COMMISSION OF THE EUROPEAN COMMUNITIES

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ENERGY FOR EUROPE : RESEARCH AND DEVELOPMENT

(Communication of the Commission to the Council)

C O N T E N T S

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ENERGY FOR EUROPE : RESEARCH AND DEVELOPMENT

I. Basic Facts, Assumptions and Options

The oil supply crisis of 1973/74 reinforces the recognized need for a long term energy strategy for Europe.

Strategic assumptions about future development have to be made to ensure that :

- there is an adequate supply to meet the demand (adequacy);
- the supply is reliable (reliability);
- the price of energy is economically acceptable (economy);
- energy is available under acceptable environmental and social conditions (safety + acceptability).

More specifically:

Adequacy: There will probably be a continuing energy scarcity. In the longer run, this will be mitigated by the development of nuclear energy and of gas resources. In any case, adequate supplies will have to be guaranteed by a strategy of mixed supplies.

Reliability: Even if a major effort is made, the European Community will continue to be heavily dependent on imports; in the foreseeable future, Europe cannot be independent for its energy supplies. In terms of reliability, this requires a reduction of the share of imported primary energy, a considered foreign (economic) policy in order to safeguard imports, and a high degree of elasticity in the supply system.

Economy: Energy is likely to remain expensive in the future. More particularly, the comparative cost advantage of oil is likely to be rather uncertain. In order to keep cost economic, a long-term strategy will have to aim at a potential energy supply somewhat above the actual needs, and recourse will be necessary to several sources which decreases dependency on any one of them.

Safety + acceptability: The environmental, social and human problems connected with energy production will continue to grow. Special attention has to be paid to these problems. This includes the maintenance, and possibly improvement, of the high degree of safety which exists today for nuclear installations and for transport and disposal of nuclear materials and waste. ./.

At the present moment it seems reasonable to assume that an adequate supply to meet a continuously rising demand is not easy to achieve; that there are justified doubts concerning the reliability of supply, that the price of oil-based energy has risen considerably and is not likely to decrease much, that a number of problems of safety and acceptability are still unsolved. The consequences of these facts may well modify the structure of energy demand. It may, for example,

- slow down the increase in the demand of oil;
- open up greater prospects for nuclear energy;
- lead to an increase in the supply of natural gas;
- produce a more competitive coal industry and give rise to the development of a greater potential market for imported coal.

Based on such assumptions, the Commission sent to the Council its proposal "Toward a New Energy Policy Strategy for the European Community" (+) with long-term objectives and objectives for 1985:

> Long-term objectives: At the end of this century at least 50% of the total energy requirements should be covered by nuclear energy; natural gas should be available to cover, if necessary, up to 30% of energy consumption. This objective takes into account gas produced in the Community or imported from outside countries, including gas transformed from oil or solid fuels; consumption of coal and oil used according to the "classical" techniques could go down to 25% of the total energy needs.
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> Objectives for 1985: To reduce consumption in 1985 by 10% in relation to the amount initially estimated for this year by the more efficient use of energy; to increase the consumption of electricity up to 35% of primary energy consumption; to limit to 40% in 1985 the degree of Community's dependence for energy on outside sources.

(+) COM (74) 550 final

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The total needs of primary energy in 1985 would be the following:

Total primary energy needs in 1985(+) - European Community (++)

	1973 (estimates)		1985 (initial forecasts)		1985 (objectives)	
	Mill.toe (+++)	%	Mill.toe	%	Mill.toe	%
Solid fuels	227	22.6	175	10	250	16
Oil	617	61.4	1.160	64	655	41
Natural gas	117	11.6	265	15	375	24
Hydroelectric power and others	30	3.0	40	2	35	2
Nuclear energy	14	1.4	160	9	260	17
	1.005	100	1.800	100	1.575	100

(+) Internal consumption + exports + bunkers

(++) See COM (74)550 final; for the initial forecasts the source is: "Prospects of primary energy demand in the Community(1975-1980-1985)" (Doc. SEC(72) 3283 final), and an additional estimate made in January 1973 for the new Member States (Doc. SEC (73) 128)

(+++) Million tons oil equivalent

The objective to become less dependent on imported energy is reflected by the following energy balance:

