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# CLEAN, SAFE AND EFFICIENT ENERGY FOR EUROPE

Impact assessment of non-nuclear  
energy projects implemented under  
the Fourth Framework Programme

EXECUTIVE SUMMARY

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# CLEAN, SAFE AND EFFICIENT ENERGY FOR EUROPE

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## Executive Summary

In 2002, a group of 38 independent experts was appointed by both the Directorates-General for Research and Transport and Energy to assess the Impact of the Non Nuclear Energy Projects of the Fourth Framework Programme (FP4). The assessment produced a number of outputs including:

- An Executive Summary of the Synthesis Report (the present report).
- A Synthesis Report on the Impact of the NNE Programme (an independent, stand alone report).
- A Thematic Report covering the following topics :
  - Fossil Fuels,
  - Rational Use of Energy,
  - Renewable Energies,
  - Socio-Economic Research & Modelling, and
  - Complementary & Support Measures
- Project summaries of all the assessed individual projects (only available on CORDIS, because of its large size)

The present document is the Executive Summary of the SYNTHESIS REPORT and has been prepared by the Core Group of the Impact Assessment Panel of Independent Experts:

**The Core Group of the Impact Assessment Panel of Independent Experts**

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# ENERGY, THE ECONOMY,

In the period 1994 to 1998, the European Union's (EU's) Non-Nuclear Energy (NNE) Programme spent nearly €1 billion on energy research, technological development and demonstration projects (RTD), with the objectives of: 1) Improving security of energy supply, 2) Encouraging the rational use of energy, 3) Protecting the environment by reducing the impact of the production and use of energy, in particular the emissions of CO<sub>2</sub>, and 4) Strengthening the technological basis of the EU's energy industry.

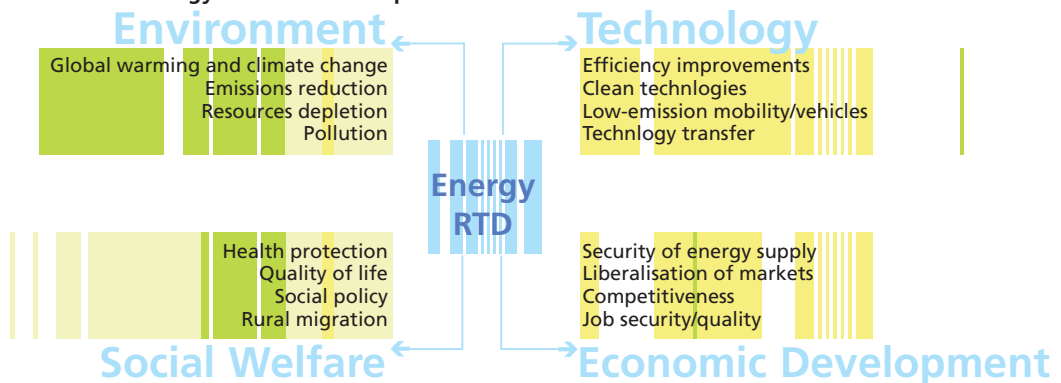
This document is the executive summary of a major impact assessment of this Programme carried out during 2002. It examines the impact of the projects in terms not only of the technologies developed, but also their impact in improving the environment and creating a sustainable economy, as well as other socio-economic effects, such as employment and education. It also investigates if the Programme itself could be better run and the money better spent. The full report is available at [http://www.europa.eu.int/comm/research/energy/gp/gp\\_pubs\\_en.html](http://www.europa.eu.int/comm/research/energy/gp/gp_pubs_en.html)

An outline of the methodology is included at the end of this executive summary. The context of the assessment is one of concern about global warming, about pollution from cars and electricity generation stations<sup>1</sup>, the security of supplies of oil<sup>2</sup>, as well as the ways in which we produce, transmit, and use energy. Our ability to improve these processes through energy RTD has implications for our future health, economy, and general well-being (See Box 1). But it is important to understand that energy RTD itself fits into a complex structure of industrial, economic and political challenges and opportunities which often determine the potential impact the research can finally produce (See Box 2).

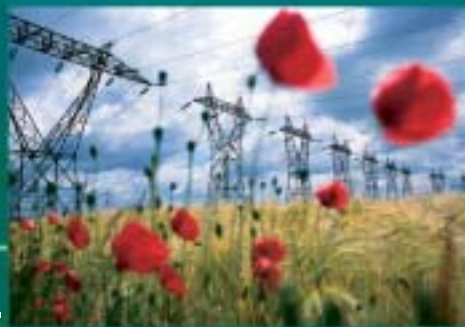
<sup>1</sup>In 2000, these two sectors emitted 60% of total CO<sub>2</sub> emissions in the EU; transport made up 46% of NO<sub>x</sub> emissions and CO<sub>2</sub> 57% (source: DG TREN "EU Energy and Transport in Figures, 2002").

<sup>2</sup>In 2000, the EU imported 75% of the oil consumed (source: DG TREN).

