Agency (IEA) which was set up in 1974 under the auspices of the OECD by sixteen oil-consuming countries to co-ordinate their responses both to the oil crisis and later to the developing world energy situation. 'The agreement, concluded for 10 years but subject to a general review after five years, provided inter alia for an oil-sharing scheme coming automatically into operation in the event of a shortfall of seven per cent or more affecting any or all of the participating countries. In the event of overall supplies of oil falling short by twelve per cent, each country would have to curb demand by ten per cent even if not directly affected.' but, 'The automatic activation of the oil-sharing scheme could be prevented by 89 (or sixty per cent) of the 148 votes or by the votes of at least twelve countries. The participating countries were also to maintain contingency oil stocks equal to at least sixty days' consumption initially (ninety days at a date to be agreed later) and would, if the oil-sharing scheme came into operation, have to make specific cutbacks in consumption and to use existing stocks on an agreed basis.'²²

The weakness of the IEA's activities surround its rationing

22. Treaties and Alliances of the World (London: Longman, 1981).

process and bureaucratic control of resources. The aim of any international emergency policy should include: minimizing the costs of a disruption and maximizing the efficiency with which supply is allocated (strategies such as curtailing price rises by increasing the quantity of oil available through stock draw, adjusting to surge production of any energy, increasing imports of non-disrupted energy, encouraging a domestic free market, and promotion of an international market free of barriers and restrictions); avoiding a disruption of supplies; and reducing the risk that international agreements or activities are inappropriate or injurious.

The IEA refrains from encouraging the imposition of market restrictions and opposes 'in the interests of all its members, country imposition of price controls/allocation during disruption'. It has even encouraged its member states to move away from price controls and subsidies - Spain is a case in point.

The IEA deals with two types of disruption: the first where a country (or group of countries) is denied access to oil which is available on the open world market; the second where total world supply is cut, but the IEA countries have access to what remains. These disruptions are met by the Emergency Sharing System (ESS) which is meant to assure members of buying oil they would not otherwise have access to. For those who have a mistrust of producers and of the marketplace, it also represents preparation against the action of cartels.

The problem is that during 1979-80, an ESS trip-wire was not sprung because the ESS would only be used if a lack of access to supplies currently on the market could be proven. In effect, this would mean the ESS is considered inappropriate for the two disruptions we have experienced, and probable future disruptions. Also, while much of the concern centres around a desire to maintain lower fuel prices, the ESS would do the opposite - because it freezes the total of supply rights at the level already prevailing at the time of the disruption.

If there is a shortfall (above 7%) then the IEA calls for both supply and demand to be set at a new pre-determined level and then holds it at that level. On the supply side, these IEA restrictions act as a disincentive to non-IEA suppliers to increase production because their largest market is constrained from buying their output by the cutback policies. There is thus no incentive for surge producers to facilitate a reorganizing of the market.

A solution

In appraising the situation, three points can be made: the need, based only on security considerations, to deal with a major shortfall in world supply - for whatever reason; the need to have a mechanism to deal with those countries prevented from entering the market; there ought to be the minimum of tinkering with the

market, to allow it to return to a state of normality as soon as possible.

It is also clear that while the sentiments and some of the IEA's activities attempt to do this, there is more to be done to promote the effectiveness and therefore the esteem of the IEA. We suggest that the following points form the basis of a new British policy at the IEA:

(a) increased support for any additional moves to relax or remove market restrictions; and

(b) to propose a change in the Emergency Sharing System for dealing with falls in the supply of oil.

This latter point warrants greater clarification: a policy to deal with major shortfalls must strike a balance between the need for state (or international state-funded bodies) to intervene when the market is threatened and to step aside at other times to allow the market to do what it does best - allocate resources in the fairest and most efficient manner yet discovered.

Ideally, a free market could accommodate any fall in the supply of the commodity concerned. This would induce greater care being taken by consumers of the good, and it would encourage additional (and higher-cost) producers to enter the market. In an imperfect world market, where governments operate, authoritarian states exist, and politicians face elections, the task must be to approach as near as possible to this ideal.

We recommend that the restrictions governing shortfalls in world supply ought to be removed, unless security is threatened. If that is the case then rationing ought to be performed on a different formula; we suggest that it be based on a cut in the appropriate monthly figure of a year previously. Outside that limitation (and subject to any emergency readjustment of the figure) supply would be more of a 'panic-suppressant', to restrict the adverse reactions that might follow a serious cut in supply. Initially it would operate for thirty days, with the need for agreement to reduce or extend this time.

Another argument for control was the poor conditions in which the miners worked and lived. Coal-mining, like any other risk venture, can turn out to be unprofitable: the seams may suddenly run out, or the cost of transporting the product may increase. Geological prospecting and infrastructures were not as well developed as they are now, and all this made it less attractive to invest in permanent, good-quality housing and amenities for the workforce.

4. THE COAL INDUSTRY

ORIGINS AND DEVELOPMENT

Even though coal-mining goes back as far as the thirteenth century, it was not until the industrial revolution that coal became the country's main energy source. The industry experienced tremendous growth during the last two centuries, reaching a peak in 1913, when it produced 292 million tonnes of coal, exported 74.2 million tonnes, and employed over a million workers.

The interwar period saw moves to rationalize the coal industry by placing it under the direct control of the government while still retaining a measure of private ownership. In the words of Lloyd George himself: 'State control worked during the war because there was an unlimited market for war products and no limit to the price which would be paid. Such conditions can never exist in the mining industry. It can only survive if it is efficient.... Few can seriously believe that more efficiency will be displayed in... units now mining coal if they are managed by a body of bureaucrats instead of by those whose personal livelihood depends on efficient management.'²³

There were many reasons used to justify rationalization. It was recognized that coal was a vital strategic resource (much as North Sea Oil is today) and in the aftermath of the first world war and the coal stoppage of 1921, state control of such a resource seemed desirable. Coal also provided a cheap source of fuel for the generation of electricity which was then (as now) an energy source with the attractions of cleanliness and convenience to all consumers; it was thus considered desirable to encourage the development of the fledgling industry by direct intervention. The UK was thought to be lagging behind all other major powers in the exploitation of the potential of electricity, and at that time, the domestic combustion of coal was mainly in open fires with a thermal efficiency of 10%-15% whereas the thermal efficiency of the power stations averaged 20%. (Modern technology has reversed this relationship - solid fuel central heating systems are twice as thermally efficient as the most modern power stations.)

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²³ Richard Dally, 'Coal in a Changing Market', in National Westminster Bank Quarterly Review, August 1983, p. 14.

²⁴ Colin Robinson and Eleanor Marshall, What Future for British
²³ Lloyd George, Coal and Power, 1924.

Nationalization

After the end of the second world war, doctrinaire and strategic reasons were used to justify extending control into complete nationalization, which occurred on January 1st 1947. The 1946 Coal Industry Nationalization Act set up the National Coal Board (NCB) whose work involves mining (both deep and opencast), the manufacture of coal products (coke, smokeless and manufactured fuels, and chemicals), and ancillary activities (solid fuel distribution, engineering, manufacturing, etc).

'The NCB has, with limited exceptions, exclusive rights over the extraction of coal in Great Britain, but is empowered to licence private operators to work small mines and opencast sites. It also has powers to work other minerals, where discoveries are made in the course of searching for, or working, coal; and to engage in certain petrochemical activities beneficial to the future of the coal industry.'²⁴

Decline of the industry

Since 1950, coal usage has declined from 61% to 32% of the total energy used in the UK, and the usage is mainly for the purposes of electrical generation and coking. The steel surplus, coupled with the decline in manufacturing output of local heavy industry, make it certain that UK industrial usage will diminish, especially since the world market can meet most the needs for coking coal in the developing steel industries elsewhere. It is probable that after denationalization, the UK steel industry will be devoted almost entirely to high-priced specialist alloys and that its total energy requirements will diminish even further.

Only five years after nationalization, the European Coal and Steel Community (ECSC) came into being as 'the embodiment of the Schuman Declaration that the central control of coal and steel industries of Western Europe was a determining factor in the preservation of peace.'²⁵ In fact the early 1950s marked the industry's peak in the postwar period. Coal's share of the British energy market fell from 90% at the end of the second world war to a mere 37% in 1980.²⁶ The international picture, while not as dramatic, was significant, with a decline from the 1950 level of around 60% to 32% in 1979. However, while the relative picture appeared to be one of decline, in absolute terms the tonnage consumed in the world as a whole rose considerably,

24. Britain 1983 (London: HMSO), p. 254.

25. Richard Baily, 'Coal in a Changing Market', in National Westminster Bank Quarterly Review, August 1983, p. 14.

26. Colin Robinson and Eileen Marshall, What Future for British Coal? (London: Institute for Economic Affairs), p. 34.

and almost doubled between 1950 and 1979 - a rate of increase of just over two per cent per year.²⁷

The 1973 oil crisis revived demand, both absolutely and relatively, as coal became a more competitive energy source. Subsequent rises in oil and gas prices have further promoted the optimism for future continued growth in coal demand. As recently as 1979-80, anxiety was again aroused over the reliability and cost of oil supplies, when the Iran/Iraq war caused a further sharp oil price increase. It seems likely that the trends of recent years may continue in a similar fashion for the foreseeable future; but the anticipated growth outlined in the 1974 Plan for Coal shows the weakness of central planning.

RECENT PROBLEMS

Paucity of planning

In June 1974 The NCB announced the Plan for Coal, which declared a firm commitment to creating mining capacity at a greater rate than it was being lost. It marked 'a complete and significant change in the industry's fortunes after nearly two decades of enforced contraction'.²⁸ It outlined the plans for the industry up until 1985, including:

- (a) a halt to declining output and a target of 150 million tonnes annual production by 1985;
- (b) investment of £600 million at 1974 prices on top of ordinary capital expenditure of £800 million;
- (c) a £73 million coal and mining research programme; and
- (d) an anticipated average four per cent per annum improvement in productivity.

