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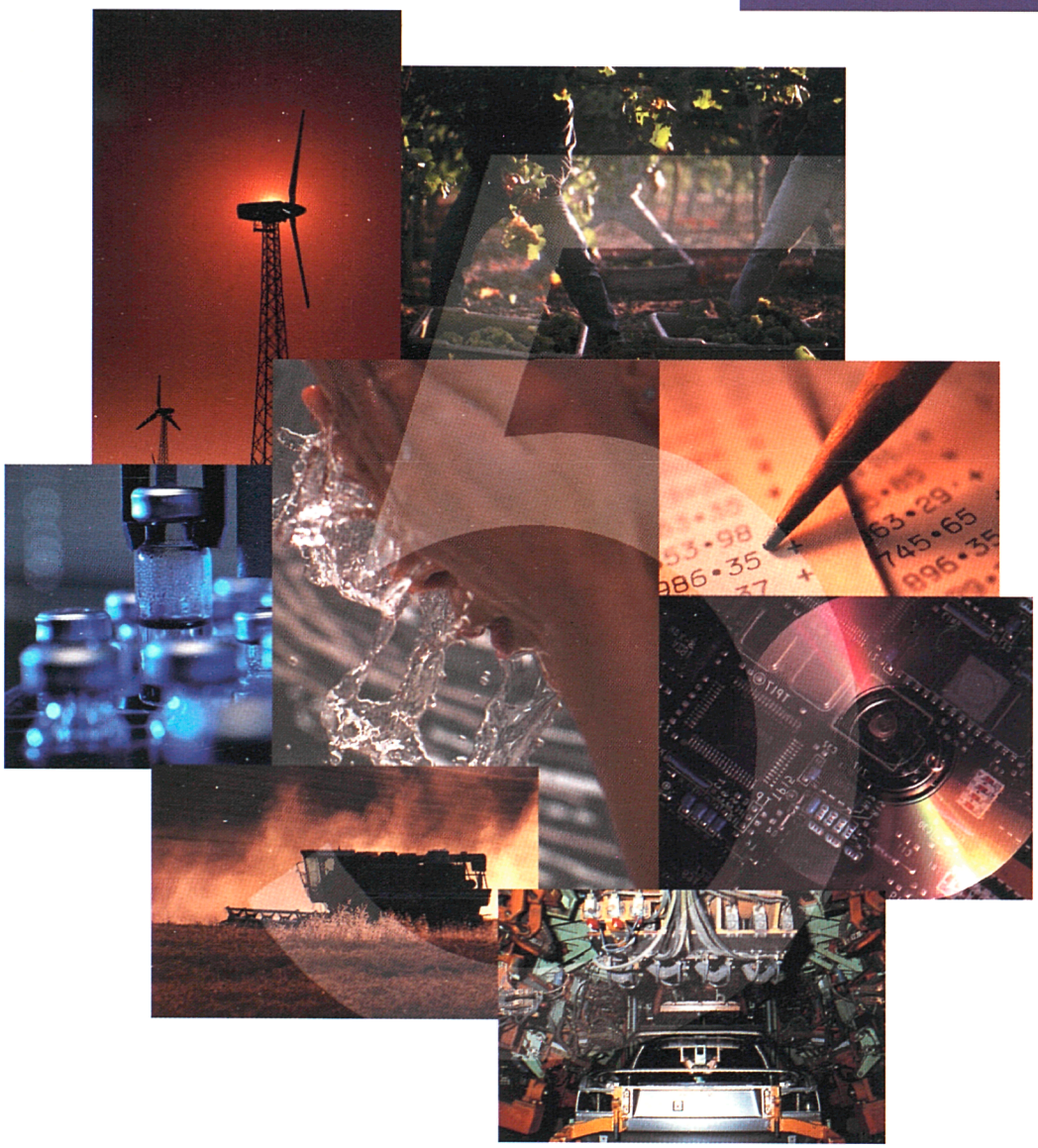

# The Fifth Framework Programme

## The research programmes of the European Union 1998-2002

EUR 18764


**EUROPEAN COMMISSION**

**Edith CRESSON,** Member of the Commission
responsible for research, innovation, education, training and youth.

DG XII - Communication Unit

*Contact: M. Michel Claessens - rue de la Loi 200 (SDME 2/82), B-1049 Bruxelles*
*Tél. (32-2) 299 18 65 - Fax (32-2) 295 82 20 E-mail: info@dg12.cec.be*



**Published by the EUROPEAN COMMISSION**

**Directorate-General XII - Science, Research and Development**





Cataloguing data can be found at the end of this publication.

Luxembourg: Office for Official Publications of the European Communities, 1999

ISBN 92-828-5811-1





*Printed in Belgium*

PRINTED ON WHITE CHLORINE-FREE PAPER

# The Fifth Framework Programme

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## Foreword

## Building the future by inventing tomorrow

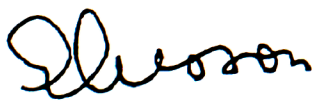
Research and technology not only supply solutions to the questions we raise, they also provide us with innovations and solutions to the problems we encounter, such as those related to employment, health, the environment, the energy supply, transport and mobility, education and training.

European research must "Invent Tomorrow", joining forces to understand the world in which we live better, to solve the problems of today and anticipate those of tomorrow, and to improve our way of life.

With this in mind, the Fifth Framework Programme, which will cover all European Union research from 1999 to 2002, occupies an essential and central role. Essential, because it should enable Europe to invest more - and more effectively - in several up-and-coming sectors; central, because - in the fields it covers - it will contribute real added value to the activities of the Member States.

In order to respond to the challenges of the 21st century, and of globalisation, the Fifth Framework Programme, which is unique as a means of conducting research in Europe, has had to evolve considerably in relation to the programmes which preceded it. From research concentrating largely on technical performance, we are moving to research focused on the social and economic problems faced by individuals, research designed to bring about the changes they require. At the same time, new methods of management have been implemented to make it easier to participate and to accelerate the decision-making process.

Through a multiplicity of scientific exchanges, links and networks, the growing cooperation catalysed by the European Union is building up the European scientific community. Quite apart from the direct research results, this cooperation constitutes a solid base from which Europe can invent tomorrow and build the future.



Edith Cresson
Member of the Commission responsible for research,
innovation, education, training and youth

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## Introduction

This booklet provides a general introduction to the programmes and principal topics of the Fifth Framework Programme, which encompasses all European Union research from 1999 to 2002.

It is intended for the reader who wishes to have an overall picture of current Community research, which means of the Fifth Framework Programme. Those who would like more detailed information, perhaps with a view to participating, will probably want to consult other sources, such as the information packs of the specific programmes.

The booklet comprises three main parts:

1. a general presentation of the Fifth Framework Programme and the policy behind it (below);
2. a description of the various programmes (pages 8 to 71);
3. some practical information on the conditions for participating in the programmes, together with sources of more detailed information (pages 72 to 73).

## A unique instrument for a common policy

The Fifth Framework Programme provides a uniquely coherent and truly European framework for supporting research and technological development as part of Community research policy, and effectively constitutes a four-year strategic plan. During this period, the programme will stimulate transnational collaboration in research, particularly between universities and industry, and the establishment of networks of excellence. This is one of the essential objectives of the Community research programmes.

It will also contribute to establishing an environment in Europe that is favourable to innovation. That means encouraging technology transfer, ensuring the availability of venture capital, helping to protect intellectual property rights, and developing human resources.

But if - today more than ever - science and technology are the driving force behind industrial development and therefore job creation, it is clear that in Europe, the drive belt connecting research and economic development is still too loose. It is on this point that the EU's new programmes will concentrate: putting research and innovation to work for precise socio-economic objectives, such as job creation, improved health, and increased personal mobility.

In short, the programmes of the European Union stimulate the mobility of both those involved and of ideas. That is fundamental, because technical and scientific knowledge is the principal raw material of modern industry.

In accordance with the principle of subsidiarity - which requires an activity to be undertaken at the level of the European Union only if that proves more effective than the national, regional or local level - the Fifth Framework Programme sets out Europe's major research priorities. The contents of this programme were defined by the Council of Ministers and the European Parliament, on the basis of the Commission's proposals, which themselves incorporated the wishes of those involved or concerned – the worlds of industry and science, consumers' associations, etc.

## The principal characteristics of the Fifth Framework Programme

The Fifth Framework Programme comprises four thematic programmes (covering a series of well-identified problems) and three horizontal programmes (responding to common needs across all research areas). The total budget allocated to the programme is 14.96 billion euros, funding three main types of activity.

◆ ***The key action***

This is one of the major innovations of the Fifth Framework Programme. The aim of the key action is to concentrate the resources and the skills of all relevant disciplines, technologies, and people on a series of well-defined socio-economic problems. A total of 23 key actions have been identified. The spirit of the key action is thus quite different from the traditional organisation of research with separate disciplines. Key actions deal with concrete problems through multi-disciplinary approaches involving all the interested parties.

◆ ***Generic research activities***

These activities support research work complementary to that undertaken within the key actions. They aim to maintain flexibility in the Fifth Framework Programme and to support research and development of generic technologies in up-and-coming sectors.

◆ ***Support for research infrastructure***

Although the construction and operation of research infrastructure falls within the competence of the Member States, Community support is justified at two levels: to ensure the optimum use of existing infrastructure, and to allow the rational and economically effective development of additional research infrastructures through transnational cooperation.

## The strong points of the key actions

- high-priority socio-economic problems;
- integration of research, demonstration, training and other activities;
- better coordination of research between Member States, countries outside the EU, international initiatives, etc.

The Fifth Framework Programme also incorporates changes in its management and implementation mechanisms. Among the changes are the simplification of procedures and quicker payments; greater involvement of industry, academia, and users in the management process (particularly through the 17 external advisory groups assisting the Commission on the contents and direction of the key actions); and the establishment of a more dynamic partnership with SMEs, especially through increased information and assistance.

## Two essential elements: high-quality research and international cooperation

But if the Fifth Framework Programme makes changes, it also fits into the tradition of the previous programmes. Thus, its objective is the development of a truly European scientific community, equipped with the best skills. Consequently, it will continue to support scientific and technical work of the highest quality, conducted by transnational partnerships. This will be accomplished by promoting researcher mobility, building on the success of the previous programmes, in particular the networks developed with the support of the European Union. All Community research can be summed up in these two fundamental principles: high-quality research, and transnational cooperation.

In addition to a series of independent programmes, the framework programme also implements a coherent set of additional measures. Generic research activities in priority sectors, international cooperation, dissemination and exploitation of results: all the links are there to form a genuine integrated and common European research and innovation policy. The results obtained, as well as the statements of programme participants, all point to the fact that if Europe has been able to gain - or regain - a lead in several scientific or technical fields in recent years, this has often been due to Community programmes facilitating the coordination of research efforts and/or the assembling of a critical mass of physical and intellectual resources.

A special effort will be devoted to SMEs, which constitute the principal source of jobs in Europe. Since, historically, they have had difficulties in taking part in Community programmes, they will benefit from specific measures and from individual assistance. More than 12 000 SMEs were involved in various projects in the Fourth Framework Programme (1994-1998), which was twice as many as during the previous framework programme. Today, European SMEs show more interest in Community programmes than in national programmes.

All this explains why the interest and the impact of this programme extends beyond the specialists, since it enables Europe to derive greater benefit from technological progress, in particular in terms of job creation.

# Thematic programme 1

The central topic of this programme is "quality of life". Quality of European life means the quality of our individual lives (especially in terms of health), quality of the environment, and quality of communal life, including enjoying the economic benefits of the expected developments in life sciences and technologies. In concrete terms, the objective is to support research aimed at development which is truly sustainable, both for individuals, society, and the environment.

Since the beginning of the 20th century, we have seen technical progress bring about an increase in the quality of life in both developed and developing countries. But this progress has a cost: there is an increasingly obvious difference between the demands of human activities and the availability of natural resources. Research and technological development is thus necessary to strengthen the bonds between society, the living world, and the environment.

This programme will contribute towards the achievement of that goal by means of three specific objectives:

- ***To meet socio-economic needs***

  The research envisaged is specifically intended to improve health, reconcile economic progress with environmental requirements, and improve the response to consumer needs. There is also huge potential for economic growth and job-creation in this field.

- ***To increase European added value***

  In all the fields covered by this programme, Europe adds value, either because the subject is cross-border by nature (e.g. environmental protection and management of living resources), or because it is worth studying at the European level (e.g. epidemiology), or because it has a direct link with Community policies (e.g. bio-ethics and biosafety) - in short, because the research, owing to its breadth or complexity, will be more effective if undertaken at a European level.

- ***To support European competitiveness***

  Developing sectors covering health, biotechnology, and the management of living resources, and creating the conditions for environmentally friendly economic growth should contribute to increased competitiveness and employment in Europe. For example, in 1997, the number of European biotechnology companies increased by 45%, leading to the creation of about 12 000 jobs.

To achieve these objectives, six **key actions** have been identified (see page 10 onwards).
Longer-term research activities will also be supported in the following **generic** fields:

- chronic and degenerative illnesses (in particular cancer and diabetes), cardiovascular diseases, and rare diseases;
- research on genomes, and diseases of genetic origin;
- neurosciences;
- public health and health services (including the fight against drug-related problems);
- research relating to the disabled;
- studies in biomedical ethics and in bio-ethics in the context of respect for fundamental human values;
- study of the socio-economic aspects of life sciences and technologies within the perspective of sustainable development (the impact on society, economy and employment).

