Response to the European Green Paper on Future Energy Supplies

Synopsis

The recent European green paper is a very substantial analysis of the energy situation that is developing in Europe. It is an exhaustive study, looking at all the present range of fuels in the community states and projecting forward for several decades. Not surprisingly, nuclear power is considered at length, as it contributes more electricity than any other fuel (35%). It is however just one part of a changing total picture and its prospects are by no means clear.

Other fuels will remain important for decades, but of all the possible energy sources, nuclear power offers the greatest potential for long term security, by replacing others for electricity generation. Fossil fuels are being exhausted rapidly, are being challenged by attitudes to CO_2 output and will be under the control of a reducing number of suppliers. Renewables may expand, but they have very severe inherent physical limitations that prevent their use for base load electricity supply. The states of the EC will become increasingly dependent upon imports of gas, to add to the dependence on oil imports. It would be strategic folly to become dependent upon imports for almost every aspect of energy supply.

Nuclear power offers a wide range of benefits, but it is the very few drawbacks, which usually receive attention. The great benefits are rarely mentioned. Substantial EC technical studies have shown that environmental impacts are far smaller than those of other fuels.

There is a wide spectrum of attitudes across community states, including clear hostility and doubts about the financial logic, as nuclear power involves a very substantial initial investment and pay back period. However, if standards of living are to be maintained, it is difficult to envisage a secure energy supply regime in Europe that does not have a large nuclear element.

1 DISCUSSION

1.1 Energy Demand

The widespread industrialisation of Europe over a period of 250 years has brought us great benefits. The high standards of living, social welfare and mobility are supported by our use of prodigious quantities of energy - the principal fuels being oil, uranium, coal and natural gas.

In the 30 years since the Middle East oil crisis, energy efficiencies have improved, but oil and electricity consumption in the UK have almost doubled. Since 1970, vehicle efficiencies have improved by about 50%. However, consumers now choose cars with much larger engines, to give better performance for the same cost, so that vehicle consumption has increased by about 80%. Electricity demand has been growing inexorably at 1 – 2% pa over the same period.

George Bush is criticised for his contempt for Kyoto, but campaigns against fuel taxes in the UK show that the public opposes reducing consumption through higher energy prices. Environmental sympathies may be expressed, but frequently are not applied in practice, if any personal inconvenience arises. These attitudes are unlikely to change in the next 10 - 20 years.

Oil and electricity are the two foundations that support our prosperity. Although the oil crises in 1956, 1971 and 2000 revealed our vulnerability to unexpected threats, they have been largely forgotten. Electricity supplies could be affected in a similar way unless more resolute action is taken in the next 2 or 3 years to maintain the nuclear element in electricity generation.

1.2 Security of Supply

There have been no serious threats to UK electricity supplies for almost 20 years, but we need to plan ahead, because electricity is not a simple commodity; it is unique, because for all practical purposes, it must be available when needed. It cannot be stored. No higher-priced import can be substituted for it at short notice.

With electricity, security is more important than cost. Its fuel supplies could be cut off in weeks, but it can take seven years to commission a replacement power station, so the corrective power of the market may not help. In providing future energy supplies, it is better to have too much plant, than to little. The problems that California and Brazil are suffering should serve to warn us in Europe.

The current UK energy policy was established by the Conservative Government in the 1980's. The decision was taken rely on the market to provide feedback and control. The States of the European Community have very different attitudes and policies, as can be seen from the sample in Table 1 below, and some will face more severe problems than the UK.

State	Nuclear Electricity	Future plans
UK	25%	Depends on market decisions
France	75%	Traditional monopoly to continue
Germany	35%	Phase out planned in 2000
Sweden	45%	Phase out planned in 1978
Spain	30%	No decision
Italy	0	Plants closed in referendum decision, but may look again in near future

As there is a very clear connection between energy consumption and standard of living and as no governments are planning to reduce national living standards, some new plants will be needed to replace coal and nuclear plants as they are retired. These new plants could use gas nuclear or renewable power. The present fuel position in the UK is discussed below, with a review of possibilities for substitution.

2 ENERGY SOURCES

2.1 General

Currently, electricity is available in the UK for all but a few hours per year, because we have fuel diversity and adequate spare capacity. We have a margin of about 20% of *reliable* capacity connected to the grid, compared with maximum demand on the coldest winter day (58GW = 58 large power stations). We have diverse fuel supplies as follows.

- Natural gas from the North Sea 35%
- Coal - mostly deep-mined with increasing quantities of imports. 30%
- Nuclear power 25%
- Imports - About 5%, but 25% of the electricity consumed in the South East and London comes from French nuclear reactors.
- Renewables only about 2 - 5% of routine demand, most of which is historic hydro.