## Box 1: Energy RTD: A broad impact on the EU



# THE ENVIRONMENT



## Box 2: The context of European energy research

In assessing ways of improving the impact of energy research and technological development (RTD), a number of non-technical factors must be considered. The political, economic and social environment into which the RTD flows strongly conditions its impact:

- High-energy prices dramatically increase the economic benefits of research. Low prices make renewables (i.e. renewable energy sources) and RUE (rational use of energy) uneconomical and their research ineffective. Government policies on pricing and taxing energy sources are critical in the effectiveness of energy RTD.
- Of course, a national policy framework for renewable energies with various supports, subsidies or credits makes renewables more viable and the research undertaken much more useful.
- The type of energy need and solution may vary with the physical and economic nature of a region (not only with geography and climate but also with population density, historical infrastructure, etc.). The same energy RTD can have very different levels of impact across Europe.

Thus, improving the impact of energy RTD is not simply a matter of running more *efficient* RTD programmes. It requires RTD objectives to be attached to strong and reasonably stable, politically determined energy policies. This is not an easy matter. For example:

- The main barrier to the use of renewables is cost, despite the reductions achieved through public and private research (wind energy costs have been halved in the last decade). Yet, the lack of political will to ensure full-cost pricing, particularly the negative environmental and health costs, hinders the development of clean energy sources and hence the effectiveness of any research on renewables.
- The cost of money puts at a disadvantage projects with high initial investment but low running costs, such as renewables and RUE. Such costs can also marginally disadvantage any efficiency gains from RTD work. Similarly, high upfront costs for the integration of renewables into the main electricity networks are particularly disadvantageous.
- The liberalisation of electricity markets and the subsequent drop in energy prices have caused further difficulties in adopting more expensive clean fuels. Some energy RTD outputs require a far more flexible, receptive and open market if they are to succeed. Governments and regional authorities and, indeed, energy utilities need to become more flexible, organisationally open to new sources of energy, and financially more sophisticated in assessing their potential.
- Finally, relatively weak information networks disadvantage, both directly and indirectly, the use of renewables and RUE and the impacts of any RTD undertaken.

# THE NON NUCLEAR ENERGY (NNE)

The NNE Programme was launched in 1994 as a part of the EU's Fourth Framework Programme for research, technological development and demonstration activities (FP4), the overall structure within which the EU undertakes its research and technological development (RTD), including demonstration projects. Its €971 million made up almost 10% of total FP4 funding and was divided administratively between two of the European Commission's Directorates-General (DGs):

- Directorate-General for Research, which received €460 million to part-fund (up to 50% of costs) research projects<sup>3</sup>, and
- DG Transport and Energy (DG TREN), which received €517 million to fund near-to-market demonstration projects (up to 40% of costs) as well as support measures<sup>4</sup> (up to 100% of costs).

Research and demonstration activities were divided into four thematic sectors (Box 3).

- Rational use of energy (RUE), which included work in areas such as energy efficiency in buildings, industry, and in transport systems, as well as the development of fuel cells.
- Renewable energy sources including their use in buildings and industry, wind energy, solar photovoltaics, energy from biomass and waste, and energy storage, etc.
- Fossil fuels including oil, gas and coal, and associated clean technologies.
- Socio-economic analysis, policy and modelling (called RTD Strategy).

## THE INPUTS

The budget breakdown by activity and sector is shown in Figure 1. Here we see the research budget spending strongly on renewables, with relatively little to fossil fuels and RTD Strategy research. The demonstration budget was evenly divided across the different sectors. The support measures budget was small, only 7% of the total. The budget supported 57% of the total costs of research projects – a leverage ratio of 1.8, and 33% of total costs in demonstration projects – a leverage ratio of 3.

<sup>3</sup>Research projects were managed under a sub-programme called "JOULE".

<sup>4</sup>Demonstration and support projects were managed under a sub-programme called "THERMIE". The management was undertaken by DG Energy until 2000, when it merged with DG Transport to become DG Energy and Transport (DG TREN).

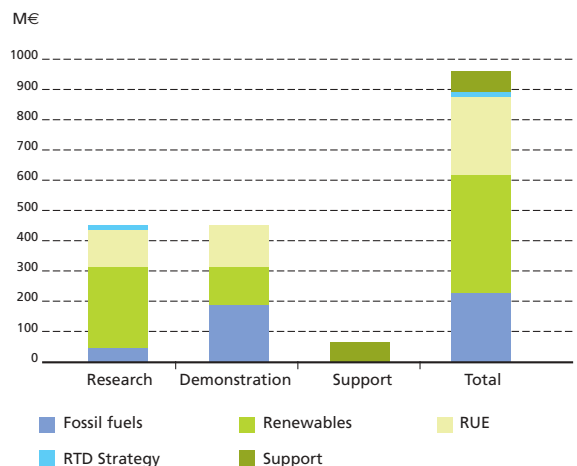


Figure 1: Programme budget by activity and sector



# PROGRAMME

## Box 3: Examples of research and demonstration projects supported by the NNE Programme

### Rational use of energy (RUE)

- Smart controls and thermal comfort;
- Absorption chiller for buildings: air-conditioning with efficient, flexible operation;
- Development of an energy optimiser for asynchronous motors;
- Clean and efficient new transport approach for urban rationalisation;
- Advanced solid polymer fuel cells for operation at temperatures up to 200°C;
- Safe and high-density lithium battery module for electric vehicles; and
- European integrated hydrogen project.

