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## EVALUATION OF TECHNOLOGICAL PROGRAMMES IN THE FIELD OF ENERGY

(Communication from the Commission to the Council)

## EVALUATION OF ENERGY TECHNOLOGY PROGRAMMES

### Introduction

1. This Communication describes the results of independent evaluations of the Community's two Energy Technology Programmes, that is the Energy Demonstration and Hydrocarbon Technology Development Programmes.
2. The regulations<sup>1</sup> governing these Programmes expire at the end of 1989. In line with the Council's wishes<sup>2</sup>, the Commission sponsored separate evaluations of the Programmes by independent consultants<sup>3</sup>. The evaluation reports have been published and distributed separately by the Commission.
3. The evaluation reports have also been discussed by respective Consultative Committees consisting of experts from Member States. By and large, these Committees were in agreement with the principal conclusions of the evaluation reports.

### The evaluation of the existing programmes

4. The Energy Demonstration Programme was launched in 1978 and the current phase is covered by a Council Regulation<sup>4</sup>. In force from January 1986 to the end of 1989.

The detailed evaluation reports form two separate documents<sup>5</sup>, one covering general aspects, energy efficiency, renewable energies, electricity and heat, and the other coal and other solid fuels.

5. In a general way, these reports show that the programme has favoured the development of innovative technologies which have contributed to a more efficient utilisation of energy, to the diversity and security of the Community's energy supply and to the consolidation of the Community's industry in the various fields concerned.
6. Up to the end of 1987, the period covered by the evaluation, 1455 projects had been selected on the basis of more than 5000 proposals submitted.

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1. Regulations (EEC) Nos. 3639/3640/85 of the Council, 20.12.1985.

2. P.V. Council 20.12.1985

3. - Evaluation of Energy Demonstration Programme:  
- Energy Efficiency and Renewable Energies Projects, November 1988; Mr. Caprioglio and March Consulting Group;  
- Solid Fuels, November 1988; Mr. Thurlow and Mr. Kallenbach;  
- Evaluation of the European Community's Programme of Support on Technological Development in the Hydrocarbons Sector, August 1988; Smith Rea Energy Associates Limited.

4. Council Regulation (EEC) No. 3640/85 of 20.12.85

5. See note (3)

The breakdown of these projects by sub-programme is given in Table 1. Overall, 52% of the projects are concerned with renewable energies (solar, wind, geothermal, low-power hydro-electric, biomass and waste), 36% with energy saving in the various sectors of industry, in buildings and in transport, 9% with solid fuels including the technology of liquefaction/gasification, and 3% with electricity.

7. With regard to energy saving, renewable energies and electricity<sup>6.</sup>, of the 1322 projects selected (see Table 2 and Fig. 1):
  - 330 projects had been completed or were in the final phase so that an evaluation could be carried out;
  - 661 projects were in progress;
  - 331 projects (25%) had been abandoned; in the great majority of cases these were projects that had not been started, mainly as a result of financing problems.
8. For the 330 completed projects, the evaluation report indicated that:
  - 206 projects (62%) were considered to be completely or partly successful from the technical point of view;
  - 82 projects (25%) were judged to be completely or partly successful from both the technical and the economic points of view, while there was uncertainty about 108 projects, and 140 were considered to be failures on the basis of these criteria.
9. Nevertheless, these figures should be regarded with caution, since they are based on information provided by the organizations carrying out the projects. Moreover, several sectors were affected by the fall in energy prices, which considerably reduced the economic prospects of the projects. On the other hand it should be noted that even in the case of a failure, a quantity of very useful information, essentially of a technical nature results from the experience acquired, which can be utilised in future applications.
10. An important part of the evaluation concerned aspects connected to the replication of the projects. 475 contractors replied to a questionnaire and this was accompanied, in certain cases, by direct discussions (Fig. 2).

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6. which form the subject of the evaluation report by Mr. Caprioglio and March Consulting Group (see note (3))

The replies showed that:

- of the projects that had achieved their technical objectives, 43% had already been replicated and replication was foreseen for another 30%;
  - In addition, replication was assured for 10% of the projects that were still ongoing.
11. It is also worth noting the results of the evaluation in relation to the non-energy benefits of the projects carried out. On the basis of replies to the questionnaire on this subject, 60% of the contractors mentioned, as an advantage of the projects concerned, improved impact on the environment (see Table 3).
  12. In the solid fuels sector, the programme is divided into two parts relating to the liquefaction and gasification of solid fuels<sup>7</sup> and to the utilization of solid fuels<sup>8</sup>.