1985 Energy Balance(+) (by origin)

	1973 Estimates		1985 Original projections		1985 Objectives	
	Mtoe	%	Mtoe	%	Mtoe	%
Production ++	370	37	640	36	915	58
Imports	635	63	1.160	64	660 +++	42
	1.005	100	1.800	100	1.575	100

(+) Total Community requirements (internal consumption + exports + bunkering)

(++) Including nuclear energy

(+++) Including the non-EEC North Sea (= 50 ÷ 100 Mtoe, or 3 ÷ 6% of the total)

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In order to achieve the above objectives various policy measures are at disposal of the Community. Among them are in particular legal and regulatory measures such as taxes, allocations, rationing, etc... But perhaps the most powerful tool for attaining the goals of a common energy policy is provided by Research and Development. R & D can contribute to coping with medium and long term issues, act as a permanent insurance against future unforeseen trends, strive for economic as well as social objectives, ensure the basis for defensive as well as aggressive industrial strategies.

Given the intellectual and financial resources available to Europe, the skill of European scientists and engineers, the entrepreneurship of European industrialists and the political will to act jointly, there is no doubt that a common energy research policy can contribute substantially to attaining the objectives of the new strategy for a common energy policy.

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II. R & D Facts, Assumptions and Options

Within a Community energy strategy R & D is designed to create the prerequisites for increasing the adequacy, reliability, economy and safety of supply. This necessary R & D effort could concern the economization and conservation of energy, better exploitation of indigenous resources (coal, gas and oil), substitution of oil and natural gas by other resources (coal and nuclear energy), energy transportation and storage and new non-conventional energy resources (thermonuclear fusion, geothermal, solar energy etc...).

The interim report prepared by a subcommittee of CERD under the chairmanship of Dr. P. Della Porta "Initial energy R & D programme for the European Community" (+) (Della Porta Report, attached as annex 1) contains a detailed

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(+) XII/142/74

description of most of these elements with a view to the definition of priorities. Based on an analysis of the energy situation and the possibilities to cope with the needs of the future energy supply, the report examines conventional energy sources and substitution possibilities as well as new non-conventional energy sources, in particular their impact on R & D.

The report concentrates its conclusion on the answers to three essential questions:

- How to conserve energy and improve efficiency of energy utilization?
- How to increase rapidly indigenous energy supplies, maximizing the production of coal, oil and gas and substituting oil by other energy sources (including nuclear power)?
- How to develop new technologies?

The following priority areas are defined to answer these questions:

1. Economization and conservation of energy;
2. Increasing indigenous supplies of oil and gas;
3. Substitution of oil:
   a) by coal
   b) by removing obstacles to the introduction of nuclear energy for electricity generation;
   c) by nuclear energy for uses other than electricity generation.
4. The Hydrogen Energy Systems;
5. Other methods of transport and storage of energy;
6. New non-conventional energy sources:
   a) geothermal and solar,
   b) fusion.

A systematic definition of priorities must be based on the possible optimum impact of R & D to improve the energy situation as soon and as efficiently as possible. The report of an Energy Programme Group composed of Commission

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research officials under the chairmanship of Professor Lindner (Lindner-Report Mark 2, attached as annex 2) tries to evaluate the different R & D activities possible on the basis of the chance of success, feasibility, demonstration scale, industrial scale, development cost to industrial scale, investment cost and operational cost as well as the energy output and the time of its availability. The result of this evaluation is related to safety criteria and environmental impact. Moreover, the report tries to specify the degree of the impact of possible R & D activities on oil substitution in the short term and in the long term in order to find out the optimum combination of these impacts.

On the basis of the Della Porta and Lindner Reports, the field of energy R & D can be mapped and programmes can be identified to cope with the needs defined on the basis of the above assumptions and options.

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III. The European Case

1. Need for a common European policy on energy R & D

Energy R & D poses problems which cannot be solved by individual European nations alone; it requires action at national level, common European action and international co-operation.

In fact, the interdependence of the economies and of the energy supplies, the considerable financial, technical and human resources needed for the development of new energy sources as well as the necessity of sustained action over a long period demand the integration of the efforts of the member states and the development of international co-operation.