### Renewable energy sources

- Certification and standardisation issues for sustainable PV market in developing countries;
- Optimisation of converters for building integrated photovoltaic systems;
- High throughput crystalline silicone solar cell key manufacturing technologies;
- Pilot production of thin films for photovoltaic modules;
- Design and prototype production of a wind turbine rotor blade for the 46-50m diameter class;
- Pollutants reduction in small biomass combustion systems; and
- Optimising the performance – economic and technical – of tidal current turbines.

### Fossil fuels

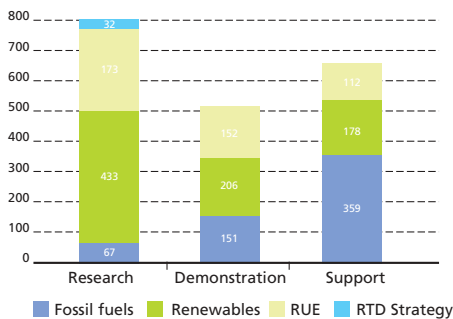
- IGCC and circulated fluidised bed for clean coal technologies;
- Pre-drying of moist fuels for power production;
- Direct injection engine technology for Europe;
- Characterisation of exhaust particulates and their contribution to air quality;
- Detection of over-pressure zones from seismic and well data;
- Estimation of reserves potential for near critical systems; and
- Decommissioning of complete offshore deck units.

### RTD Strategy

- Industrial benefits and costs of greenhouse gas-abatement policies;
- Energy technology dynamics and advanced energy system modelling;
- European emission mitigation policy and technological evolution;
- Non-technical aspects of demand-side management in European electricity markets;
- Reducing barriers to energy efficiency in private and public organisations; and
- Voluntary agreements – implementation and efficiency.

This budget was used to fund nearly 1 900 projects, as shown in Figure 2. Immediately obvious is the large number of small support measures, with an average size of only €160 000. The average size of the three main sectors of research projects was €1.16 million, with the RTD Strategy projects somewhat smaller at €0.69 million. The average size of demonstration projects was about €2.7 million.

Figure 2: Number of projects by activity and sector



## THE OUTPUTS

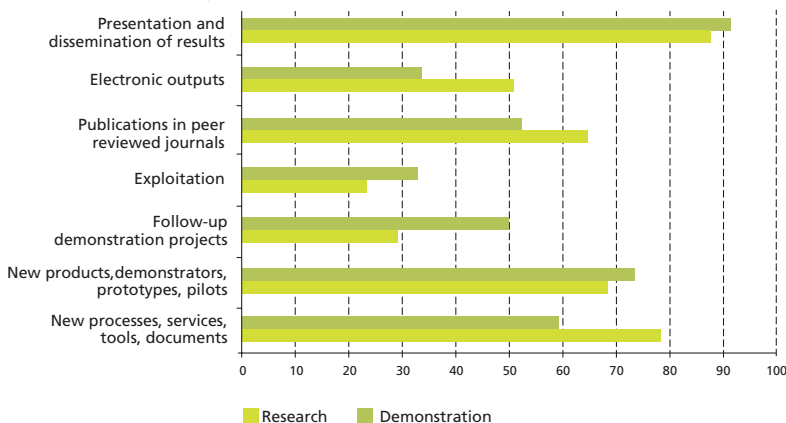
The pattern of outputs from research and demonstration projects is shown in Figure 3. It is important to remember that these outputs are *not* impacts. Rather, they are the raw material projects need to work with to

achieve an impact. This additional step, turning outputs into impacts, is one of the most critical issues in an effective RTD programme, the more so in the political world of energy research. About 90% of projects made presentations and undertook dissemination activities. One of the main project outputs was new products and processes which were developed by about 70% of projects.

The technical output from research and demonstration projects was good. The Programme resulted in about 400 applications for patents protection, more than 800 articles in peer-reviewed articles and the involvement of 1600 new partners not previously involved in RTD activities. About 30% of the projects made some form of technical breakthrough. In total, about 60% of the projects resulted in significant technical advances compared to the state of the art. Approximately two-thirds of the projects achieved their objectives in full.

The support measures also added to Programme outputs. Through these projects alone, it is estimated that an impressive 75 000 people attended workshops, conferences, and seminars financed by the support measures during the life of the Programme. Around 3 500 pieces of published material – CDs, books, pamphlets, and brochures – were created by the support measures.

Figure 3: Outputs of research and demonstration projects (% of assessed projects)



We now turn to the impacts of the Programme. In the next section, we will look at the socio-economic impacts and in the following section the technological impacts.