As in the other areas of the programme, abandonment was due, to a great extent, to the fall in energy prices. In addition, some projects failed to start because of financing difficulties and some were stopped as a result of changes of technical orientation.

13. The evaluation report for the liquefaction and gasification sector stressed the fact that since 1985, apart from the projects supported by the Community, no major initiative had seen the light of day, and that it was thanks to the sustained and substantial support of the Community that it was possible to continue the work of developing processes that can be applied in various sectors of industry.

With regard to the utilization of solid fuels, the experts judged that, thanks to the major support provided, it had been possible to accumulate a considerable amount of experience, particularly in connection with the combustion of low-grade coal.

14. The comments made in para. 9 apply also to the solid fuels sector. In addition, it should be noted that in this sector, a rather large number of projects were supported by successive instalments because of their size (e.g., one of the projects related to the gasification plant with a capacity of 1500 t/day of lignite) and their long duration. Certain projects under way can thus be considered as the outcome of a series of partial successes.

It should also be added that the liquefaction/gasification sector is particularly sensitive to changes in the price of energy, and that this sector includes several pilot projects for which the criteria of success are not exactly the same as those for demonstration projects.

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7. The subject of the evaluation report by Mr. THURLOW.

8. The subject of the evaluation report by Messrs. KALLENBACH and BUBECK.

15. The Hydrocarbon Technology Development Programme was launched in 1974 and the current phase is covered by a Council Regulation<sup>9</sup>. In force from January 1986 to the end of 1989.

The evaluation of this programme was entrusted to a firm of independent consultants assisted by 9 independent experts of various nationalities<sup>10</sup>.

16. The evaluation report showed clearly that the programme had contributed towards the security of the Community's supply of hydrocarbons and had favoured the emergence of a Community industry for the provision of equipment and services to the oil sector.
17. From the beginning of the programme to the end of 1987, 516 projects had been selected for financial support totalling 426 MECU.

Half of these projects, 258, had been completed; 39% were in progress. The remaining 11% represented technical or financial failures.

18. Of the 258 completed projects, the evaluation report showed that 67 (26%) had already been commercialised and 93 (36%) had good prospects of commercialisation. The remaining 98 projects do not appear to have commercial prospects for the moment, although most of them achieved their technical objectives. The industrial application of successfully-developed technologies is reflected globally by the reimbursement of 25% of the aid granted. Figs 3, 4 and 5 illustrate the information summarised above.

#### Main conclusions of the evaluation

19. The conclusions and recommendations of the experts who evaluated the two programmes are annexed to the present communication. The experts confirmed the validity of the programmes as well as their positive contribution towards the achievement of long-term energy objectives.

With regard to the Energy Demonstration Programme, the evaluation report states:

"The Programme has stimulated a very important amount of activity in the application of innovative energy technologies. The combined results of the projects demonstrated, together with those of similar national programmes will, in a few years, represent an impressive body of knowledge".

According to the consultants, the Hydrocarbon Programme has "contributed to the security of Community hydrocarbons supply". It has also "increased the pace of technological innovation in the Community's hydrocarbon industries, strengthened the technical base of these industries.....and helped create a Community industry identity".

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9. Council Regulation (EEC) No. 3639/85 of 20/12/85  
10. See note (3)

