RESEARCH AND DEMONSTRATION

Chapter Eight

INTRODUCTION

Historically, research and technological development (RTD or R&D) has been one of the areas, along with agriculture and regional development, in which the European Community's Member States have been willing to pool huge resources for mutual benefit. RTD in the energy field has always figured strongly in the Community's efforts because of, according to the Commission, "the importance of technology in the supply, conversion, and utilisation of energy, and also through its potential contribution to competitiveness, diversification of energy supply and sustainable development".

All the original Treaties (EC, Euratom, ECSC) contain provisions for some degree of joint RTD and, until recently, this gave rise to a number of different programmes and management structures, particularly concerning energy. Since the mid-1990s, though, the trend has been towards a single more coherent structure.

The bulk of the Community's research is managed under the provisions of the EC Treaty. A radical evolution began with the Single European Act (SEA) which introduced a new chapter on R&D and, in particular, the concept of the multiannual Framework Programme (FP). Until 1994, the Commission also managed a series of energy demonstration programmes based on Article 235. Thermie, the last and biggest of these, had a budget of Ecu700m.

By the Third FP (1990-94), the legislative process of cooperation with the Parliament introduced by the SEA was already under considerable pressure. Among the Treaty changes agreed at Maastricht, the Member States consented to base future FPs on the new codecision process (although they retained the requirement of unanimity within the Council). For the Fourth FP (1994-98), the first under the codecision procedure, the Commission introduced a new structure of four so-called Activities based directly on the Treaty specifications. Its budget was twice increased, once to take account of the three new Member States, and once because of pressure from the Parliament. With this latter increase, the Commission also introduced the idea of Task Forces to provide a more focused approach to the R&D.

During 1997, the institutions began work on a Fifth FP. The Commission's proposal again made substantial structural alterations, this time reducing the number of programmes to three. The Council and the Parliament, although deeply divided over the budget, agreed with the main thrust of the restructuring but called for four programmes, one of them devoted to energy and the environment.

Nuclear research is underpinned by the Euratom Treaty and is usually divided into two main programmes, one to support RTD into improving nuclear safety, and the other for the long-term fusion project. For most of the 1990s, both programmes have been under pressure from the European Parliament, which has been partially successful in diverting some of the money to supporting renewable energies, even though, under the Euratom Treaty, it has no legal influence over the programmes. The nuclear programmes are always put forward and agreed in parallel with the non-nuclear programmes and are generally talked about as part of the Fourth or Fifth FP, even though they require separate legal decisions - one for the FP, and one each for the specific programmes on fission safety, fusion, and for the nuclear work carried out by the EU's own R&D agency, the Joint Research Council (JRC).

This chapter, although unable to go into much detail because of the enormous scope of the EU's activities, gives an overview of the Third and Fourth FPs, with a focus on the energy programmes, and at the direction being taken for the Fifth FP. It also covers briefly the small programme of coal technology research funded through the budget of the European Coal and Steel Community, and some international aspects of RTD cooperation.

THE THIRD RTD FRAMEWORK PROGRAMME AND THERMIE

The Third FP, approved under the SEA, and the parallel Euratom programme, ran from 1990 to 1994. Of the Ecu5.7bn budget, Ecu157m was devoted to the non-nuclear energy programme (Joule), Ecu458m for the thermonuclear fusion programme and Ecu199m for nuclear fission. The total was supplemented half way through by a further Ecu900m, of which a disproportionate amount went to non-nuclear energy (Ecu110m) because of the persistent efforts of the Parliament. All three programmes were managed by DGXII (research).

An evaluation of the Joule programme's activities during the 1990-94 period, based on 100 projects (a quarter of the total), was published by the Commission in 1997. It noted that projects were generally well managed with effective internal relationships but that improvements were possible, particularly in terms of clearer guidelines and management tools. It said the added value provided by EC support was "very important" because of the technical or commercial risks involved, and that the trans-European involvement of other partners was useful in terms of experience exchange and network building.

The report advised that performance in terms of commercialisation and exploitation of results was mediocre according to a strict definition of success, but that because the support was for pre-competitive projects, it was necessary to take a wider definition and that this pointed to "a positive picture" in the widespread dissemination of results and wider potential for energy, socio-economic and environmental benefits. However, it concluded that "the complete commercialisation process is slow and complex, and relies on many external factors such as energy prices, standards, policy, regulation and access to innovative financing schemes".

Thermie support for targeted projects and dissemination

Alongside the Third FP, the Commission ran its last separate programme dedicated to demonstration of energy technologies - Thermie. This programme, managed by DGXVII (energy) had a total budget of Ecu700m for the 1990-94 period, the bulk of it used for actual projects, but with a sizeable amount dedicated to technology promotion.

More than Ecu570m was spent on over 700 technology projects in four areas (rational use of energy, renewables, oil/gas and solid fuels). Within the energy saving area, the Thermie programme gave a strong bias to industry projects and to a few large transport projects. The growing importance of biomass was reflected by the fact that it was the most heavily funded area of renewables R&D. The idea of targeting certain project areas to encourage larger-scale schemes and pan-European cooperation - the world's largest integrated gasification combined cycle project at Puertollano in Spain, for example - gave Thermie an extra dimension over previous demonstration programmes.

The Opet network for dissemination of demonstration results

Another innovative aspect of Thermie was the attention and funding it gave to the dissemination of results - not only of EC-funded technology but all technology with a beneficial impact on the energy objectives, such as that with an environment or security of supply objective. DGXVII managed the so-called Associated Measures through a network of organisations for the promotion of energy technology (Opet). The Opet began work in 1991, and approximately Ecu25m was allocated each year for their operations. They also organised a number of strategically placed Energy Centres in Eastern Europe and the New Independent States, sometimes in collaboration with other Commission programmes such as Phare, Tacis and Synergy. These Centres proved effective as a short-term focus and support system for Western assistance to the countries and regions concerned.

Potential replication rate for Thermie projects estimated at 80%

In December 1995, the Commission published an evaluation of the Thermie programme based on 157 projects completed and assessed, out of an overall 726 projects funded (most of them were still under way at the time of the assessment). In just 30% of cases, the replication of the technology was considered "successful" although the report noted the potential rate of replication was closer to 80%.

THE FOURTH FP - CLOSING THE GAP BETWEEN R&D AND DEMONSTRATION

The very considerable amount of wrangling between the Parliament and the Council over the Third FP and the consequent delays to implementation of the specific programmes led to a restructuring of the rules under the Maastricht Treaty. The European Parliament was given codecision powers (Article 189b) in approving the Framework Programmes, but only a single reading under the cooperation procedure on the specific programmes. The Maastricht Treaty also insisted on the inclusion of demonstration activities within the FP. Article 130f-3 reads: "*All Community activities under this Treaty in the area of research and technological development, including demonstration projects, shall be decided on and implemented in accordance with the provisions of this Title.*" Nuclear research, though, remained within the purview of the Euratom Treaty.