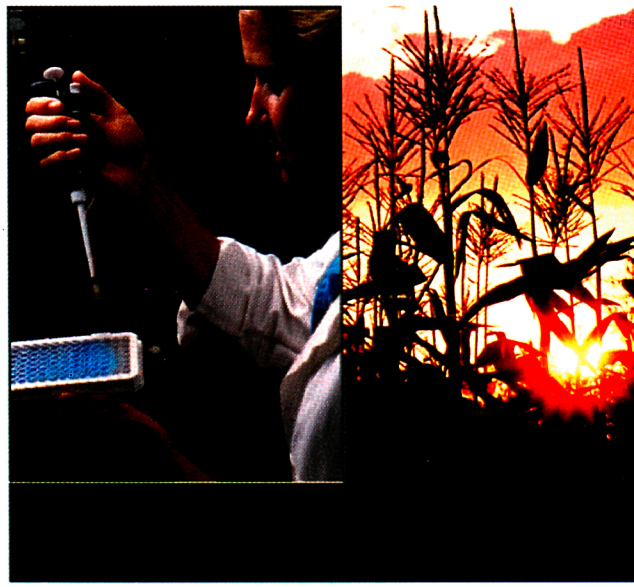
Support may also be available for the following research infrastructures, in particular with regard to their transnational coordination and their networking: biological databases and collections of biological material, clinical research facilities, facilities for aquaculture and fisheries research, etc.

## Health and the European approach

More than 10 million people in Europe suffer from diabetes. Often, the illness does not reveal itself until later in life, but one particularly serious form appears in childhood, affecting the person throughout their life. In this case, the only treatment consists of taking regular insulin injections. The European Union's *Eurodiab* project attacked this major problem by combining scientific work with observations carried out in various European countries. The results show that, although diabetes is genetically based, its incidence among children varies considerably between countries and over time. They also revealed the fact that the illness results from a complex interaction between genetic and environmental factors.

## Genetics, health, and agri-foodstuffs

In 1997, a project supported by the European Union finished the complete sequencing of the *Bacillus subtilis* genome, a bacterium of major scientific and industrial importance. This result, which involved the collaboration of 28 European laboratories, should lead to the development of new medicines to replace antibiotics which have become ineffective in the face of drug-resistant bacteria. Benefits are also expected in the agri-foodstuff industry.



The quality of food is important to Europeans, who expect the European Union to provide a framework guaranteeing the highest standards. The recent public concern about *mad cow disease* and transgenic maize illustrated the importance that the population attaches to food quality and the need to address this at a European level. But there is a second reason for a European approach: the fact that the European Union is the world's leading agri-foodstuff producer. This sector accounts for 16.5% of the EU's industrial production and is an area where continued competitiveness is absolutely vital.

The aim of this key action is to improve European health by supporting research designed to ensure the provision of safe, healthy, balanced and varied foodstuffs.

## Scientific and technological objectives

- ***New and/or improved manufacturing technologies that are safe and flexible***

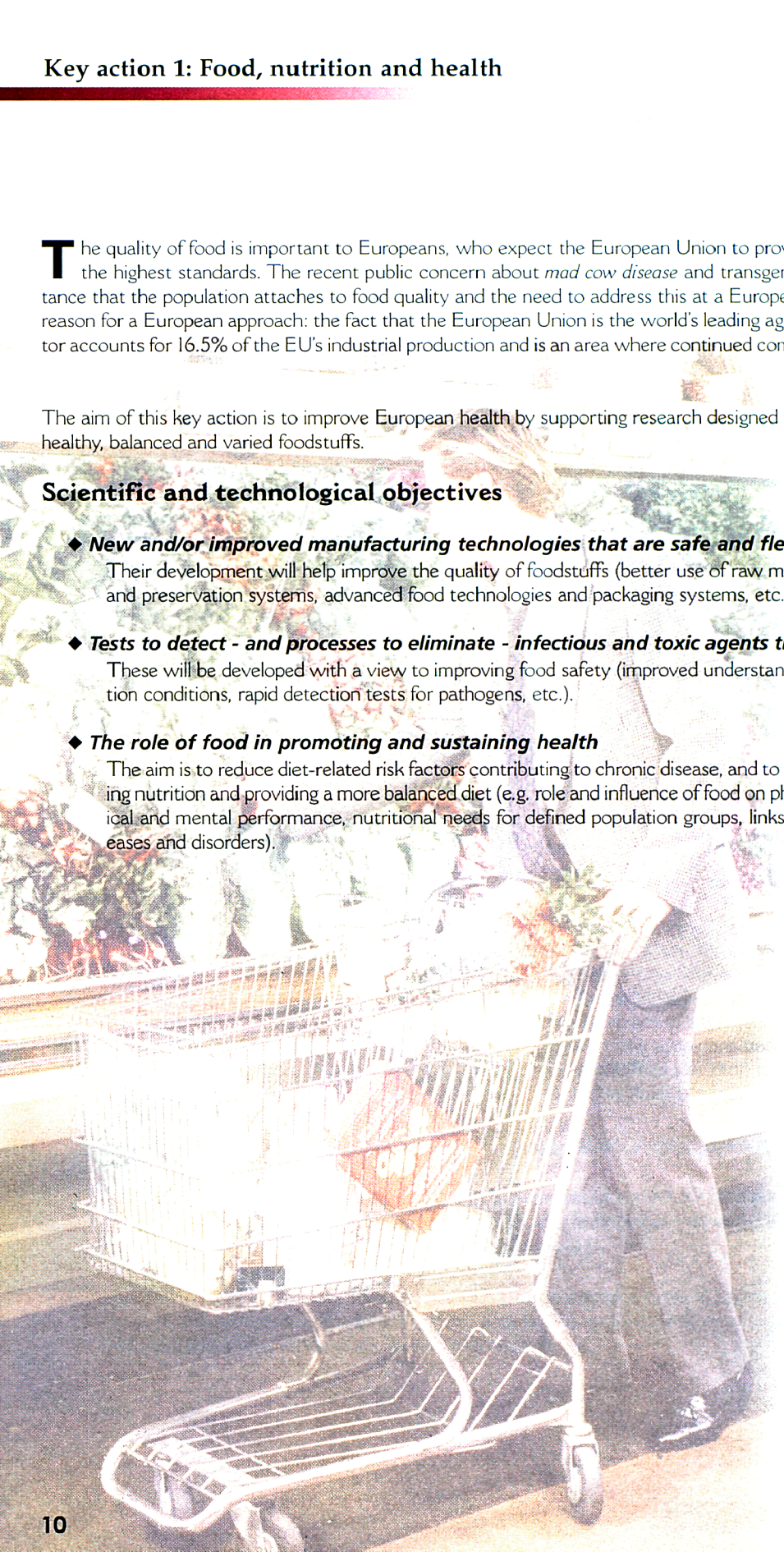
  Their development will help improve the quality of foodstuffs (better use of raw materials, production, processing and preservation systems, advanced food technologies and packaging systems, etc.).

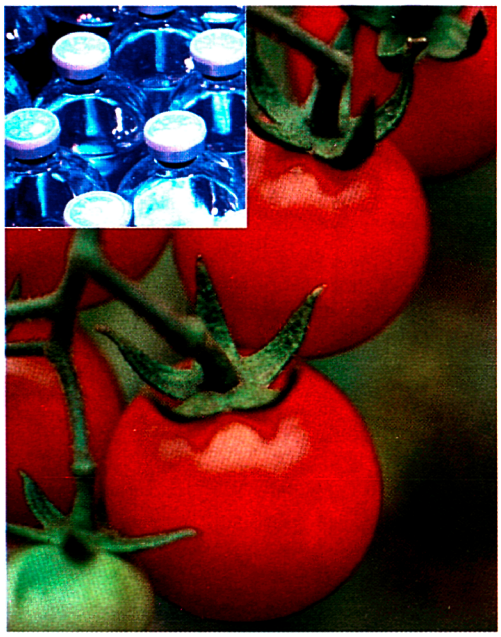
- ***Tests to detect - and processes to eliminate - infectious and toxic agents throughout the food chain***

  These will be developed with a view to improving food safety (improved understanding and control of contamination conditions, rapid detection tests for pathogens, etc.).

- ***The role of food in promoting and sustaining health***

  The aim is to reduce diet-related risk factors contributing to chronic disease, and to develop new ways of a improving nutrition and providing a more balanced diet (e.g. role and influence of food on physiological functions and physical and mental performance, nutritional needs for defined population groups, links between diet and chronic diseases and disorders).





## Functional foods help fight fat

Several EU projects cover "functional" foods (so called because they contain a beneficial element for health), which could represent a world market of 25 billion euros early in the 21st century. One study, for example, has shown the virtues of *inulin*, an ingredient present in numerous plants whose physical properties and texture make the industrial preparation of a substitute for oils and fats possible. This can then be used in a considerable number of low-calorie products such as margarine, cheese, and yoghurt, thus helping to reduce the risk of illnesses like osteoporosis and obesity.

Each year, infectious diseases are responsible for the death of 17 million people around the world, with 30 pandemics during the last two decades alone. In addition, epidemics affecting animals involve considerable economic losses for the European livestock-farming sector, most notably in the case of mad cow disease. Thus, despite significant medical progress over the 20th century, numerous infectious diseases are still resisting treatment. Research and development aimed at new therapies and medicines therefore remain a priority, while the world market for vaccines, which today is about 3.5 billion euros, could grow by almost 10% per annum in the years ahead.

In this context, the European approach is undeniably a plus. Multi-centre studies, for example, which consist of testing therapeutic strategies by comparing the results of various types of treatment across a broad network of hospitals in different countries, lead to invaluable statistical data which make it possible to identify new therapies and to accelerate both their development and approval.

In exploiting this European added value, the key action's aim is to support research to combat established, emerging and re-emerging infectious diseases. This involves mixing complementary expertise in transdisciplinary projects involving both public and private, national and international organisations.

## Scientific and technological objectives

- ***Development of improved or novel vaccines, especially against viral diseases***

  Examples include vaccines against emerging or re-emerging infectious diseases and other diseases related to infectious agents, such as some cancers; vaccines against animal pathogens; and support for multi-centre clinical trials.

- ***New strategies to identify and control infectious diseases***

  Research will address improved understanding of mechanisms of protection against infectious agents, of drug resistance and control of immunological responses; technologies for safer and more effective vaccines; and development of an early-warning system and response network for infectious diseases; etc.

- ***Public-health, healthcare and care-delivery systems - notably management, prevention and monitoring***

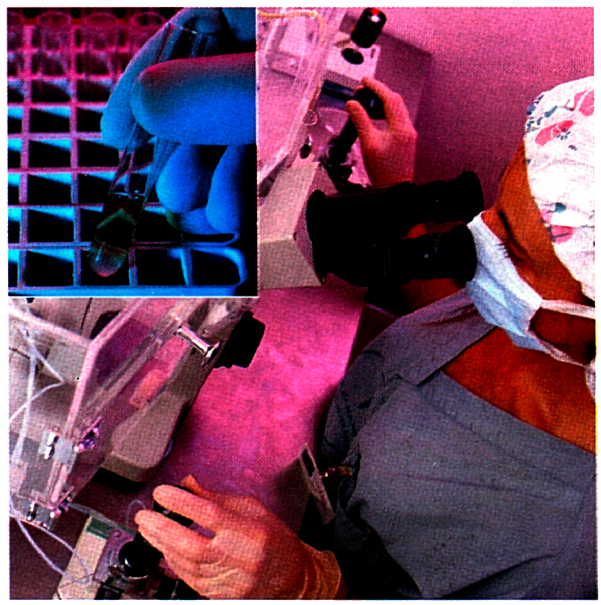
  This area covers the organisation and economics of public-health and healthcare systems; monitoring, follow-up and evaluation methodologies for prevention and treatment; and methodologies for monitoring product safety in the market-place.

## Edible vaccines

A plant that produces vaccines against three viral diseases specific to cats, dogs and minks is hardly commonplace. This "world first" is the result of a Community research project involving biologists from four European countries (E, DK, NL, UK). Experiments in progress indicate interesting possibilities for human health, too, and the large-scale production - by the plants themselves - of low-cost "edible vaccines" could represent a real revolution in pharmacology.

## The first synthetic vaccine

A European Union project is at the root of the first "synthetic vaccine". This vaccine is composed of a protein that provokes an immune response against a family of viruses that mainly infect animals – the *parvovirus*. Compared with traditional preparations, synthetic vaccines are both more economic and safer. In addition, they are not eliminated by the mother's immune system, which means they can even provide protection at the foetal stage. The results of the project, which could not have been carried out by one participant alone, are excellent: three patents have been filed, and negotiations are underway with a view to putting the product on the market – an obvious commercial benefit for the three project partners, who include a Spanish SME.



In the field of life sciences and technologies, the European Union has a significant research potential but - so far - applications have not reached a level commensurate with it. Efforts must therefore be made to bring the long-latent potential of bio-products – particularly in the areas of health and the environment – to the fore, so that Europe's companies can take full advantage of a world market which is forecast to reach 100 billion euros early in the 21st century, bringing with it up to 200 000 new jobs.

The aim of this key action, then, is to support the development of the European biotechnology industry and to increase the capacity of companies - existing or new - to exploit the advances made in life sciences and technologies. Given the number of fields concerned - health, environment, agriculture, agro-industries and high value-added products, such as chemicals - the results of this work are likely to bring widespread benefits to European society, and to every individual, too.