A political lesson can be learnt from the exercise: where one of the parties to a central planning agreement is powerful and well-organized (in this case the employees in the coal industry), they can gain tremendous advantages while the taxpayer foots the bill. In terms of productivity and output, the industry has failed to deliver the agreed improvements, while investment has exceeded planned targets and closure of surplus capacity has been well below target. The facts speak for themselves:²⁹

Investment. The Plan for Coal forecast that, in the decade to 1985, a total of £4,380 million (at current prices) would be spent on new mines and other investment. In the event, £6,550 million will be invested in the pits - over £2 billion above the 1974 target.

27. Ibid., p. 34.

28. Plan for Coal (London: National Coal Board, 1974).

29. For these details, see The Sunday Times, 24 June, 1984.

Creation of new capacity. The 1974 proposals envisaged 42 million tonnes of new capacity being created by 1985. The figure to mid-1984 was 29.3 million tonnes, with another 14.1 million tonnes of capacity under construction and scheduled, roughly as targeted, to be on stream by 1986.

Productivity. The agreement aimed at a four per cent rise in production over the subsequent ten years (1974-84), but the actual rise was a mere two per cent per annum.

Closures. It was agreed that between three and four million tonnes of capacity should be closed each year. Again, the actual figure of only 1.3 million tonnes per year falls well below this target.

The Plan for Coal did envisage closing pits for economic reasons, and not just because they were exhausted. Paragraph 27 of the report hoped that 'the need to close pits on economic grounds should be much reduced', but that 'inevitably some pits will have to close as their useful economic reserves of coal are depleted'. However, resistance to closures on economic grounds has been strong, despite the planned commitment.

Energy demand. Compared to the view held by the planners that by 1985 Britain would be consuming 430 million tonnes of coal equivalent, of which deep-mined coal would provide 120 million tonnes (28%), 1984 estimates showed an expected energy demand in 1984/5 of only 330 million tonnes equivalent, of which the demand for coal was expected to be 100 million tonnes (30.3%). The future demand for local coal for the remainder of the century is limited, especially with the advent of high technology requiring less energy. Recent disruptions in supply have not served to improve the demand prospects.

EEC coal policy. The European Coal and Steel Community has reinforced the problems. The ECSC, which was set up in 1951, set out to establish a common market in coal and steel. 'In the early days, the main thrust lay in maintaining workable competition within the Community and in protecting the consumer from price discrimination,'³⁰ but this was modified in 1967 when a system of subsidies to promote intra-Community trade in coking coal was introduced. This was followed by the publication of a New Energy Strategy for the Community in 1974 which proposed that the run-down of productive capacity should be checked, and that capacity should be maintained at 270 million tonnes per year to 1985 and beyond. It was the European equivalent of the British Plan for Coal. Various measures have been introduced in recent years, aimed at increasing the use of coal artificially. The ECSC policy therefore further reduces the pressure on the industry to adjust to real market conditions.

30. Select Committee on the European Communities, European Community Coal Policy, p. xvi.

Fortunately, the policy is still modest in scope and coal policy is largely a matter for member states. A sounder European policy would demand resistance to any expansion of the ECSC beyond the promotion of free and fair trade, and moves to stop or reduce ECSC project funding should be welcomed.

Public choice issues today

Predicting supply and demand is difficult. Global prospects appear bright, but to conclude that any world expansion will mean a similar expansion for every country's coal industry would be wrong. 'In particular, it is erroneous to assume that, because there is likely to be an expansion of coal production in such countries as the United States, Australia, and South Africa where comparatively low-cost strip-mining techniques can be used, there will also necessarily be increased output from the relatively labour-intensive deep mines of Western Europe.'³¹ This may or may not apply to the British industry since it will depend on how it behaves in the light of foreign competition. At the moment, 'import restrictions keep British coal prices up around £40 to £44 a tonne, whereas foreign coal can be landed in Europe for under £35.'³²

Other problems abound

In the last few years, the mining industry has been a prime example of how a well-organized monopoly can use its political strength to gain economic advantages. On a number of occasions, strong worker reaction has usurped the intentions of government - the most recent being in February 1981 when the NCB withdrew its programme of closures, despite being faced with a crisis of overproduction. Several other disputes are a further indication of what is a commonplace public choice problem. When the state owns an industry, the politicians who control it are prey to the lobbying groups dependent on its expansion; and so the easy option is to succumb and to support the industry with higher taxation. A private concern is not so fortunate.

It would have made obvious sense to close uneconomic pits as the need arose, thus allowing resources to be committed to more useful developments, and enabling mineworkers to move from old pits to new ones (or even into new industries) gradually, naturally, and without enormous dislocation. The reality, however, has been that effective opposition has kept open uneconomic mines at a cost to the taxpayer now reckoned in terms of billions of pounds per annum and at the cost to the industry of a great deal of new development. Like other heavy industries in the United Kingdom, the coal industry has been preserved for

31. What Future for British Coal, (op. cit.) p. 37.

32. The Economist, April 21, 1984, p. 20.

many years in the amber of political control, and its structure is now far behind the needs of today's energy market. Having held back for so long, the choices presently facing the industry are that much more widespread, more severe, and more bitter.

Traditional communities. If the development of new mines and the closure of old ones had proceeded gradually (as sound commercial sense suggested) instead of being resisted (as the political control of the industry made inevitable), the plight of traditional mining communities would today be much less. New industries would have developed to soak up the labour that was being gradually shed, and families would have gravitated one by one to new pit jobs nearby or to completely new jobs farther afield. In many cases, the transition would have been almost imperceptible: but now it will be much more sudden and severe.

It is hard to justify the imposition of higher taxes on everyone, particularly on young people who have moved to grasp new opportunities in the industries of the future, so that particular groups can continue to live where they have always done or so that uneconomic workplaces can be preserved indefinitely. On the other hand, the prospect of the rapid and forlorn decline of traditional communities is not an attractive one.

However, there are ways out of this dilemma. One solution is to recognise that new industries can in fact arise quite rapidly in the place of old ones, and to encourage that development. Subsidies will not work: a permanent subsidy to new employers is as unjustifiable as the support of the old ones, while temporary subsidies tend to encourage only the easily-relocatable industries that move out again as soon as the subsidy is removed. The correct approach must be to promote the generation of completely new businesses by making employment and trading conditions easier inside the designated area, including: the removal of wage restrictions and most planning regulations; the reduction, simplification, or removal of taxes such as national insurance payments, local authority rates, and corporation tax; more flexible employment regulations; and so on. In such a less-restricted environment, it is probable that many of the new jobs will come from people within the communities themselves setting up their own new businesses, particularly if the measures are aimed at small firms. They would also encourage new industries from outside for whom the deregulation was a spur to growth.

A second solution is to accept that the decline of old communities is inevitable, and to make it less painful wherever possible. Mobility payments to families who move to new jobs outside the area would help to achieve this. Since council housing is a barrier to mobility, the outright gift of council houses to tenants in the area, the encouragement of sales policies elsewhere, and the provision of a housing grant or voucher in addition to redundancy payments could all assist people to move if they desired.

A third approach would be to improve the world competitiveness

of British coal, and thus to slow the decline of its employment generally, by lowering the costs of coal extraction. For example, a mine that is judged to be uneconomic under present practices might still be a viable proposition for a number of years if managed by a new private company or a co-operative of existing workers: by extending the life of the pit, the new methods and new management would provide some breathing-space for the community to adjust. Also, there are large coal resources that could be mined economically by low-cost operators that present policy keeps below ground: these resources could be a boon to threatened communities nearby or to miners who wish to stay in the industry by moving to new developments. This brings us into the wider question of NCB policy on independent mining companies.

Private mining and the NCB

Some coal is already mined privately in Britain. However, the independent operators are beset by legislative and other restrictions and by the unhelpful policies of the NCB. Under Section 1 of the 1946 Coal Industry Nationalization Act, the National Coal Board is charged with the duties:

- (a) to work and get coal to the exclusion of all others except licensed operators;
- (b) to secure the efficient development of the coal mining industry;
- (c) to make supplies of coal available so as to further the public interest in all respects, particularly price, sizing, quality, and quantity, and in so doing
- (d) to direct its policies towards ensuring that its revenues are sufficient to meet its costs on average of good and bad years.

Under Section 36(2) of the 1946 Act, the NCB may grant licences to others to work coal, and as amended subsequently, the law now enables the Board to license opencast operations where the amount of coal that can be extracted by such operations in the area specified in the licence is not, in the opinion of the Board, likely to exceed 25,000 tonnes.

NCB shortcomings. The overriding aim of the 1946 Act is to make supplies of coal available in the public interest in all respects, and to do so without requiring continuing support from government. It therefore charges the Board to make supplies of coal available and authorizes it to use discretion in determining the amount of coal to be produced by its own operations and by those of licensed operators. However, the Board has always given first priority to the duty of working and getting coal itself to the neglect of its other obligations.

For example, the Board cannot claim to have secured efficient development of coal-mining, nor to have been successful in covering its costs: on both counts, it has failed disastrously. Furthermore, the Board's prices to its domestic customers are

usually higher than world coal prices (even after substantial government grants have been taken into account); some qualities of coal are often unavailable; and the overall quantity of coal supplied has long been completely out of balance with demand. The conclusion must be that its other 'public interest' obligations have not been met either.

All of this does suggest that the NCB does not have the right balance between its own operations and those of licensed operators. These private operators produce only about five per cent of the total British opencast output of around fourteen million tonnes, but they generally do so more efficiently than the NCB, as is shown by the fact that the NCB receives more profit per tonne through the payments of royalties by licensees than it can earn from its own opencast operations (see Table 6).