In April 1994, the Fourth FP was formally adopted jointly by the Council and the Parliament, and the Euratom FP by the Council alone. The overall RTD budget was agreed at Ecu12.3bn, with a possible Ecu700m supplement to be decided in 1996. Later the same year, the Council approved 20 specific programmes, 17 under the Fourth FP and three under the Euratom FP.

The EU Treaty not only introduced the codecision procedure for the RTD FPs but also adapted their structure by introducing, in Article 130g, four so-called Activities. Thus, the 1994-98

Fourth FP was divided as follows:
- First Activity (made up of 14 RTD programmes including one for non-nuclear energy, and one for the JRC) - Ecu9.432bn;
- Second Activity (cooperation with third countries) - Ecu0.540bn;
- Third Activity (dissemination) - Ecu0.33bn;
- Fourth Activity (training and mobility) - Ecu0.744bn.

Fourth FP Activities and their budgets

Under the separate Euratom FP, Ecu0.414bn was allocated for nuclear fission safety, and Ecu0.840bn for nuclear fusion (although part of the funding for both was allocated to the JRC).

The non-nuclear energy R&D programme

The non-nuclear energy programme, formally adopted in November 1994, was given a total of Ecu967m with the following breakdown:
- rational use of energy - Ecu261m (R&D - Ecu116m, demonstration - Ecu145m);
- renewable energy - Ecu435m (R&D - Ecu271m, demonstration - Ecu164m);
- fossil fuels - Ecu271m (R&D - Ecu48m, demonstration - Ecu223m).

During the Council negotiations, there was a debate over whether there should be one or two committees overseeing the R&D and demonstration parts of the programme. To some extent, this debate mirrored the tussle within the Commission, prior to adoption of the proposal, between DGXII, which wanted to manage the entire programme, and DGXVII, which wanted to hold on to the demonstration activities. The Commission opted to propose two committees, and the Council ultimately agreed. The resulting programme, called Joule-Thermie, with separate priorities for R&D and for demonstration, was really two programmes, the Joule part managed by DGXII, and the Thermie part managed by DGXVII.

The priority areas, defined in 1994 by the Council, give a general idea of the kind of projects tackled in the two programmes.

Priority areas for Joule-Thermie programme

Area 1 - R&D, demonstration and dissemination (maximum 5% of budget): General analysis of RTD policy options; socio-economic research; energy models; "energy-environment-economy" forum; synergies between programmes; promotion of energy technologies.
Area 2 - Rational use of energy (RUE) (about 26%): RUE in buildings; RUE in industry; energy industry and fuel cells; RUE in transport.
Area 3 - Renewable energies (about 44%): Integration of renewable energies; photovoltaics; renewable energies in buildings; wind energy; energy from biomass and waste; hydroelectric power; geothermal energy.
Area 4 - Fossil fuels (about 27%): Clean technologies for solid fuels; generic combustion; new fuels in transport; hydrocarbons.
Area 5 - Dissemination of energy technologies (about 2.3%): Activities linked to market simulation; advice on practical application of technologies; advice and support for the appropriate application of financing instruments etc.

Examples from the Joule part of the energy programme

Because of the time-scales involved in setting up and completing RTD projects, no evaluation of the non-energy activities of the Fourth FP was yet available in 1998. However, in recent years, the Commission has published annual reports on the progress of the FPs, and these provide some feedback for the public. Nearly 1,000 projects were submitted for consideration following the first Joule call for proposals in December 1994. This resulted in 115 contracts being concluded in 1995 and a further 18 in 1996. Following a row with Parliament in 1995 over funding for renewables, the Commission agreed to a special call for proposals with Ecu25-30m. In fact this initiative resulted in 51 projects being funded with Ecu39m.

Special call for renewables projects

The 1997 annual report picked out a few specific projects to illustrate the work of the Joule programme. An energy saving of 30% was achieved through the production of CHP from hybrid solar panels on the facade of a municipal library. The weight of a windmill was reduced to 100t/MW, half the usual weight, in the Vestas project. The development of new materials for batteries, through an inexpensive process, has helped triple the range of electric vehicles.

The energy RTD programmes do not only focus on technology but they also have components which seek to drive the future direction of energy RTD itself and energy/environment policy more generally. In this context, one of the more interesting themes being developed within Joule is a scientific basis for applying external costs to energy use. The ExternE programme, which has been running for most of the 1990s, seeks to find ways of quantifying, in a consistent way, the external environmental and health costs associated with the use of different energy sources. The ExternE Accounting Framework projects, for example, were designed to analyse the external costs of

electricity production (i.e. those costs not accounted for in the price of electricity). The large table (below) shows the results of impact assessments based on individual plants in most of the Member States (and Norway).

Marginal damage by model

	FUND		Open Framework	
Discount rate	1%	3%	1%	3%
CO_2 (Ecu/t CO_2)	63	20	60	22
CO_2 (Ecu/t Carbon)	230	74	220	80
CH_4 (Ecu/t CH_4)	710	370	550	410
N_20 (1,000 Ecu/t N_20)	23	6.8	36	12

Source: ExternE project, Joule

The small table (to the side) shows the results of another Joule project within the ExternE framework, in which the ExternE methodology for calculating external costs was extended to climate change damages caused by greenhouse gas emissions, and used in conjunction with two existing analytical computer models - FUND and the Open Framework. The project concluded that, for the main greenhouse gas, CO_2, using base case assumptions, the external costs were in the range Ecu74-230/t of carbon emitted. This is significantly higher than the range reported by the Intergovernmental Panel on Climate Change which found damage estimates in the range $5-125/t of carbon emitted. The project's lead author Nick Eyre summarised the importance of the findings: "*The economic benefits of reducing greenhouse gas emissions could be very large - much higher than the costs of taking action to reduce emissions.*"

External costs of CO_2 could be in range Ecu74-125/t of carbon emitted

The non-nuclear energy demonstration programme

The Thermie part of the Joule-Thermie programme has operated around three activities: supporting technology projects (Type A actions); working on associated measures for helping bring these technologies to the market (Type B actions); and coordination with related efforts by the EU and Member States. Funds are split between three sectors: renewables, rational use of energy and fossil fuels. In 1995-96, 241 Type A actions were supported (out of over 700 proposals) with grants totalling Ecu224m, and 412 Type B actions were supported with Ecu47m. In 1997, a further Ecu119m went to 134 Type A actions, and Ecu18m to Type B actions.