In fact, thanks to the combination of scientific and technological approaches associated with the disciplines concerned, this key action should make it possible to understand the operation of the miniature "factories" constituted by living cells, in order to reproduce this on an industrial scale.

## Scientific and technological objectives

- ***New health-related processes and products particularly from molecular engineering***

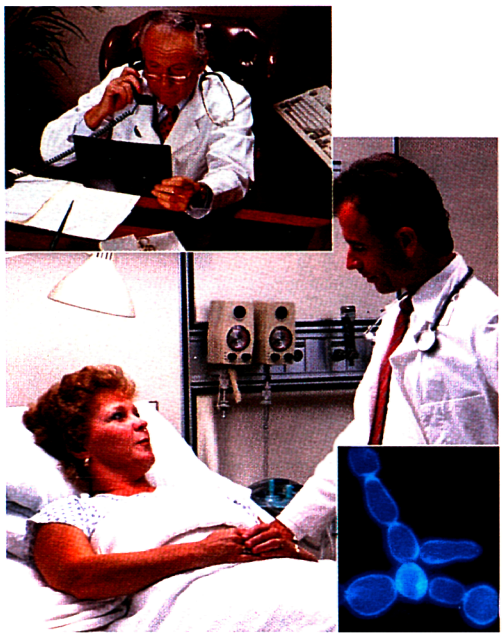
  Research will focus on treating diseases and improving the quality of life (e.g. understanding of the cell, gene functions, and gene delivery-methods applicable to the development of new diagnostic and therapeutic substances; novel in vitro testing and screening methods as alternatives to animal testing; cells as production units).

- ***Bio-remediation and waste bio-treatment processes***

  The objective is to prevent, detect and remove pollution (e.g. bio-processes for preventing industrial pollution, treating or recycling waste and industrial by-products; bio-assays and bio-sensors; biodiversity and ecological dynamics).

- ***New biological and biotechnological processes and products, new processing technologies using micro-organisms, plants or animals***

  Research will make it possible to identify high-value bio-molecules and bio-processes (approaches at the genome level; development of methods and strategies for identifying recombinant organisms and their residues in the environment and their impact on human and animal health or the environment).



## Yeast, man and cancer

On 24 April 1996, a Community project gave rise to another "world first": the complete sequence of the yeast genome. It was the first time that a complex living organism had been truly "laid bare". The success is the result of a project, initiated by the European Commission, which involved almost 100 laboratories. This breakthrough should have an impact not only in the food field and industrial enzyme production, but also in the medical field. Indeed, one of the findings of this work is that approximately 50% of yeast genes are identical or similar to human genes. This should lead in turn to a better understanding of the way human illnesses - such as cancer of the colon, and cystic fibrosis - work. To this end, the new *Eurofan* project should help us to understand the role of yeast's "orphan" genes (for which no function is known at the present time).

## Enzymes which came in from the cold

The researchers in the *Coldzyme* project are isolating and characterising enzymes present in bacteria collected in the Alps and Antarctic. These enzymes are active at low temperatures, which is why the pharmaceutical and food industries, and the dairy sector are interested in the project. In fact, certain enzymes exhibit new properties at low temperatures, leading one of the companies involved in the project to think in terms of cold-washing powders. This could save significant amounts of energy – and the washing machines would no longer need heating elements. Other applications of the low-temperature enzymes concern the cleaning of contact lenses, the development of biosensors for environmental monitoring, and the fight against pollution.

Every European is aware of the extent of current environmental problems and the various forms of pollution - atmospheric, noise, chemical, etc. – that threaten our health. In fact, in the European Union, there is a worrying increase in health problems linked to the environment, such as allergies, respiratory diseases, and cancer.

However, quantitative estimates of the impact of environmental factors on health are still largely lacking.

The aim of this key action is therefore to support research focused on reducing the harmful effects of environmental factors such as air pollution, heavy metals, toxic substances, electromagnetic radiation, and noise, as well as the effects of pollution at work.

## Scientific and technological objectives

- ***Research into diseases and allergies related to or influenced by the environment***

  Methods of treatment and prevention, based on sound epidemiological data and an understanding of pathogenesis mechanisms; analysis and quantification of the impact of environmental factors on human health; interrelations between environmental and public-health indicators for better treatment and prevention; etc.

- ***New methods of diagnosis, risk assessment and prevention***

  Implementation of multi-disciplinary approaches for better understanding of the interactions between the social and physical environment; identification of vulnerable groups to environmental exposures and of preventive measures in order to reduce causes and environmental factors hazardous to health (e.g. bio-markers; improvement of predictive toxicity testing and mechanism-based risk assessment; epidemiological and biomedical studies on possible effects linked to non-ionising irradiation, particularly from cellular phones).

## The measurable effects of air pollution

After having studied the short-term effects of air pollution in large European cities, the European researchers of the *Aphea* project concluded that all the pollutants studied (suspended particles, sulphur dioxide, ozone, carbon dioxide) - with the exception of $NO_2$ - had a real effect on daily cardiovascular and respiratory mortality rates, even if results vary from one city to another. Environment, climate, and health of the population (notably life expectancy) are all factors which *Aphea 2* is currently studying. Already, *Aphea* has revealed a difference between Western and Eastern Europe: in Poland and Slovakia, the effects of air pollution on health are weaker than in those cities of the European Union with a comparable level of pollution.

The European agricultural sector - one of the most efficient in the world - provides employment for 14 million people, while fishing involves some 70 000 companies. Clearly, these sectors are vital for Europe, not to mention the fact that they account for almost half the Community budget.

The aim of this key action is to support the development of knowledge and technologies for the sustainable use, transformation and management of natural resources - including forests, whose contribution to rural development is well established. This knowledge will also be useful for the definition of Community regulations and standards.

## Scientific and technological objectives

- ***New and sustainable systems of production and exploitation***

  In the fields of agriculture, fisheries, and aquaculture, this involves taking into account profitability, the sustainable management of resources, product quality and employment as well as animal health and welfare (e.g. agriculture: sustainable farm production systems and methods, diversification of production, support for Community policies; fisheries: support for integrated management, including ecological and socio-economic considerations and the sustainable use of resources; aquaculture: sustainable production systems, improvement of production techniques).

- ***Integrated production and exploitation of biological materials for non-food uses***

  The objective is to contribute to the development of integrated production and processing chains likely to lead to industrial applications, in particular green chemicals, bio-polymers and bio-energy.

- ***Sustainable and multi-purpose utilisation of forest resources; the integrated forestry-wood chain***

  This encompasses sustainable management and multiple use of European forest resources, in harmony with political, environmental and social needs, bringing economic growth and employment to rural and coastal areas.

- ***Support for common policies***

  This involves contributing both to the development of control and protection methods to support the implementation of common policies, and to the definition of standards and relevant regulations.

- ***Pre-legislative research designed to provide a scientific basis for Community legislation***

  The aim is to provide the scientific basis for regulations in the context of the common agricultural and fisheries policies through prenormative research.

- ***New tools for the development of rural and other areas***

  The objective is to optimise the development of each area (e.g. analysis of technological and socio-economic changes, diversification and job opportunities, integrated development of rural and coastal areas).

## Up-and-coming crops

The cultivation of rape and sunflower have developed considerably in Europe during the last few decades, especially since health experts started recommending using fatty acids of vegetable rather than animal origin. But these crops have an even greater potential, not least in the chemical industry, which can use vegetable fatty acids as raw materials for the manufacture of detergents, bio-plastics or polymers. To this end, the 15 partners involved in the EU-funded *Sonca* project are looking for new varieties of rape, sunflower, and other wild, oil-producing plants whose seeds contain chemical compounds for industrial use.

## Images for agriculture

Collecting reliable statistics on agricultural production is essential for the management of the funds allocated to the common agricultural policy. Under the decade-long MARS project, research carried out by the Joint Research Centre - together with 200 companies, universities and research centres - has made it possible to develop a remote-sensing tool which provides objective images of the cultivated areas. This work has also led to specific control and prevention tools in the fields of desertification, drought, famine, deforestation and soil degradation.

The ageing of the population is one of the most striking aspects of the European Union's demographic evolution. Two facts reflect the breadth of this development.

- The median age, i.e. the age which divides the population into two numerically equal groups, seems set to increase from 36 in 1995 to 45 in 2025.
- The proportion of under-20s and over-60s will be reversed between now and 2025. Thus in 2025, there will be 11% fewer people under 20 compared with 1995, while the number of adults in retirement will increase by almost 50% over the same period.

The objective of the key action is to meet the challenge of the growing ageing population through research to help increase the quality of life and independence of older people, and reduce the need for long-term care and its consequential costs.

## Scientific and technological objectives

- ***Age-related illnesses, disabilities and health problems with high morbidity***

  This covers areas where there are real prospects for prevention, treatment, or delay in onset (studies on age-related diseases and disorders such as Parkinson's and Alzheimer's diseases; physiology and patho-physiology of ageing and disability; co-morbidity).

- ***Biological, psychological, social and economic determinants of healthy ageing and of the mechanisms leading to disability***

  Research in this area includes cellular and molecular bases of ageing, genetic predisposition, basic biological and psychological mechanisms underlying age-related changes, psychological implications of ageing, etc.

- ***Demographic and epidemiological research into ageing and disability trends***

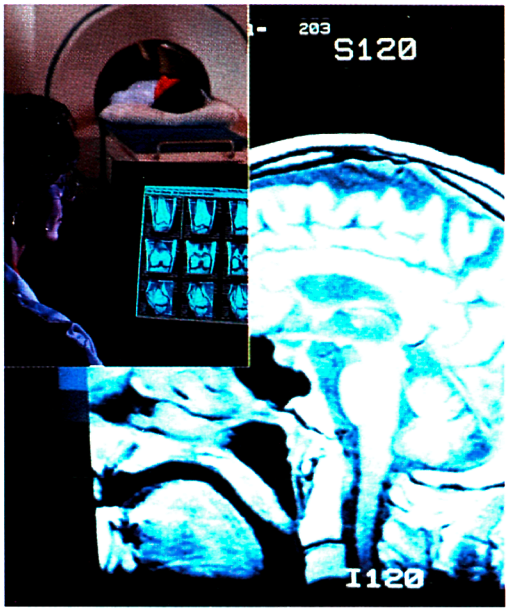
  The objective is to enable prediction of the size and nature of the ageing population as a basis for policy and planning (e.g. clinical trials, analysis and quantification of demographic, medical, sociological, lifestyle - including exercise, mobility and nutrition - and environmental factors).

- ***New approaches to delaying the onset of disability, and reducing the challenge to older people of their social and physical environment***

  Work here will include the design and development of products and services adapted to the needs of older people (housing, transport, leisure, etc.) and to supporting mental and physical functioning (e.g. methodology relating to quality of life, social integration and coping mechanisms, technologies to reduce dependence, sensory degeneration, psychomotor, sensory and cognitive impairments, rehabilitation and replacement therapies).

- ***Effective and efficient delivery of health and social care services to older people, including comparative research on the financing of long-term care and of the pensions***

  Research into healthcare outcome for the elderly and disabled, and into specific health and social care services, as well the organisation of healthcare services, etc.




## Computer-aided rehabilitation

Two per cent of the population of Western Europe suffers from the consequences of a cerebral illness or accident. If we take into account the other pathologies of the brain (tumours and encephalitis), 7 million Europeans are affected. With differing levels of disability, these patients almost always depend on external aid. A network of 53 European centres has now made it possible to improve and harmonise methods for evaluating disabilities and programmes for patients' rehabilitation. Computerised tools were designed specially for patients suffering from a cerebral problem, specifically allowing rehabilitation in the fields of language, memory, attention and problems with vision. Some of these tests have now become official standards.

# Thematic programme 2

Over the course of human history, revolutions in agriculture and subsequently in industrial production have provided the economic driving force for society. Today the revolution in information technologies is emerging as the new driving force, shaping the economies and society of the developed, "knowledge-based" world, and bringing with it new production methods.

But beyond the setting up of a genuine information society, these developments have many important repercussions, whether this is at the economic (industrial competitiveness of Europe and job creation), ecological (improvement of the quality of life, sustainable growth) or political level (contribution to European cohesion).

The aim of this thematic programme is thus to reap the benefits of this new society, now emerging in Europe, by ensuring that the needs of both private individuals and companies are satisfied, and at the same time to facilitate its advent. More specifically, four complementary specific objectives have been set concerning:

- private individuals (to satisfy their needs and expectations);
- companies and workers (to innovate, and improve productivity and working conditions);
- multimedia content (to allow Europe to express its creativity and its culture);
- technologies (to accelerate their development and to promote their application).

With a view to achieving these objectives, four **key actions** have been identified (see page 24 onwards).

In addition, cross-programme themes will promote project clustering and exchanges of information on ten topics including Mobile citizens and services, Privacy and personalisation, and Space technologies and applications.

The programme will also fund long-term research on emerging and future technologies. An open door thus exists for any new idea likely to have an effect on industry or society. Proactive initiatives will also cover such areas as quantum computing and communications, personal bio-information systems, and nanotechnology information devices.

Lastly, the programme also research networking, the objective being to facilitate and allow the development of trans-European broadband interconnections between national research, education and training networks, as well as between various existing testbeds benches across Europe. This work should make it possible to try out state-of-the-art applications at an early stage and to help Europe play a major role in the definition and the validation of the next generations of standards and protocols.

