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CRITICAL CHOICES FOR THE ENERGY TRANSITION

An Initial Evaluation of Some Energy R&D Strategies for the European Communities

INTRODUCTION

This short paper summarizes a study which reports upon the first ever quantification of the Community's long term energy future. The project was initiated by the Directorate General for Research, Science and Education early in 1978 and the results were obtained by a variety of analytical methods. These included the use of computer models to simulate the useful energy demand, supply, and long-range macro-economic implications spanning a fifty year period from 1975.

THE PERCEIVED PROBLEM

There is no doubt that to achieve a smooth transition from our current position to that of a post-oil society will require a strength of purpose rarely demanded by world events. Paradoxically this need arises from the ease of discovery of past oil resources and our natural inclination to utilize such abundant energy across a wide range of our activities such that currently it provides over 6o % of our needs. In the simplistic terms of a "do-nothing" situation, the future, even before 2ooo, becomes untenable. If we wish our economic well-being continue, then it becomes essential to relax the coupling between economic activity and energy demand. In addition a considerable level of energy conservation is required.

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Despite the great efforts needed to reduce specific energy demand to a much lower level a massive effort is still required to provide an alternative technological base from which to supply our energy needs. Typically an exponential growth in energy demand of 3 % per annum would require 11 % of total energy demand to be supplied from new alternatives to oil in the next decade. This would rise to about 9o % in the final decade of the proposed fifty year period. Even a substantial reduction of the growth increment cannot change this requirement qualitatively.

There is an urgent need to recognise that time is the essence of any solution. Historically in Europe energy demand has doubled every ten years. It is neither desirable nor possible to simply extrapolate this past activity, however, because current technology must be largely expanded from a new technological base. 4oo - 5oo GW installed capacity of new technology is required by the year 2o25.
Utilising the historic standards of market penetration behaviour this implies that at least 25 GW must be operational by 199o - only eleven years hence.

The above findings lead to the conclusion that in the long term economic growth may well fall below 3 %.

THE ANALYTICAL EVALUATION

The use of any particular energy technology depends of many techno-economic factors which have different weights and characteristics. While cost considerations are used here, as in most other studies to discriminate between alternative technologies, the cost comparison is second to other factors, such as availability of resources, environmental impacts or specific demands of consumers, which provide the framework within which economic competition can take place.

In examining the European Problem this study utilised two different, but complementary modelling approaches :

The market allocation model MARKAL

It has been demonstrated that, given the will, modern societies are able to place strong emphasis upon technical solutions to major problems. This approach therefore considers a purely technical solution to the energy problem freed of techno-macroeconomic interactions. It is based on a demand driven linear programming model, time-phased and designed for complex energy systems when alternate supply technologies are competing to satisfy demands.

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COMMISSION OF THE EUROPEAN COMMUNITIES
Directorate-General Research, Science and Education
Rue de la Loi 200 – B-1049 Brussels

The MACRO-MESSAGE model

This procedure focusses upon the dynamic inter-action which exists between the energy sector and the rest of the economy, while the information obtained by MARKAL was achieved at the expense of ignoring the feed-back which exists between these two sectors.

The primary purpose of the analytical work was to examine the range of possible alternatives available to the European Community. In order to generate the ground rules for the analysis a series of internal meetings, within the Commission of the European Communities gave rise to the following scenarios :

I The Reference Case with Policy Constraints
II The Reference Case with minor Modifications of the Policy Constraints
IIa The Reference Case with major Modifications of the Policy Constraints
III The Enhanced Nuclear Case
IV The Reduced Nuclear Case.

The Policy Constraints

It appeared desirable that certain policy constraints, over and above the purely technical and economic ones, should form a basis for the investigation. These were :

That the total primary energy requirements should be not more than 5o % dependent upon imported resources ;

That the total imports should not be more than 3o % dependent upon any single energy carrier ;

That nuclear energy should not exceed 3o % of the total supplies.

These requirements have of necessity been applied towards the end of the time horizon of 2o25 considered in the present study.

THE SUBSEQUENT PROBLEMS

The detailed analyses revealed that the European energy problem was far more serious than had been originally perceived. The two analytical approaches both led independently to the conclusion that it was not possible to provide a feasible solution which satisfied the given energy demand under the above policy constraints except in the low growth case (IV). It must be emphasised that this result presented itself even given the considerable energy savings assumed within the analyses (conservation index of up to 56 % !).

In order to bring the analyses to their conclusion, other than for the reduced nuclear case, the analysts found it necessary to make one or more of the following changes :

Increase the supplies of indigenous resources ;

Relax the 5o % and 3o % import constraints ;

Relax the 3o % nuclear constraint ;

Reduce the level of economic activity.

These results, therefore, covering a broad range of possible economic and related energy futures for the EC region, quantify the essential need to create future political manoeuvrability by an immediate transition away from imported oil and gas.

THE HIGHLIGHTS OF THE ANALYSES

The results quantify the well-known fact that a gradual transition away from imported oil and gas is a must for Europe. Against this background it is concluded that the following goals are essential for meeting the energy requirements.

a) The Conservation Option

The analysis was concerned with three primary sectors from which it was concluded :

Residential and Service Sector

This sector provides the greatest opportunity for energy saving, primarily in space and water heating. There are three areas in which immediate increased R&D will be effective :

Heat Pumps
Building Design and Insulation
The Local Community Use of Waste Heat.