Examples of Thermie projects

Typically, larger Type A projects can receive upwards of Ecu1m in grants. Several such projects were highlighted by the Commission in its 1997 Thermie annual report. One project, for example, aimed at implementing low energy design and construction housing schemes in Spain, Italy and Portugal, and involving a French partner, had a total cost of Ecu29.4m, with Ecu1.2m from Thermie. Another scheme, with eight participating Member States, aimed to demonstrate the introduction of hybrid electric buses into urban transport schemes in 11 towns. Its projected cost was Ecu32.4m with Ecu1.25m from the EU.

As with the Joule side of the programme, Thermie also supports projects driven by the need to research the EU's policy. One of these, due for completion in 1998, made a comparative study of

Damages (milli-Ecu/kWh)

	Coal/ lignite	Peat	Oil	Gas	Nuc-lear	Bio-mass	Hydro	Wind	Waste (Ecu/t)
Aus				11-26		24-25	0.04[1]		
Bel	37-150			11-22	4.0-4.7				
Den	35-65			15-30		12-14		0.9-1.6	
Fin	20-44	23-51				8-11			
Fra	69-99		84-109	24-35	2.5	6-7	6		67-92
Ger	30-55		51-78	12-23	4.4-7.0	28-29		0.5-0.6	
Gre	46-84		26-48	7-13		1-8	5.1	2.4-2.6	
Ire	59-84	33-38							
Ita			34-56	15-27			3.4		46-77
Net	28-42			5-19	7.4	4-5			
Nor				8-19		2.4	2.3	0.5-2.5	
Por	42-67			8-21		14-18	0.3		
Spa	48-77			11-22		29-52[2]		1.8-1.9	15-24
Swe	18-42					2.7-3	0.04-7		
UK	46-67		29-47[3]	11-22		5.3-5.7		1.3-1.5	

[1] benefits not included; [2] biomass co-fired with lignites; [3] also 31-52 for orimulsion.

Source: ExternE national implementation project, Joule

over 200 individual technologies in the EU, US and Japan, with conclusions on how important they were and how advanced, or otherwise, the EU was in developing them.

Another project, a bottom-up study called Atlas completed in 1997, researched in detail the existing and future markets for more than 50 innovative energy technologies. A highly informative report, "Energy technology - the next steps", published as part of the project, provided specific guidance on these technologies. It also gave some general policy advice, as follows.

General results of the Atlas projects on technology markets

- The innovative energy technologies which are being developed in the EU can provide a quality of service to users which is at least the same as and often better than conventional energy technologies, but with much less environmental pollution. However, in many cases additional costs are involved so market frameworks need to be developed at the EU, Member State, regional and local levels in which the costs of the environmental damage are internalised in the costs of the services provided to the final user.
- Although technology prices have fallen, work on demonstrating energy technologies must continue to take account of reducing manufacturing costs, improved performance, and the removing of market barriers.
- Feedback from users to RTD teams is important, and can be greatly assisted by well chosen and well managed demonstration projects at EU level.
- In order to minimise the creation of market barriers, improved coherence is needed between policies in the energy sector and policies in those sectors where technologies are used.

Future of Opet secured through DGXIII budget line

The future of the Opet network, previously the main mechanism for implementing the Type B actions, was in jeopardy for a period during the transition of the Thermie programme into the Fourth FP. The Commission, with the support of the Parliament, did try to persuade the Council that there was a need for a separate programme, outside of the Fourth FP for supporting the Opet and other activities. However, the Member States rejected this approach. Although DGXVII was not able to support the Opet network directly, it was rescued by DGXIII (which handles exploitation of research results under the Third Activity) through a call for tender in 1995. DGXIII now uses its own allocation of Fourth FP funds to support the 40 or so organisations - although the grants for Type B actions, allocated by DGXVII, provide their actual business.

The nuclear fusion and fission programmes

The two nuclear programmes were formally adopted in December 1994. The nuclear fission safety programme was allocated Ecu160m for five priority areas:

- Exploring innovative approaches (on reactors and fuel cycles) - Ecu7m;
- Reactor safety - Ecu48m;
- Radioactive waste management and disposal and decommissioning - Ecu43m;
- Radiological impact on man and the environment - Ecu50m;
- Mastering events of the past - Ecu12m.

Nuclear fission programme projects

A first call for proposals was issued in January 1995 and resulted in around 200 projects being contracted for in the 1995-96 period, the vast majority of which were for research and training, with around 30 for "concerted actions". One project highlighted in the annual report was RODOS (Real-time online decision support system), a software developed to manage emergency situations in the event of radiological accidents and now being incorporated into national emergency response protocols in the EU and the CEEC. The programme also supported a number of technical conferences, such as one in Minsk in 1996 on the radiological consequences of the Chernobyl accident.

The long-term objective of the nuclear fusion programme is "the joint creation of safe, environmentally-sound prototype reactors which should result in the construction of economically viable power stations which will meet the needs of potential users". Unlike other forms of Community RTD, the fusion programme embraces all the research efforts by Member States (and Switzerland) in this area. Moreover, the programme is being developed in collaboration with the three other major fusion countries - Russia, Japan and the US - all of whom have agreed to aim for an international thermonuclear experimental reactor (ITER). Canada, meanwhile, is taking a minor role through an ongoing involvement in the Euratom programme.

Fusion programme priorities for 1994-98

The priority for 1994-98 is the Engineering Design Activities (EDA) programme, for the so-called Next Step (an experimental reactor to demonstrate the scientific/technological feasibility of fusion energy). Of the Ecu794m allocated to this programme, the Council indicated 40-46% for Next Step activities; 23-32% for the JET Joint Undertaking which, to date, has been the main focus of European fusion research; some 22-25% for concept improvements; and 5-7% for long-term technology. According to a 1991 Council Decision, the Joint Undertaking should be wound down by 1998 and expertise transferred to other parts of the programme.

Chapter Eight

The Fourth FP supplement and task forces

In March 1996, the Council and Parliament approved an Ecu800m increase for the overall programme to accommodate the three Member States that had acceded to the EU since the original proposal was put forward. This brought the total budget to Ecu13.1bn, with the funds for non-nuclear energy programme rising to Ecu1.067bn, and those for the Euratom Programme to Ecu1.336bn.

Ecu115m top up for the Fourth FP

A supplement of Ecu115m was agreed by the Council and the Parliament in autumn 1997, but not until nearly two years after the Commission had first presented its proposal to make use of the extra Ecu700m (the maximum amount agreed under the original Council and EP Decision for the Fourth FP). The Council was reluctant to agree any extra funding at all, but the Parliament strongly supported the Commission's proposal. The final figure was agreed under the conciliation procedure on 23 September and formally adopted in December.