Table 6
Comparison of royalties paid by licensees and NCB opencast profit

| | 76-77 | 78-79 | 80-81 | 82-83 |
|-----------------------------|-------|-------|-------|-------|
| Royalty paid by licensees £ | 8.50 | 10.59 | 14.75 | 16.00 |
| NCB opencast profit £ | 5.73 | 7.07 | 10.24 | 13.08 |

Source: National Association of Licensed Opencast Operators

Although the NCB is charged with a duty 'to secure the efficient development of the coal-mining industry' - it has never done anything to encourage the development of the private sector. Contrary to the public interest, the NCB chooses to produce low-quality high-cost coal from its own deep mines rather than to encourage the production of high-quality low-cost coal from licensed opencast operations. The 1974 Plan for Coal ignored licensed mining and concentrated on the creation of 42 million tonnes of new capacity, costing £7,150 million (£170 per tonne) and requiring borrowing levels which the NCB has had difficulty in sustaining. By contrast, the NCB could have created several million tonnes increase in capacity in licensed mining without incurring any capital expenditure, this capacity being more profitable to them than that created in their actual plans.

Encouraging new private mining

Opencast sites. When in 1977 the NCB was increasing its own opencast productions, it withdrew a considerable proportion of the established licensing opportunity. The situation was partially restored in 1981 when the NCB, after consultation with the

Department of Energy, undertook to respect new guidelines which included the licensing of opencast sites with up to 35,000 tonnes of workable reserves, and the phasing out of the practice of requiring many opencast licensees to deliver their coal to the Board. However, whilst in the past the Board was prepared to issue a series of licences for areas, each for 25,000 tonnes, which would enable a site with a potential of perhaps 100,000 tonnes to be worked under licence, the Board is now restricting new licences to isolated deposits where the total workable reserves do not exceed 50,000 tonnes.

As an interim measure, the very first reform should be to increase the statutory limit on the operations of licensed operators from 25,000 tonnes to 100,000 tonnes, as recommended by the Monopolies and Mergers Commission in its 1983 report on the NCB. However, it is difficult to see any justification at all for an upper limit, suggesting that it should be removed altogether.

Deep mining. Under Section 36(2)(a) of the 1946 Coal Industry Nationalization Act the NCB licenses small-scale deep coal mining. Before 1946 there were hundreds of operators of small mines, and those who wished to continue were given the opportunity to apply for a license from the NCB to do so. Some 550 did, and were given temporary licenses which have since been renewed at regular intervals, usually every ten years. Many of these small mines are family concerns, producing a very modest amount of coal, but others are more ambitious concerns, keen to expand.

Like the private opencast mines, these private deep mines are beset with restrictions imposed by the NCB. The most onerous of these is the prohibition on the employment of more than thirty men underground. (This arbitrary limit was set at thirty mainly because small mines were defined as those employing less than that number in the 1911 Coal Mines Act.) There are generally no restrictions on output, although the Board does have the power to impose quotas, and did so in the 1960s. However, there is obviously a limit on the amount of coal that can be produced by only thirty men. Furthermore, other restrictions apply to these mines, such as the obligation to provide the same wages and employment conditions as the NCB. All of these restrictions have no basis in common sense, and so we suggest that they should be swept away as a matter of priority.

MORE FUNDAMENTAL REFORMS

On a more fundamental level, the unfavourable treatment that has been suffered by private companies which are perfectly able and willing to expand their employment and coal production figures suggests that the dual role of the NCB as a producer and a licensing authority was a mistake. The activities of private operators are evidently being constrained far below their potential level because the authority that licenses them sees itself as a competitor. It is, in addition, a competitor that

has been unwilling to make way for new operators because of the political pressures against it closing uneconomic pits and shedding labour.

A new industry regulator

This crowding out of the private sector by the very body which is supposed to license it has blocked the only escape route for an uncompetitive industry, and it suggests strongly that the operating and regulatory functions of the National Coal Board should be divided. An attractive option would be for the NCB to retain its powers to extract and market coal but for the duties of overseeing and regulating the industry to be split off into a new National Coal Trust. The Trust would be vested with the freehold on coal in the United Kingdom, issuing leases to the private and public operators and extracting royalties to cover its costs and the 'economic rent' inherent in the coalfields.

For its part, the production functions of the NCB could probably be broken down conveniently into the twelve area management units by which the Board presently controls its deep mining operations throughout the United Kingdom, or any other number as might be deemed appropriate. These units would then become autonomous corporations, owned by the public but otherwise charged to produce coal and profits and therefore on a par with the other, private operators in the business.

Gradual transfer. If some of the new units proved profitable, it would be possible to take them out of political control entirely by sales of equity, with shares going to the existing workforce and to new investors who would be able to elect new management boards in the normal way. With employee shareholdings giving the workforce a stake in the success of the business, and the new corporations having access to private capital markets for future investment and expansion, the future could be bright.

If some of the units were marginal, it might still be that private investors would see their potential as good under new management and with the new investment that can be raised on the private capital markets, so similar flotations on the stock market might well be appropriate. Alternatively, it might be necessary for the government to support them until they were marketable propositions (on the model of Jaguar Cars) or to guarantee a temporary, tapering grant to the new commercial body.

Having returned profitable and marginal sectors to independent control, public attention can be concentrated on the uneconomic regions. To some extent, the expansion in private mining operations that can be expected as a result of less restrictive licensing policies and the development of present NCB pits under independent ownership will alleviate part of the problem by creating new opportunities for miners where they do not presently exist. Meanwhile, the gains to the Treasury resulting from successful sales could be devoted, possibly through a fund set up

under the new National Coal Trust, to help miners in the uneconomic areas by paying them increased redundancy bonuses or relocation grants. Together with the 'economic rent' extracted from private operators, which could be devoted to the same end once the running costs of the Trust had been met, this fund could be considerable indeed.

Transfer of new capacity. Another strategy for dealing with the uneconomic areas would be to break them down even further. For example, new pits under construction or planned by the NCB might be sold as individual units or as small batches to single or multiple buyers. Indeed, the initial reform measures might require this, confining all such future developments of new capacity to the private sector.

Even large projects, such as Selby or Belvoir, could be left to the private market in this way. Groups of private operators could form consortia to exploit the fields; or the state could continue to manage them, in competition with other operators, until buyers could be found.

The new National Coal Trust would take over the Secretary of State's powers to decide applications for opencast operations, and would be able to grant leases for surface mining as well as deep mining. Land rights and planning permission would, of course, be prerequisites. Royalties to the Trust would probably be higher for opencast than for deep mines, reflecting the environmental costs, but all would be negotiated. There is a case for the almost automatic award of leases to private operators and for moving, in time, to an auction or tendering system. Auctioning may not be desirable at first, however, if the new private corporations formed from the NCB areas are sufficiently large to dominate the local market. It would also be necessary to have an appeal procedure to the Secretary of State or through the courts in all cases where mining leases were refused by the new Trust.

Royalties raised by the Trust would be available to help soften the adjustment problems of declining pit areas, or for loan-backs to aid the development of new mining capacity. The removal of the NCB's monopoly power over coal production and regulation, the new access to private capital markets for investment, and the unleashing of the potential of the private mining concerns will be important spurs to competition and technological development within the industry. As such, the new arrangement would be the first step towards rapidly expanding, efficient, and profitable coal-mining in the UK.

Research and development

A measure of independent involvement in the coal industry would also spur research and development, as well as capital replacement and improvement. Research into in situ gasification and liquefaction is an obvious need, as is research into new capital systems that reduce the necessity for men to go underground and

risk their lives in old workings (an argument that is particularly valid in cases where gas or water influx is a problem). This research and capital improvement will bring on stream a number of workings that are presently regarded as marginal or even impossible to mine.

'Fuel from coal' research would be conducted more efficiently by competing research teams in different companies, and by competing research in the universities which are financed from several different sources rather than through the NCB. Research and development can also be boosted by the transfer of the further processing of coal (such as smokeless fuel manufacture, liquefaction, gasification, tar by-products, and so on) firmly into independent hands, but with no restriction on feedstock sources.

A new research development from the USA highlights the continued importance of Research and Development:

'A coal cocktail mixed by energy researchers could revive the mining industry and provide oil-fired power plants with cheap fuel. Tiny particles of crushed coal are stirred into water with a zest of chemical additives to produce a liquid that burns like oil but costs less than a third of the price. The fuel cocktail is seventy per cent coal and has the consistency of thick paint. Power companies estimate that by the mid-1990s it could mean sixty million tons of extra sales annually for the American mining industry alone.'³³

It is therefore vital that the entrepreneurial skills of the private sector should be allowed to operate to ensure the most effective exploitation of these new ideas.

Export-import trade

Barriers against the import of coal have the perverse effect that some of the coal which Britain burns is of a higher grade than it needs to be. This coal is trapped in the United Kingdom, instead of being exported to high-grade coal users abroad and thus earning an income for the industry and the country.

Although the political obstacles for the removal of this mercantilist approach are considerable, its easement, perhaps over a period of years, would confer considerable economic advantages on the UK, albeit at the cost of speeding up the restructuring and development of the UK coal industry. British-mined high-quality coal would still command a premium on world markets, and export earnings would offset some of the low-price imports that would be allowed. Economically, it makes sense to export or process high-quality coal and to burn poorer-grade imported coals. To prevent dumping, where production costs in the country of origin are

33. Mail on Sunday, 20 May, 1984.

subsidized, an import tax exactly equal to that subsidy could be levied. Our own low-grade coals can be held in strategic reserve, as can marginally viable pits. Concurrently, as more coal-fired boilers are installed in industry, innovative designs will be marketed and the packaged coal-fired boiler will fall in price, stimulating the demand.