# SOCIO-ECONOMIC IMPACT

The projects had two types of socio-economic impact: 1) on EU policy objectives (economic, employment, environmental, legislative and educational) and 2) on the participants in the projects, themselves. Here we are moving from the outputs of the research and demonstration activities of the laboratory to the impact of the projects on the wider society and economy. As long as research remains in the laboratory, it has little impact on the wider society.

Overall, the survey of some 700 projects showed that the support measures have a near immediate impact, while demonstration projects deliver most of their impact, technical and non-technical, by project-end. Research projects, on the other hand, deliver technical innovation at project-end, but then take a number of years to deliver the wider socio-economic impacts.

## IMPACTS ON EU POLICY

### **Environmental and S&T impacts:**

Across all types of project, the two outstanding areas of impact were improving scientific and technical quality – 93% of projects had an impact, with 30% having a “highly positive impact”, and environmental impact – 94% having an impact and a quarter having a highly positive impact.

The major environmental impact concerns reducing pollution and CO<sub>2</sub> associated with energy production and use. The Programme’s smaller, more immediate support measures had a particularly strong impact. On the other hand, research and demonstration activities look towards new, more efficient technologies and operate with a longer time horizon.

Overall, the Programme activities delivered a logical structure of S&T impacts: research projects were particularly strong in the production of new knowledge and expertise; demonstration projects emphasised the strengthening of EU industry, and support activities excelled in technology transfer and networking. Overall, more than half the projects felt they contributed to moving the EU towards global leadership in their area.

### **Economic, commercial and employment impacts:**

These are extraordinarily difficult questions for RTD projects as the impacts are often indirect and occur long after project-end. Judging from the survey, the projects made a good contribution to economic development.

Almost half of the demonstration projects and one-third of research projects led to cost reductions. Positive return on investments was expected by the partners in half of the demonstration projects and one-third of the research project partners.

The question of employment impacts brought forth indications of non-relevance and difficulties in assessing this, as well as no response from some. This has implications for the usefulness of employment considerations in RTD proposal evaluation. Only 38% thought that they had some impact on employment.

Over time, there is a general progression for research projects, from national/EU markets on to EU and global markets. In demonstration projects, fossil fuels projects tend towards EU and global markets, whereas RUE and renewables projects emphasise local, regional, and national markets.



### **Quality of life, education and legislation impacts:**

Over half the projects had an impact on quality of life, with the short-term impacts of the support measures showing most strongly.

The educational impacts were strongest – on a per-euro basis – for the support measures where the direct industrial education and training and dissemination activities were very effective, as well as changes in final consumer behaviour. Research projects with their postgraduate training dimension had stronger educational impacts than the demonstration projects.

Generally, legislative and regulatory impacts were the lowest (along with employment) in the survey. However, many renewable and RUE projects helped to establish a good basis for the development of certain pieces of local, national and community legislation. The further proposed Directives on renewables electricity, cogeneration, and bio fuels took as a basis the results of the projects. The RTD Strategy (i.e. policy analysis and modelling work) had an extraordinarily high impact in this area, presumably from engaging directly with such issues.

### **IMPACT ON PROJECT PARTNERS**

Looking at the impact undertaking the project had on the project partners, the very different nature of impacts from research and demonstration projects is striking.

Demonstration projects delivered strong immediate innovation and cost-reduction impacts to participants. But there was relatively little increase in impact levels once the project had been finished – except in the area of improving market penetration and a steady improvement in cost savings.

Research projects, on the other hand, saw much weaker impacts at project-end, although indications of improved innovativeness were high. Over time, the indicators of impact increased to the same levels as those of demonstration projects, with very strong increases in markets and cost improvements. How far this “drawing level” is a reality rather than a statistical artefact is difficult to tell.

For research projects, the main impacts were an increased number of new products and services, improved educational base, and increased innovation performance. Research projects do not directly internalise the cost benefits of their own research.

Turning to demonstration projects, the differences were striking. Direct energy savings for technology users are now a major issue. RUE projects consistently rated it as a top impact and projects on renewables ranked it strongly. Unlike research projects, cost factors were highly rated for RUE demonstration projects, but fell away for renewable and fossil fuel projects.

# TECHNOLOGICAL IMPACTS

Overall results:

- Two-thirds of the projects achieved their objectives completely.
- About 60% of the projects resulted in significant advances compared to the state of the art, and 30% resulted in technical breakthroughs.
- About 60% of the projects aimed at energy efficiency improvements and resulted in average efficiency gains of 30%.
- The co-operation between industry and RTD was strengthened as a result of the Programme in more than 60% of the projects; industry provided half of the cost of demonstration activities.

## RATIONAL USE OF ENERGY

RUE in buildings has achieved a mature state where certain, but incremental progress can be expected. Specific research dealing with indoor air quality and the adequate maintenance of ventilation plants in buildings went beyond energy efficiency and contributed positively to the quality of life and health. In some targeted demonstration projects involving more than 50 cities, a global concept for buildings was developed, including urban planning, good integration of bio-climatic design, integration of renewable energy sources, use of efficient technologies, and appropriate use of buildings.