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Apart from the benefits of research for making energy available, the capacity to export advanced technologies related with energy is likely to become an increasingly important factor for commercial power in which Europe has a legitimate interest.

Non member countries, in particular European ones, should be invited to participate in the programme in an appropriate way. The Community, on the basis of the Paris and Rome Treaties, has established in the fields of R & D a set of appropriate forms of cooperation with third countries and international organizations, in particular in the Euratom and the ECSC framework. Experience in this R & D area indicates that once an R & D programme has been agreed at the Community level, third countries and international organizations can fruitfully cooperate with the Community.

2. A Role for the European Communities

The Commission proposes that the Community Institutions should concentrate on four main methods of action:

- coordination of national R & D activities (short, medium and long-term);
- public service activities;
- long-term activities (including an integrated view of the problem area);
- strengthening of areas in which Community experience exists (ECSC, Euratom).

The European Community should play its role specifically in the following ways:

- provision of incentives for initiating or developing imaginative research projects in areas of public concern (e.g. rational utilization of energy);

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- pursuit of key projects with a long-term impact which require sustained public support over a long period of time (e.g. solar, geothermal energy);
- pursuit of risk projects where the chances of success are limited but worth exploring and where the sharing of expenses could help realization (e.g. deep-sea drilling);
- continuation of projects for which the Communities have particular experience and traditional interests (e.g. coal);
- R & D about objectives which are by their very nature of common interest (such as nuclear power safety, environmental and social aspects, etc.);
- pursuit of projects at the Community level in order to complement or improve upon existing national activities (e.g. recycling of plutonium, nuclear ship propulsion, etc.).

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IV. Programme of action ENERGY FOR EUROPE

The realization of the proposed R & D programme ENERGY FOR EUROPE fits into the framework of the resolution of the Council of Ministers of 14 January 1974 to develop gradually a common policy in science and technology. The programme should include all R & D activities carried out either by the Community or by the Member States and integrate them into a coherent strategy according to the objectives of the common energy policy. This will be done, on the one hand, by the co-ordination of national activities, and, on the other hand, by the definition of common actions.

The Commission has identified eight large priority areas, in which co-ordination should be organized and detailed proposals for specific common actions elaborated and submitted to the Council before the end of 1974. It is of major importance to include, to the maximum possible extent, the activities carried out by industry.

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1. Basic Information: Inventory

A European programme of action must be based on well-established qualitative and quantitative estimates. A generally available set of such data could at the same time improve the flow of information; for there are good reasons for believing that the vast amount of scientific knowledge and technical skill already existing remain at least partly unused.

It is therefore a matter of priority to establish an inventory of energy R & D in the countries of the European Community. This should, in so far as this is possible, include both government-financed and industrial research, and indicate the commitments already made for the future.

These data once available would be a solid base for programme decisions, for an effective co-ordination of R & D effort and for organizing the flow of information among all bodies concerned, such as professional associations, trade associations and R & D organizations.

The CREST subcommittee on energy R & D has already proceeded with a first enquiry on the financial and human means devoted to energy R & D in member countries and its results should be available before long.

2. Strategic area: Conservation (more rational use and reduction of loss of energy)

Reducing the growth in demand for energy through conservation measures is a policy option that promises short-term payoff by decreasing the need for oil and gas to be imported from abroad.

In this field, the Community should act in three ways:

- co-ordination of the current programmes in member countries;
- support of innovation for conservation of energy with Community funds to give incentives for initiating and developing imaginative R & D projects proposed in collaboration with industry or with research institutes of at least two member countries;
- improvement of exchange of information and setting up of an information system to disseminate the results of the research in order to harness inventions especially in this field.

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Specific actions to be supported by the Community will be selected in the light of the objectives established by the group of national experts set up by the Energy Committee.(+)

3. Strategic area: fossil energy (coal, natural gas and oil)

Coal extraction and improvement

As a means towards achieving the production and productivity targets which the Community coal industry has set itself, R & D activities co-ordinated at Community level must be stepped up, they must be carried out in parallel in the various mining sectors and must be designed mainly to achieve:

- improvement of completely mechanized and automated high-performance workings and the complete mechanization of roadway driving;
- further improvement in working conditions peculiar to mining;
- improvement in the utilization factor of mining equipment;
- optimal use of infrastructures at the pits and programming and monitoring of operations;
- automation of coal preparation plants.