Quantity, price, and revenue. The opening of import markets to potentially cheaper sources of coal supply does not, of course, spell disaster for the industry. At present, UK-mined coal is generally expensive, but more open trade links could induce the industry to produce and sell more. New techniques, under the stimulus of competition, will help to improve the production of marginal sources and will speed the extraction of coal from good sources. The production of greater quantities of coal, even at lower prices, could generate a larger total revenue for the industry.

Greater efficiency will speed this increase in production by stimulating the demand for coal, but uncompetitive prices will surely kill it. Indeed, the British taxpayer's subsidies to the NCB today stimulate it to overproduce coal that is so expensive that it requires further subsidies to industrialists to induce them to use it up. This vicious circle adds to the tax burden, discourages the development of more efficient coal-fired boilers, increases environmental pollution at home, and further reduces the pressure on coal-mining to be competitive. Such perverse subsidy arrangements cannot be justified.

At present, the price of coal, in relation to the (artificially cheap) prices of gas and other forms of power is not sufficiently low to make it attractive, given its inconvenience to users. A lower price, made possible by the development of a more efficient coal industry, would improve the market at home and abroad. But a low price does not mean badly-paid miners; it would actually generate the expansion of the industry which the workforce itself argues is justified. If coal-mining remains within the walls of a siege economy, that development would not occur, and the attempt to make it occur by yet higher tax transfers would simply impoverish the rest of the public and restrain the development of the new industries on which their future will depend.

The Area Electricity Boards. These twelve Area boards are supplied by the CEGB and are responsible for the distribution and the retail sale of electricity to end customers.

The Area Electricity Consultative Councils. Their purpose,

34. *Hansard* v.432, c.1409 and c.1471, 3 February, 1947, quoted in *Consumers of Power* (London: Social Audit Ltd., 1981).

35. CEGB Report 1982/3, p. 3.

5. THE ELECTRICITY INDUSTRY

HISTORY AND PRESENT STRUCTURE

The public supply of electricity started in 1881, at Godalming, Surrey. By the end of the second world war it had grown to '70-odd private or municipal electricity supply undertakings in London alone, and over 560 in the whole of the UK.³⁴ In 1948, electricity supply was nationalized following the passage of the Electricity Act 1947, which also set up the British Electricity Authority with twelve regional boards in England and Wales.

Since then, there has been little change in the industry's organization, and even though a number of major proposals have been put forward, none have been implemented. The main changes were that the Central Electricity Authority ('British' became 'Central' in 1954) was replaced by the Central Electricity Generating Board and the Electricity Council following the passage of the 1957 Electricity Act.

Structure and organization of the industry

The state-owned electricity supply industry in England and Wales has four elements.

The Electricity Council. The council is the non-trading, co-ordinating body of the industry. It is responsible for the formulation of general policy, and includes representatives from the generation and distributive parts of the industry. Its main duties involve advising the Secretary of State for Energy; undertaking research; capital development and finance; and industrial relations.

The Central Electricity Generating Board (CEGB). The CEGB 'is a statutory corporation responsible for developing and maintaining an efficient, co-ordinated and economical system of electricity supply in bulk and for providing supplies to the area boards and a small number of direct customers'.³⁵ It also owns and operates the power stations and the grid system of main transmission lines, and therefore generates and transmits all the electricity in England and Wales.

The Area Electricity Boards. These twelve area boards are supplied by the CEGB and are responsible for the distribution and the retail sale of electricity to end customers.

The Area Electricity Consultative Councils. 'Their purpose,

34. Hansard v.432, c.1409 and c.1671, 3 February, 1947, quoted in Consumers of Power (London: Social Audit Ltd., 1981)

35. CEGB Report 1982/3, p. 3.

broadly speaking, is to safeguard and represent the interests of electricity consumers'.³⁶ They were set up when the industry was nationalized but did not come into use until 1949.

In Scotland, the electricity industry is organized differently. Two boards, the North of Scotland Hydro-Electric Board (NSHEB) and the South of Scotland Electricity Board (SSEB) generate, distribute and sell electricity. The NSHEB, while it was set up in 1943, only took on the municipal and private undertakings at the same time as its English counterparts, in 1947. In Northern Ireland, 'generation, transmission, and distribution are carried out by the publicly-owned Northern Ireland Electricity Service.'³⁷

Future projections

'In 1982-83 the Board (CEGB) made a net profit of £232 million after the payment of interest (compared with a loss of £167 million in 1981-82)'.³⁸ This, coupled with recent changes permitting the private generation of electricity in the 1983 Energy Act, means that the electricity industry could prove to be quite lucrative and as such appears to have a healthy future.

The current trend is for most (over eighty per cent) electricity generation to be from fossil fuels - virtually all from coal. It has been suggested that at the start of the next century as coal becomes the feedstock for synthetic oil and gas and for the petrochemical industry, its use in power stations will decrease. However, coal will probably still supply well over half of the power station market unless doubts about the security of supply continue, in which case other sources will undoubtedly grow.

The future of the industry, however, raises many problems because of its control under political, rather than economic, objectives and mechanisms. The debate over energy prices and standing charges is an old one. Because the industry is government-run (even though there is no direct control over energy prices), the funding and setting of financial targets represents a form of indirect price and production control. The government is therefore a lobbying target for those with vested interests in low prices, overproduction, and a taxpayer funded subsidy. This may not be the best arrangement for healthy future growth.

36. Charles Medawar, Consumers of Power - Measuring and Improving the Performance of the London Electricity Board (Social Audit Ltd).

37. Britain 1983 (London: HMSO), p. 257.

38. CEGB Report 1982/3, p. 5.

THEORETICAL CONSIDERATIONS

Electricity is a refined energy-form, exhibiting a high degree of order (or low entropy), and as such it is a valuable commodity but not any different from refined products such as copper, flour or petrol. A certain amount of mysticism is attached to it, since it is a very convenient and versatile form of energy, and so it is easily made into a 'special case' (the result being that electricity generation was considered 'too vital to the country' to be left in private hands).

Unlike other sources of energy, electricity's high degree of order imposes some severe technical constraints upon its generation and distribution. All electricity which enters or leaves a general supply network must have certain properties:

- (a) correct voltage;
- (b) current within limits of switching and conduction apparatus;
- (c) synchronism - electricity is generated as an alternating current and the wave form of input/output must exactly coincide with that of the transmitting system;
- (d) standard frequency; and
- (e) no transients from defective apparatus which can cause radio interference and, in bad cases, breakdown of insulation.

It may be readily appreciated that the generation of electricity easily lends itself to the arguments of standardization, (which is technically speaking essential), and centralization, (which is neither technically necessary nor economically desirable). Historically, alternating current generation was originally carried out at many different voltages and frequencies, but standardization of the voltage and frequency for consumer use (at 50 Hz and 240 V in the UK) was essential to allow the economies of mass production for all the electrical items now in use. Of course, 50 Hz (60 Hz in the USA) is purely arbitrary, and any mechanically-feasible frequency would have done.

Alternating current has become the main form in use because of two distinct advantages:

- (a) voltages are easily stepped up to allow low-loss transmission over long distances (loss occurring because of the resistance in the line); and
- (b) AC motors are rugged and simple to produce. They also turn at a constant speed determined by the frequency.

However, AC transmission at high voltages does require costly equipment made to very high standards, and this equipment can be irreversibly damaged by any mismatch - the most common form being an asynchronism during the coupling of additional supply to a transmission system and the overloading of a section of the system due to a failure in another part of the system. Protection equipment is available but the cost is prohibitive for a very small system.

Certain economies of scale exist for electrical generation, and this provides an economic limitation on the smallest size of generator unless there is a substantial efficiency gain such as employing the waste heat from generation for process or other purposes.

For a large-scale unit, power generated would typically be 500MW (equivalent to half a million electric fires) at a voltage of 400 to 800 KV (about 3000 times the domestic mains voltage) and at a frequency of 50Hz. At the other end of the scale, a diesel engine coupled to a heating system may produce only 25 KW at 240 V and 50Hz.

Methods of generation

All electricity is generated by providing rotative motive force to a shaft - possibly the only significant exception is the future potential for the collection of solar energy by galvanic cells. Rotative power is commonly provided by expanding a working fluid (usually steam) through a heat engine (steam turbine) which drives a generator (alternator). Power can be provided by diesel or gas turbine engines, something that is normally only economical for standby equipment. It can also be generated by hydro-electric sources and from the wind or the tides, but none of these are significant at present. Over 90% of electric power in the UK is generated by steam turbines. In 1982, the public supply electricity industry generated a total of 255,439 GWh. 'Conventional steam power stations provided 82.2% of the total, nuclear stations 15.7%, and gas turbine, hydro-electric and diesel plant 2.1%.'

There are thermodynamic limits to thermal efficiency and, to the layman, the efficiency of a power station will appear to be appallingly low. The fact is that, given the age and design of the equipment and the thermodynamic limitations of the steam cycle, the CEGB is very efficient. Time and time again this is used as an argument to support the status quo, but it confuses thermal or technical efficiency with economic efficiency.

Many older power stations with small generating sets, such as those very often found in decaying city centres, may achieve only 20% thermal efficiency. The more modern integrated sets of 500-600 MW capacity coupled to boilers with expensive and complex heat recovery systems may achieve 37%. For example, the CEGB best for 1982/3 was Rugeley B at 37.87%.

Economic aspects

Because of the thermodynamic limitation on efficiency, it is essential that the fuel used in the generation process should be

39. Britain 1984, (London: HMSO, 1984), p. 247.

cheap. Coal still is the cheapest to buy, but in addition to the supply problems, it creates problems of pollution and ash-handling, amongst others.