## GSM, a European success

The success of the GSM (Global System for Mobile Communications) digital cellular telephone system constitutes an excellent example of the benefits of European cooperation. In this instance, Community support was initially at the technical level: under the *Eureka* programme, various designs of ultra-miniaturised electronic circuits were developed. The action of the Commission also made it possible to establish a single GSM standard. This standard is now used by more than 230 telecommunications operators in over 110 countries, including the United States. The success of GSM thus extends well beyond the borders of Europe. The dividend is estimated at tens of thousands jobs.

According to current estimates, the penetration of computers and electronic communication in the home and at work will increase spectacularly in the years ahead.

This development is likely to change our methods of work, communication, and information retrieval quite radically. It will also provide the individual with a whole range of new – and extremely beneficial – services in the fields of health, education, transport, tourism, and so on.

The aim of this key action, then, is to take advantage of current and future situations by stimulating – through research – the creation of a new generation of user-friendly, inexpensive, reliable, and mutually compatible services in the following fields:

- health;
- persons with special needs, including the disabled and the elderly;
- public administrations;
- environment;
- transport and tourism.

- ***Health***

  The objective is to develop new-generation computerised clinical systems, advanced telemedicine services and health-network applications to support health professionals, and intelligent systems allowing citizens to assume greater control over their own health (intelligent systems for non-invasive diagnosis and therapy, advanced medical imaging, "virtual hospitals", high-speed secure networks and applications for linking hospitals, new-generation electronic health records, systems for personal health monitoring and prevention, tele-systems for supporting care, etc.).

- ***Persons with special needs (elderly people, the disabled, etc.)***

  Research will address person/system interfaces and adaptive and assistive systems to overcome problems caused by physical or intellectual impairments, as well as intelligent systems and services to support autonomous living, social integration, and participation in the information society.

- ***Public administrations***

  The objective is to develop multimedia systems and services addressing the specific needs of all types of administrations (Community, national, regional, and local), particularly to support the accomplishment of European union, and offering an extended range of interactive services to EU citizens (on-line support for the democratic process, improved access to information and services, enhancing the transparency and accessibility of administrations and promoting multimedia data interchange between administrations; applications to support the adaptation of administrations to the information and processing systems needs of Community policies.)

- ***Environment***

  Research will focus on new-generation monitoring, forecasting and decision-support systems and services, addressing both external and internal environments, together with advanced systems and services for the management of risks and emergencies (advanced systems for monitoring pollution and natural resources, high-performance systems for data-gathering and modelling, information tools and support systems for sustainable development, advanced systems exploiting satellite imagery for the management of risks and emergencies, etc.).

◆ ***Transport and tourism***

The essential objective is to contribute to the development of telematic systems for intelligent vehicle operations in all modes of transport, improving their compatibility (surveillance, positioning and guidance systems, new traffic-control systems, on-board systems to improve passenger safety, telematic systems allowing intelligent vehicle operations in all modes of transport, on-board *infomobility* services, multimedia personalised-information systems for the transport and tourism sectors, etc.).

## Example of a project from the Fourth Framework Programme

### New technologies fighting disabilities

100 000 Europeans with reduced mobility will enjoy a distinctly improved quality of life - and become more independent - thanks to the development under the *Focus* project of standardised techniques to equip wheelchairs with various assistance mechanisms. And the partners of the *Testlab* project have developed a technique which allows blind people, and the visually-impaired, to use library catalogues and other documents.

It is estimated that, by the year 2005, a third of the world's banking transactions will be carried out electronically. By then, commercial telematic services in Europe could represent a market of some 11 billion euros.

The consequences of these technological changes, and the implications in terms of commercial practices, go well beyond the framework of the company or the industrial sector, and even beyond national economies. They affect the whole world, and require action at the European level if we wish our countries to remain active, world-class trading partners in the years to come.

These new technologies also directly concern the worker and the consumer, enabling them to throw off certain constraints, particularly those imposed by space and time.

The aim of this key action is to allow European workers and companies, especially SMEs, to increase their competitiveness on the world market by developing relevant information technology, particularly electronic payment techniques, smart cards, mobile systems, business-process modelling software, etc.

## Scientific and technological objectives

- ***Flexible, mobile and remote working methods and tools***

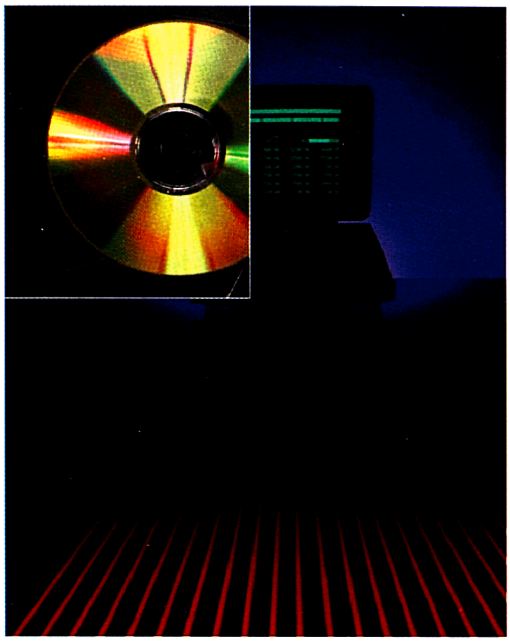
  Research will cover the development of competitive, flexible, and human-centred work methods and organisation, including public administrations and non-profit organisations (telework and networked cooperative working, new methods based on virtual reality; new organisational methodologies; analysis of the implications of change in terms of human resources, etc.).

- ***Management systems for suppliers and consumers***

  Under this topic, research is intended to develop electronic trade with and between consumers, self-employed workers, companies and administrations (marketing and sales, particularly customer interaction, negotiation and contracting; financial services, especially for the euro; management, including decision-support and planning; consumers, in particular the purchase of goods and services, the protection of the consumers' rights, etc.).

- ***Information security***

  The objective is to ensure the reliability and integrity of received and/or transmitted information (and therefore also to protect privacy and manage intellectual property rights) as well as user-friendliness and the effectiveness of infrastructures (electronic signature techniques, prevention of fraud, protection of privacy, secure electronic transactions and payments, etc.).

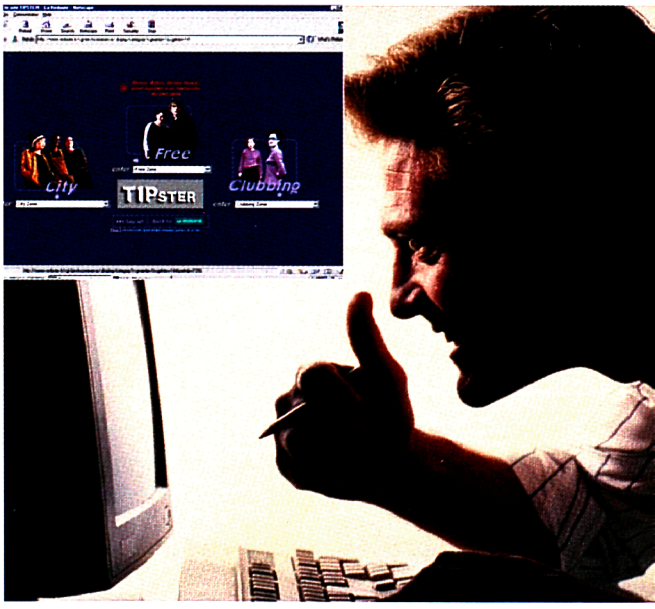


## Internet and virtual shopping baskets

In the distribution sector – which already includes a large number of electronic supermarkets where consumers can fill their virtual shopping baskets - five European companies working together in a Community project have launched the *Homestead 2000* system throughout Europe. Using a combination of two technologies, consumers can select their purchases from a multimedia catalogue (a user-friendly CD-ROM containing high-quality video images) and place their order on-line via a secure Internet site.

## Totally secure electronic trade

Increased security and better service interoperability are, in the opinion of the experts, essential prerequisites for the success of electronic commerce. Such is the object of the *Semper* (Secure Electronic Marketplace for Europe) project, which has developed the first complete and secure architecture tailored to Internet trade. In this system, the service suppliers draw up catalogues in the form of databases accessible to customers via the Web. The latter send their orders using on-screen forms. Confidence between the partners is guaranteed by digital certificates issued by a certification authority, which customers can access by means of the password included in the *Semper* software. Thanks to the electronic signatures, a recipient of data transmitted via the network is in a position to determine its origin and to check if it has been altered.



As a consequence of the development of information and communication technomogy, the companies specialised in the development of software and multimedia services today represent an industrial sector which, in Europe, generates an annual turnover of 150 billion euros, employs almost two million people, and should create one million new jobs within the next ten years.

It is a boat which Europe cannot afford to miss. But at the present time, nine out of ten companies in this sector are American.

The aim of this key action is to improve the fonctionality and usability of software and services according to the following four three following main o bjectives:

- to enable the expression of Europe's linguistic and cultural diversity;
- to stimulate creativity;
- to enhance education and training systems;
- to represent information, knowledge and know-how.

## Scientific and technological objectives

- ***Interactive electronic publishing and digital heritage and cultural content***

  Research will cover the development of new content and new forms of content, for applications in the following four fields: scientific and professional publishing, lifestyle publishing, geographic, statistical and socio-economic data, as well as access to cultural heritage (interactive electronic publishing and creative content, managing digital content, personalising content delivery, integrated access integrated to the digital heritage and cultural content - library holdings, museums, etc. - improving the functionality of large-scale repositories of content, etc.).

- ***Education and training***

  Under this topic, research will aim to develop technologies making it possible to improve education and training systems (improving the learning process, developing higher-quality learning material, broadening access learning resources and services, etc.).

- ***Human language technologies***

  Research will concentrate on technologies connected with human language (spoken and written) with a view to allowing interchanges across language and culture and to facilitate access to digital and multimedia-content services, and in view of applications in commercial and business publishing, education and training, cultural heritage, electronic commerce, and public services and utilities (adding multilingual facilities to systems, enhancing natural interactivity, development of techniques allowing active assimilation and the use of digital content, etc.).

- ***Information access, filtering, analysis and handling***

  The objective of research is to develop advanced technologies for the management of information content, to give to the user the means of selecting and handling, with respect for their privacy, only that information required (mastering information; definition of information profiles; new organisation and management methods for multimedia information; information filtering).

## Improving communication between police forces

Today, police forces and emergency services across Europe can fight crime and cross-border fraud more effectively thanks to a multilingual communication system developed under the *Linguanet* project, which provides simple machine translation according to requirements. This tool has already led to numerous concrete results, such as stolen vehicle recovery, the prevention of kidnapping, and drug interception.

## A multimedia tool without equal

Following the results obtained by a Community research project, a multimedia post-production system capable of converting all recording formats was put on the market in March 1998. There currently seems to be currently no competition, and it has already been awarded several international prizes.

This key action is intended to support research on a number of technologies and essential infrastructures, which are crucial to the development of the information society, with a view to ensuring convergence between information processing, communications, and networking technologies and infrastructures.

## Scientific and technological objectives

- ***Processing and management of information, communications, and networks***

  Here research must ensure convergence between the technologies concerned (concurrent systems for the sharing and interactive use of remote resources; real-time systems handling large volumes of data; broadband telecommunications networks; network integration; etc.).

- ***Technologies and engineering for software, systems, and services***

  The work will concern the development and operation of software-intensive systems embedded in goods, services and industrial processes (software and systems engineering; service engineering; software technology; etc.).

- ***Real-time and large scale simulation and visualisation technologies***

  In this area work will adress the development and integration of advanced simulation and visualisation technolgies and environments in all applications (simulation and visualisation; distributed simulations; shared virtual environments; etc.).

- ***Mobile and personal communications and systems, including satellite-related systems and services***

  Research will target the move to an integrated, seamless network that enables access to wireless multimedia communications and services by anyone, from anywhere, at any time (broadband wireless systems and technologies; service mobility and terminal roaming; etc.).

- ***Interfaces making use of the various senses***

  The work will address the provision of intuitive ways to capture, deliver and interact with systems, including the development and integration of advanced sensor, actuator and display technologies (multimodal, multisensory interfaces; processing and synthesis of images and sound; etc.).

- ***Peripherals, subsystems and microsystems***

  Research in this area will be devoted to the development of intelligent, advanced and user-friendly network peripherals, (technologies for peripherals and terminals; intelligent subsystems and microsystems, mainly for medical, biochemical, environmental, automotive and aerospace applications; optical interconnections; etc.).

- ***Micro-electronics***

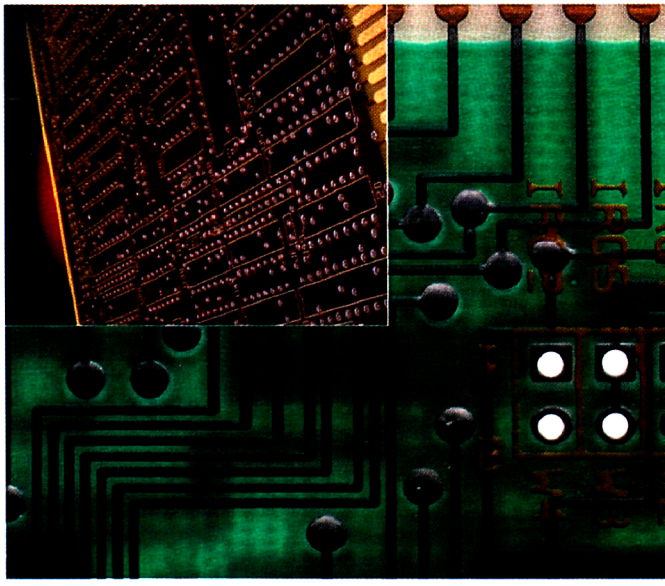
  The work will concern materials, and design and test methodologies for the development of electronic components, their packaging, interconnection and application (hardware/software co-design; technology requirements; semiconductor components; optical technologies; etc.).