In the interests of upgrading the use of coal, R & D activities are also necessary to improve the competitivity of coal, e.g. by improved combustion, increased productivity in coking plants, development of processes for the manufacture of new products.

Conversion of coal into hydrocarbons

The conversion of coal into synthetic hydrocarbons, irrespective of coal prices, is a costly operation when performed by the traditional methods. In view both of the increase in oil and natural gas prices and the unreliability of supplies, less expensive processes must be studied and developed to the pilot and prototype stages, and their technical and economic value assessed in order to arrive as soon as possible at a fully-established technology lending itself to widespread industrial application. R & D projects should be directed towards obtaining

(+) See Annex IV of doc. COM(74) 550 final.

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non-polluting synthetic fuels, in particular by means of coal gasification and liquefaction.

Oil and gas

Exploration and exploitation of oil and gas fields are being carried out by industry, which, on the one hand, will only drill when the probability of success is high and, on the other hand, abandon the wells when more than 50% of the oil reserves are still in the ground. A substantial increase in the exploration techniques and by supporting work favouring the use of secondary and tertiary recovery and adequate reservoir stimulation technique is needed.

Deep-sea drilling to a water depth of 3,000 m. brings a new dimension to the problem. By 1980 commercial offshore drillings may go down to 1,000 m. of water depth. This will require special research efforts. Methods of undersea construction and new concepts for drilling platforms able to operate in deeper waters are still to be developed. Furthermore, the development of control devices and practices for reducing possible offshore oil spillages and of suitable oil-spill clean-up methods in order to make the increased exploitation of offshore reserves environmentally acceptable is necessary.

The Community should continue R & D programmes in support of technological innovation in the field of hydrocarbons, in particular in the field of deep-sea drilling and secondary and tertiary recovery.

4. Strategic area: Nuclear energy (fission and fusion)

Fission reactors

Presently, Light Water Reactors (LWR) using enriched uranium fuelling are commercially available and have been adopted by most industrialized nations. Around 1980, High Temperature Reactors (HTR) should become commercially available on a large scale; their essential advantages are their use of the abundant thorium for fuelling and the opening of new fields of application in the chemical and metallurgical processes. Also the potential of HTR for lignite and coal gasification as well as hydrogen production is an important factor to be considered.

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In the period 1985-1990, as a new major source of energy, Fast Breeder Reactors (FBR) are supposed to become commercially available; this type of reactor could ultimately give complete independence from enriched uranium supply in the first decades of the next century.

To improve the present solutions of the problems connected with a massive recourse to nuclear energy, while ensuring an adequate protection of man and environment, and in addition to industrial efforts, R & D should be pursued, in particular on:

- radiation protection of man and environment;
- safety of the installations under normal or accident conditions (reactor safety);
- understanding of basic phenomena involved in the irradiation behaviour of fuel (swelling, material displacement, fission products migration, etc.);
- advanced fuels development;
- reprocessing methods, mainly for advanced types of fuel;
- treatment, transportation and disposal methods of radioactive wastes;
- protection of nuclear material against diversion;
- ultimate disposal of nuclear power plants after decommissioning;
- problems of siting;
- assessment studies, in particular on ecological consequences and safeguards problems;
- uranium extraction from low content ores and phosphate industry by-products.

This will require a sustained R & D effort by the Community for all subjects that, by their very nature, are of the public service category.

Furthermore, it appears necessary to continue and to strengthen a co-ordination action of R & D activities in the member countries in the field of HTR and breeder reactors for bringing them on line in the 1980's and 1990's.

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Thermonuclear Fusion

The past five years have seen significant progress in the understanding of the physics of magnetic confinement fusion (MCF). Many experts now expect that the scientific feasibility of MCF using deuterium-tritium fuel, will be demonstrated in the period 1978-1982. Parallel technological development and further physics research should lead to the operation of a prototype reactor in the 1990's, which will demonstrate the technological feasibility and economic possibility of fusion power. New methods of laser fusion have also shown considerable progress, but the development of more powerful lasers is still necessary. Investments in money and time required to prove the concept of laser fusion are less known and less predictable, since part of the research is in the military sector.