The Commission's proposal for supplementary funds was oriented around the new concept of "task forces." Eight task force areas were specified. Five of them - new-generation aircraft, multimedia education software, car of tomorrow, transport intermodality and interoperability, and environment (water and nuclear safety) - were chosen as the focus for the extra. (Three other task forces - vaccines and viral diseases, trains and railways systems of the future, and maritime systems of the future - were to be used to reinforce inter-programme coordination.)

The Commission's objectives for the task forces

The Commission said the task forces would have the following objectives:

"*- To define research priorities better in close consultation with industry, including SMEs and the users of results, taking greater account of needs of society;*

- to ensure that the means available under the Fourth Framework Programme are more efficiently coordinated and targeted towards the identified priorities, and thereby to coordinate national activities in these fields more effectively;

- to ensure a better match between supply and demand where research and technological development are concerned and to promote an environment favourable to innovation by providing additional funding and facilitating inter-firm cooperation, especially where the legal aspects are concerned."

In fact, the Council and the Parliament declined to accept the idea of task forces, and allocated the Ecu115m according to the Fourth FP programme split, with an additional Ecu9m for energy, bringing the total to 1.076bn. The Commission, nevertheless, used the task force idea to reorganise the management of some of its projects during the latter years of the Fourth FP. A similar concept reappeared as "key actions" within the Fifth FP proposal (see below).

The role of the Joint Research Council

Of the Ecu600m earmarked for the general JRC programme under the Fourth FP, Ecu20m was allocated for non-nuclear energy projects. The Ecu300m programme for the JRC under the Euratom FP was largely devoted to nuclear fission safety (Ecu254m), with a smaller effort (Ecu46m) going to the fusion programme. The Commission-run JRC comprises five sites in Germany, Belgium, Italy, the Netherlands and, since 1994, Spain.

Additional efforts needed to make JRC more competitive

Whereas the JRC was initially set up to carry out the Community's nuclear research projects, its remit has gone far beyond that and it now covers research work of many different types. Moreover, the Council is intent on making it a more competitive organisation. In April 1994, the Council reaffirmed the need for the JRC to pursue and reinforce its move towards a more competitive approach on the basis of a genuine customer/contractor relationship. A transitional period was agreed, to 1998, in which the JRC would transfer 24% of activities to a competitive system under the Fourth FP, and 10% of activities under the Euratom FP.

In December 1996, the Council said that positive and encouraging progress had been made towards implementing its 1994 Conclusions, but noted that "there is a need to sustain and further develop initiatives already undertaken and that additional efforts are required". To that end, the Council said it would establish some new orientations for the Fifth FP.

On the nuclear side, the JRC has been responsible for the analysis of confiscated nuclear materials to determine their origin, and is involved with ongoing work to counteract the illicit trade of nuclear materials (Chapter Seven). It also operates the High Flux Reactor at Petten, for which the Council approved, in 1996, a supplementary programme directed at a more commercial use of its capacity (for the production of radioisotopes for medical use). On the environmental side, the JRC

has been put in charge of the ongoing analysis of BAT (Best Available Techniques), upon which the Integrated Pollution Prevention and Control Directive will depend (Chapter Three). Non-nuclear energy projects tend to focus on materials for clean technologies and on standardisation activities, such as for photovoltaic devices.

THE FIFTH PROGRAMME - BETTER TARGETING, IMPROVED TRANSPARENCY

"*There is no denying that the world has become increasingly complex. In order to understand it better and to feel more at home in it, individuals require more knowledge. However, the answers to many of the major problems now facing society - growth and unemployment, and also health, the environment and mobility - have to be sought in science and technology. This is the purpose behind European research. It is now time to change direction slightly in order to put it in its new context. Hitherto research has been based largely on technical achievement. The aim now is to make research more efficient and increasingly directed towards meeting basic social and economic needs by bringing about the changes which each individual citizen desires.*" This is how, in its first working document - "Inventing tomorrow" - on the Fifth FP, the Commission summed up the need for change.

By early 1997, the Commission had already identified, in a further working document, the major structural changes it wished to propose for the Fifth FP. The Programme would need to have a simple structure, it argued, in order to make it easier to achieve the major social and economic objectives and to guarantee efficient operation and transparency. It proposed managing the Fifth FP through three thematic programmes: unlocking the resources of the living world and the ecosystem, creating a user-friendly information society, and promoting competitive and sustainable growth; and through three vertical programmes reflecting the Second, Third and Fourth Activities as in the Fourth FP: international cooperation; dissemination of results; and training/mobility of researchers.

Five year assessment of Community RTD

In February 1997, a high level panel of experts, headed by Viscount Etienne Davignon, a former Research Commissioner, published a five year assessment of the Community's RTD FPs. The report, which had been called for by the Council in its 1994 Decision, pulled no punches. It said the FP was not fulfilling its promise - "it lacks focus and is underachieving" - and it called "for a leap forward as qualitative and fundamental as the creation of the FP itself".

The Fifth FP should be based on the twin pillars of scientific excellence and social and economic relevance, accompanied by European added value, the experts said. They pointed to large-scale facilities which no individual Member State would develop and sustain, pan-European standards, and the promotion of internationally competitive R&D communities. The report also said the Council should act by qualified majority (rather than unanimity) in its codecisions on the FPs with the Parliament, and that the Commission should be given greater control over implementation of the programmes.

Proposal to reduce thematic programmes to three

Not long after, in April 1997, the Commission's formal proposal was presented to the Council and the Parliament. Each of three thematic programmes would comprise certain elements, the Commission said: a series of key actions, activities for R&D into generic technologies, and activities in support of research infrastructures. The key actions, 16 in total, should be on subjects "which can be considered to be of major economic and social importance to the EU". All the energy R&D topics, including nuclear energy, should be contained within the thematic programme "Promoting competitive and sustainable growth" and most of them within a key action entitled "Advanced energy systems and services".