## A popular microprocessor

The ARM microprocessor, developed from a project supported by the Esprit programme, is the leading low-consumption microprocessor, with widespread use in the fields of portable multimedia and mobile telephony. The turnover of the company selling it has increased tenfold during the last five years.

## Europe in pole position

European industry leads the world leadership in *Bicmos* analogue integrated circuits for industrial and telecommunications applications, an achievement that owes much to research work carried out under the Esprit programme.



# Thematic programme 3

The future economic power of the European Union will be based on a range of goods and services, both competitive and environmentally friendly, which will help improve the quality of life in Europe and beyond. It is therefore clear that, from now on, helping European industry become more competitive and attaining sustainable development are inseparable objectives.

This is a field where research obviously plays a vital role, as demonstrated by this programme's dual aims, seen in its title. But if the accent is on the production of high-quality, "clean", and "intelligent" industrial goods and services, which should help improve the competitiveness of European industry, this cannot be achieved without comparable efforts in the following basic and essential areas:

- the development of safe, economic, and environmentally-friendly transport;
- the development of high-quality materials and reliable methods of measurement and testing;
- the optimum use of research infrastructure.

To achieve these goals, four **key actions** have been identified (see page 34 onwards), with a general objective of helping current research efforts converge in what are sometimes rather disparate domains, such as materials, information technology, and environmental technologies.

Research activities likely to give rise to applications in different sectors and therefore to strengthen European industry will also be supported in the following **generic** fields:

- ***New and improved materials, and their production and transformation***

  e.g. materials: nanostructured materials, supramolecular chemistry, functional materials, materials that are easy to recycle; methods: production technologies for high-value-added sectors - fine chemistry, minerals, composites, etc. – taking material lifecycles into account;

- ***New and improved materials and production technologies in the steel field***

  e.g. medium and long-term technologies for the production of iron and steel; casting, rolling and downstream treatment; use of steel;

- ***Measurements and testing***

  e.g. the fight against fraud, support for standards and Community policies, development of measurement and testing methods for quality improvement.

Approximately one quarter of the programme's resources will be devoted to supporting generic research (i.e. the areas mentioned above) and research infrastructure, including access to existing facilities, the creation of virtual institutes, the European metrological infrastructure, and reference databases.

## Hypoallergenic materials

Nickel is an important factor in the appearance of allergic reactions, especially in jewellery and bracelets. Now, 15 SMEs and 6 research organisations working together in a Community project have developed a technology which limits the negative effects of nickel, as well as new hypoallergenic alloys which could replace it, responding to consumer demand for healthier products.

In the European Union - the largest economic bloc in the world - industrial goods and services represent an annual market estimated at 4 500 billion euros, involving two million companies and employing about 40 million people.

It is therefore essential to give European industry the means of remaining competitive on the world scene, especially by supporting research and innovation to create the conditions for launching competitive goods and services and developing new production and manufacturing methods.

The aim of this key action is to support the modernisation of industry, improve quality, and reduce overall life-cycle impacts through the development of new design methods and process technologies, and improved understanding of organisation, management, logistics, etc. In the implementation of the research projects, close attention will be paid to systemic approaches to production (products, production facilities, processes, and organisation) and to project clustering in targeted groups, which will make it easier to take socio-economic objectives into account, and to encourage the integration of approaches as well as technological assimilation and innovation.

## Scientific and technological objectives

- ***Efficient production, including design, manufacturing and control***

  The objective is to improve industrial competitiveness, through increased quality and a more rapid reaction to market trends (technologies for integrated product-service design and development; advanced production and construction techniques, etc.).

- ***Intelligent production***

  The aim is to optimise the performance of all the elements of the industrial environment by incorporating information society technologies in production and related logistic systems (intelligent production systems, machines and equipment; on-line control using advanced actuators and sensors; intelligent operation and maintenance systems, including self-repair, etc.).

- ***Eco-efficient processes and design***

  Under this topic, research should minimise the environmental impact at all the stages of the product life cycle, from the extraction of raw materials through production to waste management (clean processing technologies; mastering basic phenomena such as synthesis, separation mechanisms, process modelling and simulation; in situ and on-line recovery of waste; novel processes for treatment, re-use and safe disposal of waste, and for upgrading, reusing or dismantling products and production systems; etc.).

- ***Organisation of production and work***

  The goal is high-performance industrial systems, virtual networks, and agile, customer-driven, networked industrial and related service enterprises, including SMEs, with a multi-skilled, highly motivated labour force, working in efficient, safe, and pleasant workplaces (study of human, organisational, socio-economic and regulatory factors; new decision-making tools and new approaches to the management of change and human resources; studies on the impact and acceptance of the new, clean production models, etc.).

## An example of an "eco-efficient" process

A new pollution-free method of treating hides has been developed as a result of a collaborative project between the chemical and tanning industries. The method makes it possible to guarantee the production of very high-quality leather while reducing the manufacturing costs, and enables the industry to conform to increasingly strict Community rules on environmental protection while staying competitive.

## Intelligent production

Certain industrial processes are dependent on the fluctuating quality of raw materials, while the quality of the finished product must remain constant. A Community project has used artificial intelligence in the production of wood and paper pulp in order to predict the quality of the end product from data on the raw materials and the state of the production process. The industrial users have seen dramatic reductions in their energy, water, and starch consumption as well as the quantity of residues.

Everyone is aware that the question of transport is one of the major problems confronting industrialised countries. The difficulty is how to reconcile the ever-increasing demands for mobility and the increasingly urgent ones for environmentally friendly transport? How, in other words, to reconcile mobility and competitiveness, on the one hand, and sustainable development, on the other?

Some statistics demonstrate the size of the task: the demand for goods transport within the European Union doubled between 1975 and 1995 and will probably double again by 2025; the increasing number of traffic jams on Europe's roads represents an annual cost of about 120 billion euros and it is estimated that the total cost of the impact of transport, on the environment in particular, runs to approximately 250 billion euros each year.

The aim of this key action is to arrive at a better balance between the growing demand for mobility, the need for sustainable use of resources, and environmental, social, economic, and safety constraints.

## Scientific and technological objectives

- ***Socio-economic scenarios for the mobility of people and goods***

  The aim is to develop strategies and tools for managing the impact of future developments in the transport sector, including deregulation and general economic development, on mobility demand and transport policies (scenarios relating to transport supply and demand; legal, institutional, organisational and financing aspects of transport systems; methodologies to measure the costs and benefits, safety, performance and impacts of different transport systems; etc.).

- ***Infrastructures and their interfaces with transport means and systems***

  Under this topic, the goal is to enhance the interconnectivity and interoperability of different modes of transport (e.g. improvement of existing infrastructures; interconnection between trans-European, national, regional and local networks; effective interchanges; relationship between transport, land use, regional planning, environment and health; reduced congestion, resource and energy consumption, pollution, and infrastructure degradation; innovative concepts for urban, inter-urban, and rural mobility and intermodality).

- ***Modal and intermodal transport management systems***

  The objective is to develop effective transport management systems, including the use of information technology (e.g. traffic-management systems for modal and intermodal transport; information and data-exchange systems across modes of transport, including real-time user information, electronic documentation, and user services; second-generation navigation and positioning systems).


## A "black box" for ships

A Community-funded project has developed a "maritime black box" (MBB), similar to those used in aircraft, which records the circumstances in case of an accident. The MBB will allow more detailed analyses of accidents to be made, so improving the safety of operations at sea. It is also planned to use it for cargo-monitoring, which will facilitate short distance navigation and the exchange of documents.

## Improving the performance of airports

The *Tape* (Total Airport Performance and Evaluation) project has developed prototype software to determine the interaction between airport ramp and apron services, passenger ground-handling, airport access, etc. This tool will help optimise the overall performance of airports in terms of efficiency and capacity.

In the Member States of the European Union, travel by land and sea play an essential role in both personal mobility and the transport of goods, and thus in each country's overall economic performance.

Research and technological development is necessary to develop the new generations of road and rail vehicles and ships. Such is the aim of this key action. For vehicles, the aim is to respond to demands for sustainable mobility and improved safety, while reducing the impact on the environment and boosting the competitiveness of European industry. With regard to maritime activities, the objective is to develop knowledge of marine technologies in order to be able to design safe, efficient, environmentally friendly ships, as well as marine vehicles and structures allowing the sustainable exploitation of marine energy and mineral resources.

## Scientific and technological objectives

- ***Critical technologies for road and rail vehicles***

  The objective is to develop economical, efficient, clean technologies to improve both vehicles and infrastructure, and thus to meet both the new socio-economic needs and public expectation (e.g. advanced power-train concepts ; reduction of noise, vibration and electromagnetic radiation; light-weight components and structures; micro-technologies and sensors; improvement of safety).

- ***Innovative road and rail vehicle concepts***

  The aim is to develop and demonstrate new vehicle concepts, using new construction techniques and materials (new systems of propulsion and transmission, integration of on-board systems for intelligent, safe vehicles, etc.).

- ***Human-vehicle interaction***

  Research will concentrate on the incorporation of human-vehicle interaction systems, from the point of view of the overall design of the vehicle and its production line (taking account of human-vehicle interaction in the design and prototyping processes; ergonomic vehicle design; cognitive engineering for effective driver-vehicle or occupant-vehicle interaction; technologies for improved cabin environment; etc.).

- ***Advanced technologies for the development of ships and offshore vessels***

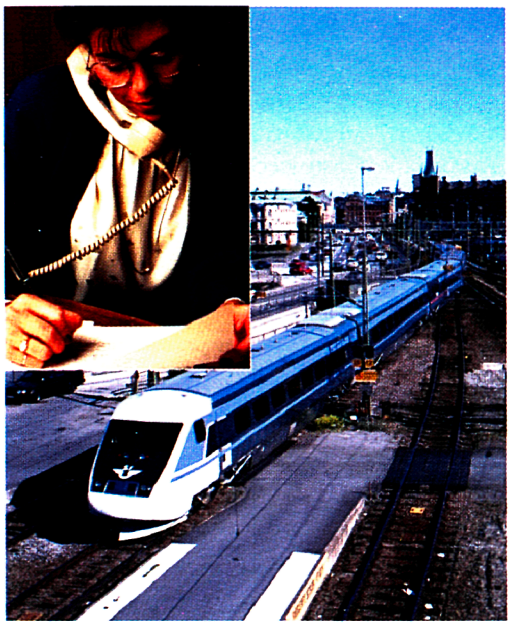
  The aim of this research is to develop advanced technologies for the development of safe, efficient, and environmentally friendly vessels and offshore structures (critical technologies for vessels, systems and subsystems; new-generation on-board systems; application of new materials; new power-train concepts; etc.).

- ***Use of the sea and the inland waterways to transport goods and passengers***

  The research undertaken under this heading will develop and validate innovative vessel and port infrastructure concepts, intermodal facilities, and new technologies for freight handling (technologies for efficient, safe, and environmentally friendly transhipment facilities and operations; research to support the development of technical standards; etc.).

- ***Technologies for the rational and sustainable management of the sea***

  The aim is to develop technologies intended for the study and observation of the seas as well as the sustainable exploitation of marine energy and mineral resources, while aiming to improve coastal zone management and minimise the effects on the environment (innovative technologies for monitoring and forecasting the state of the sea and sea floor, including remote-controlled vehicles; safe and efficient underwater sensing technologies; offshore structures and floating production units; underwater acoustics; etc.).



## Safer trains

The safety of passengers on high-speed trains is crucial. A consortium including rolling stock manufacturers, research centres, and railway companies from four countries of the European Union have invented a new type of railway carriage with low distortion in the passenger areas. This has allowed a new European safety standard for railways to be put forward.

## Children on board, children first

A broad partnership of car manufacturers, university laboratories and public research centres from six Member States (France, Germany, Italy, Netherlands, United Kingdom, and Sweden) was launched in 1996 in order to improve children's safety in vehicles. Indeed, the restraint systems designed for young passengers, whose tests would seem to indicate effective operation in 70% to 80% of accidents, really protect them in only 30% to 50% of cases. Research has revealed the phenomenon of *submarining:* in an accident, young children on booster seats using standard safety belts can slip under these, incurring abdominal injury. In traditional tests using test dummies, this phenomenon does not occur. The project's results have made it possible to improve the design of test dummies representing children of 3, 6 and 10 years of age.

Air transport is set to experience strong growth in the years ahead: in fact, it is estimated that the volume of traffic will triple between 2000 and 2015. To meet this demand, more than 5 000 new aircraft will have to be built each year. It is a sector where European industry has enjoyed increasing success, ever since the construction of the first Airbus. But continuous efforts are necessary to improve the quality and competitiveness of products, especially since the European aircraft industry exports two thirds of its production. Moreover, following the recent mergers in the American aeronautics industry, Europe is faced with a virtual monopoly which controls 70% of the world market. It is therefore a sector where research and technological development activities play an essential, if not a crucial role.