RUE in industry has a high potential in Europe (and even higher in developing countries). It is, in many cases, on the verge of profitability and "process intensification" has a huge replication potential. Projects here helped increase the international competitiveness of European industry, both

for the consumers and the manufacturers of energy-efficient equipment.

By far the greatest compound impact regarding energy saving, pollutant abatement, social effects, and European added value could be observed from the clustered and targeted demonstration projects in transport. More than 60 cities were engaged in these projects to develop, demonstrate, and operate clean and efficient urban transport.

Fuel cell research leapt ahead in technical progress, but is bound to need possibly another ten years to become commercially viable for everyday mobile applications. For stationary applications, the time would appear to be much shorter.

## RENEWABLES

Many projects aimed to achieve major cost reductions per unit of electricity generated. A number of possible ways have been proven, such as increasing efficiency of energy conversion devices, reducing the production cost of equipment, using cheaper feedstock, and adapting conventional equipment to use renewable energy sources. One project even resulted in the setting up of a pilot production line.

Some projects have considered the possibilities of integrating renewable energies into the economy and the daily activities of EU citizens, as well as within the EU energy system. This issue needs to be further addressed in the future.



## FOSSIL FUELS

The innovative technologies developed in hydrocarbon exploration and exploitation have proven to be of exceptional value, where methods and techniques have been demonstrated and, in a majority of cases, used by the industry.

The results obtained on the safety of pipelines and in the decommissioning of oilfield and offshore platforms, and the technologies developed and implemented, had the most beneficial impact on the environment and the best return on investment of taxpayers' money. The innovative technology for the decommissioning of a complete deck unit offshore in adverse weather conditions, demonstrated in the open seas and proven, has been one of the most successful stories in industrial technology.

The projects on new clean technologies achieved positive results with an overall improvement in efficiency and environmental performance of solid fuel electricity generation.

The results obtained in the development of new, more efficient and less polluting engines can be used by the European authorities for improved quality standards for the reduction of emissions in the urban areas and for guidance in future legislation on automotive pollutants.

The support measures are effective activities for achieving short-term objectives. They are most useful in technology transfer to industry and in achieving the application of existing technologies, as well as in the implementation of policy which has already been developed.

# IMPROVING THE IMPACT OF ENERGY RESEARCH

## INTEGRATION INTO EU AND MEMBER STATE CONCERNS

Perhaps the strongest and most consistent message across the impact assessment is the absolute need to integrate technical research and demonstration activities with the political, social, and economic structures of both the EU and Member States – strategically, in the planning of the Programme and operationally, in the undertaking of the projects. All programme activities indicate that the more successful projects have engaged strongly with the non-technical, external world. This is most obvious in the commercialisation of research and demonstration projects, but extends into areas such as impact on legislation and regulation, impact of energy modelling on policy, and so on. Unlike other RTD fields, successful research and demonstration projects in energy add major social, economic and political components to the technical experiments – and should be recognised *and financed* as such.

## DEVELOPING A PROGRAMME IDENTITY AND DIRECTION

There were many indications that projects themselves felt isolated – that they were acting alone, and had little contact with other projects or the Commission. Of course, much has changed within the Framework Programme since these FP4 projects finished – but a number of useful points can still be made.

A programme is not simply a collection of projects in the same research area. Synergy and coherence in their widest sense are necessary if the programme – as opposed to the individual project – is to have maximum impact. The major suggestions from projects and experts to improve synergy were to:

1) better inter-link projects in similar or contiguous areas, and 2) increase information flow between different projects, activities and sectors.

Programme coherence might be improved by:

- | Developing tools to maintain programme focus. For example, rapid feedback from project selection results to help orientate the subsequent work programme and develop the wished-for project portfolio.
- | The strong use of support measures to develop programme structure and solidity.
- | Developing both Commission- and project-level extramural activities to create a global programme identity.
- | Increasing the linkages between the programme and its work programme on the one hand and the socio-economic concerns (legislative, commercial, policy related, political, etc.) of Member States, on the other.
- | Promoting the programme's "global approach" in the framework of the ERA, establishing common tools in the Member States.

## PROJECT SELECTION

Proposal evaluation has implications for both Programme and project quality as well as coherence. Projects failings included projects which were:

- | Already covered or being covered at the same time in other EU or non-EU countries;
- | Too far away from technical or commercial viability at a mid-term horizon;
- | Lacking the prerequisites of available technologies or expertise in the consortium; and
- | Financed incompletely.

Stronger Commission policy around the call for tender/proposal evaluation could be helpful. A number of areas were mentioned:



- | The selection of evaluators to assure technological and industrial knowledge;
- | Better information to potential proposers about current research and demonstration activities across the EU – possibly operated as a support measure, and a stronger requirement to have already explored and be familiar with the state of the art; and
- | Stronger requirements on partnership structures.

The use of indicators of “employment creation” and “economic potential” in proposal evaluation should be reviewed. The survey showed the use of these indicators was particularly problematic.

### CREATING RESEARCH PARTNERSHIPS

Care with partnership formation is crucial to project success.