The costs of planning, building and coupling-in a large power station run into millions. A wrong choice of fuel would be a financial disaster. Nevertheless, privately generated electricity makes a valuable contribution to electricity supply. It accounts for about six per cent overall and about fifteen per cent of industry's needs, and it is clear that there is considerable potential for the expansion of private generation of electricity, especially as it is often cheaper than that provided by the monopoly supply industry. The Energy Act of 1983 removed the statutory prohibition on private generation of electricity as a main business, and made it possible for a private company to use the CEGB's grid system for transmitting electricity to customers and the electricity boards themselves on established standby and buyback terms. Effectively, it introduced an obligation for the area boards to allow the private use of their transmission systems and to buy surplus electricity from private consumers. Prior to that Act, the generation of electricity had been the exclusive domain of the CEGB and the Hydro-board and SSEB in Scotland. This exclusivity made private generation of electricity for sale into the national grid totally uneconomic, because the CEGB only paid the 'fuel only' part of the cost of a unit of electricity supplied by any private concern. No provision was made to allow for the capital cost of installing and maintaining the generation and switching apparatus.⁴⁰

Private generation was thereby ruled out, and a valuable potential increase in efficiency was thus lost, since the thermal efficiency of electrical generation as a **by-product** of raising process steam is the same as that of the boiler which raises that steam. This is of the order of 70% and in a large process steam installation could reach 78%. In the case of a diesel motor being employed, overall thermal efficiency may be as high as 85%. This is therefore a sector of the potential electricity generation capacity which should clearly continue to be actively encouraged and accommodated.

The distribution of electricity

Since the second world war, the national grid has expanded so that:

(a) Remote generation of electricity is possible. This has some advantages but also encourages centralization.

(b) Different regions can be fed from one another. This works very well in theory but less well in practice. In fact, two of the incidents of total failure of electricity supply in England

40. Unfortunately, the Act allows the area board to set the tariff and (in Scotland) such tariffs have been set at a level which discourages private generation.

were identical - a failure in one small part of the grid causing a total failure of the entire system. In each case the problem started with a bird alighting on a high voltage cable on a hot day, causing the cable to sag too near to an adjacent tree.

(c) Load-sharing between regions is possible. However, the argument is overstated - peak demand tends to occur simultaneously in all areas. It is not clear that the costs incurred by a single, large installation to deal, on a standby basis with peak loads nationally is more efficient than relying on local peak-use generation as and when needed.

(d) The **maintenance and expansion** of the grid so that freedom of interchange of capacity between all regions is maintained is a **very costly operation** and contributes significantly to the price to the consumer. Eight per cent of capital spending 1981/2 was on expansion of the grid, and an estimated one-third of total maintenance costs is on the grid.

(e) Sectors of the distributive system can be by-passed for maintenance. However, this is also achievable by selectively shutting down small sections within smaller regions and is hardly sufficient reason on its own to justify the vast expense of the national grid.

It has never been proved satisfactorily that a national grid is either necessary or, indeed, advantageous. The strategic justification for the grid is equally dubious - instead of having many separate and easily-separable generating units, the grid allows the rapid and complete crippling of the entire system by damaging one or two vital links.

Combined heat and power (CHP)

CHP is the exploitation of waste heat from power stations and industrial generating units. It obviously has serious potential in the field of energy conservation, since savings and a more efficient usage of fuel will mean that supplies will last longer.

Much of the electricity generated in the UK today (about 20%) is used for low-grade heating of industrial and domestic premises, and is therefore rather wasteful. The stations providing this power obviously tend to be located in crowded areas. Typically, these areas have the oldest, least-efficient power stations serving them, e.g. Battersea and Acton Lane (recently closed), and Watford (which is a peak station only). The heat rejected in the cooling towers from these plants requires upgrading in order to be suitable for heating purposes. A small amount of electrical generating capacity is foregone but a large amount of heat is then made available in the form of hot water which can then be pumped around the district. Piping by conventional methods would be expensive but running pipes via sewers, for instance, could be a much cheaper way to distribute this heat.

New housing and industrial estates could be encouraged to use such a scheme by selling off the power station as a going concern

to them, or other heating suppliers. The smaller, more remote districts or schemes can also be adequately supplied by one of the many small integrated electrical heat and power sets now on the market.⁴¹

CHP vastly increases the thermal efficiency of electrical generation and can halve the cost per unit to the consumer. (For example an engine unit running off gas at 55p per therm or £5.21 per GJ or 1.45p per KWh at say 75% efficiency gives a cost of 1.91p per KWh, plus capital depreciation, compared to domestic rate of 5.0p per KWh.) The consumer would not have to buy gas or coal but would have hot water pumped to the premises for use as bath or central heating water. On a larger scale, Spondon power station has a 30 MW set, but achieves an overall efficiency of 64.5%.

Much is made of the costs and disadvantages of CHP schemes but little of the potential. The CEBG commissioned a report on CHP by W. S. Atkins which found that only a 5% ROI was possible - however the accounting method used and the constraints applied are not shown in detail. A further investigation was also recommended, consuming two years' work in the evaluation of finance, surveys, and construction parameters at a cost of £1.15 million. Now that this survey is complete, the announcement of the choice of 'lead cities' is currently awaited.

Industrially based units

On a smaller scale than the revitalized inner-city power station is the use of industrial firms as peak lopping sources. In the first case peak load would be satisfied by a series of industrially based prime movers designed so that the waste heat from these generators would satisfy the heat load of the individual firms operating them. The firm of consulting engineers McLellan and Partners investigated this concept on behalf of the CHP working party and concluded such an idea would be workable using diesel engines as prime movers. In this case, however, only a peak lopping situation was considered rather than a flexible, industrially based heat and power generating set which would operate all the year round. The relaxation of the legislation so that heat and power could be sold independently by such schemes to any conveniently placed purchaser would be the first requirement before this could be effective. There is an obvious strategic advantage in decentralizing electricity generation and there will also be new job opportunities, especially for skilled electrical engineers.

It is unfortunately the case that despite the passing of the 1983 Energy Act, firms with standby generators which attempt to utilize them to alleviate internal peak demands are still

41. Fiat, for example, make a 25 Kw set with a thermal efficiency of 80% running off petrol or town gas.

actively discouraged by the Electricity boards.⁴² There is still confusion between what constitutes a standby supply and a private generator. The redrafting of the technical specifications G26 and G47/1 is presently in progress and should be subjected to independent review prior to approval. The use of standby equipment especially to alleviate peak loading should be encouraged. The fundamental problem is that the Electricity Boards still effectively have monopoly control over all aspects of supply and distribution in terms of this and previous Acts.

Many small firms with standby capacity could very effectively peak load and satisfy their space heating needs at an effective thermal efficiency of 85%. Certainly, this would be less economic in the summer months (but demand is then low anyway and for small users, the set tariff is often so high as to make the cost of public supply electricity prohibitive). For instance, in the SSEB area which enjoys a 70% surplus generating capacity, small to medium size businesses are paying around 6p per KWh. This high charge reduces profitability (and ultimately, employment) in what is already a depressed area.

Encouraging the alternatives

One of the ways in which surplus capacity could be taken up would be to encourage the use of electricity by lowering the price to small businesses. It was the intention that, as a consequence of removing restrictions on the generation and distribution of electrical power and heat, many firms would find it feasible to do one of two things:

- (a) generate electricity for sale where the process heat load is such that a lopping cycle would generate surplus to internal needs; or
- (b) use a diesel set to reduce load on the grid during peak periods and utilize the waste heat for space heating.

In terms of the 1983 Energy Act, these measures are possible but the approval of the electricity board for the area has to be obtained and any surplus electricity generated has to be sold either to the Board or via the grid. The result is that the boards have been able to set their own tariffs for the purchase and transmission of electrical power. The tariffs set in the SSEB area, for instance, are not surprisingly unattractive to the prospective producer of electricity. A marginal reduction in unit cost is made for the co-generator which would certainly not justify investment in the plant for (say) peak lopping purposes alone. The price paid by the SSEB per unit of electricity exported into the grid is only 1.5p overnight and 2.27p during the day. The former rate is less than the cost of natural gas on a gross calorific value basis and not much in excess of the real

42. At the request of the Adam Smith Institute an independent consultant carried out several case studies on firms of different sizes to evaluate the possibilities of industrial CHP units.

cost per unit of using a large diesel set with cheap bunker oil as a fuel. This effectively discourages not only the capital investment required for the larger plant, but also the export of power from smaller units where the fuel cost is higher. Proposals by private companies to buy old power stations and to sell electricity to the grid have failed because of the lack of an effective price reward.

A better rate is offered for electricity generated during the day in the peak winter months - 3.3p for the first week's generation capacity and 4.6p thereafter assuming the generator is run all the time. This might be attractive were it not for standing charges which include both a fixed charge and a per KVA of authorized export capacity charge. In addition to this there is a charge of 0.38p for any reactive current supplied by the board. (If the generating system is properly designed, the latter charge should be insignificant.) Plainly, a more effective pricing policy is required if independent power generation - with its attendant benefits of efficiency and flexibility - is to fulfil its potential.

Any new pricing policy would have to (a) attempt to reduce the distortions due to the political control of energy sources, (b) establish what would be a realistic depreciation period for a CHP scheme, (c) establish the local effect of a CHP scheme on the diurnal and seasonal load factor, and (d) establish the break-even cost per KWh of a small scale CHP scheme. This will provide a guide to the economic selling cost.

Summary of proposals on electricity

In summary, we suggest that the least thermally efficient CEBB stations can be sold to private enterprise and linked with tax incentives for their conversion into combined heat and power (CHP) units. Manufacturers, especially those who have processes requiring a heat-to-power ratio of more than two to one, can be encouraged to generate electricity and sell it into either a local private retriulation scheme or the main grid. The economic gain to the manufacturer should be made as attractive as reasonably possible. At present, decisions regarding pricing and standards are made by the boards. There is a strong case for transferring these functions to an independent regulatory authority. There should not be any restrictions on the type of fuel used, so long as basic safety and pollution criteria are satisfied.