20. The evaluation reports are however not without criticisms of the existing Programmes. For example, in the case of the Energy Demonstration Programme, the consultants take the view that the Programme has not yet made sufficient impact on European energy supply and demand. Hardware demonstration on its own, they say, is unlikely to be enough to ensure a suitable and effective link with the marketplace. This link can be provided, however, by a substantial increase in consolidation activities (see para 23).
21. Both reports are emphatic that continued action is necessary in all the areas covered. The improvement of technology will condition to a great extent both the development of the energy situation during the coming years and the Community's security of supply. Moreover, action at Community level will make a decisive contribution to the strengthening of the Community's industrial base in the energy technology field.
22. To increase the effectiveness and relevance of the Programmes, the consultants recommend more emphasis on consolidation activities. This would mean greater effort in the area of dissemination and promotion of successfully demonstrated technology throughout the Community, and increased diffusion of results. The aim would be to increase the impact and cost-effectiveness of the Community effort as well as improving knowledge and awareness of the market, which in turn would assist in identifying future priorities.
23. To increase effectiveness further, the evaluations indicate that new categories of projects should be introduced. In particular, the results obtained under the existing Programmes suggest that emphasis should be given to pilot projects designed to stimulate particularly promising technologies or to encourage widespread dissemination of successful technologies throughout the regions of the Community. These should include targeted projects, undertaken at the Commission's initiative, in technology areas of high priority such as the environment.
24. The experts also recommend that more emphasis should be given to dissemination projects aimed either at extending successful technologies into different regions of the Community or assessing variations of the technology involved. Joint ventures should be encouraged involving undertakings from different Member States. There should also be more projects involving small and medium-sized enterprises which are a frequent source of innovation.

#### A new programme

25. The existing Programmes have clearly been successful but they are in need of revision to increase their effectiveness still further and to bring them in line with the new policy framework. The Commission is therefore proposing a single new Energy Technology Programme to replace the present Programmes when they expire at the end of this year. This Commission proposal forms the subject of a separate Communication to the Council.

26. The new programme will place increased emphasis on what may be termed consolidation and promotional activities, including dissemination projects to aid the transfer of technology and the spreading of results throughout the Community. It will contain more targeted projects to ensure that Community funding is channelled towards high priority areas. Its principal themes are energy efficiency, renewable energy sources, the clean use of coal, and oil and gas exploration and development.
  
27. The new Programme for the Promotion of Energy Technology will incorporate the successful elements of the existing Programmes but will take account of the Community's Internal Market and Flanking policies as well as changes recommended in the evaluation reports and by Member States' experts. It is designed to respond still more effectively to the challenges facing the European Community in the coming years.

TABLE 1

SUPPORT FOR SUB-PROGRAMMES  
1978 - 1987

Sub-programmes	Number of projects	Total allocated MECU	% of support
Alternative energies	752	240.6	31.5
Energy saving	526	216.5	28.3
Substitution of hydrocarbons	117	113.4	14.9
Liquefaction and gasification	50	193.6	25.3
TOTAL	1445	764.1	100.0

Source: DGXVII contracts

TABLE 2

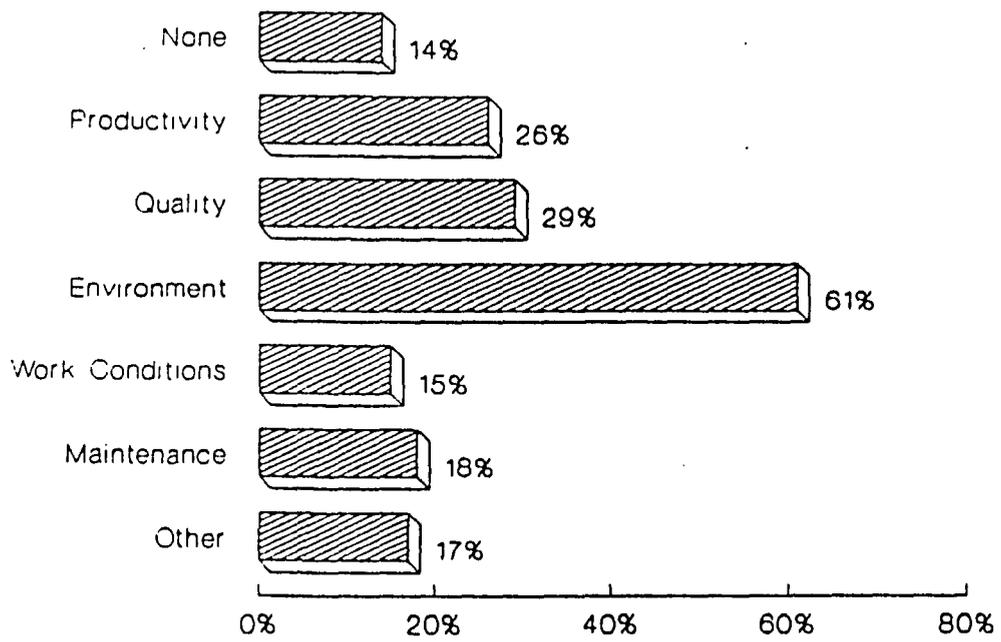
SUPPORT FOR SUB-PROGRAMMES (BREAKDOWN)