- | Developing appropriate partnership skill mixes is, of course, essential and, while differing from sector to sector, seems to be reasonably well understood. Large partnerships present particular difficulties ranging from integrating disparate technical skills to difficulties in simply respecting reporting deadlines.
- | Including, in the broadest sense, the “end-user” *within* the project seemed to be essential. Given the well-documented problems of technology transfer and the not-invented-here syndrome, an active role for the institution(s) was recommended which would eventually bring work on to a broader commercial or public stage. Such persona ranged from policy developers in the energy administrations for energy models, to appropriate commercial companies for exploiting new improvements in fuel cells, to NGOs as activists and publicists in the field. Even the

smaller projects involved in support measures pointed to similar needs.

- | Greater guidance supervision from the Commission services on the formation of partnerships, their structure and functioning, might be helpful. More flexibility in drawing more partners in, when necessary, was seen as useful. A broader use of sub-contracting might both strengthen the project, and involve SMEs and NGOs in a more appropriate and less bureaucratic manner.

### PROJECT MANAGEMENT

Project management was called into question from two aspects:

- | The management of the projects by the Commission services; and
- | The internal management of the project.

*As regards Commission management*, there was a call for greater contact with the project officer at a number of levels, ranging from cross-project information and attendance at project meetings to management advice. At the same time, for the benefit of the Programme as a whole, there is a need to reorient project officer effort from the detailed administrative management of individual projects to overall programme management and improvement. In this conflict of resources, consideration might be given to the externalisation or centralisation of project officer administrative functions, and moving project monitoring from an administrative annual report system to a critical milestone approach. Strong, consistent, quality improvement systems could also relieve the administrative burden. Increasing the formalised input of project officer experience and insight into the development of programme management



systems has been successfully launched in some parts of the FP – such techniques might also be helpful in the energy area.

*As regards internal project management, difficulties were identified relating to the need for consistent and dedicated manpower. The task of coordinating a multinational research or demonstration project is enormous. There is a positive correlation between the size of the consortium and the problems that can occur in the course of the project. It was suggested that an independent professional project manager, neither engaged in the research directly nor employed by a member of the consortium, should be employed for the term of the contract.*

## PROJECT FUNDING AND CONTRACTING

A common finding across Programme activities was that project-funding mechanisms need to be matched to project requirements, if the project is to be effective.

- The pace and time horizons of much energy research are not the same as those of the life sciences or information technology. Success horizons for many research and demonstration projects can be quite long. Funding a consortium over longer periods may be helpful. This may occur in a number of guises: longer contracts for the same funding, repeat or periodic funding, and so on – but with the objective of maintaining a consortium and a certain research momentum. This is particularly true for non-mature technologies such as fuel cells.
- EU energy models require to be regularly updated, a near impossible task using national funding structures. Similarly, EU

level information and analysis from such work requires ongoing diffusion, thereby arguing for a constant EU-funding structure.

- Support projects, in particular, emphasised the need for strong, well-planned, and targeted activities, delivered rapidly to “customers” who could use the project results. This requires rapid financial decision and payment structures to be developed by the Commission.
- There is a need to introduce some flexibility in the contractual arrangements to permit modifications in the work programme to adjust, while the project is ongoing, to the industry requirements, economic climate, and changes in market forces. This may be all the more necessary in energy research and demonstration with, for example, the need for weather windows for trials – requiring work programme time schedules to be flexible.

## DISSEMINATION

- Dissemination of information and results outside of the consortium is generally seen to be weak. Dissemination is too often seen as an end-of-project burden which occurs when the project is running out of energy, money and, possibly, commitment. There is a need for explicit planning and funding within the project consortium for a dissemination phase.
- Possible diffusion activities undertaken by the existing consortium may range from the provision of training courses to workshops and seminars, to consultancy packages, depending on the nature of the project. Active development of a shared website from day one for project management and dissemination was seen as a basic element.



- Diffusion of research results across the EU is, however, a special skill and it was suggested that, in many cases, this might best be done via a specialist commercial firm rather than the technically focused researchers themselves. An allied approach to support the major ongoing development of energy-related software and engineering systems was to form a specialist EU-level open forum for such activities. In a similar vein, an information network, like the Caddet network of the OECD, could serve as a model for other energy-related technical information.
- Incentives and/or procedures for follow-up actions (dissemination and marketing activities, successor projects, etc.) should be envisaged for successful projects.
- Finally, the most effective and surest form of dissemination is commercialisation of the project results. Projects which reach commercialisation have a far greater impact than any other. This should be a project objective from the start.

### IMPACT ASSESSMENT

There is a need to develop *both* project and programme management structures which will:

- Turn the collection of project impact information into a simple, regular and formal activity, and

- Make the use of impact assessment an explicit, regular part of programme management.

In terms of programme management, information from impact assessment can be integrated into improving proposal evaluation systems, improving partnership selection and management, and so on. The basic requirement is to interface the impact assessment with the programme's continuous improvement/quality improvement system.