Existing power stations could also be sold off as units of approximately 500MW. The most convenient mechanism is probably to give each existing consumer non-transferable shares and voting rights proportional to usage, with the total number of shares to be two-thirds of the entire capital issue. The remaining third of quoted shares can be held by an operating consortium which can be voted out at AGM if it fails to meet the consumers' needs.

The cost of maintaining the grid should be apportioned according to KWh fed in by each generating concern, regardless of its capacity, i.e. according to usage. Grid maintenance, meter reading, and installation of new equipment should be contracted out to private enterprise. The national grid could be divided into metered zones according to capacity - but with no standard price for electricity from zone to zone, although uniform prices will prevail within zones. Furthermore, no price restrictions should be imposed on electricity transmitted outside the grid.

There is a strong case for tax incentives for factories and/or housing conglomerates who make themselves independent of the grid. Similar incentives, and an improved pricing policy, can be devised to reduce the peak-hour demands which are so costly, from a capital point of view, for the grid to supply.

Measures to permit transmission of electricity over any distance by means independent of the national grid (but subject to safety standards), are needed if new transmission systems are to develop. An independent study should be commissioned to investigate whether the national grid is justifiable and whether resources might not be better allocated in decentralization of generating capacity.

At present, around forty per cent of France's electricity is generated in nuclear power plants, and it is hoped that this will reach between sixty and sixty-five per cent by the end of this decade.

Even with the costs of reprocessing and vitrification of residues from nuclear fuels and the final decommissioning of the stations, nuclear energy does compare favourably with oil and coal. Research nearing completion in the United States suggests that enriched uranium will soon be made at a tenth of the present cost. The process uses a powerful laser to convert raw uranium to nuclear fuel, and the first production plant is expected to be operating by 1988. However, since there is some doubt as to the role for nuclear power in the future, it would make sense for the market to decide, rather than the government, this could be improved with greater private involvement in the industry.

Costs will probably continue to fall relatively as technical expertise continues to rise. Australia the supplier of around 10% of the non-communist world's uranium, about 41,000 tonnes,⁴³ is a secure source of supply for nuclear fuel, and if anything the price of fuel should fall, since the total world uranium stockpile, at the end of 1983, was 182,000 tonnes - the equivalent of well over four years' supply. If this is coupled with the slow adoption of nuclear power in other countries, then the input costs for the British industry would prove to be quite favourable.

43. The Economist, 12 November, 1983, p. 73.

6. NUCLEAR ENERGY

ORGANIZATION OF THE INDUSTRY

In 1956, Calder Hall (Cumbria) became the world's first full scale commercial-sized nuclear power station, and began to supply the national grid with electricity. Since then, the industry has grown to fourteen nuclear power stations controlled by the various electricity authorities, while four other stations also feed electricity to the national grid: the two original Magnox stations (both with a net capacity of about 200 MW) operated by British Nuclear Fuels at Calder Hall and Chapelcross (Dumfries and Galloway), and two experimental or prototype stations at Winfrith (Dorset) and Dounreay in Highland (the site of the prototype fast reactor).

The present and the future

In output terms, nuclear power accounts for around seventeen per cent of total electricity production. Compared to France, where the industry has actually been encouraged by the government, this is small. At the moment around forty per cent of France's electricity is generated in nuclear power plants, and it is hoped that this will reach between sixty and sixty-five per cent by the end of this decade.

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Costs will probably continue to fall relatively as technical expertise continues to rise. Australia the supplier of around 10% of the non-communist world's uranium output of 42,000 tonnes,⁴³ is a secure source of supply for nuclear fuel, and if anything the price of fuel should fall, since the total world uranium stockpile, at the end of 1983, was 182,000 tonnes - the equivalent of well over four years' supply. If this is coupled with the slow adoption of nuclear power in other countries, then the input costs for the British industry could prove to be quite favourable.

43. The Economist, 12 November, 1983, p. 73.

Organization of the industry

Aside from the notable involvement of the CEGB (Central Electricity Generating Board) in the construction of power stations (both nuclear and non-nuclear) and the generation and transmission of electricity, there are a group of organizations who run the industry.

The Atomic Energy Authority. The UKAEA was established in July 1954, under the Atomic Energy Authority Act of 1954 (and subsequently amended by the Atomic Energy Authority Acts of 1959 and 1971), and its functions grew with the passage of the 1965 Science and Technology Act. It provides a wide range of research and development support for the British nuclear industry and regulatory bodies. This work is financed primarily from voted money but there is also a substantial element of work performed under contract to the industry. Besides work in support of thermal reactors of current interest to the United Kingdom and in support of comprehensive fuel cycle activities, the Authority has continued its development of the fast reactor system. Considerable programmes of research and development work relating to safety and environmental aspects of nuclear power also continue to be carried forward. The Authority participates in the European Fusion Research and Development Programme. These programmes are sustained by work on underlying research. Using the skills so derived the Authority mounts a variety of programmes of non-nuclear research and development on a contract basis to assist many areas of British industry.⁴⁴

British Nuclear Fuels plc. This 'provides nuclear fuel services covering the whole fuel cycle, that is: uranium conversion, uranium enrichment, fuel element fabrication, transport and re-processing of spent fuel, and the manufacture of specialized fuel element components'.⁴⁵ BNFL is broadly organized into three divisions, covering uranium enrichment, based at Capenhurst (Cheshire); fuel manufacture at Springfields (Lancaster); and reprocessing at Sellafield (formerly Windscale, Cumbria) where valuable unused uranium and plutonium are recovered from the spent fuel. In 1984, BNFL became a public limited company under the 1980 Companies Act and it 'is expected to allow the company, at some state in the future, to gain access to further financing options than are available at present'.⁴⁶

National Nuclear Corporation (NNC). This is responsible for overseeing the construction of nuclear power stations. It 'retains a monopoly on design and construction and will be responsible for both the Advance Gas-cooled Reactor (AGR) and Pres-

44. UKAEA Report 1981/2.

45. Britain 1984 (London: HMSO, 1984), p. 250.

46. BNFL Newsletter, April 1984, p. 4.

surised Water Reactor (PWR)'.⁴⁷

Other bodies. There is a variety of minor organizations which provide information, research, and other services in the nuclear field: for example, the National Radiological Protection Board which is intended to 'advance the acquisition of knowledge about the protection of mankind from radiation hazards and provide information and advice to persons (including government departments) with responsibilities in the UK in relation to the protection from radiation hazards'.⁴⁸ Even the Electricity, Council which draws up general research programmes, is involved in this area - even though most nuclear research is carried out by the UKAEA, at the Atomic Energy Research Establishment at Harwell (Oxfordshire), the Culham Laboratory and a variety of other UKAEA establishments.

International bodies. International agreements have been dominated by non-proliferation moves - based on the understandable fear that the spread of nuclear technology and the benefit it brings must be carefully balanced against the proliferation of nuclear weapon capability. An attempt to promote nuclear energy as a cheap fuel source for developing nations, while at the same time imposing safeguards and detecting misuse, resulted in the International Atomic Energy Agency being set up in 1957.

On the development side, Britain is also co-operating in the European Atomic Energy Community (Euratom) whose main programme is attempting to establish the feasibility of achieving controlled thermonuclear fusion. The Joint European Torus (JET) is nearing completion and the break-even point has been reached on the existing test installation. Fusion power may be closer than we think.

Safety of production

Much has been said about the potential danger from the contents of a nuclear power station, but it is a mistake to equate what is definitely a lethal content with a potential danger. According to one comentator 'It is true that there is sufficient radiotoxic material in a reactor to kill many hundreds of thousands, but by the same criterion there is enough water in the Serpentine to kill millions. Obviously, both assertions, while true in themselves, are absurdly misleading, since no dispersal mechanism exists whereby either material could be so lethally distributed'.⁴⁹

47. Duncan Burn, 'Nuclear Power: A Progress Report', Journal of Economic Affairs, Vol. I, No. I, (October 1980).

48. NRPB Accounts, 1982/3.

49. Richard Vaughan, 'After the Meltdown', Free Life (Winter 1981).

The leakage of radioactive gas is a major concern but one point to come out of the Three Mile Island (TMI) incident was the remarkably high natural retention of toxic gases. In the event of a gas leak accident, iodine is the most dangerous product likely to be released, because it concentrates itself in the human thyroid gland, but most other gaseous fission products are noble gases which are chemically inert. But the evidence suggests that it is likely to combine with Caesium, another abundant fission product, to form Caesium Iodide, which is less problematic. In addition to this, iodine reacts chemically and physically in other areas, and since nearly all the surfaces inside any reactor containment are covered with paint, plastic or organic films, iodine retention is bound to be high - even in the British gas-cooled designs. This means that the generally believed consequences of the worst possible accident have been much exaggerated.

Other problems with the behaviour of the reactor itself are probably less worrisome. No nuclear explosion can occur in a reactor as the required conditions can never exist - reactors do not become bombs. Cadmium control rods are used to regulate the fission activity of the pile; if circumstances arise to prevent these rods being inserted into the pile and there is a risk of a super-critical condition occurring, it is simply a matter of design to have ancillary rods, or even small spheres actually located outside the core to make the pile subcritical.

Reactors with liquid moderation, which could suffer from a loss of liquid, can have the safety feature whereby they are flooded with a solution of boron salts to effect a rapid, i.e. emergency, shut-down. A runaway fission reaction in a thermal reactor will be practically self-terminating as the temperature of the pile increases. At high temperatures the density of the moderator will decrease thereby reducing the amount of thermalization of the neutrons occurs.