In this context, this key action should help develop new generations of aircraft, while ensuring the rational management of air traffic. More precisely, the research to be undertaken aims to achieve the following three objectives:

- to reduce the time and money needed to develop new aircraft;
- to improve their efficiency (in terms of fuel consumption and maintenance costs);
- to reduce their environmental impact.

## Scientific and technological objectives

- ***Acquisition of critical technologies***

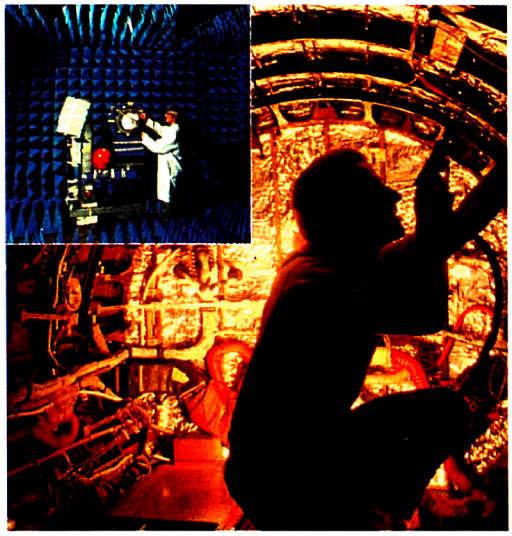
  Under this topic, research should make it possible to develop new aeronautical concepts, including those designed to reduce the environmental impact of air traffic (innovative approaches to aerodynamics, structures, propulsion, equipment, etc.; research on aero-elasticity, flight mechanics and airframe-propulsion integration; methods and processes for aircraft design and manufacture; etc.).

- ***Technology integration for new-generation aircraft***

  The objective is to facilitate the introduction and combination of the newest technologies so as to reduce design, production, and operational costs and consumption, and improve aircraft performance and environmental qualities (e.g. advanced design and engineering tools; developments in the field of propulsion, aerodynamics and the technologies to reduce emissions and engine noise and improve the cabin environment).

- ***Operational efficiency and safety***

  Research aims to achieve the following triple objective: to relieve congestion at airports, increase Air Traffic Management (ATM) system capacity, and improve aviation safety performance (e.g. validation and integration of on-board technologies, in particular to support aircraft integration within the future ATM system; maintenance and monitoring techniques; technologies and methodologies, including the study of human factors and flight simulation, with a view to more effective accident prevention).



## Sound-proof cabins

Silence on board an aircraft is certainly one of the key factors in passenger comfort. Under the *Brain* project, European researchers from nine universities and research centres and seven aircraft manufacturers have developed new mathematical models making it possible to perfect the sound-proofing of cabins as early as the design stage. These models allow a remarkably precise forecast of noise levels, which will not only improve the comfort of the cabins but also lead to time savings in the design, development and production cycle of new aircraft. The European Space Agency also uses these results for the design of future manned spacecraft.

# Thematic programme 4

All industrialised countries are confronted with two challenges which, in the context of sustainable development, are closely connected: to ensure satisfactory long-term energy supplies and to reduce the impact of human activity on the environment. These are also two areas where research and development has an essential role to play. For they are likely to have an important influence on both quality of life and socio-economics, especially given the potential for job creation represented by the developing markets for new and renewable energy sources and "clean" technologies.

The environmental and energy supply problems must also be tackled in their overall context. This is best addressed at the European level since the majority of challenges are common to all Member States. The aim is not only to pool knowledge and know-how but also to take account of the intrinsically transnational character of certain problems. Observing and protecting the ozone layer, for example, simply does not make sense for an individual country working alone.

To achieve the agreed objectives, six **key actions** have been identified (see page 44 onwards), and these will respond to a series of challenges - important, even urgent for the European Union - which must be tackled at the European level. These are complemented by the Euratom programme with its two key actions, generic research and support for research infrastructure (see page 56).

In addition, research activities of a **generic** nature will be supported in the following three fields.

- ***The fight against major natural and technological hazards***

  The objective is not only to understand natural and technological hazards better, but also to develop tools for risk forecasting, prevention and mitigation (factors influencing natural risks; risk assessment methods; innovative methods and technologies to combat disasters; improving the safety of hazardous installations; etc.).

- ***Earth-observation satellite technologies***

  Research should contribute to providing Europe with services for monitoring the Earth from space, particularly in order to understand our planet better, protect our cultural heritage more effectively, and mitigate major hazards (innovative pilot applications; study of the technical, legal and economic considerations; requirement and feasibility studies; promotion, education and training campaigns; etc.).

- ***Socio-economic aspects of environmental changes***

  The objective is to develop a scientific basis for sustainable development models and to facilitate the integration of sustainability considerations into strategic EU sectoral policies (key relationships between socio-economic development and environmental change; performance measures for sustainable development; etc.).

Lastly, the programme encourages the transnational use of public or private research infrastructure, in particular facilities for climate and global change, marine, and natural hazards research.

## Understanding ozone layer depletion by monitoring the stratosphere

400 researchers, a wide-ranging field programme throughout the northern hemisphere, and 13 Community projects: this is the *Theseo* recipe for tackling the fundamental problem of the depletion of the ozone layer. In fact, in recent winters, the arctic ozone layer has suffered 30% to 40% depletion. Thanks to its meteorological balloons, ozone-sondes, aircraft, and network of ground stations, *Theseo* (Third European Stratospheric Experiment on Ozone) makes it possible to quantify the loss of ozone in one or another region during late winter and early spring.

The relation between the ozone and temperature is one of the basic discoveries of this campaign: the increase in greenhouse gases involves stratospheric cooling, which increases ozone loss in the presence of chlorine and bromine compounds. The ozone loss starts at -78°C. The impact of aircraft has also been studied. Air traffic has been increasing by 5% to 6% a year, which produces more and more greenhouse gases and pollutants. These destroy stratospheric ozone, but are precursors of tropospheric ozone, raising a series of questions: at what altitude should we fly? and what kind of aircraft should we build? These are the questions which *Theseo* will help to answer.

**Contact: eesd@dg12.cec.be**

At present, 20% of the European Union's surface water is threatened by pollution, and 60% of cultivated land contains fertilisers and pesticides at levels which are hazardous for water quality. Water represents wealth which, because it is widely shared, is truly European; indeed several Member States import more than 50% of their water resources.

The rational management of this increasingly rare and increasingly threatened resource is one of the major challenges of the 21st century both for the European Union and for the rest of the world. Addressing an area where agricultural, environmental and regional policies intersect, this key action is intended to develop the knowledge and technologies needed to guarantee European water supplies - particularly high-quality drinking water - at an affordable price and in sufficient quantity.

## Scientific and technological objectives

- ***Treatment and purification technologies to prevent pollution, purify water, prevent and mitigate salination of water resources, and use or re-use water rationally; integrated management of water resources and wetlands***

  The objective of the research envisaged under this topic is to develop the technologies needed for the rational management of water resources (e.g. cost-effective and sustainable integrated management of water resources and wetlands; optimisation of technologies to treat and purify drinking water and minimise water use and pollution; process-integrated treatment of waste water at source; integrated procedures to assess the state of water systems; advanced processes to prevent and alleviate salination).

- ***Technologies for monitoring and preventing pollution, protection and management of groundwater and surface water resources, including ecological quality***

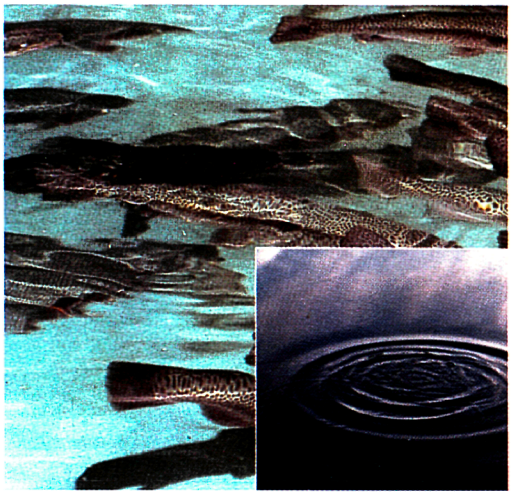
  The goal is a more rational management of resources, through research aimed at characterising the quality and quantity of surface water and understanding the functioning of aquatic and wetland ecosystems (improved methods of measurement and monitoring; techniques for analysing pollutant flows; soil pollution control; models and advanced pollution impact assessment methodologies; etc.).

- ***Surveillance, early warning and communication systems***

  This involves developing systems able to provide direct feedback to pollution sources and to manage certain types of natural disaster (surveillance systems for point and diffuse pollution sources; control and data management systems, including leakage detection and stormwater management and systems for floods and drought assessment; etc.).

- ***Technologies for the regulation and management of stocks and technologies for arid and semi-arid regions, and generally water-deficient regions***

  The research to be conducted under this topic should help improve the management of water resources and shortages in arid regions (integrated approaches at catchment and collection point level; management of water resources and their use at EU, national, regional and local levels; etc.).

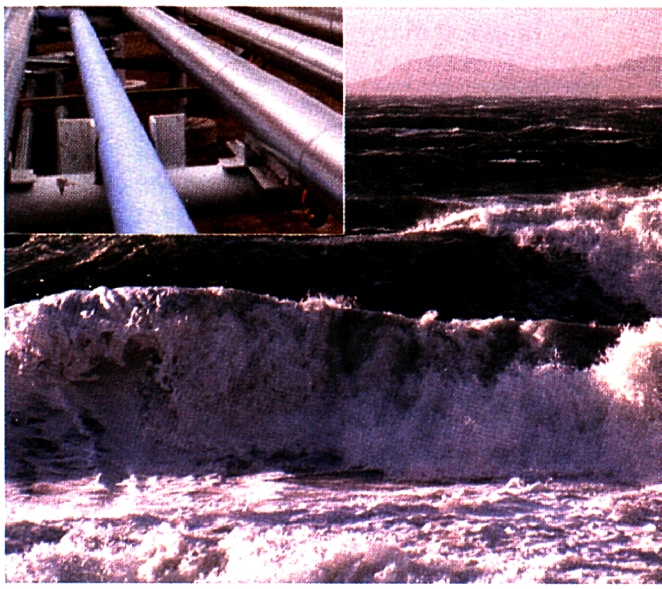


## When life's waste changes life

The increasing volume of organic compounds entering the water cycle can cause alterations to the sexual systems of living creatures. Since the beginning of the 1990s, specialists have started to express their concerns about the effects of substances collectively known as *endocrine disrupters*. Independent scientific studies undertaken in various European rivers and fish-farms have shown with certainty that the high concentration of certain products which mimic oestrogen results in abnormal feminisation of the species present, and a marked decrease in the birth-rate of male fish. A group of five Community projects, the *Waste Water Cluster*, sets out to understand how organic pollutants develop chemically once diluted in water, to analyse their toxic effects, and to evaluate and model the seriousness of the risks involved.

## Distribution of drinking water: the infrastructure problem

In Europe, the networks for bringing water to our homes – and taking it away again – are suffering from old age. The pipes, long considered indestructible, are in fact leaking at an alarming rate. No European standard exists to assess the operation of such systems, and expertise is often confined to a national or regional level. Now, however, an action within the COST framework is tackling this problem at a European level.



The impact of human activities on global systems is not only one of the largest and most serious problems confronting the world's industrialised nations - and indeed humanity - it is also one of the most complex facing science and technology today.

In fact, although the exact size of the problem is still uncertain in many cases, the possibility cannot be ruled out that man is in the process of permanently and significantly altering not only his immediate environment but also the biosphere, thus threatening the existence of various species and ecosystems, as well as endangering aspects of the atmosphere, and even affecting the earth's climate.

The aim of this key action is to develop the scientific, technological and socio-economic basis and tools necessary for the study and understanding of changes in the environment.

## Scientific and technological objectives

- ***To understand, detect, assess and predict global-change processes***

  The objective of the research is to identify and understand the causes and effects of global change, such as climate change, the loss of fertile land, and the disruptions to ocean circulation (variability in atmospheric composition, ozone depletion, and UV-B radiation; bio-geochemical and hydrological cycles, biodiversity, climate, ocean processes, sea level; link between climate change and extreme events; socio-economic interactions; etc.).

- ***To foster better understanding of the terrestrial and marine ecosystems and the interaction between them and other ecosystems***

  The objective is to understand the land and marine ecosystems better, particularly their interactions with soil, water, atmosphere and oceans (global change and the impact on ecosystems; assessment of biodiversity; role of ecosystems in bio-geochemical cycles; land-use modelling, soil degradation, and desertification trends; etc.).

- ***To develop strategies for the prevention and mitigation of - and possible adaptation to - the effects of global change, and the conservation of biodiversity***

  The objective is to provide a sound scientific basis for strategies to address the negative implications of global change (formulation and evaluation of options; conditions for decoupling economic growth from environmental deterioration; etc.).