This current impact assessment is at the forefront of FP work in the area, both in timing and scale. It has developed much experience and expertise. Other FP programmes are currently planning similar exercises, as well as planning for future FP6 project and programme impact assessment. Lifting impact assessment up to a coordinated Framework Programme level could have many advantages, ranging from assessment costs, experience sharing and improving methodological approaches to comparability of results across programmes and better planning at a Framework Programme level. The experience gained by DG Research and DG Transport and Energy might be used to further such an FP-level approach.

The three key issues in the improvement of the impact of the NNE Programme are:

- The absolute need to reorient and re-engineer *both* projects and Programme to actively participate in the social, economic, political, legislative, and especially commercial framework of Member States and of the EU. Energy RTD is a profoundly socio-economic activity.
- The need to build programme coherence and identity; making the programme more than the sum of their parts. Equally, this coherence and identity applies to the other non-technological programmes, such as SAVE, ALTENER and their successors.
- Putting in place, by programme management, a continuous improvement system which covers management processes from setting work programmes to undertaking impact analysis.

# CONCLUSIONS AND RECOMMENDATIONS

While these conclusions draw on our experience with projects undertaken during FP4, it is essential to recognise that the context of EU energy RTD has changed dramatically. Thus, our recommendations must be framed with FP6 as the background, while even looking towards its successor. In particular, we must recognise the future development of the European Research Area.

## THE CONTENT OF THE PROGRAMME

The Programme is structured along four major themes: renewable energy sources, rational use of energy, fossil fuels and a much smaller modelling and strategy area. Given that much of the NNE Programme took place before clustering became a recognised practice, two comments can be made:

- A more effective connection and bridging between projects would, of course, increase impact; and
- A more issue/problem-focused approach – for example, focus on “energy and buildings” or “energy storage” – would develop more coherent groupings of interest than the more conventional classification by energy sources.

## THE ACTIVITY OF THE PROGRAMME

Looking towards FP6 and the ERA, there is a major potential, particularly in the Integrated Projects, to fulfil even more effectively the EU energy objectives. The Integrated Projects, if structured correctly, have the potential to draw Member States into reflection and action on renewable energies and rational use of energy not only in technological research areas but also in regulatory, fiscal, and commercial areas. These extra additional dimensions, the demonstration and research

projects of the NNE programme found difficult to address, or felt outside their scope of competence. From the start, Integrated Projects in Energy should:

- Examine the feasibility of project structures, which group sets of “horizontally complementary” research needs.
- Ensure all projects have a strong extramural dimension.
- All projects should have explicit legal / tax / fiscal / commercial / publicity / political dimensions in its research and demonstration activities, as appropriate.
- Formally involve Member States administrations at a legal / tax / fiscal / political / publicity, etc level, as appropriate.

## MANAGEMENT OF THE PROGRAMME

### Formalising extramural linkages

As we have seen consistently at the project level and in the sectoral reports, projects which have integrated into the external legislative/administrative/commercial/policy world of the Member States have had a greater overall impact than the purely scientific and technically focused projects. The issue is how can we best institutionalise such an extramural dimension at both a project and programme level. The basic recommendation is to provide structures in which EU energy RTD work programmes could be discussed alongside Member State programmes (and then, at a later stage, allied to micro-level specialised fora – wind, fuel cells, energy modelling, etc.). This might make a major contribution to forming high-impact projects, with strong extramural linkages built in from the beginning.

The suggestion for the EU work programme level is to complement the Programme Committee structure with a “high-status” system which formally reviews and discusses Member States’ energy RTD policy and programmes in an EU context. Here, it is suggested that the responsible ministry (ies) submit their energy RTD policy and associated programmes, on a regular basis, to the Commission for discussion in the context of developing the Commission’s work programme. While the narrow objective is to improve the type of individual proposal available for EU funding, the potential for developing synergy, concertation, and joint projects between Member States is obvious, as well as the possible contribution of such a structure to the development of an energy ERA. The direct involvement of both DG Research and DG Transport and Energy in the EU energy RTD programme is a major potential strength in developing such a structure.

#### **Internal management structures**

As we have seen, the Programme’s management structure is dominated by the

division of activities between DG Research (research projects) and DG Transport and Energy (demonstration and support measures). The new FP6 presents major opportunities to build a stronger, strongly coherent management structure. “Integrated Projects”, with their need for team management across research, demonstration and support activities, will provide the operational opportunity for the traditional divide – which has been criticised by some – to be overcome.

Energy is a relatively small element within FP6. Acting together, DG Research and DG Transport and Energy can be a powerful influence, within the Commission, within Europe and, indeed, globally, for high-impact, progressive and forward-looking energy projects and policy. The sharing of EU energy RTD responsibilities across two DGs should be seen as a major asset, given the “political-social” dimension of so much energy research.

Finally, in Box 4, we comment on the fulfilment of the Council Decision which set up the NNE Programme.