The future prospects for these supplies are considered below.

2.2 Natural Gas

Natural gas use for electricity supply has grown rapidly, and more than one third of our electricity is generated by Combined Cycle Gas-fired Plants. It is still however, also the heating fuel of choice for 20 million domestic consumers. This dependence upon natural gas has significant risks. As there is no other fuel that can be pumped along domestic gas pipes, the same gas supplies are in demand for two vital purposes.

Oil and gas from the North Sea will be in steep decline in ten years. The continued growth of demand from Europe, India and China will keep the upward pressure on oil prices and hence on gas prices (increased by 50% in the last year.) After the decline of the North Sea fields, imported oil and gas may suffer due to political actions, supply companies' commercial decisions or terrorist groups, since the countries that could replace North Sea Gas – Algeria and FSU, are not stable democracies. There will be fierce competition for supplies from Norway. We could see problems akin to the crises 1947 and 1961, when the reduced supply of a single fuel, coal caused problems for both home heating and electricity.

2.3 Coal

Some 30% of electricity production comes from coal and its use has increased (via extra imports) with the higher gas prices. Prospects for coal production in the UK are not very good. It is unlikely that private capital will support new mine developments. There are 249,000 claims for compensation being processed in the present scheme from former miners. Such problems will deter shareholders from investing in new collieries and it may prove difficult to recruit employees to work in dirty conditions underground, when they have been brought up in a world dominated by service industries and computers. Imports can increase, but increase our vulnerability to external threats. Coal is also the fuel least able to meet EC pollution targets.

There are other less obvious implications for coal, when oil and gas are in short supply. Coal will be needed to replace oil as a chemical industry feedstock. Fuel oil and gasoline are just two of the 1000 or so compounds that are produced from cracking crude oil. Plastic and other oil products will still be needed for so many essential products. The Government might react by prohibiting coal burning for power generation. When fuel oil shortages affect car use, people will make more use of the railways, but electric trains require a fuel for power generation.

2.4 Imports

Electricity imports from France cannot be considered secure in terms of decades ahead. The inter-connector was established to transfer surplus power in a daily cycle, but the flow is almost always from France to the UK. This contributes about 5% to UK consumption and about 20%

to consumption in London and the South East. Replacing this with power generated locally would require 2,000 MW of new plant and represents a formidable challenge, but could be achieved by two new 1000 MW PWRs.

Germany proposes to close its nuclear stations and use renewable supplies. These on their own will not power the might of industrial Germany, so competition for French nuclear electricity will increase.

2.5 Renewables

2.5.1 General

As of year 2000, renewables produce only about 2% of UK supplies (depending upon what is included in the definition). Wind and solar make minute contributions. The blind faith in the capacity of renewables to be expanded effortlessly is misplaced. Growth over the last few years has been very small. There is a presumption that if a renewable energy system has been tried at prototype level, it can be automatically assumed to be capable of exploitation at an industrial level, with perfect reliability and that all production processes will have zero environmental impact. It is not clear why the renewable technologies should occupy this singularly privileged position. They need to be looked at in turn.

Calculations for renewables show that in every case, the scale of installation is impossible, or the necessary land is just not available to provide the reliable supplies that consumers require.

2.5.2 Solar

Solar heating/voltaics can contribute in a small way to energy demand over a narrow time window, but produce no electricity at night, or during blizzards, freezing fog, thunderstorms or the other times when a school, hospital or water works needs it most urgently. They can only ever be a small scale supplement to a reliable base load system in a North European climate.

2.5.3 Wind Power

Wind turbines produce maximum power only about 20% of the time. If this power source is to provide a high proportion (say 50%) of renewable power, it will be necessary to install excessive numbers, to cope with low wind speeds. There are very few suitable sites in areas such as the South East, where demand is increasing most, other than areas of natural beauty .

2.5.4 Biomass

Biomass plants requires at least 4sq.ml/ 10 MW, ie 400 sq.ml to replace a large nuclear or coal plant. If land area is available on this scale for a monoculture crop, there will be pressure to use it for low intensity farming or for planting traditional hard wood trees to restore some of our natural forests. Biomass on this scale will conflict with policies to introduce less intensive farming and bio-diversity. Wood gathering could also be stopped by problems such as F and M.

2.5.5 General Problems

All renewables will depend upon a base-load electricity system with large turbo-generator plants controlling the frequency at 50 Hz and the voltage within prescribed limits. This is their fundamental weakness. The three fuels for driving the large turbo-generators – fossil fuel, hydro

and nuclear are all out or favour. Of these, only nuclear is likely to physically capable of use at the levels required in future, but it is opposed for specious reasons.