One can assume that if the experiments planned for MCF are successful, the introduction of large-scale fusion power would take place at the beginning of the next century, making it an essential, clean and abundant energy source from that time on.

Considerable R & D efforts still have to be made in fusion, from basic experiments to prototype plant.

New proposals in the fields of thermonuclear fusion, radiation protection and environmental impact will be made in 1975 within the framework of the next multiannual programmes (1976-1980) for these research areas.

5. Strategic area: Hydrogen economy

In the long term, the use of fossil fuels for the generation of electricity and other energy purposes will have to be drastically reduced. Energy will come from a variety of sources; in particular, breeder reactors, fusion, large-scale solar and geothermal energy sources, for all of which the final product is essentially electricity. In an all-electric economy, hydrogen represents an interesting storage and transportation medium. Furthermore, it represents a new fuel which is easily and cheaply transportable and non-polluting after combustion. If its economic production by electrolysis or by chemical cycles using high temperature nuclear heat from HTR can be proven, considerable transformation efficiency could be obtained and an alternative to the all-electric economy would be available.

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The introduction of hydrogen as a new energy vector should be a priority area for Community action. This would concentrate on:

- production of hydrogen by thermochemical decomposition or electrolysis;
- studies, experimental research and pilot scale testing of hydrogen transportation, distribution and storage devices and systems;
- assessment and experimental work on hydrogen and methanol fuelled aircraft and ground transportation systems;
- preparation of a European safety manual.

6. Strategic area: new, renewable sources of energy

The development of new sources of energy is mandatory. In the nuclear field fast breeder and fusion reactors have a great potential.

In the non-nuclear field the development of new, renewable sources could be based on the exploitation of existing energy sources, e.g. solar, geothermal, wind, and sea thermal gradients. Of these, the solar and geothermal sources appear to be the most promising ones.

Solar energy

Solar energy represents a very large, diffused, potentially unlimited resource, without adverse environmental effects, if technology allows its economic use. However, because it is diluted and the supply varies greatly according to time and weather conditions, it requires large quantities of collection and concentration equipment. Photovoltaïc methods and concentration thermal methods for electricity generation are not yet approaching costs of conventional systems.

In the short-term, other more promising methods of utilizing solar energy are in the form of heating and cooling houses, heating water and in the production of clean recoverable fuels. Residential use requires only minor engineering development and relatively simple architectural modifications.

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Biological conversion, aimed at maximizing energy yield of plant material by improvement of photo-synthetic efficiency and transformation of organic plant material, can contribute to a better exploitation of solar energy induced processes.
The Community should define and carry out an action programme on the utilization of solar energy for heat production for residential use and for electricity and fuel production (thermodynamic cycles, photovoltaïc conversion and biological conversion).

Geothermal energy

There are vast amounts of heat present in various types of geothermal deposits for which technology has not yet been developed. Additional resource information is needed for all types of geothermal deposits, especially for fields of hot rocks.

Methods of locating this latter type of resource from surface measurements or other techniques are needed so that expensive random drilling can be avoided.

Most of the unsolved problems in utilizing geothermal energy are in engineering, but some new fundamental information about how to develop the various types of resources is still needed. Investigations of possible adverse environmental effects and methods for their prevention should be made; these would include prevention of subsidence, seismic studies and effluent disposal. Research should be conducted on such problems as reservoir development and management, utilization of brines, drilling and well completion under various geological conditions, and for hot rocks.

The Community should study in depth whether geothermal energy is a long-term alternative to fossil or nuclear fuels, and, in case of a positive answer, define and carry out an action programme on geothermal energy.

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7. Strategic area: Environmental protection

Energy production and utilization have obvious important impacts on the environment. The actual energy situation should not result in a reduced concern for, and further deterioration of, the environment. Any programme for the development of new energy supplies and the production and utilization of energy should be made compatible with protecting and improving the environment.

At the present time the on-going Community research programme, aimed at providing scientific support for the environmental policy of the Community, already includes actions which have a bearing on the subject of energy and environmental relationships.