#### **Box 4: Delivery on Council Decision objectives**

Of the NNE Programme’s formal 1994 objectives in the Council Decision, the Programme’s two most striking successes have been:

- “Strengthening the technological basis of the energy industry”. The survey pointed to this as the strongest and surest outcome of the Programme. Only 7% of projects did not have an impact on the scientific and technical quality of energy RTD, while nearly one-third had a “highly positive” impact.
- “Protecting the environment by reducing the impact of the production and use of energy, in particular the emissions of CO<sub>2</sub>”. Again, the survey points to a strong and sure success. Only 6% of projects did not have an impact on the environment, while a quarter had a “highly positive” impact. At a more detailed level, the two strongest environmental impacts came in 1) reducing the impact of energy production and use, and 2) reducing CO<sub>2</sub> emissions.

The objective of “Encouraging the rational use of energy” was well met, but the survey does not show as strong a programme impact as in reducing the effects of energy production and CO<sub>2</sub> emissions. However, the individual sectoral report indicates much success.

It is more difficult to comment on the objective “Improving security of energy supply” since the Programme contributed to this goal at a number of levels (from better planning and policy to energy efficiency), without having a specifically targeted set of projects. All in all, there is no doubt that a significant contribution was made, but it is difficult to rank it alongside the other more focused objectives.

## Annex – The impact assessment methodology: a pyramid exercise

The impact assessment was carried out by a team of independent experts made up of:

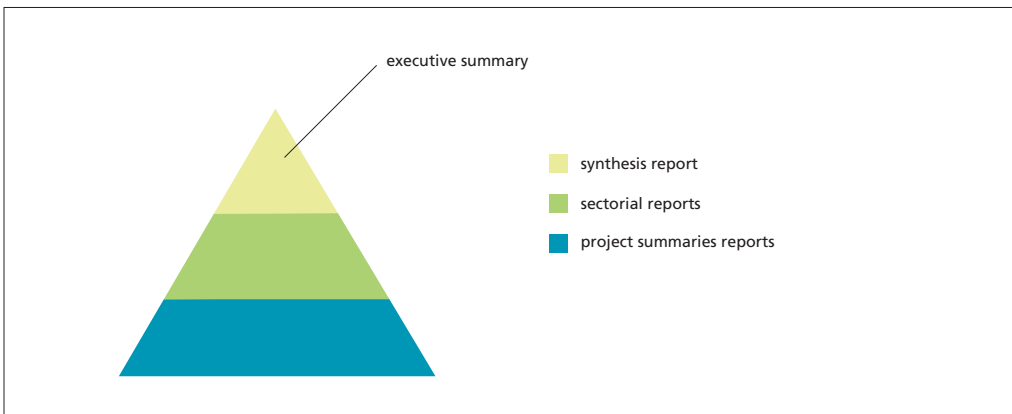
- A Core Group ensuring overall coordination of the assessment;
- A group of five thematic coordinators to coordinate work in their respective areas; and
- Some 29 experts charged with the evaluation of individual projects.

The impact assessment focused on a sample of almost 700 projects, comprising about 400 research projects (58% of all research projects), 70 demonstration projects (15% of all demonstration projects) and 215 support projects (33% of the total).

The impact analysis was organised into three main phases:

- An assessment of the impact of individual projects by independent experts. This included a phone or face-to-face interview with the project coordinator, a review of project outputs – most commonly the final project report – the administration of a questionnaire and, finally, the expert's written project summary. The project summaries are available on CORDIS.
- An assessment of the impact of the five main Programme sectors, based on the material from the above first phase: Rational Use of Energy (RUE), Renewable Energy Sources, Fossil Fuels, Socio-Economic Research & Modelling and Support Measures. The individual thematic reports, drawn up for each sector, are published as separate documents.
- The production of a synthesis report, based on the five coordinators' reports along with a statistical analysis of the questionnaires, and an extensive executive summary of the synthesis report are published as a separate document.

THE METHODOLOGY WAS DEVELOPED BY THE CORE GROUP IN COLLABORATION WITH DG RESEARCH AND DG TRANSPORT AND ENERGY.



European Commission

**EUR 20876/1 – CLEAN, SAFE AND EFFICIENT ENERGY FOR EUROPE**

**Impact assessment of non-nuclear energy projects implemented under the Fourth Framework Programme  
Executive Summary**

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This publication is an executive summary of the main results of a major impact assessment of the non nuclear research and demonstration energy projects from the Fourth Framework Programme (1994 – 1998). It examines their overall impact in different fields (energy RTD strategy, rational use of energy, renewable energies and fossil fuels) in terms of the technologies developed, and in protecting the environment and creating a sustainable economy, as well as other socio-economic effects, such as employment and education. Its main results can be linked to the actual energy policies which aim at reducing greenhouse gases and pollutant emissions, increasing energy supply security, improving energy efficiency, and increasing the use of renewable energy, as well as enhancing the competitiveness of European industry and improving the quality of life both within the EU and globally. A synthesis report and a thematic report of this study are also available on the following website: [http://europa.eu.int/comm/research/energy/index\\_en.html](http://europa.eu.int/comm/research/energy/index_en.html)