Key action on advanced energy systems and services

The aim of this key action, the proposal said, should be: "*To help satisfy the Community's demand for energy while minimising the risks to the environment. It helps to promote the development and improvement of advanced energy systems that are efficient in terms of both production and consumption, in particular to achieve a substantial reduction in CO2 emissions and other greenhouse gases and to boost the Community's industrial competitiveness. Work will focus by way of priority on:*

- *the main new and renewable sources of energy and their integration, in particular, into decentralised systems;*
- *technologies for the storage and distribution of energy;*
- *technologies for the clean production and use of fossil fuels and for the rational use of energy;*
- *the elaboration of scenarios on economy/environment/energy interactions.*"

This key action should also embrace, according to the Commission's proposal, controlled thermonuclear fusion. During the period from 1998-2002, implementation of the strategy should entail:

"*- The fusion physics and technology activities needed for the associations and European industry to develop the capacity to construct the Next Step and prepare to operate it; Europe will continue to participate in the detailed design activities for the ITER with a view to possible construction;*

Fifth FP fusion programme proposal

- activities in the field of physics to improve the basic concepts of fusion devices;

- technological activities for the longer term which are essential to make progress with harnessing fusion."

Moreover, "the full-scale operation of JET, the main instrument from which data can be extrapolated for the experimental reactor, will be completed", the Commission said; "once this Joint Undertaking ends, JET facilities could be used to obtain knowledge for use in the operation of the Next Step". The key action should include a "fresh assessment" of safety and environmental aspects and socio-economic studies, it advised (also see below).

Nuclear fission safety programme proposal

The generic technologies element of the thematic programme "Promoting competitive and sustainable growth" would include, according to the Commission proposal, such projects as research into resistant materials for energy generation and engines, and new materials and technologies for coal production. It would also embrace the programme of nuclear fission safety projects with the following priority areas:

- operation safety of existing facilities;
- security and safety of the fuel cycle;
- radiation protection;
- studies on new nuclear facilities;
- technologies for safeguards;
- cooperation with the CEEC.

The Fifth FP budget and management proposals

The other major change to the Fifth FP proposed by the Commission, compared with earlier FPs, concerned the management structure. The Commission said the committees, which are made up of national experts and which monitor operations of the specific programmes, should only take decisions on measures of a legislative and general nature (definition of work programmes, indicative allocation of funds to the various actions making up the programme) and no longer on individual measures (i.e. the selection of projects and their financing).

Alongside the two FP Decisions (one based on the EC Treaty and the other on Euratom), 11 separate Decisions would be required to implement the Fifth FP, the Commission said: the three thematic programmes; the three horizontal programmes; one for the activities of the specific programme "promoting competitive and sustainable growth with regard to nuclear energy"; two for the activities of the Community's own Joint Research Council in the EC and Euratom fields respectively; and two for the participation rules in the EC and Euratom fields respectively.

Commission proposal for Ecu16.3bn

Because of the dependence of the budget for the Fifth FP on the EU's long-term Financial Perspectives, themselves linked to the enlargement process, the Commission held off making its RTD funding proposal until after it had put forward the Agenda 2000 package in the middle of 1997. In July, it proposed the Council and the Parliament should allocate Ecu16.3bn to the five year programme. This, it said, would be a 3% increase based on GNP forecasts.

Each of the three thematic programmes should be funded with Ecu3.925bn; the three horizontal Activities (Second, Third and Fourth) should be funded with Ecu0.491bn, Ecu1.405bn, and Ecu0.815bn respectively. Ecu1.467bn should go to the Euratom Programme and a further Ecu0.326bn for nuclear activities within the JRC.

Neither the Council nor the Parliament were overjoyed at the Commission's proposals and they worked hard throughout 1997 to reach agreements on how to change them, the Parliament adopting its Opinions in December, and the Council agreeing its Common Position in February 1998. Although they both separately agreed there should be four thematic programmes rather than three, with one sub-programme focused heavily on energy, there was a wide divergence of views on the budget.

The EP's call for over one hundred amendments

The Parliament, in its first reading, called for over one hundred amendments, many of them altering the structure of the proposal and many others strengthening its composition. The most

substantial structural proposal was to require four thematic programmes under the First Activity:
- life sciences and technologies;
- information and communication technologies;
- transport - mobility - production;
- energy - environment - sustainable development.

The latter thematic programme, it said, should consist of two sub-programmes "Energy for the future" and "Environment, sustainable development and cultural heritage".

EP proposal to fund energy RTD with Ecu1.3bn

The other key amendments concerned the budget which, the Parliament said, should be increased to Ecu16.7bn, with some of the money from the nuclear programmes reassigned to the non-nuclear programmes, giving a breakdown of Ecu15.4bn for the EC Programme, and Ecu1.3bn for the Euratom Programme. Of the Ecu12.165bn assigned to the First Activity by the Parliament, Ecu2.38bn should go to the energy-environment programme (with Ecu1.3bn for energy and Ecu1.08bn for environment). The Parliament also called for the agendas and complete minutes of the programme committees, including the results of any votes, to be published and notified to the EP within one month.

Although the rapporteur MEP Godelieve Quisthoudt-Rowohl was highly critical of the proposal for the Euratom Framework Programme (see below), there were far fewer amendments than to the non-nuclear Programme. The EP suggested an International Parliamentary Committee to "be kept informed of the technical and financial results of ITER". The Committee would consist of Parliamentary members from the countries participating in ITER (EU, US, Japan and Russia). Another amendment called for an external assessment of the nuclear RTD programme prior to any proposal for a Sixth Framework Programme. The assessment should be carried out by an independent technical/engineering consultancy chosen by the Council and the EP on a proposal from the Commission (i.e. not by high level experts chosen by the Commission), the Parliament said.

Budget cutbacks agreed by the Member States

The Research Council gave a first guarded welcome to the Commission's proposals in May 1997, but the Dutch Presidency was not able to get agreement on the structure of the programmes because of a decision by Spain to link the dossier to the future of financing for regional policies. Spain's reservations remained a problem right up until the political agreement achieved by the UK Presidency in February 1998.

Council agreement on need for energy/ environment programme

In its Common Position, the Council made some concessions to the Opinion of the Parliament and agreed with the need for four thematic programmes:
- improving the quality of life and the management of living resources;
- creating a user-friendly information society;
- promoting competitive and sustainable growth;
- energy, environment and sustainable development.

It also decided, like the EP, that the fourth programme should have two separate budgets and committees, one for energy, and the other for environment and sustainable development.

For energy, the Common Position said there should be two key actions:
- cleaner energy systems;
- economic and efficient energy for a competitive Europe;

and for environment and sustainable development, four key actions:
- sustainable management and quality of water;
- global change, climate and biodiversity;
- sustainable marine ecosystems;
- the city of tomorrow and cultural heritage.

Rejecting the Commission's attempts to merge the EC and Euratom Framework Programmes, the Council also agreed to two separate key actions under the Euratom Programme, one for fusion and one for fission safety (very much as in the past), and (also as usual) a separate programme of actions to be undertaken by the JRC.