By considering R & D needs arising from energy production and utilization as well as the environmental protection problems linked to energy production, R & D proposals will be submitted to the Council; these proposals, according to the conclusions of the interim report (+) of the Commission to the Council on pollution problems linked to energy production, underline R & D activities in the following fields:

- siting problems for power plants, with special attention to cooling tower design and technology;
- desulphurization, i.e. development and demonstration of large pilot and full-scale installations for flue gas desulphurization and fluidized bed combustion;
- nitrogen oxides: abatement technology, improvement of methods of measurement, effect on human health and the environment.

8. Strategic area: Systems modeling

Within the programme ENERGY FOR EUROPE and according to the needs and aims of the energy policy, medium and long-term options for a common R & D strategy have to be developed. This task must take into account the complexity of energy systems, their implications and dynamic interrelationships.

(+) Doc. SEC (74) 1150 final

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Up to the present, the supply, production, transportation and the distribution of energy has been mostly considered in a fragmented manner. Generally only sub-systems have been analyzed and concern was given primarily to technical and economic problems. Today, because of the interdependence of the various energy sources and technology and of their interactions with society, concern has to be given to the whole system (integrating technical, economic, environmental, societal, resource, reserve and potential risk factors).

The method of systems modeling provides a powerful tool to elaborate alternatives for R & D strategies. Systems modeling should allow simulations of influence of all kinds, strategic assumptions and interdependencies.

While the techniques of systems modeling have made considerable progress in the past few years, they still need further improvement and the Community should develop activities in this field. Examples of issues involved in this analysis are: long range expectation on energy demand for various primary sources as a function of external constraints; optimum strategies for the introduction of nuclear technologies, for the use of finite, non-renewable resources (oil), for shifting from electricity to other energy vectors, for transportation schemes for fuels other than oil, and socio-economic aspects (energy costs and standard of living, reinvestment of oil revenues, quantitative effects of regulatory limitations, etc.).

On the other hand, if work continues for the proposed study "Europe + 30" and the proposed "Foundation for improvement of life and work", these strategic studies must be carried out in close collaboration with these two activities.

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9. Summary view

Present activities

At present, total approved funding is of the order of 70 Mua/year. Details are summarized in the following table:

	Amount (Mua)	Period (yrs)	Yearly average (Mua)
1. JOINT RESEARCH CENTER (+)(++)			
a) Technical support to power plant operators	6.10	4 (1973 - 76)	1.525
b) Plutonium and transplutonium elements	21.65	4 (1973 - 76)	5.402
c) Waste processing and storage	6.90	4 "	1.725
d) Reactor safety	21.10	4 "	5.275
e) Fissile material safeguards	5.40	4 "	1.350
f) Hydrogen production by water-splitting	6.70	4 "	1.675
g) Solar energy	1.52	4 "	0.380
2. FUSION	71.10	5 (1971 - 75)	14.420
3. DRAGON PROJECT	10.63	3 (1.4.73-1.3.76)	3.543
4. COAL (Art. 55 ECSC Treaty)	6.00	1974	6.000
5. OIL (regulation 3056/73)	25.00	1974	25.000
TOTAL			66.295

(+) The 1974 pluriannual programme revision is not accounted for.

(++) The activities dealing with health physics and environmental protection are not considered.

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Proposed new activities

In line with the aforementioned eight strategic areas, the Commission is now preparing detailed proposals for common research actions in a multi-annual frame-work. These will be submitted to the Council before the end of 1974. A first list of themes deals mainly with the following subjects:

- energy conservation: co-ordination of national programmes and stimulation of the industrial innovation across frontiers;
- fossil energy: coal conversion to hydrocarbons by means of liquefaction and gasification;
- nuclear energy: fission: strengthening co-ordination of national programmes and developing action as a public service (e.g. waste treatment and disposal);
  fusion: new proposals for the next multi-annual programme will be made in 1975.
- hydrogen economy: the action will aim at interconnecting existing capabilities, including JRC, into one integrated framework;
- solar energy: the action will aim at interconnecting existing capabilities, including JRC, into one integrated framework;
- geothermal energy: starting from existing potentials a common action programme will be defined;
- systems modeling: a detailed proposal for action at Community level will be developed.