- ***To support the development of the European component of the global observation systems for climate, terrestrial systems, and oceans***

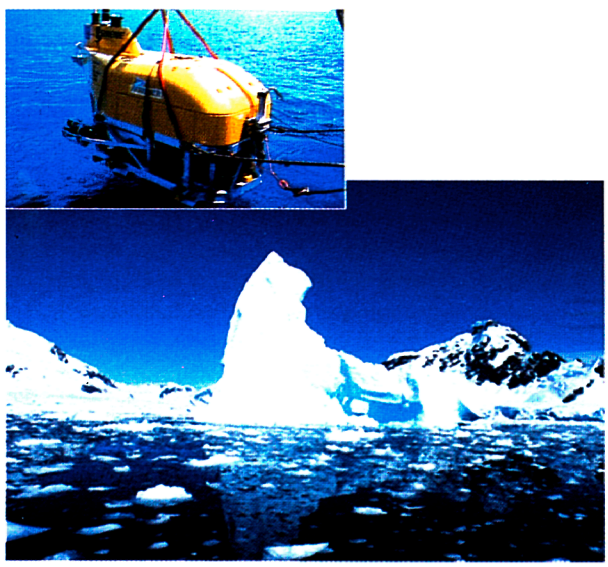
  Research should help improve the capacity of current observation systems, with a view to improved prediction and evaluation of the implications of global change (methods and tools to obtain and process data from *in-situ* measurements and remote sensing techniques; etc.).

## Predicting the weather six months ahead

European researchers working together in the Community-funded *Provost* project, have succeeded in designing a computer model which, under certain conditions and using global observations, can provide reliable regional and seasonal climate forecasts. For example, the model succeeded in predicting the 1997 *El Niño* six months before it appeared, as well as its overall impact. It also allowed a scientifically valid forecast for the 1997-1998 winter to be made for the first time in Europe. The model was also able to anticipate the exceptional floods which occurred in 1998 in China and along the Pacific Coast of the United States and South America.

## The mysteries of the deep

The European research project *ESOP2* focuses on the circulation patterns that form the very deep, cold water in the Greenland Sea. Deep-water formation in this area is important for the climate of Europe because it encourages the northward flow of the Gulf Stream. However, the physical processes involved in this phenomenon are still poorly understood. Releasing an inert tracer into the Greenland Sea at a depth of 300 metres, researchers discovered two previously unknown mechanisms of water circulation. In certain places, strong currents, which rapidly transported the tracer-labelled water from the 300 m level down to a depth of more than 3 km, caused storms on the seabed. The team also discovered a localised "chimney" effect, which takes water from the surface straight down to the bottom. One chimney, detected in May 1997, takes surface water down to a depth of 2 km.



Marine resources play an important role in Europe's life and economy. The fisheries sector, for example, involves some 70 000 companies, mainly SMEs, and generates an annual turnover of 20 billion euros. In fact, almost 5% of Europe's wealth is produced by maritime industries and services.

However, the marine ecosystems are still poorly understood and consequently conceal riches we can as yet only guess at. Understanding these ecosystems better and ensuring the sustainable management of the marine resources they contain are two of the principal aims of this key action. Another is achieving better coordination of national maritime policies, clearly a necessity since European seas are among the most heavily exploited on earth.

## Scientific and technological objectives

- ***To develop scientific knowledge on marine processes, ecosystems and interactions***

  The aim is to facilitate the sustainable use of the marine environment and its resources (effects of physical and environmental factors on ecosystems; study of extreme environments; analysis of sedimentary systems; etc.).

- ***To reduce the anthropogenic impact on both biodiversity and the sustainable functioning of marine ecosystems, through analysis of its causes, consequences, and possible solutions, and through development of safe, economic, and sustainable exploitation technologies***

  The research undertaken under this topic should make it possible to reduce the impact of human activity, in particular as regards the biodiversity of marine ecosystems (effects of human activity, in particular the introduction of species and bio-geochemical cycling; mechanisms of marine biodiversity evolution; processes reducing the impact of contaminants and eutrophication; development of technologies for the study and monitoring of marine environments, sampling, exploration of living resources for biotechnological applications; etc.).

- ***To develop the capacity for monitoring and managing coastal phenomena***

  The aim is to alleviate pollution, flooding, and erosion in coastal areas, and to facilitate land reclamation from the sea (long-term coastal morphology changes; interaction between ecology, morphology, erosion, and the impact of human activity; estuarine morphodynamics and interactions between estuaries and coasts; fate of pollutants; natural coastal defence mechanisms; etc.).

- ***To enable operational forecasting of environmental constraints on offshore activities***

  The aim is to develop techniques making it possible to guarantee the proper implementation of operations at sea (pilot systems for monitoring, prediction, and management for the safety of offshore operations: acquisition of oceanic parameters, forecasting techniques and mathematical models, assessing the relevance of environmental parameters, identification of best practice, etc.).

## Voyage to the bottom of the sea

Several Community projects have developed technologies for deep-water and seabed exploration. One of these is *Sirene*, a remote-controlled shuttle which can install underwater laboratories up to 6 000 metres deep, with extreme precision, by using a state-of-the-art tele-acoustic communication system. Others include *Alipor*, an entirely automated submarine which descends to the seabed to carry out experiments there, and the robot developed under the *Roman* project to carry out heavy work at great depth and to take the place of people in dangerous situations.

## European sea, European research

An ocean in miniature, the Mediterranean is an important sea not only for Europe but also for science, since it contains a wealth of information for researchers. Supported by the European Union, the *Mediterranean Targeted Project* (MTP), the largest research project on the Mediterranean, involved 250 scientists from some 70 institutions during its first phase. Researchers observed that the temperature of deep water in the western basin had increased by 0.13 °C over the last forty years, which could be a sign of global climate change affecting the whole planet. Another alarming discovery was the increasing concentration of phosphates and nitrates, which leads to accelerated eutrophication and consequently the presence of algae and cloudy waters. However, there are positive findings, too: a reduction in the concentration of lead – the direct result of European regulations on fuel additives.

Today, 80% of Europeans live in cities, and this is also where most of the economic activity of the European Union takes place. These two facts subject the urban environment to significant and sometimes opposing pressures.

This key action is intended to develop forms of global city management that look to the future, without forgetting the past. Through the research and technological development envisaged, the aim is to reconcile economic activity with quality of life and the protection of cultural heritage.

## Scientific and technological objectives

- ***Integrated approaches aiming at the sustainable development of cities and rational management of resources***

  The research envisaged under this topic is intended to support the sustainable development of cities and urban areas (e.g. urban development scenarios; impact of technologies, infrastructure, noise, and air pollution from all sources on development and the environment of cities; supply of essential resources, e.g. energy, land, and water; reduction of pollution and waste).

- ***Protection, conservation and enhancement of European cultural heritage***

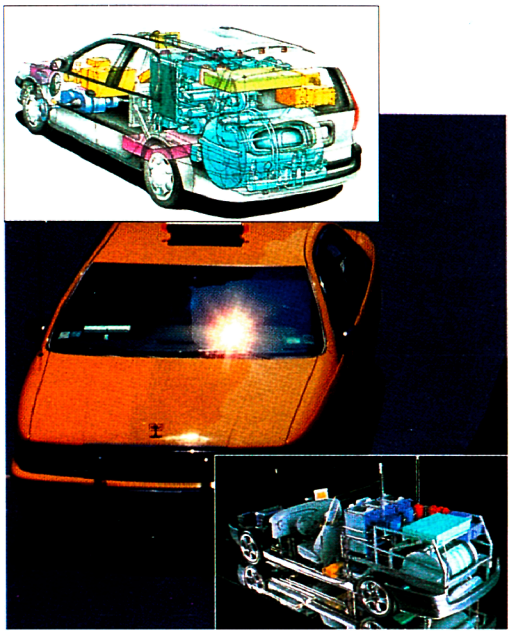
  The objective here is to develop European cultural resources in order to improve citizens' quality of life, promote tourism, and stimulate job creation (e.g. technologies for diagnosis, protection, conservation, restoration, and the sustainable use of cultural heritage; harmonious and effective integration into the urban environment).

- ***Preservation, recovery, renovation, construction, dismantling and demolition of the built environment, in particular for large groups of buildings***

  The research envisaged, together with the development of suitable technologies, should enable better use to be made of buildings in the urban environment, particularly in response to cultural and social needs (technologies for the design, maintenance, modernisation, conversion, construction and demolition of buildings; combating hazards and deterioration; safety, security and social dimensions; rehabilitation of resources; indoor environmental management; etc.).

- ***Strategies for sustainable transport systems in an urban environment***

  The aim is to promote sustainable transport strategies in order to reduce urban pollution and congestion (comparative assessment and demonstration of strategic approaches and technical solutions for innovative and sustainable transport systems - collective and individual - methodologies, and related infrastructure).



## A completely clean car

A revolutionary prototype electric car powered by a fuel cell with a polymer electrolyte has been designed by the *Fever* project (part of the EU's Joule-Thermie programme), which involves two car manufacturers and several other industrial partners. Consuming only hydrogen and atmospheric oxygen, and emitting only pure water, this car of the future has achieved a record level of performance thanks to this still very experimental propulsion system: 120 km/h and a range of 500 km. It heralds the forthcoming industrial development of this use of the fuel cell, which could constitute an important way of reducing the increasing impact of the transport sector on global warming.

## Cultural heritage: Europe in the lead

Since 1986, Member States and associated countries have joined forces and resources in a Community research programme to improve their understanding of the causes and consequences of the deterioration of cultural heritage – both in Europe and throughout the world – in all its forms (architecture, art and *objets d'art*, old books, etc.) and to develop treatments for its conservation and protection. This initiative, which is currently the biggest in the world, explores the scientific, technological, and even the socio-economic aspects of the subject. It aims to develop tools to evaluate environmental attacks on cultural heritage, as well as new products, technologies, and management methods to conserve, protect, and restore it.

Besides the interest and very important participation of museums and other conservation institutions in the projects, an increasing presence of companies - including numerous SMEs - also attests to the economic issues represented by the heritage technologies.

Energy demand in Europe is on the increase. It is estimated that the total energy consumption of Europe will increase by approximately 20% between 1998 and 2020, while, if appropriate measures are not taken, $CO_2$ production is expected to grow by about 14%. These two figures illustrate the energy problem: how to secure - and diversify - the European Union's energy supplies in the face of the expected growth, while reducing the impact of this consumption on the environment?

The aim of this key action is to answer these crucial challenges for European companies and economies, and in particular to develop and improve renewable energy resources, which should account for 12% of the European Union's energy supply by 2010 - double the 1998 level.

## Scientific and technological objectives

- ***Energy production from coal, biomass or other fuels***

  The objective is to improve the efficiency and reduce the cost, external dependence, and environmental impact of electricity and heat production, whether from renewable energy resources or fossil fuels (combustion and other thermo-chemical conversion processes, such as gasification, and pyrolysis; improving the efficiency of gas turbines; combined heat and power; etc.).

- ***Development and demonstration of the main new and renewable energy sources***

  Research will support the deployment of new and renewable energies, in particular biomass, wind and solar technologies, and efficient energy conversion technologies such as fuel cells (e.g. clean conversion and cost-effective use of biomass in the context of energy generation systems for heat and power; fuel cells for stationary and transport applications; land-based and off-shore applications of wind energy; photovoltaic and solar thermal technologies).

- ***Integration of new and renewable energy resources into energy systems***

  The goal is to develop new applications and overcome barriers to the use of renewable energy (integration of renewable energy resources into energy grids and processes; hybrid systems; improving the acceptability of renewables, e.g. by decreasing visual intrusion and noise; etc.).

- ***Reduction of the damage caused to the environment by power production***

  Research will focus on emission abatement technologies for power stations ($CO_2$, $SO_x$, $NO_x$, and other pollutants), hot gas cleaning, and the understanding of basic phenomena.

## "Clean coal" power stations

It was through a Community project that the following surprising result was discovered: by mixing coal with organic waste, polluting emissions (in particular $CO_2$) are appreciably reduced, whatever the type of waste used. This "world first" was obtained by a consortium supported by the Joule programme, which involved 31 participants including 16 major European companies. On this basis, a pilot-site power station in Germany now produces "clean" electricity for a town of 30 000 inhabitants, burning all the town's rubbish in the process.

## Europe is "blowing in the wind"

The German wind turbine manufacturer, Enercon, started in 1987 with a staff of 20, but is today number two in the world and boasts 850 employees. Its remarkable growth is explained both by the new German legislation compelling electricity producers to pay wind power stations a good price for their surplus electricity and by its participation in eight Joule projects (1992-1997) which helped it to increase the performance of its products while decreasing their cost.

Having energy resources is one thing, but ensuring their correct use and reducing costs and consumption are just as important a challenge if Europe is to have a reliable, safe, and economic energy supply - something which is certainly essential for individuals, society, and the competitiveness of industry.

This key action is therefore designed to improve the efficiency of the energy cycle and to reduce costs at all stages - production, distribution and use.

## Scientific and technological objectives

- ***Rational and efficient use of energy***

  The objective is to use research and demonstration activities to support the development of new technologies - or the improvement of existing technologies - with a view to reducing energy consumption in buildings, transport and industry (particular emphasis will be given to cross-sectoral technologies, such as process control, and an integrated approach to improving energy efficiency; lighting, heating, air-conditioning, and integration of renewables in buildings; improved energy and environmental performance of vehicles and the corresponding infrastructures; industrial processes; etc.).

- ***Transmission and distribution of energy***

  Research will help the efficiency of energy transmission and distribution systems, whilst reducing costs, transmission losses, and environmental impact (intelligent energy transmission and distribution systems; long-distance transmission of gas and electricity; network management and control; superconductivity; etc.).