Council accord on Ecu14bn for Fifth FP

On the budget, though, the Council's figure of Ecu14bn was far below that of the Commission and the Parliament. It allocated Ecu12.74bn to the EC FP, with Ecu2.48bn to the energy, environment and sustainable development thematic programme (around Ecu1bn each for the energy and environment sub-programmes), and Ecu1.26bn to the Euratom FP (Ecu792bn for fusion, and Ecu187bn for nuclear fission, plus Ecu281m for the JRC programme). The European Commission objected to this figure and told ministers it was the first time the budget for a Framework Programme would fall in real terms. It also noted concern about the addition of two budgets and

committees for the fourth thematic programme. Difficult negotiations on the budget question were expected in 1998 between the Council and the Parliament.

The Fifth Framework Programme approach to fusion

The background to the Council's decision to maintain the fusion programme on roughly the same course as hitherto is worth recording. In the autumn of 1995, and following the submission of a report from the Commission on the interim design report package for the ITER project, the Council adopted Conclusions approving the basic assumptions underpinning the Commission's programme. Ministers also asked, however, for an "external assessment" by "independent experts" prior to any decisions being taken on the Next Step.

Independent report on fusion programme

The Commission appointed an eight-man board, led by Professor Sergio Barabaschi, a former Italian under-secretary of state for R&D, which held seven full meetings between June and November 1996. Its 40-page report, published in December 1996, gave a rather glowing account of the programme. It concluded that the EC should make construction of the ITER the first priority of the Community's fusion programme. It should also aim to host construction because this would maintain Europe's position as world leader in fusion technology. It estimated that the EC would need to contribute Ecu200m/yr from the Fifth FP and increase funding thereafter by 50%. Moreover, the host country would have to raise substantial additional funds.

However, in response to a suggestion, at around this time, that Japan, as host nation, might be prepared to carry 70% of the costs of building, Germany and France put out a joint statement saying that, if the host country costs were 70%, then neither of them would be prepared to act as host. Italy, however, was reported as a potential EU candidate.

In early 1997, the Dutch Presidency put forward five scenarios, with their financial implications, for the future of the EU's fusion programme. At the May Council, research ministers asked the Commission to assess them and report back. Then, in November, they indicated their preference for the third scenario. The Presidency's five scenarios were:

1) Bringing a halt to nuclear fusion. Do not go ahead with ITER, close down JET and cancel agreements made. This would imply "the complete obliteration of nuclear fusion research in which Europe has invested Ecu8bn over the past 30 years". A first rough cost estimate would be Ecu250m for the Fifth FP to cover existing commitments and phase-out.

Five scenarios for the future of EC involvement in fusion

2) Science-driven nuclear fusion. Abandon construction of the next reactor and ITER, preserve the current scientific and technological base, and put off to an unknown date "somewhere in the distant future" the decision to take a possible subsequent step. Carrying on at the present level would require Ecu400m for the Fifth FP and the continuation of JET would require a total of Ecu700m.

3) Postpone the decision. "*This decision offers the advantage that in the meantime, together with the partners (US, Japan and Russia), several other matters could be looked at in greater depth.*" This would allow a deeper analysis of the significance of nuclear fusion as a long-term energy option in relation to other options (as in the US). To safeguard the international collaboration, there could be an extended ITER design phase. This would imply the prolongation of JET by 2-3 years and about Ecu850m for the Fifth FP.

4) Construct ITER. This would be a continuation of the current strategy, with a site in Europe or Japan. This decision would depend on support from the partners but such support looked unlikely from the US and Russia, especially for a European site. Establishing ITER in Europe would mean a cost of at least 50% of the total Ecu7bn from the European partners and an increase from the current Ecu220m/yr to Ecu350-400m/yr. Approximately Ecu1.05bn would be needed for the Fifth FP. Building ITER in Japan would mean Europe ceding its leading role and the costs would be roughly Ecu950m for the Fifth FP.

5) A European Next Step. "*If Europe decides to embark upon the Next Step on its own with an ITER type of reactor, the financial burden on the Community would exceed the present budget several times over. It seems rather unlikely that a more modest technical approach within the present financial envelopes would lead to a real Next Step compared with the technical performance of JET today. The question whether to keep this option open in the Fifth FP should be assessed again.*"

Meanwhile, the European Parliament's rapporteur Quisthoudt-Rowohl had produced a highly critical report. She reminded MEPs that the Council can decide on nuclear programmes, under the terms of the Euratom Treaty, without taking any notice of the Parliament. Indeed decisions on the

JET Joint Undertaking and on any future ITER design agreement do not need Parliamentary approval, she said, and yet Parliament actually votes the budgets for the Euratom component of the programmes. She added: "*Parliament has put up with this inconsistent and anomalous state of affairs for many years. Whether it should continue to do so, given the failure of the 1997 Amsterdam draft Treaty to address the problem, must now be a serious issue for the Parliament.*" Her report concluded that there was very little difference between the second and third scenarios.

DWINDLING FUNDS FOR TECHNICAL COAL R&D PROGRAMME

Despite the Maastricht Treaty's embracing of all non-nuclear RTD under the Framework Programme, the Community continues to support coal R&D outside of that framework through the legal requirements of the ECSC Treaty. However, because the ECSC Treaty is due to expire in 2002, the ECSC levy which finances the actions, including R&D, is being wound down. Although the Commission has tried to reduce the amounts each year, the Parliament has held the amounts steady in recent years at around Ecu20-30m/yr.

Guidelines for technical coal research

In 1994, the Commission published new guidelines for technical coal research to take account of the diminishing size of the programme and dovetail the priorities into those of the Joule-Thermie programme. The priorities included increased emphasis on competitiveness; commitment to working conditions, safety and health; the need to maintain coal as a strategic resource; improving the public understanding of coal; and the potential of clean technology.

Calls for tender are made annually, usually mid-year. The Commission then selects the projects to be funded and these are approved by the Council the following spring. In April 1997, for example, the Commission announced 31 coal and mining R&D projects, out of 80 proposals submitted, and approved grants totalling Ecu28.7m, with a further Ecu0.3m to be used to cover the dissemination of the research results. More than half of the projects related to environmental protection: reducing acid pollution from coal combustion, for example, and developing advanced coal burning technologies that can reduce CO_2 emissions.

The largest single grant, of Ecu3.2m, was for an Ecu5.3m project on improving coke oven operations and service life. Partners from Spain, France, Italy, Germany and the UK were all involved. For the 1997 programme, Spain and the UK were the most active countries with firms taking part in 19 of the 31 projects. German firms were involved in 17 and French ones in 10. Only the Netherlands, Ireland and Luxembourg had no companies involved in any of the projects.