Sub-programme	Amount allocated (MECU)	Number of projects	Average amount per project (x 1000 ECU)	% of total
<u>Alternative energies</u>				
Biomass	78.5	173	454	16.3
Geothermal	58.9	120	491	12.2
Hydro-electric	21.7	90	241	4.5
Solar and photovoltaic	46.8	248	189	9.7
Wind	34.7	121	287	7.2
TOTAL ALT. ENERG.	240.6	752	320	49.9
<u>Energy efficiency</u>				
Agro-food	14.0	48	292	2.9
Buildings	15.5	96	161	3.2
Industry	135.5	278	487	28.2
Energy Industry	33.8	56	603	7.0
Transport	17.7	48	369	3.7
TOTAL Energ. Eff.	216.5	526	412	45.0
Electricity and heat	24.3	44	552	5.1
GRAND TOTAL	481.4	1322		100.0

Source: DG XVII Contracts

TABLE 3

NON-ENERGY BENEFITS



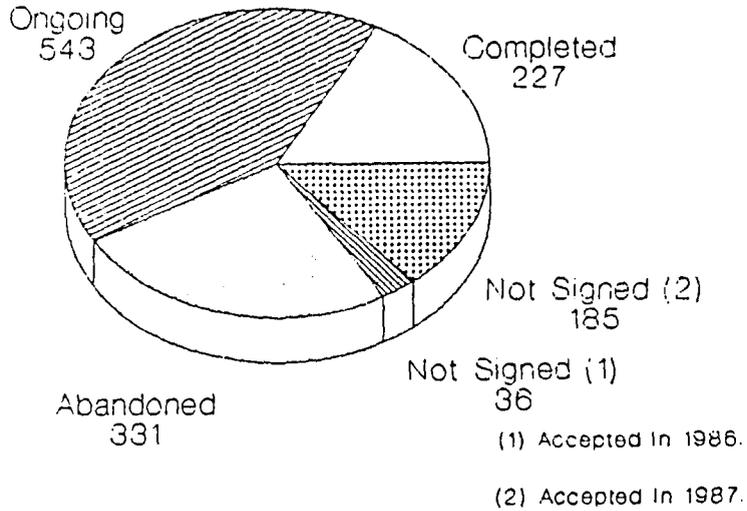
Source: Study Questionnaire

TABLE 4

DISTRIBUTION OF SUPPORT IN THE SOLID FUEL SECTOR

Sub-programme	Amount allocated (MECU)	Number of Projects	Average amount per project (MECU)	% of Total
<u>Liquefaction and Gasification</u>				
Gasification	116.5	21	5.5	45.6
Underground gasific.	21.9	2	11.0	8.6
Liquefaction	37.5	6	6.0	14.7
TOTAL L & G	175.9	29	6.1	68.9
<u>Utilisation</u>				
Fluidised bed combustion (FBC)	27.6	15	1.8	10.8
Pressurized FBC	13.2	4	3.3	5.2
Coal-water mixtures	18.8	13	1.4	7.4
Combustion of pulverised coal	6.3	9	0.7	2.5
Waste, Environment	8.8	7	1.3	3.4
Miscellaneous	4.8	7	0.7	1.9
TOTAL Utilisation	79.5	55	1.4	31.1
GRAND TOTAL	255.4	84	4.2	100.0