Financial implications of the programme ENERGY FOR EUROPE

As the Member States are spending a total of 950 Mua of public funds in 1974 on energy R & D projects, the Nine's total expenditure on energy R & D is about 1,020 Mua (0.1% of the GNP in the current year).
To cope with the objectives proposed by the energy policy (COM(74)550 final, pp. 13-14) an investment of 250 billion u.a. (300 billion 1973 dollars) is foreseen in the energy sector in the period 1975 - 1985, i.e. on the average 25 billion u.a. per year.

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In a sound technological system the average ratio between research and development expenditure and capital investment is of the order of 10%. In the energy sector it would be reasonable to earmark about 6% for public R & D investment. This, in the case of the Community as a whole, would amount to some 1,500 Mua/year.

It might be interesting, in this context, to note that the United States, within the framework of its "Project Independence", proposes to spend about 1,680 Mua yearly over the next five years on energy R & D funded by the Federal budget; this amounts to 0.14 per cent of its GNP. Japan, with its energy research programme, which also includes the new "Project Sunshine", will spend abount 575 Mua yearly, amounting to 0.15 per cent of its GNP.

The realization of the programme ENERGY FOR EUROPE will mainly consist of the alignment of the national programmes according to the jointly elaborated orientations, and of the corresponding definition and financial support (research by contracts) of the necessary Community actions. This implies that an increasing portion of the necessary funds will be progressively shifted from the national budgets into the budget of the Community; in doing so the funds foreseen in the Communities' budget should increase to a level ranging from 25% to 50% of the total expenditure in the Community in the field of energy R & D.

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V. Organization and Operational Conclusions

At present, energy R & D in the framework of the Community is organized in the following manner: research is conducted in the JRC; other, mostly contractual actions, are initiated and co-ordinated by different General Directorates; advisory support is provided by a sub-group of the Committee CERD (Della Porta Group) as well as a special task force of officials (Lindner Group); co-ordination of national R & D is considered by a sub-

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committee of CREST; policy decisions are prepared by the Commission, discussed in various Council groups and decided by the Council.

The organizational structure which is found for EC energy R & D should satisfy the following requirements:

- a clear relationship to strategic political decisions in the field of energy policy;
- ability to produce a comprehensive picture of needs and available resources for energy R & D;
- a budget with considerable financial and administrative autonomy, involving both one-year allocations and medium-term commitments;
- the possibility to co-ordinate research in the member states in defined areas effectively and with an obligatory character;
- access to government-financed as well as industrial R & D;
- a commitment on the part of all participants to give full information;
- a machinery to make information available to all participants;
- an effective system of controlling all activities in the energy R & D field (technology assessment);
- a recognized monopoly position for the co-ordination of energy R & D in the EC.

A method must be found to organize energy R & D in an effective manner in the light of these requirements and of the potential of existing instruments (such as the JRC).

In order to launch the programme ENERGY FOR EUROPE, the following steps are required:

1) CREST, which has already begun to coordinate energy R & D, is invited by the Commission to confirm the priority of this subject and concentrate on setting up an inventory of R & D activities in the Community, the machinery for making such information available for all concerned,

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and other measures required for an effective coordination of national research efforts.

2) The realization of the abovementioned tasks could be assigned to a Community organ having the necessary legal and financial autonomy. This organization would operate within the framework of the policies defined by the Community institutions, with the necessary financial means. It would be under the control of the Commission and would be assisted by a consultative committee.

3) The Commission proposes to the Council to recommend a substantial increase in the funds spent within the Community for R & D in the energy field, and that in due course expenses should reach the amount of 1,500 Mua/year. The portion of the expenses that are provided via the European Community budget, in the framework of the execution of the ENERGY FOR EUROPE programme, should rise to between 25 and 50%, with the corresponding decrease in the national budgets.

4) The Commission will accelerate the preparation of specific research proposals concerning the eight "strategic areas" and to submit these to the Council before the end of 1974.

5) The Commission confirms its general orientation to cooperate closely, in the field of R & D, with third countries, international organizations and other relevant agents. It will report regularly about methods for rendering the co-operation more effective.

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ANNEXES I AND II WILL BE DISTRIBUTED SUCCESSIVELY