Energy and Conservation

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A dominant fact for Britain either as a developing or 'post-developing' society is that the day of cheap energy is over. For 20 years, the economy ran on oil at under $2 a barrel. This low price undercut other sources, induced extreme wastefulness, vastly expanded use, particularly in the most wasteful forms of energy distribution, such as electricity, and created the private motorised community with all its implications for city sprawl and the decay of public transport. But most future forms of energy will be ever more costly because of greatly increased capital costs and, for fossil fuels, steady exhaustion. For the North Sea oilfields, the investment required to increase capacity by an extra barrel per day is roughly $10,000 (present prices). For the US Arctic and offshore oil and gas in the 1980s, it will be $10,000 to $25,000. The cost of transforming coal into usable liquid and gaseous fuels when North Sea oil and all oil and gas runs out is also relatively high—from $20,000 to $50,000 or more per daily barrel. The capital costs of nuclear power are very high and rising. Given Britain's relative lack of capital a radical reconsideration of energy policies should be among the first proposals of any visiting team of experts.

A first step would be the construction of a table of comparative capital costs for energy supply in Britain. This would not be easy, given the uncertainties and lack of basic data. But it is clearly a vital input for a well designed energy policy. An illustrated table, based largely on American figures, is given in the Appendix.

Next would come a genuine examination of energy conservation. There are two fundamental areas of energy waste: firstly, within the energy systems that deliver energy (in whatever form) to where it is needed and secondly, the energy wasted at the point of use. For energy systems, one can begin with some orders of magnitude. Let us consider the four units of energy needed to deliver one unit of electricity to the house, the factory or the office. In the power station, two thirds of the energy produced in burning coal, oil or uranium has to be dumped as waste heat. There is then a further energy loss in the transmission and distribution process. It makes no sense, thermodynamically, to use a very high temperature in the traditional power stations box furnace or in nuclear reactor core to heat steam to generate electricity to power an electric resistive heater in the house to warm a room by, perhaps five degrees. Compare the complexity and the waste inherent in such an energy delivery system with utilising solar heat to perform the same task—with no distribution problem and with the temperature of the heated fluid passing through the solar collector matching the energy need. The number of purposes for which electricity is really essential—all lighting, electronics, telecommunications, electrometallurgy, arc-welding, electric motors in industry, home appliances and railways—do not amount to more than 6 to 8 per cent of total energy needs. To use electricity—the highest quality form of energy—to undertake tasks that a lower grade energy source could accomplish is quite simply wasteful. Today, a house with gas-fired central heating and water heating is three times as energy-efficient as the same house with electric fan heaters and electric water heaters. Solar use would increase fuel economy and would save money later, as gas supplies dwindle and prices rise.

To the basic wastefulness of the system should be added a whole range of wastes at the point of use—of buildings leaking heat like sieves, of high rises requiring simultaneous heating and cooling, of industries lacking sensible energy management and energy-efficient machinery, of materials discarded in the non-returnable society, and of city patterns that necessitate two cars per family where buses cannot operate effectively. Then there are all the institutional arrangements that reward the large energy users and penalise the thrifty and the recyclers. Waste on so large a scale is only conceivable when oil is dirt cheap, coal prices depressed and assumptions are based on the mirage of everlasting supplies.

A particular area for examination would be agriculture where, in spite of a large increase in energy use—mechanisation, artificial fertilisers (the 'Green Revolution'!)—only 40 per cent of the total energy used in food production is spent on the farm. The rest goes in packaging, distributing over long distances, freezing, selling and all the household energy costs of getting the food on to the table.

Such analyses of the cost of new energy supplies and of waste would accomplish two objectives. They would put an end to simple extrapolations of future energy needs from the wholly exceptional circumstances of supercheap energy in recent years. The country would then not enter into capital commitments for energy systems (Drax II, IIII, IV and no doubt V—and the commercial fast breeder reactor system) which it could not afford and, by cutting down on energy waste, would cease to need. As President Carter has said, conservation is the only way we can buy a barrel of oil (or its equivalent in energy terms in whatever form) for a few dollars. The second consequence would be to suggest a whole range of conserving measures which could get the economy running on sustainable energy supplies from renewable resources by easy, well planned stages over the next century. (Precisely the same kind of calculations would have to be made for developing countries, since an unsustainable level of high technology, high waste, high urbanisation and energy-intensive industrialisation and agriculture have tended to be the prescriptions for development over the last 25 years).

There are, of course, a wide range of conserving strategies which aim in the short-term to make existing levels of supply go much further, and in the longer term to move the economy to a stable, energy-efficient form where various kinds of 'energy income' become the basic source of power. Only some are mentioned here.

—An end to the expansion of nuclear power. With the present electricity generating capacity far exceeding demand in the short term no new power stations are needed. In the medium term, the reduction of energy wastes in all sectors and the use of oil and gas directly for all new heating needs (supplemented, where appropriate, with solar equipment) will mean that electricity growth rates would be sharply reduced.

—Many electricity demands can be more efficiently and more cheaply met not by nuclear expansion but by cogeneration in industry, combined district-heating power stations in urban developments, recycling and the use of municipal wastes for fuel. Oil and gas can be replaced by coal, and the highest environmental standards for air pollution can be met with new coal technologies.

—All forms of waste should be subject to reduction at source as a first priority. Then all realistic re-use and recycling strategies should be undertaken, bearing in mind the energy savings from recycling metals. (Recycling aluminium, for instance, takes 5 per cent of the energy needed to extract and refine it from bauxite, ignoring collection and separation costs).