A serious situation that could arise with a reactor is that the core could melt, but this could only happen if there were a loss of coolant. This is serious in any reactor but is much more serious in a fast breeder where a highly enriched fuel is used. The problem can be overcome by submerging the reactor in a substance that would have enough thermal capacity to prevent melting of the core. A fast breeder has the additional advantage of being self-moderating. Additionally it helps to conserve radioactive fuels for future generations.

Radioactivity in perspective. There is still some uncertainty over the effects of very strong short bursts and prolonged exposure to radiation, but what is not often recognized is that radiation is a natural part of everyday life. In fact, most radiation occurs naturally (see Table 7).

At present there has not been a single mortality directly attributable to the nuclear power industry, which puts it in stark contrast to the number of deaths caused by the more trad-

Table 7
Annual effective dose equivalent, UK

| Source | Percentage |
|-------------------------------|------------|
| Natural background | 67.6 |
| Medical irradiation | 30.7 |
| Fallout | 0.6 |
| Occupational exposure | 0.45 |
| Disposal of radioactive waste | 0.15 |
| Miscellaneous sources | 0.5 |

Source: National Radiological Protection Board.

ditional fuels, (e.g. miners dying through the inhalation of coal dust, oil workers being killed on rigs, disasters following hydro-electric dam collapses, and so on). The Electrical Power Engineers' Association (which represents the engineers, managers, and scientific staff who work in the electricity industry) said that the PWR 'cannot be opposed on grounds of its safety implications for the staff who will be involved in its commissioning and generating'.⁵⁰

However, a common argument against nuclear energy concerns possible externalities - that the general public (not just those who work in the industry) face the serious health risks involved in the event of an accident. Yet it should be remembered that other fuels have worse externalities. For example, the notorious London smog of 1952 resulted in 4,000 fatalities and the fog itself was generated by fossil fuel waste. Even now, people worldwide are harmed by lead in petrol, and the sulphur dioxide in the atmosphere negatively affects thousands - especially bronchitis sufferers.

Radiation is dangerous, but it should be seen in its real context as a natural phenomenon. Compared to other primary fuel sources, nuclear energy represents a major shift towards improving safety and reducing world pollution.

Nuclear waste disposal

If anything symbolizes the current trepidation towards the nuclear industry, it is the 'problem' of nuclear waste. Yet the debate often involves false comparisons between nuclear waste and the wastes and toxic substances that occur in many other industries. The first point to remember is that nuclear waste is small - one estimate suggests that 'nuclear wastes are some 3.5 million

52. BNEL Newsletter, April 1984.

53. Peter Beckman, *The Non-Problem of Nuclear Waste*, op. cit.

50. The Guardian, 5 January, 1982.

times smaller in volume' than fossil-fired power station waste.⁵¹ Second, certain toxic products from conventional industries retain their toxicity for centuries and in the case of the more stable compounds, e.g. beryllium and arsenic, they will remain toxic forever. However, radioactive substances decay exponentially and even though radioactivity may last for a considerable time it should be seen in this perspective. Third, a radioactive substance can be detected with comparative ease compared to chemical and biological toxins which in many cases only reveal their existence after the damage has happened.

Types of waste. Radioactive wastes are classified according to the level of activity they contain: low, intermediate, and high. Each is treated in a different manner not only because of its radioactivity but also because of its size, with low-level wastes being much larger and high-level wastes being smaller. In simple terms, the wastes are either disposed of through a process of dilution and dispersion, or concentration and containment.

High-level wastes result mainly from the reprocessing of spent fuel. Present storage is in high-integrity stainless steel tanks surrounded by reinforced concrete. However, a method of converting highly active wastes into blocks of heat-resistant (borosilicate) glass has been developed. It represents a move towards more effective long-term disposal since the glass used will be resistant to corrosion and tests have shown that the 'radioactivity does not lead to deterioration of the glass, and specimens have been subjected to radiation doses equivalent to several thousand years' storage without any significant change in their physical properties'.⁵²

The final decision as to when to dispose of these wastes rests with government - the burial areas usually involve a choice between deep land burial, emplacement on the seabed, or burial beneath the seabed. The safety of a well-chosen site was eloquently described by Peter Beckman⁵³:

'The canisters can now be buried deep (1500 to 1800 ft)... a typical geologically stable formation is a salt formation, of which the US has many. The very existence of the salt shows that no water has been present for as long as they have been there (some 100 million years), or they would have dissolved. And if water were to get in after all, the salt would seal up and prevent more water getting in. And if the water kept coming? If all the ground water now flowing near the proposed repository site in New Mexico were diverted by

51. Peter Beckmann, The Non-problem of Nuclear Wastes (Colorado: Golum Press, 1979).

52. BNFL Newsletter, April 1984.

53. Peter Beckman, The Non-Problem of Nuclear Waste, op. cit. p.7.

an evil genius to the proposed repository site, it would take 50,000 years to dissolve the salt enclosing a single year's deposit of wastes, the canisters would corrode in 10,000 years or more, the glass would be leached away in another 30,000 years, and the wastes carried by this water would take another 1,000 years to reach the surface in the 931st century AD,

By this time, the radioactivity would have decayed to 1/100,000th of its present value!

A new policy

In the present nuclear power industry, political intervention and control has 'created and nurtured a highly-centralized system in which the major roles have been played by ministers, and the monopoly agencies they created and appoint and direct'.⁵⁴

As in all industries, it is by no means evident that this monopoly stranglehold of production works in the best interest of the consumer. Monopolistic provision raises prices; lack of competition stifles innovation and new methods; guaranteed markets generate complacency, lack of responsiveness, and possibly even greater carelessness than one might expect under competitive pressure. Decision-making by politicians and bureaucracies adds to the problem, by making it possible for the industry to be located and organized in ways that arouse public opposition.

The safety considerations surrounding nuclear power are paramount, as they are when people are sent underground to mine coal or any other mineral. But that does not mean to say that the building and operation of nuclear power plants, collieries, or mines of any sort must be a government job. It is perfectly possible to impose rigorous safety standards, while allowing independent groups to undertake the activities themselves. Indeed, having separated the safety watchdog from the builder, mining concern, or operator, it is in fact **easier** to ensure that adequate standards are met without the fear of conflicts of interest and bureaucratic collusion. And because such a framework means that safety issues being raised in one particular installation does not reflect on the whole industry, it is easier to avoid the 'closing of ranks' that monopoly control would imply, and is thus easier to expose potential weaknesses and to deal with them in an open forum.

This leads to the conclusion, which might not be clear at first, that the safety of an industry such as nuclear power, or coal, could actually be enhanced by the greater involvement of independent operators, subjected of course to rigorous safety and

54. Duncan Burn, 'Nuclear Power: A Progress Report', Journal of Economic Affairs, Vol. 2, No. 2, (October 1980).

other regulations.

Realistically, the construction time, stringent safety requirements, and large costs involved in building of power stations of any sort will impede a speedy transfer of the power industry to independent hands, particularly so in the case of nuclear power. But a number of deregulatory procedures would certainly help to clear the ground and to ensure that the introduction of a measure of competition could proceed, as and when the necessary resources can be raised by the independent sector to take it on.

Recent legislation has permitted the private ownership of fossil-fuel power stations. A similar arrangement, subject to clear safety arrangements, can in principle be made to apply to nuclear energy generation as well. An associated step would be to remove the monopoly powers of the NNC to enable utilities to buy electricity from whom they choose. While it is obviously desirable to maintain a strong regulatory agency to supervise standards within the industry, this would probably require a new agency with expertise drawn from several existing parts of the business.

Transferring the shares of British Nuclear Fuels to independent hands would promote innovation within the industry, and might even provide the public with a much more powerful weapon to stop undesirable nuclear developments than is currently possible; it is therefore to be welcomed. Ideally, a reconstruction of the industry, rather than its transfer as a single block, would proceed at the same time. Those installations already under construction could, at this time, be offered to independent operators at the best available opportunity, and a plan for new potential sites and licences for the building and operation of new installations, would help to secure the future of the industry and the public interest in the stock floatation.

Research work and development can also be further transferred to independent companies, probably with an improvement in the speed and safety of new techniques. Naturally, competitive pressures will encourage more effective spending on all such research.

In summary, nuclear energy is probably the safest and cheapest means of serving the expanding future energy demands of the United Kingdom. The reliability of its source of fuel, and its flexibility in meeting occasional or secular output requirements, suggest that it will account for an increasing portion of electricity generation. We believe that the structural reforms of the industry proposed above would assist in maximizing that potential.

55. *Britain 1984* (London: HMSO, 1984), p. 281.

56. *Science Digest* (June 1984), p. 24.

57. *Science Digest* (June 1984), p. 24.

7. RENEWABLE AND ALTERNATIVE FUEL SOURCES

Policy concerning alternative fuels hinges on a national concern that as a country, Britain may become too dependent on one fuel source; and an equally understandable concern that the world's present fuel resources are declining. The fuels under discussion include: 'seawave, wind, tidal, and geothermal (from hot dry rocks) energy for electricity generation; solar and geothermal (from deep aquifers) energy for low-grade heat for domestic and industrial uses; and the conversion of biomass (plant tissue or animal waste) to fuels'.⁵⁵

Of these it would appear that the potential for wave energy is reasonable - because of the large length of the UK's coastline - and that wind and solar energy could prove to be significant. Current studies include the construction by the CEGB of a pilot 200KW vertical axis wind generator on the site of a power station at Carmarthen Bay (Dyfed), wave programmes, geothermal projects at Cambourne and Southampton, and many others. Two new devices have been developed, which harness ultra-low-head hydro power. The AUR water engine is a modern device for harnessing energy available in rivers, canals, estuaries, and tidal inlets at heads too low for the economic installation of conventional turbines. Its more sophisticated counterpart, developed with assistance from Salford University, is known as the STO or the Salford Transverse Oscillator. Both represent a major move towards harnessing hydro-power from common sources at low cost.