Commission proposal for new mechanism to fund coal and steel R&D

One of the key issues with respect to the expiry of the ECSC Treaty is what to do in future with the Ecu700-800m of guarantee funds which underpin the ECSC loan mechanism. In October 1997, the Commission proposed a mechanism whereby the ECSC funds, estimated to generate at least Ecu40m in interest each year, could be funnelled into coal and steel research. It suggested the Member States, the direct heirs to the ECSC, should decide unanimously to transfer these assets to the Communities remaining. In order to ensure that all the revenue generated by these assets be used for coal and steel research, the sums would be placed in an autonomous internal fund to be administered by the Commission in association with the sectors concerned.

For coal, the Communication proposed the following guidelines: "*Support in this sector should be aimed at satisfying a genuine need for public aid to Community level research (critical size, synergy, dissemination of technology) and should also be directed at growth sectors associated with coal where technological progress can create jobs, in particular in the areas of clean technologies and reduction of emissions (CO_2, acidification). The scope of research should be enlarged from hard coal to other associated solid fuels, primarily brown coal and biomass. Two large sectors involving many small businesses would also be concerned: coal combustion and conversion technologies and mining technologies in the broad sense.*"

New guidelines could be adopted every five years, on the basis of which projects would be chosen annually. Experts would help the Commission select the projects, and an ad hoc committee of representatives from the Council, producers, users, workers and small businesses would help make the final choice prior to a Commission decision. There would also be an annual report to the Council and Parliament.

INTERNATIONAL ASPECTS - WIDENING COOPERATION OPPORTUNITIES

The EU is slowly widening its cooperative approach to RTD programmes, through the mechanism of bilateral accords, through strengthening ties on a regional basis, and through stronger links with the CEEC because of the accession process. Since the Fourth FP, the EU has also maintained the Second Activity programme of international cooperation (known as INCO) which provides grants

for projects bringing European and foreign partners together; it also assists eligible partners to participate in First Activity programmes, such as non-nuclear energy and transport.

In autumn 1995, the Commission put forward a Communication on "Perspectives for international cooperation in RTD". It outlined a fresh policy to help confront the major challenges of the 21st century - such as energy use, environmental protection, water supplies - through international scientific cooperation while maintaining a balance against increased competition from newly industrialised countries.

Council Resolution on international R&D cooperation

The following March, research ministers approved a Resolution on the subject and endorsed five objectives for cooperation with third countries:
- strengthening European competitiveness and developing technologies for future markets;
- developing partnerships with countries of strategic interest;
- sharing responsibility and conducting RTD on economic and social challenges;
- promoting RTD relevant to the needs and priorities of developing countries for fostering their sustainable growth;
- sharing information and contributing to large-scale and frontier science technology.

The Resolution underlined the need for reciprocal access to be a condition of cooperation with industrialised countries and for a differentiation of approach between third country partners for economic, political and geographical reasons.

International partners in RTD programmes

A number of bilateral accords with developed countries exist. The Council formally adopted a Decision for an RTD accord with Canada in February 1996, and in 1997 asked the Commission to negotiate a nuclear R&D agreement as well. As envisaged under the New Transatlantic Agenda (Chapter Ten), the EU and the US signed, in December 1997, a new science and technology accord (covering energy, environment and climate, and transport among a range of areas). Other similar agreements include those signed with South Africa, Australia and Israel.

All the members of the European Economic Area (i.e. Norway, Iceland and Liechtenstein) are associated with the Fourth Framework Programme. Other European countries are also permitted to take part in some of the specific programmes. Cooperation in research is one of the priorities of the Euro-Mediterranean partnership: Cyprus, Malta, Turkey and Israel all have access to the Fourth FP.

Cooperation with and support for the CEEC and NIS

Research necessarily plays an important part in the relationship with the CEEC. Research ministers meet with their counterparts from applicant countries once a year as part of the Structured Dialogue. At the May 1997 meeting, the CEEC representatives expressed their views on the Fifth FP, and the two groups agreed to explore means of facilitating CEEC participation in the FP, including the financial aspects.

Energy technology promotion in the CEEC through Femopet

It is worth noting that a Commission Decision, in December 1997, approved grants for 13 actions to set up organisations, similar to the Opet in the EU, for the promotion of energy technology in the CEEC; these organisations have been dubbed Femopet. The 13 Femopet, with funding of Ecu0.1-0.4m each for 1998 and 1999, are to be targeted at: the Czech Republic, the Black Sea region (Bulgaria and Romania), Bulgaria, Poland, Hungary (two, including the long-running Hungary Energy Centre), Slovenia, Latvia, Slovakia, Estonia, Romania and Lithuania. The grants, which are being made available from several different budget lines, total Ecu3.2m, and represent, on average, about 70% of the budget for each Femopet during the two year period. Only in the case of the Slovenian Femopet is the Commission providing 100% of the financing. The largest grant, of Ecu0.4m, is going to the Polish Femopet.

In terms of the NIS, the EU supported the international association for the promotion of cooperation with scientists from the independent states of the former Soviet Union (INTAS). The Commission reported in 1995 that it was not operating effectively, but the Parliament and the Council said funding of about Ecu10m/yr should continue and the future of INTAS should be considered within the overall context of the Commission's Communication on international cooperation. In December 1997, the Commission was given a mandate by the Council to negotiate a science cooperation agreement with Russia covering aspects of the Fifth FP.

As part of the INCO programme, the Commission manages a number regional schemes. INCO-Copernicus, for example, covers scientific and technical cooperation with the CEEC and the NIS; INCO-DC is for cooperation with the developing countries (and includes the Mediterranean countries).

Finally, the EU also takes part in other international scientific fora involving the active participation of the EU's Member States and other countries outside the EU. For example, the

Council and the Commission provide the secretariat for COST (European cooperation in the field of scientific and technological research), an inter-state structure operational since 1971 and involving 28 European countries. Another organisation, Eureka, brings together 24 countries and the Commission. It aims to create partnerships between applied research teams. The EU also works closely with a number of large international R&D organisations such as the European Laboratory for Particle Physics and the European Space Agency.

ASSESSMENT

Much of this chapter is weighed down with attempts to clarify the Community's research programme structure. At times the organisation seems vaguely Kafkaesque, even to those trying to follow developments in Brussels. There are Framework Programmes (Third, Fourth and Fifth), divided into Activities, sectoral or thematic programmes, task forces, key actions, etc. For energy, the confusion has been even worse. In the early 1990s, there was Thermie, for demonstration projects, managed by DGXVII, and Joule for research projects, managed by DGXII. Then the Maastricht Treaty came into force, and demonstration activities were brought within the Framework Programme so that research and demonstration projects were combined within one programme: Joule-Thermie. And yet, the programme was managed separately, with DGXVII still operating the demonstration side, which was called Thermie (not Thermie II for example); and DGXII managing the research side - which was called Joule (not Joule II for example).