# STATUS OF APPROVED PROJECTS (AS AT APRIL 1988)



Source: DGXVII Contract Data

## REPORTED SUCCESS AGAINST CONTRACTUAL CONDITIONS (330 PROJECTS)

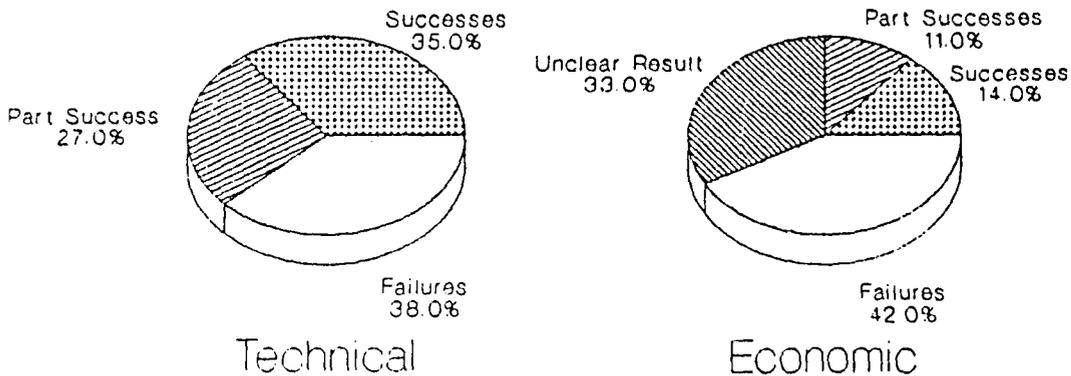


FIGURE 1

Source: DGXVII Contract Data

# PROJECT REPLICATION

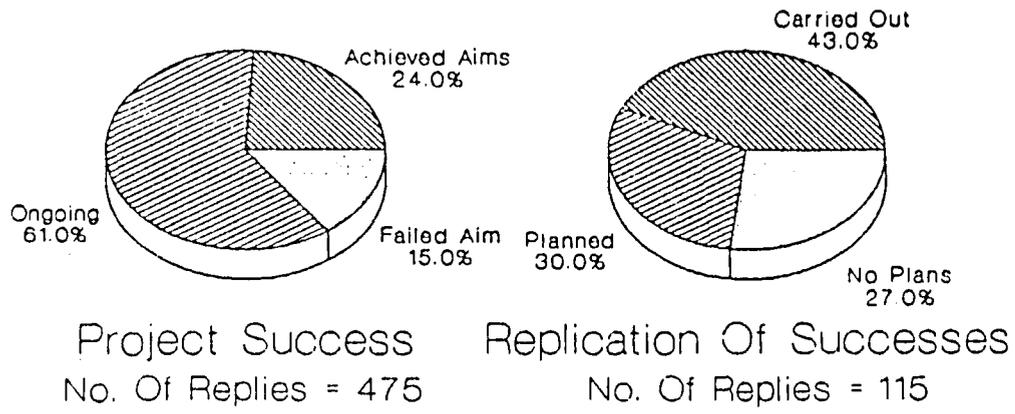
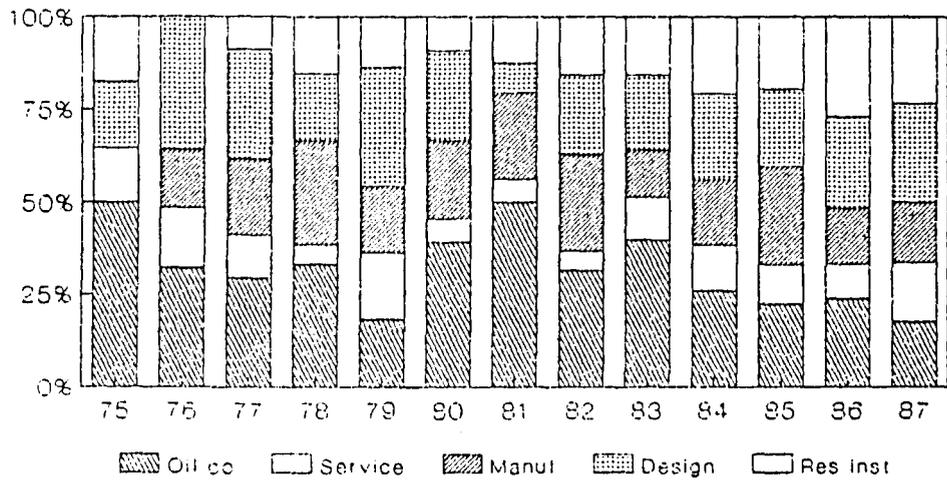