For new developments, America appears the place to be at the moment. There, the trend appears to be away from big energy production for big units and towards smaller scale operations. As a recent review claimed:

'Small, independent energy producers, willing to take risks, are developing energy sources that, in some cases, go beyond the traditional wind, solar, and hydro-electric power. Alternatives to the alternatives - everything from peach pits to peat - are being enlisted in the cause.'⁵⁶

The examples are legion. For example: 'Sun Diamond Growers of California produces 4.5 megawatts of power simply by burning walnut shells that are a by-product of its nut-processing business'; Imotex Inc of Sacramento generates '8.5 megawatts by burning almond shells and pits from olives, peaches, and prunes'; and there is the exploitation in Arizona of the local chaparral brush - 'for every ton of chaparral harvested, 40 gallons of fuel can be generated'.⁵⁷

55. Britain 1984 (London: HMSO, 1984), p. 251.

56. Science Digest (June 1984), p. 34.

57. Science Digest (June 1984), p. 34.

8. ENERGY CONSERVATION

There are two principal motives for energy conservation. The first is strategic; the fear that an overdependence on some particular energy source, such as oil, could lead to serious defence problems if it came to be used as a political weapon. The second is the knowledge that energy resources (with the possible exception of nuclear and solar power) are exhaustible and should therefore be made to last as long as possible through measures that control the present rate of usage and encourage the development of alternative sources of fuel and power. This view will be discussed first.

Methods of conserving energy

Britain today displays a number of official weapons that are, or can be, used in the interests of conscious conservation planning.

Education in various guises is the first method used. For example, the Energy Conservation Demonstration Projects Scheme is aimed at encouraging the more widespread adoption of energy conservation techniques in industry simply by demonstrating their technical and economic effectiveness. The Energy Survey Scheme provides financial assistance towards energy surveys in industrial, commercial, and public sector premises. The Industrial Energy Thrift Scheme is intended to encourage manufacturers to make better use of energy and to identify opportunities for more efficient energy use.

Subsidies. Reducing the costs of transfer between fuels is another method that can be used to help people change from scarce energy sources towards others. This in the United Kingdom is often associated with the policy of subsidizing preferred fuels such as coal. For example, the Coal Firing Scheme attempts to encourage manufacturers and farmers to switch their equipment from oil and gas to coal firing.

Quotas can be used to conserve resources in two ways. Firstly, import restrictions can reduce the supply of particular imported energy sources if the authorities deem this desirable. Secondly, the monopolistic control of the energy industries in the hands of public bodies make it possible to expand some sources and restrict others by political or bureaucratic decision. Rationing of gas supplies to potential new subscribers is an example.

Levies can also be put upon scarce energy resources, in order to make them less attractive to use. Excise tax on oil is a potential weapon, but political intervention in the pricing policies of gas, electricity, and coal, are equally plausible.

Between them, it is supposed that controls such as this should be able to bring about a rational use of alternative energy sources, thus helping to conserve energy supplies for future

Some large and established American utility companies have declared that they will 'get virtually all of their additional energy for the next decade from renewable and alternative resources',⁵⁸ whether by providing their own or buying it from small independent producers. The emphasis is on using many different sources, and instead of a two-thousand-megawatt nuclear or coal facility, to have hundreds of little sources of generation - from biomass to geothermal to wind, and on contracting out their provision.

The point to note, therefore, is that if Britain is to be given the opportunity to try out its own alternatives, then the climate must allow more private experimentation, with the freedom to succeed, and to fail. If that is restricted, as it is by the present state stranglehold over the electricity industry, then the chance for any future development of alternative fuels is bleak indeed. We suggest that any work on alternative energy sources should be contracted out, rather than being a CEBG function, since innovation and diversity are likely to be more rewarding than size alone. But it will need a considerable reformation of the electricity industry - including reforms to purchasing policies and other changes already suggested - before the economic prospects of successful alternative power generation will encourage new entrepreneurs to enter the market and develop the new sources.

As a case in point, the Coal Firing Scheme appears to be one arm of government not knowing what the other arm is doing. Recently, due to the instability and uncertainty in the coal industry, an ICI scheme which 'would have been the biggest coal conversion order in Western Europe and would have guaranteed work for at least 1,000 miners for years to come' has been shelved. Furthermore, there has been a massive decline in the application for grants to convert boilers to coal-firing - from 28 in December 1983 to only 2 in March 1984.

The same misuse of government power has led to the most costly and inefficient misallocations of resources. The United States reaction to the oil crisis, for example, might be justified on strategic grounds; but as a conservation measure it was far too strong and was bound to cause present and future difficulties. Rationing of petrol (rather than simply allowing the price to rise temporarily until new supplies could be exploited) caused queues and shortages that were irritating for the ordinary motorist, and disastrous for many businesses that relied on the ready availability of fuel for transport. Government's failure to exploit shale oil, and to manipulate the price of oil to encourage alternative energy sources, caused a sizeable switching of productive resources from some energy industries to others, and a demand from oil to the rest. The strength of the policy was not just effective in reducing the demand for oil, but was also able to produce an energy glut, which indeed it did.

58. Ibid. Mail, Saturday March 31st, 1984.

generations. They do not.

Perverse results of conservation measures

Future supplies of energy are threatened with more disruption, and cheap and abundant energy is made a less likely prospect for the future because of the perverse nature of some of the 'conservation' measures described. Others serve to generate a misallocation of capital and manpower that makes economic recovery slower and more painful.

Sweeping government powers to control the use of energy increase the uncertainty of the business environment. It becomes far more difficult to plan for energy usage - say, in the design of a new factory - if the relative price and obtainability of different forms of energy is uncertain, as they are when governments effectively control the price and the supply. Any uncertainty or risk imposes costs upon those who bear them; costs of insuring against a mistake, and costs of correcting a mistake once it has been made. The fickle nature of government policy (easily demonstrated by the relative encouragement and discouragement of different fuels over the last two decades) makes the possibility of mistakes large. The outcome is higher administrative and insurance costs, and lower employment and production.

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59. Daily Mail, Saturday March 31st, 1984.

Certainly, part of the conservation efforts that have been fashionable under Western governments since the early 1970s is the opening up of alternative sources of supply, such as research into solar power. Generally speaking, however, government energy policies have served to reduce research and the development of new energy sources, rather than encourage them. Attempts to keep down the price of gas or coal and to promote conservation through rationing and moral appeals have given little incentive for people to sink investments into research on new forms of power.

Apart from these problems, conservation through rationing and other official mechanisms concentrate power in the hands of bureaucracies that may be difficult to control and, ultimately, to remove once their job is done. New officers are needed to check on energy uses, to advertise and promote government schemes, to punish quota or price offenders, to patrol the workings of the market, and to manage the administration of the conservation package. This bureaucracy carries a cost that is borne by the whole community, and not simply concentrated on those who actually use more energy than others.

Schemes to improve insulation and to reduce energy use are often economically unsound. If it is worthwhile to make such improvements, and fuel-cost savings justify them, then people will in general undertake them. But it seems pointless to raise taxes to promote similar schemes that are otherwise too expensive to justify their cost.

Conservation through pricing

Official measures, in these ways, are not only inadequate to promote conservation, but they can be detrimental to energy users. Much official policy has been in the wrong direction to promote conservation, threatening the future of cheap energy, rather than protecting it.

Allowing the price of energy to rise in response to (temporary or long-term) market pressure can often protect scarce energy resources far better than government policies. Cheap energy policies, adopted in order to buy votes, serve to exhaust existing resources more quickly than official 'conservation' palliatives can hope to protect them, while making it unprofitable to explore new sources. If prices simply rise in response to a shortage of supply, on the other hand, marginal energy users find they have to economise so that the scarce resources tend to be used only by those who really need them. Meanwhile, alternative sources become relatively cheaper, and individuals and business switch naturally between one and the other. Although this might impose an initial cost in terms of design and equipment, the relative predictability of future prices in the absence of fickle government policies (and in the presence of a smoothly functioning futures market) makes it easy for the long-term cost calculations to be done and for the savings of switching to cheaper sources to be made.

Higher prices help to conserve scarce sources of energy because they encourage exploration for new ones. As one form of energy becomes more expensive to produce, marginal sources become profitable. Research into and development of other forms of power from completely new sources is thereby encouraged. As new technologies are developed, these new sources actually become cheaper than the old ones.

Of course, a flexible price mechanism will not ensure that any particular form of energy will remain cheap and abundant in the future. But it does guarantee that new sources are brought on stream in order to replace old ones. Few people a century ago would have predicted the discovery and use of oil, the widespread generation of electricity, the application of solar power, or the growth of the nuclear industry.

In the eighteenth century, the shortage of wood as the main fuel source was a cause for concern, but coal took its place on economic grounds before all the forests disappeared. The same happened with coal when petroleum became available cheaply. Today, there are fears over petroleum exhaustion, and the answer now is the same as it was then - allow the market to solve the problem, free of government intervention and regulation.

The object of energy conservation is not to protect particular forms of energy for all time: it is to ensure that energy supplies, from whatever source, will remain cheap and plentiful. A functioning price system, by which shortages in one energy source encourage the exploitation of new ones, does just that. Government attempts to reduce demand or ration output do not.

This suggests that the policy most appropriate to guarantee the production of cheap energy long into the future is to create the conditions of a stable and open market in energy, freed from fickle and disruptive government intervention as far as possible. Measures to introduce competitive pressures into the production and distribution of energy, and the abandonment of price-fixing objectives, would go a large way to promote that market. Present conservation policies attempt to correct the distortions that prior government intervention and monopoly power have caused, and are at best a palliative, at worst the source of greater cost and disruption.