—Major research and development efforts would be required to see how Britain can utilise its vast reserves of coal cleanly and efficiently—bearing in mind particularly the unacceptable toll coal mining takes on miners' health. New extraction techniques and coal liquefaction/gasification should be explored so that coal can bridge the gap in time between oil and gas running down and the secure use of fully renewable energy sources from the sun, the wind and the waves.

—Restoration of public transport would be combined with a veto on private cars in city centres and with regulations to ensure that all cars are controlled for pollution, speed and energy use. A careful look could also be taken (as in Sweden) at the return of heavy road freight to the railways with suitably sited marshalling yards. All these developments could in any case be hastened by realistic replacement pricing for gasoline.

—Nationwide insulation standards for new buildings would be introduced, and tax exemptions (or penalties) enacted for retrofitting insulation, new energy-efficient equipment and solar equipment to supplement conventional arrangements.

—Solar technology should be rapidly developed, including solar panel use for low grade heat in all sectors (the major energy need in industrialised countries is for low grade heat) and biomass conversion technologies for producing liquid and gaseous fuels (crop wastes, forest wastes and organic wastes from the nation's dustbins all make good feedstock for biomass conversion). Solar and wind technologies can also produce electricity, particularly for local use, but their unit cost needs reducing. Research should also concentrate on cost-effective energy storage systems—so that a windmill or any form of solar equipment can store surplus energy for use when demand exceeds supply.

For Britain, such a strategy has many advantages:

—Energy-efficient households, using perhaps half as much fuel as is the norm now, mean lower bills for householders.

—Avoiding the considerable expansion of nuclear power and bypassing the fast breeder reactor programme altogether means a safer social structure without the security procedures and personnel needed to guard against plutonium theft and without the worries of catastrophic accidents and the perpetual hazards from indestructible and long living high-level nuclear wastes that accumulate in any nuclear power programme.

—Slowly moving the economy to reliance on energy income sources means the end of depending on other countries for either fuel or technology. Use of coal as a transitional fuel also avoids this problem. No cartel, after all, can dictate prices for solar power.

—Use of renewable energy sources eliminates the problem of increasing the carbon dioxide content in the Earth's atmosphere. This is why coal must be regarded simply as a transitional fuel, otherwise the biosphere's 'outer limits' could conceivably be crossed, late in the next century.

—Strong energy conservation and re-use or recycling of materials means more jobs. A study examining a strong conservation policy together with the use of fossil fuelled district heating-power stations instead of two 1150 MW(e) nuclear power stations found that for the same capital cost, the alternative plan would produce a larger effective energy supply and create four times the man-years in employment, in the process[1]. Increasing energy supply produces few jobs directly and may replace more jobs than it creates indirectly. Investing in energy conservation in all sectors creates far more jobs and, per £ invested, produces 'more energy'. This is because it is far cheaper to reduce a building's annual electricity consumption by so many kilowatt hours than to construct additional electricity generating capacity that will produce the same quantity of kilowatt hours in a year. To give some idea of the job-creation potential in energy conservation, the American Institute of Architects undertook a study of energy use in the built environment and concluded that the creation of an energy-efficient environment would provide an estimated two to three million job opportunities in construction and related industries.

1 'Analysis of Energy Usage on Long Island from 1975 to 1995 the Opportunities to Reduce Peak Electrical Demands and Energy Consumption by Energy Conservation, Solar Energy, Wind Energy and Total Energy Systems', Dubin-Mindell-Bloeme Associates, for the Department of Environmental Control, County of Suffolk, New York, 1975.

Most of these changes—except the shift from private to public transport—require little change in people's habits. They would, however, require a revolution in thinking, research and planning. No one should under-estimate the difficulty of achieving such a change, particularly given the vested economic interests which encourage the continuation of recent trends. At the same time, one should not fall into the trap of under-estimating the power of intellectual activity. It was thinking, research and planning which initiated the new energies. And it is to hard thinking, research and planning we must turn in our attempts to control them.

APPENDIX

Capital requirements for energy sources in the US

To compare the capital costs of different energy sources, the table below gives a rough approximation of the investment needed to *deliver* an extra 'barrel' per day—a 'barrel' being a measure of energy-producing capacity. Great care must be taken in directly comparing one figure with another. A 'barrel' of delivered electricity is obviously a lot more useful than a 'barrel' of coal because it is far more versatile and can be used to power an enormous range of things. It is also worth noting that a 'barrel' of delivered solar heat is worth 1.3 to 1.7 times as much as a 'barrel' of delivered fossil fuel because there is no further loss for the solar heat in a furnace (which the fossil fuel needs to convert it into end use heat.)

All figures are approximate and are meant only to give an idea of the order of magnitude of capital costs for various energy sources.

Approximate Capital Cost per unit (in dollars per barrel equivalent per day at 1976 prices)

Domestic coal	$2,800
Arctic and offshore oil and gas in the 1980s	$10,000 to $25,000
North Sea Oilfields now coming into production	$10,000
Marginal Alberta tarsands	$20,000
Biomass conversion—agricultural wastes	$15,000 to $25,000
municipal waste pyrolysis	$30,000 (?)
Mid-80s investment in solar space heating (including heat storage)	$50,000 to $70,000
Coal-electric	$170,000
Nuclear-electric	$300,000
Fluidized Bed Combustor system for supplying district heat and electricity	$30,000
Coal-derived liquid and gaseous fuels	$20,000 to $50,000