Waste problems have yet to emerge with renewables, because we are only just entering their life cycle. Solar panels to replace a large power station will take hundreds of thousands of tons of mixed toxic materials, all to be disposed of at the end of plant life (≈ 25 yrs). No process plants have yet been designed to separate and dispose of wastes on this level. Landfill of the mixed wastes would conflict with sustainability policies, but expensive treatment would be needed, as panel materials and toxic metals such as battery lead, cadmium and mercury, do not decay.

When renewables contribute more than 15 % of electricity, the problem of matching supply and demand becomes serious. It would be necessary to have as much reserve plant available as renewables to ensure continuity of supply. All this plant would have to be paid for, maintained and kept in readiness, representing a massive surcharge to the apparent cost of the solar and wind plant. In addition, all the backup plant would be fossil fuelled and so be contributing to CO_2 emissions. These power matching problems would be faced weekly or even daily at some times of the year, but there are more severe problems.

If our main electricity supplies become dependent upon the vagaries of the climate, we will be vulnerable to atmospheric disturbance from volcanic events such as Vesuvius, Sertsey or Mount St Helens. Renewables such as biomass, solar, wave or wind power are uniquely susceptible to common atmospheric effects, which means that several of the power supplies would be decimated simultaneously, bringing havoc to an industrialised society.

3 NUCLEAR OPTION

As a developed economy, we have large numbers of non-producers, including one million employees in the NHS and 10 million pensioners and millions in full-time education. These numbers can only be supported through reliable electricity supplies. The economies of Europe are becoming more service-based. This trend can continue only if energy supplies are secure.

The option that is left from all those available is nuclear power. In the short term, it has been possible for UK plc, like a man with a very old car, to delay investing in new equipment. In the long term, this brings worse damage, including serious long-term economic and social problems. In California, it has taken only about 10 years. The nuclear plant at Rancho Seco was closed in 1989 and Sano Onofre in 1992. No large plants have been built, only thousands of wind machines. All of the substantial enquiries that have investigated energy options in the recent past have concluded that replacement nuclear plant will be needed.

More so than any other major fuel, nuclear power requires very substantial financial investment and can take up to a decade to begin to make a return on the investment. It may therefore require financial guarantees that would not be needed for other fuels.

Some fuels are better used to produce heat or motive power directly, but the only use for uranium is in the generation of electricity. Although there are exhortations to use smaller quantities of carbon based fuels, it has to recognised that consumption of oil and gas continues to increase as living standards improve.

What are the possibilities in the UK? There will be no more gas-cooled reactors, such as the Magnox and AGRs. The reprocessing of the fuel from these reactors is too expensive. They are also expensive to decommission at the end of life. Since the end of the AGR programme, one PWR has been constructed. This is the reactor at Sizewell B. From this position, there are three possible ways in which the UK nuclear industry could develop.

1. Another large PWR, but based on a European or Japanese design
2. A smaller newer water-cooled reactor design, such as the Westinghouse AP 600.
3. A small reactor such as the South African pebble bed reactor in the 100 – 200 MW.

There several serious issues that come into the equation when looking at a new reactor.

- Siting options
- Operating Costs
- Initial investment
- Number of reactors in the production run
- Constructor companies and resources available
- Licensing and NII attitudes.

There are adequate sites available at many existing nuclear plants in the UK, with a skilled workforce and established fuel supply and waste routes.

Operating costs are well known and will be increasingly competitive with gas as oil and gas prices increases in the coming years. A carbon tax would of course improve the competitive position of nuclear against other fossil fuels.

The initial investment will always be a significant problem for any enterprise involving perhaps one thousand million pounds. With appropriate guarantees, these funds should be forthcoming, but as the return on the investment may take 10 years, special arrangements may be needed. Not investing may have short term appeal, but will affect our welfare and prosperity in the decade.

With a long and steady production run, the units costs of standard design will be brought down and nuclear will become more competitive with gas and coal. Trans-European collaboration should be investigated at the earliest opportunity.

The design, construction and operating resources are in decline throughout the western world. However, as the period in the 1950s showed, the engineering and scientific community can produce the required number of specialists to construct and operate plants in a remarkably short time.

Finally, the licensing regimes have achieved a very high level of safety over a period of over forty years. There could be some simplification and improvement in their operations to accelerate the approval process where repeat plants are being planned in different parts of Europe, whilst maintaining safety at present levels.

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