Industrial Sector

A vigorous industrial sector is a prime requisite for the Community's economic growth aspirations. It will, therefore, be the major growth sector in energy demand, the corollary of which should be a tightly coupled R&D programme which is aimed at improving the sector's production efficiency, i.e. a reduction in energy demand per unit of output.

Short-to-medium term goals are improved insulation, better air-to-fuel ratios in boilers, retrofitting of conservation equipment etc.
Medium-to-long term goals are the restructuring of industry to take advantage of the emergence of new and improved energy supply technologies.

Transport Sector

Personal mobility in European society is the characteristic at greatest risk whenever liquid fuel shortages occur because it is almost entirely petroleum based (93 %). In considering the various conservation options available, there are three areas of need which must be met by immediate R&D programmes of work :

Short-term methods are primarily political and/or economic in nature but in the medium-to-long term considerable superior means of public transportation require development.
Freight traffic evolution requires redirection towards a more efficient system approach than is achieved by the current competition. Energy conservation in private mobility will be gradually induced through higher fuel prices, improved public transport facilities and further development of present transport means and systems.

b) The Nuclear Option

Each of the scenarios which were analysed required a significant growth of nuclear capacity. If this option would not materialize, the quantitative treatment leads to an unfeasible European energy future. In other words to satisfy the future energy supply all potential new energy sources, including nuclear based energy are needed.

If the nuclear requirements are met only by simple fission reactors there is a strong likelihood that such development will be constrained by the availability of uranium. Breeder and converter technologies are obvious choices to widen the potential of this energy source.

c) The Coal Option

The long-term coal production projections of Germany and the United Kingdom allied with the other aspirations and constraints make it clear, that because of availability, costs and environmental constraints indigenous coal alone cannot solve all the energy problems of the Community.

The results indicated that the main thrust of coal development within the EC should be directed towards coal gasification and liquefaction.

d) The Renewables Option

The analyses re-emphasised the limiting factor of technological growth in the energy sector. Renewable resources such as direct and indirect solar energy, geothermal energy, wave power etc., will take at least twenty to thirty years, from commercial success, to achieve a ten percent market penetration. As such they cannot really compensate for a failure in meeting our energy needs through nuclear and coal development. This must not be taken as a reason for neglecting R&D in these areas. Very much to the contrary, it is these long lead times that make it essential to speed up their development as rapidly as possible if we are to avoid a second series of energy crises arising from uranium shortages and environmental problems.

Irrespective of the location there is a fundamental need to construct by the mid-to-late eighties plants with 100-200 MW capacity as a demonstration of capability. This is an essential precursor to achieving a market penetration of a few percent by 2000 which will lead to a 10 % supply position within the 2025 time horizon of this report. If in addition, a broader view is taken outside of the geographic confines of Europe, overseas investment could create an alternate energy resource base whose terms of trade and access are favourable to the Community. The selection of the lesser developed countries for this purpose, and of exporting technological expertise and economic development in return for assured supplies of energy, will be beneficial to both parties. If this activity is diversified into more than one primary energy source the impact of natural disasters and/or man-made crises will be mitigated.

A PLAN FOR ACTIONS

The European Community faces an energy supply problem of such a magnitude that despite considerable savings as envisaged within this study it requires every scrap of energy it can acquire, mine, and import if the current economic growth aspirations are to be achieved. Comprehensive R&D programmes of the right scale covering all major energy technologies should be vigorously persued and expanded without further delays.

From this analytical study, it is possible to suggest the following set of actions :

a) To encourage the creation of international study groups for the rapid implementation of energy conservation.

To encourage the preparation of R&D programmes for the enhancement of all energy supplies particularly appropriate to the individual Member States.

To make an intensive examination of the political likelihood of developing countries entering into bilateral agreements with the Community for the purposes of jointly developing alternative energy carriers.

b) To examine critically the possibility of decoupling GDP and primary energy needs in order to be able to recommend suitable political and technical initiatives.

To examine critically the consequences of accepting low economic growth. To develop medium and long term evaluations of the economic costs which will have to be met by the Community in the event of energy shortages.

c) To carry out a considerably more detailed analysis of the technical options available to the Member States.

To examine in detail a wider range of technical options which might be available for overseas investment .

To establish "complete" development and demonstration programmes extending to the capture of about 1 % of the particular market.

Planning for a technical surplus capacity, to create choices at the time of commercial maturity, and to allow for compensation of unforeseen outages.

d) Due consideration should be given to the systematic analysis of the side effects of expected and planned changes in the economic and energy infrastructures of the organisational, institutional and social patterns of the Community.

In order to avoid the inefficiencies of a piecemeal approach consideration should be given to seeking national collaboration for a long-term energy plan embracing the whole of the Community. The impact of such an effort will be at its most effective only if carried out within the framework of a European energy plan.

P.S.: If you want to study the integral text of the report please apply for your personal copy by written request to : Commission of the European Community, Directorate General Research, Science and Education, Dept. Public Relations; rue de la Loi 200, B-1049 Brussels.