FIGURE 2

Source: Study Questionnaire

HYDROCARBONS TECHNOLOGY PROGRAMME

### Contractor types by year Percentages of projects accepted (All 516 projects)

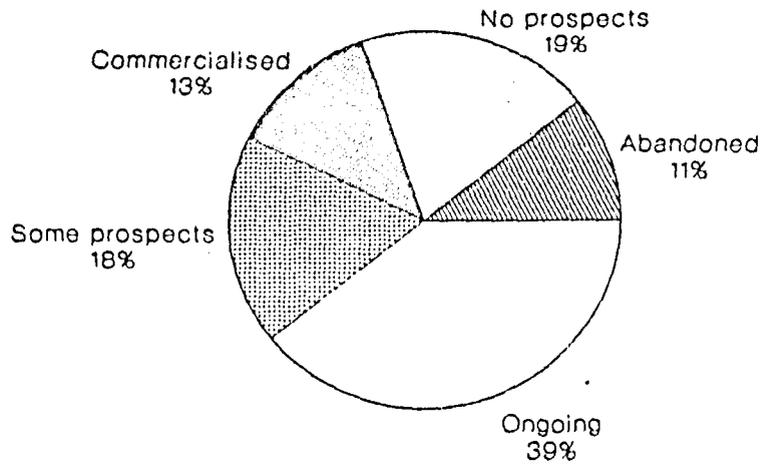


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FIGURE 3

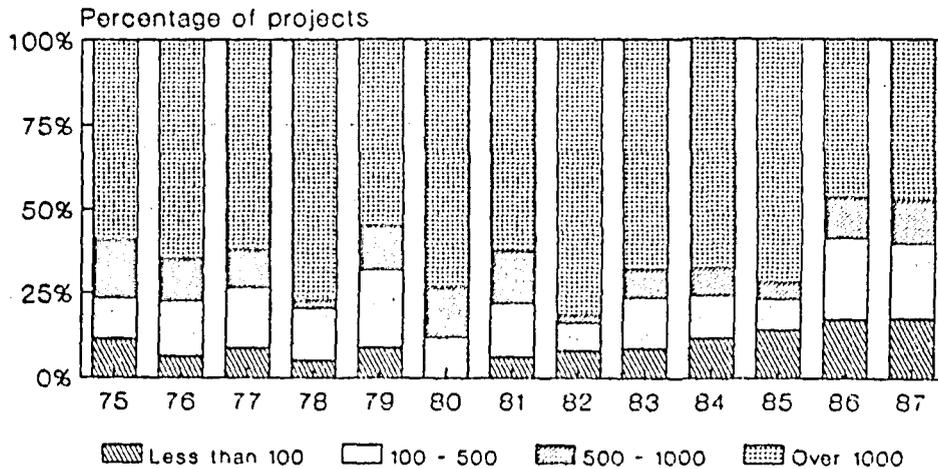
HYDROCARBONS TECHNOLOGY PROGRAMME

### All 516 projects Percentage Commercialisation Status



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### All 516 Projects Percentage Contractor Size Distribution (Group Employees)