This Eurocratic schizophrenia was at its worst during the preparations for the Fourth Framework Programme with a classic turf war between DGXVII and DGXII. The eventual solution was to ignore the spirit of the Maastricht Treaty while meeting the letter of the new law. Although, Thermie and Joule did in fact operate with separate management committees, there were joint meetings, and, through the life of the Fourth FP, officials reported an improved working relationship.

But what will happen under the Fifth FP? Given that the Commission itself has proposed a reduction to just three thematic programmes (although the Council and Parliament will almost certainly bump this up to four, including one focused on energy and the environment), there is no chance that the divided decision-making structure for energy research and energy demonstration projects will remain.

Who will manage the Fifth FP energy programme?

Moreover, it will appear bizarre if the operational responsibility for the energy-environment programme continues to be split between two different Directorates-General: DGXII handling all the environment RTD and energy research, and DGXVII handling energy demonstration. The separate units managing energy research and demonstration units ought be brought together under the Fifth FP, but whether this is within DGXII or within DGXVII should depend on how the Commission intends to prepare itself for the 21st century. DGXII is already one of the largest DGs but this would not matter if the Commission intended to reduce the number of DGs (and DGXVII would be a prime candidate for the chop). But, equally, if this is not likely to happen, then it would make sense to spread DGXII's workload where the expertise is strongest. Transport research, for example, is currently managed by DGVII, and equally DGXVII could be given more responsibility with the full load of energy RTD.

Efforts to improve transparency must be pursued

This chapter is also loaded down with figures. Yet, given the size and importance of the Community's RTD budget - the Commission oversees a budget of over Ecu3bn/yr on all RTD projects, and over Ecu500m/yr on energy RTD - it is pertinent to provide, at least, an indication and overview of where the money has gone, and is going. In general, the Commission is still rather poor about disseminating information to the general public on its RTD activities. In recent years, it has begun producing annual reports, which help a little with transparency, and it has an active website presence with general information and databases on RTD results. Increasingly, though, Europe's citizens will insist on precise, clear information as to how their money is being spent and why and how worthwhile the exercise really is.

One example of this is the nuclear fusion programme, which still consumes a huge chunk of the EU's energy RTD budget. The Council asked for an independent experts' analysis of the programme prior to making any decisions on the Fifth FP, but, when it arrived in late 1996, the experts' report proved so lacking in critical analysis that it was difficult to distinguish it from the kind of promotional material the nuclear industry uses all the time. No wonder, then, that the European Parliament in its Opinion on the Fifth FP proposal for a Euratom Decision, called for an assessment by an independent consultancy chosen by the Parliament and the Council on a proposal from the Commission. Unfortunately, the Parliament's Opinion on the Euratom Decision is virtually meaningless (Chapter Seven).

The Commission, in fact, tried to obfuscate the nuclear RTD programme issues in its Fifth FP proposal. The Parliament's rapporteur said the Commission "hardly mentioned" the Euratom FP. She speculated this was because "it seems to be a sort of guilty secret, or at the very least an embarrassment, to those in the Commission who have struggled to present a new and coherent approach to EU-supported research". She concluded: "*The programme is a perfectly reasonable one, if one accepts that it is legitimate to use public monies in support of technology which has now been called into question by at least half the Member States, and which, moreover, might reasonably be regarded as the domain of a mature industry.*"

MEP suggests Euratom FP is a guilty secret or an embarrassment

The Council, too, did not accept the Commission's approach on nuclear RTD. In its Common Position on the RTD Decisions, it unpicked the nuclear parts and repackaged them so that they looked very similar to the way they had in previous FPs. However, by choosing to postpone a decision on ITER, it may be that ministers have ensured the Fifth FP will be the beginning of the end for the Community's fusion programme. The cards are stacking up against it. International partners are finding it harder to get finance approved; the majority of Member States remain decidedly lukewarm about the project; and the Parliament is, perhaps, edging towards complete disapproval. Moreover, the Single Market and the demise of the state-owned monopoly has meant the replacement of long-term planning by short-term commercial decision-making. Finally, it is also worth considering how the Community's fusion programme - which even the backers say will not produce the goods for 50 years - will stand up to increased demands for accountability.

The importance of the ExternE research work

The Commission's support within ExternE (requiring negligible investment by contrast with the fusion programme) may not be leading to new technology itself, but is revolutionising the energy-environment policy interface. By providing a scientific methodology for quantifying the varied external damage costs of using different energy sources in different situations, and then taking sufficient readings to define those damage costs, ExternE is paving the way for politicians to justify the internalising of those costs into the price of energy. For example, the new estimates of global warming damage costs (as mentioned earlier in the chapter), were used by the Commission in the calculations for its pre-Kyoto Communication on climate change. As an illustration of the potential power of this policy tool, a Commission Communication in 1998 on transport and CO_2 (Chapter Four B) said the policy of internalising all external costs of transport at Community level would reduce CO_2 emissions on average by 11.5% - the net benefit to European citizens (including reduced congestion etc.) would be a staggering Ecu28-78bn/yr.

Although the European Parliament and the Council should find it relatively easy to reach agreement on the four thematic programme structure of the Fifth FP, they are likely to have to punch it out over the budget. As of April 1998, the two institutions were nearly Ecu5bn apart in their positions! The EP will not forget the Council's recalcitrance over the possible Ecu700m supplement for the Fourth FP - only about Ecu100m was released. It will also be aware that when the Amsterdam Treaty comes into force, the decision-making procedure should prove a little less skewed towards the Council (which will have to act by qualified majority rather than unanimity).

Directions for the future of energy RTD

As far as the future of energy RTD in the Fifth FP is concerned, the Commission promises a more flexible programme, with fewer but better concentrated topics, and with more frequent and more targeted calls for proposals. There will be enhanced support for the small and medium-sized enterprises (SMEs) which are increasingly providing hi-tech services and products to global companies focusing on their core businesses. One example of this could be the offshore oil and gas exploration industry, which traditionally has been considered rich enough to undertake its own R&D; the Commission now believes that SMEs are an important factor in exploration and production technology breakthroughs and that financial support can be critical.

Moreover, with a fundamental change taking place in manufacturing industries - from high quantity/low quality towards low quantity/high quality in order to meet more critical consumer demand - there is a need for RTD to integrate new technologies. Microelectronic technology, for example, not a typical Joule or Thermie topic, will be vital for future improvements in a wide range of energy-related technologies, such as the efficiency of electricity systems, gas turbines, and battery operation.