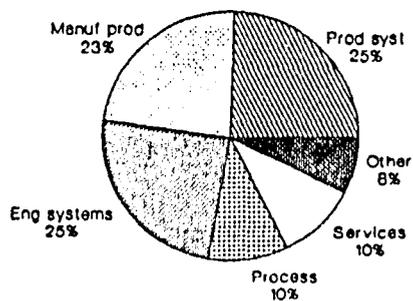


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FIGURE 4

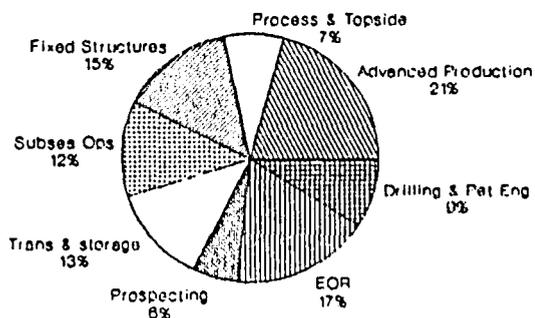
HYDROCARBONS TECHNOLOGY PROGRAMME

Completed projects (318)  
Percentages by project type



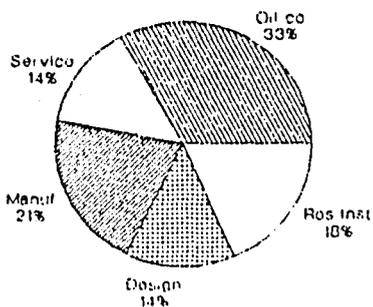
SREA Comcont, 7/88

Completed projects (318)  
Percentages by technology sectors



SREA Compara 7/88

Commercialised projects  
Percentages by contractor type



SREA COMcont 7/88

FIGURE 5

ANNEX

CONCLUSIONS OF THE EVALUATION REPORTS

Energy Demonstration Programme

24. The independent experts' final conclusions are as follows:

- (a) The original reasoning behind the programme remains valid, despite the demotivation in economic circles and even in certain political circles caused by lower oil prices.
- (b) It is vital to keep up the good work, deploying a whole range of energy policy measures and implementing a wide-ranging energy demonstration programme if we are at least to get near - assuming that they cannot be achieved completely - the objectives set in the Council Regulation.
- (c) In view of the features of the energy market, it is vital to place the emphasis on consolidation and promotional activities in order to ensure that all the knowledge acquired as a result of current research, development and demonstration activities has the desired impact. In turn, these consolidation and promotional activities should make it possible to pinpoint priorities and make for a better link between the market and future public aid programme decisions, and in particular budgets.
- (d) The consolidation activities should be conducted with the active involvement of a European network set up on the basis of existing specialist bodies. This would also make it possible to ensure better coordination with the national programmes.
- (e) In the meantime, the demonstration budget should be reviewed in such a way as to cut back on aid for own-initiative projects and introduce new types of projects. Steps should be taken to set up targeted projects designed to meet environmental concerns and implement the recommendations arising from the consolidation activities. Dissemination projects (financing of the first applications of demonstrated technologies) should mainly cover regional variations influencing economic or technical performances and promote transfrontier transfers of technologies through joint ventures.
- (f) Consideration should be given to "variable geometry" arrangements or supplementary aid, particularly in the case of major projects entailing a considerable amount of expenditure.

- (g) The relative importance assigned to energy efficiency and aid for new renewable energy technologies should be altered in favour of the former. Greater support should be given to areas such as electricity savings and new applications of non-innovating technologies, which has virtually never been done so far.
- (h) The invitations to submit projects, formulated in such a way as to take account of the above recommendations, should cover a period longer than one year and be open to own-initiative projects at all times. The selection procedure, in which stricter criteria would be applied concerning innovation and replication potential, should make it possible to take decisions about three times a year.
- (i) Serious consideration should be given to improving certain financial and contractual procedures which at present make it difficult to get best possible return from the money spent and the efforts made.

### The Hydrocarbon Technology Development Programme

With regard to the results achieved by the programme, the main conclusions of the consultant's report are as follows:

- the programme has contributed to the security of the Community's hydrocarbon supplies;
- significant technical progress has been made as a result of Community support;
- the programme has fostered the emergence of a Community industry for the supply of equipment and services to the oil sector, stimulating employment and exports and having high added value;
- the programme has acted as a catalyst for the initiation of industrial cooperation and for the participation of small and medium industries;
- the projects supported have achieved a high success rate and the industrial application of successful technologies is shown by a repayment of 25% of the support granted;

On the basis of these results, the consultant strongly recommended that the programme should be continued. This recommendation is based on three factors:

- regardless of short-term fluctuations of the oil price, security of hydrocarbon supplies to the Community will continue to be an important objective up to and beyond the end of the century;
- a unique opportunity is offered to Community industry to obtain a dominant position in the world's oil-related industry, with beneficial impact on external trade;
- the programme will contribute to the establishment of a second industrial base in the oil-related sector towards the completion of the internal energy market by 1992;

Taking into account the size of the Community oil industry, the strategic importance of hydrocarbons for Europe and the new situation in the oil-related sector, SREA considers that the annual amount of aid should be maintained at least at its real value in 1985.

The consultant's recommendation for the continuation of the programme could be implemented in two ways:

- an organic reform with no major changes in objective and organization, but with increased incentives for small and medium-sized enterprises and cooperative projects;

- a fundamental reform to facilitate the creation of a European Community hydrocarbons support industry capable of assuring world technological leadership.

The objectives of the new programme should increasingly focus on:

- long-term security of supply and reduced dependence on imported oil;
- enhance industrial capability, and increased sector integration.

The new programme should concentrate more on pilot schemes, generally require no repayment of funding, have a technical and scientific committee for strategy formulation, and foresee a close cooperation with Norway.

To abandon this support for technological development in spite of its success would put at risk the Community's opportunity to establish a leading position in this sector, and would have a negative effect on the Community's security of supply.