- ***Storage of energy***

  Research in this area should contribute to more efficient technologies for energy storage. At the macro scale, the purpose is to make the most of intermittent sources of renewable energy; at the medium scale, to permit the development of zero-emission vehicles; at the micro scale, to enable further downsizing of electronic devices (reliable and cost-efficient energy storage technologies, including liquefied natural gas, liquefied petroleum gas, hydrogen, and advanced batteries, both macro and micro, for stationary and mobile applications).

- ***Exploration, extraction and production of hydrocarbons***

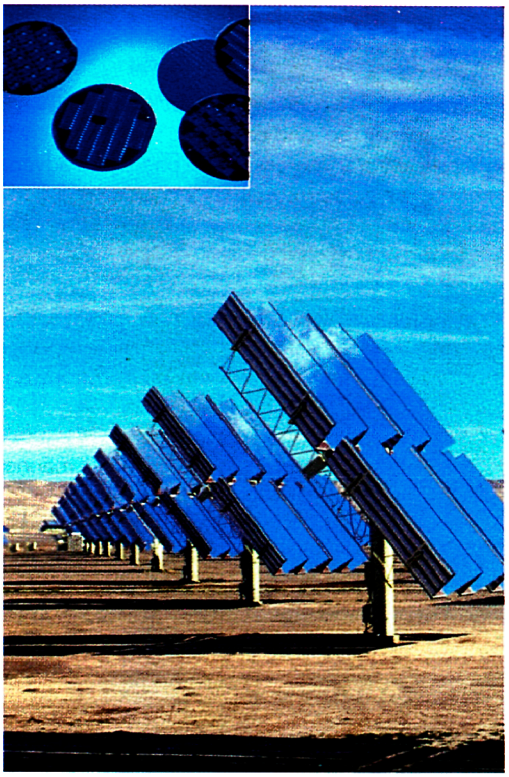
  The aim is to allow more efficient identification of the energy resources available in the European Union and to optimise their exploitation, while reducing the cost and environmental impact (characterisation and management of hydrocarbon reservoirs; exploration and production of hydrocarbons, especially in hostile submarine locations; improved recovery techniques for hydrocarbons; etc.).

- ***Improving the efficiency of new and renewable energy source***

  In order to ensure the widest possible deployment of renewable energies, the goal is to improve the technologies used and reduce the costs of manufacture and use (biomass exploitation and management of waste as a fuel resource; improving efficiencies of photovoltaic cells and wind turbines; reducing production costs of renewables technologies).

- ***Scenarios for supply and use of energy***

  The aim is to develop strategies for the production and use of energy, for the introduction of new technologies and for policy development (scenarios for long and short-term supply and demand at the global, Community, and regional levels; modelling and policy impact analysis; overall assessment of energy markets and technology impacts; etc.).



## European research for solar energy

The support of Community research programmes has been effective in complementing the efforts of both Member States and industry to develop the use of photovoltaic solar energy. For example, it has contributed to a tenfold reduction in the cost of the energy produced by this relatively young technology, whose industrial development started in the 1970s, and which employs approximately 8 000 people in Europe today.

Contact: eesd@dg12.cec.be

# Euratom programme

The availability of secure, sustainable and competitive sources of energy is essential to economic growth, prosperity and quality of life in the industrialised world. But the developing world needs energy too, and economic progress there in the coming years will lead to major increases in global energy demand, perhaps leading to increased fuel prices and adverse effects on health and the environment. The effects of such problems can only be mitigated through concerted international effort to develop promising technologies, including all current and potential sources. One such source is nuclear energy, which makes a significant contribution to diversifying energy supply and reducing overall emissions of $CO_2$ .

In fact, nuclear energy has the potential to provide Europe with a secure and sustainable electricity supply at a competitive price, which can in turn strengthen the Community's industrial competitiveness. At the same time, minimising radiation exposure from all sources, including medical exposures and natural radiation, will improve the quality of life in Europe and help in addressing health and environmental problems.

The programme's aim is to help exploit the full potential of nuclear energy, both fusion and fission, in a sustainable manner, by making current technologies even safer and more economical, and by exploring promising new concepts.

In this context, two **key actions** will be implemented (see page 58). The first of these is in the area of **controlled thermonuclear fusion**, which accounts for some 80% of the programme's total budget. The second key action is on **nuclear fission**, whichwill be complemented by **generic** research and technological development activities mainly in the field of radiation protection.

- ***Radiation protection and health***

  Research will focus on a better understanding of the hazards related to ionising radiation, and improving the basis for estimating the risks of low and protracted exposure to it (biophysical and molecular-biological aspects of DNA damage and repair; early and late biological effects and their impact on health; epidemiology; treatment of radiation injury).

- ***Environmental transfer of radioactive material***

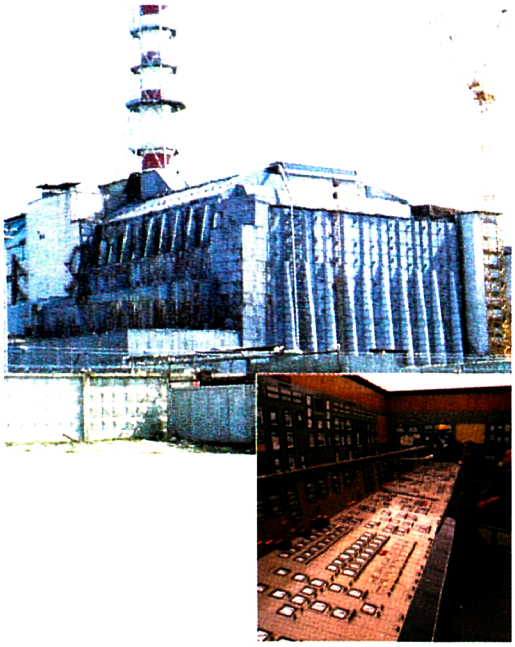
  Research will help improve our understanding of the behaviour of radioactive material in the environment, and develop strategies for managing the impact of natural and artificial sources of radiation (behaviour and fluxes of radionuclide in the biosphere; vulnerability of different environments to radioactive contamination; etc.).

- ***Industrial and medical uses and natural sources of radiation***

  The aim is to improve the safety and efficacy of medical and industrial uses of radiation and the management of exposure to natural sources of radiation (innovative approaches to medical diagnosis and industrial uses of radiation; optimisation of radiation protection; etc.).

- ***Internal and external dosimetry***

  Research will contribute to improving methods for assessing exposure to radiation (dosimetry of complex radiation fields and incorporated radionuclides; retrospective dosimetry; innovative monitoring techniques).

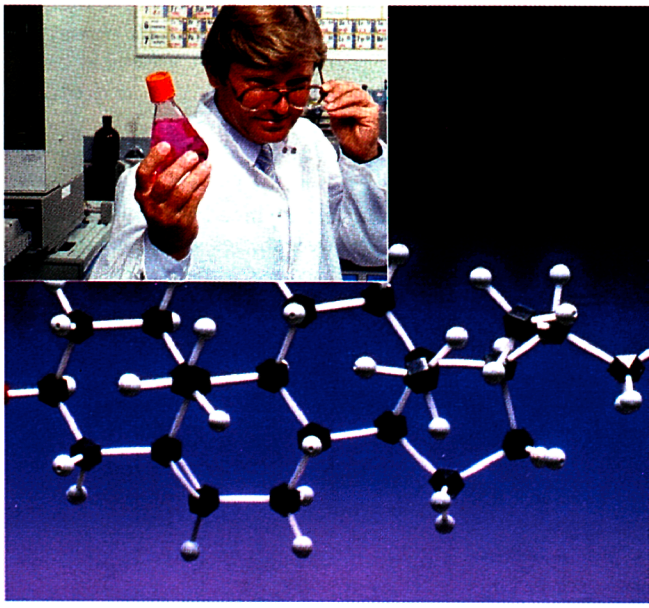


## Europe helps analyse the Chernobyl accident

In order to analyse the consequences of the Chernobyl accident, the European Union has supported 16 projects involving some 80 Member State laboratories and approximately 120 institutes from Russia, Ukraine and Belarus. One of these projects confirmed 386 cases of children suffering from thyroid cancer in Belarus and northern Ukraine. A group of international experts established that, since the accident, the incidence of this cancer has increased by a factor of 20 among children up to 14 years old, making the disaster the most probable cause. Indeed, for children born after the accident in the same regions, there was no such increase.

## Trapping radioactive waste

Eight European laboratories have together prepared new chemical compounds capable of eliminating the long-lived radioactive elements from the effluent produced by nuclear fuel reprocessing plants. The teams synthesised 140 new molecular cages, able to trap certain specific radionuclides. Some of these molecules proved capable of extracting the caesium and actinides from highly radioactive solutions. Now patented and marketed, these molecules have crossed the Atlantic and are being used by American specialists.



Owing to its potential as a practically inexhaustible source of energy and clean and safe electricity, fusion is one of the few large-scale energy options for the third millennium. Thanks to Community programmes, the achievements of Europe's fusion laboratories have made it possible to build the largest installation in the world, JET (Joint European Torus), and to make Europe a world leader in fusion research, a result that no Member State could have hoped to reach alone.

The aim of this key action is to further develop the necessary basis for the possible construction of an experimental reactor (the "Next Step"), with the objective of demonstrating the scientific and technological feasibility of fusion power production as well as its potential benefits in the areas of safety and the environment.

## Scientific and technological objectives

- ***Next Step Activities***

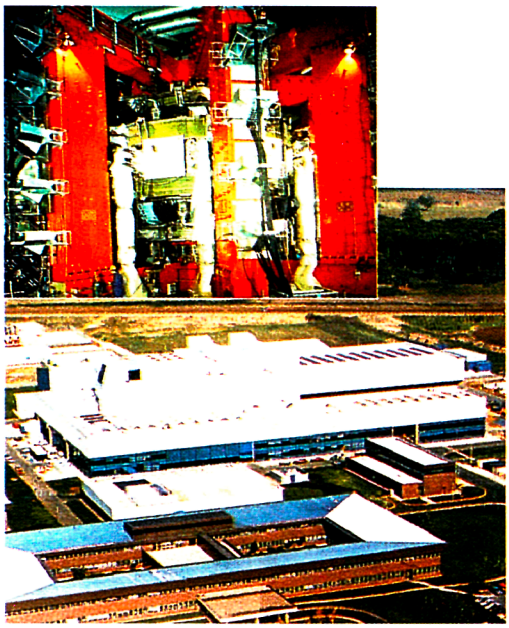
  Fusion physics and technology activities will aim to develop the capacity - especially within the associations, JET and European industry - to construct and operate an experimental reactor. Europe will also continue to participate in the ITER engineering design activities (finalise the design and complete the prototype tests and supporting research; finalise procurement specifications; consolidate the necessary scientific basis; adaptation of the design of the experimental reactor to at least one possible specific site within the EU and initiation of the dialogue with the potential licensing authorities; complete full-scale operation of JET; possible extended use of JET facilities by teams from organisations associated with Euratom).

- ***Concept improvements***

  Under this heading, research will focus on improving the basic concepts of fusion devices (e.g. construction, use and upgrading of fusion devices; diagnostics and means of action on fusion plasmas; continuation of theoretical studies; studies aiming at operating a remotely located fusion experiment; in addition to magnetic confinement – which includes the main-line tokamak research and the pursuit of a range of options such as the stellerator, the spherical tokamak, and the reversed-field pinch – coordination of national civil research activities on inertial confinement and possible alternative concepts - within the framework of a keep-in-touch activity).

- ***Long-term technology***

  Activities will prepare for the construction of a demonstration reactor, DEMO, and then a prototype reactor (development of tritium breeding blankets and a reference structural material for constructing DEMO-relevant modules; prospective studies on advanced low-activation and radiation-resistant materials; new safety and environmental impact assessment; analysis of the socio-economic aspects of fusion, including evaluation of economic costs and of social acceptability of fusion, in comparison with other energy sources; etc.).



## Europe in the lead

From record to record, JET (Joint European Torus), the European research installation located near Abingdon (United Kingdom), has exceeded its original goals and is still one of the most powerful tools available anywhere for fusion research. JET is one stage in the long-term research being undertaken with a view to reproducing on earth the mechanism of almost-inexhaustible energy production that takes place in the stars. With Jet as its flagship, the Community's *Fusion* programme, which encompasses all the research in this field undertaken by the Member States and Switzerland, has enabled Europe to become a major world player in this sector.

**Contact: eesd@dg12.cec.be**

Nuclear fission plays an important role in the European energy landscape; in some countries, as much as 75% of the electricity is produced by nuclear power stations.

The research planned for this key action should help to:

- ensure the safety of European nuclear installations;
- protect the workers and the public;
- allow the management and safe and effective final disposal of radioactive waste;
- improve the competitiveness of European industry and increase its prospects on world markets;
- explore more innovative concepts that are sustainable and have potential longer-term economic, safety, health and environmental benefits;
- contribute, through education and training, towards maintaining a high level of expertise and competence in nuclear fission within the European Union.

## Scientific and technological objectives

- ***Operational safety of existing installations***

  Research will focus on measures to maintain and improve the safety of existing installations, including the safety aspects of prolonging the life-span of reactors (common basis and methods for determining residual life-spans; effects of ageing on the integrity of structures and systems; improved inspection and monitoring methods to enhance safety and reduce occupational exposure; organisation and management of safety; etc.).

- ***Safety of the fuel cycle***

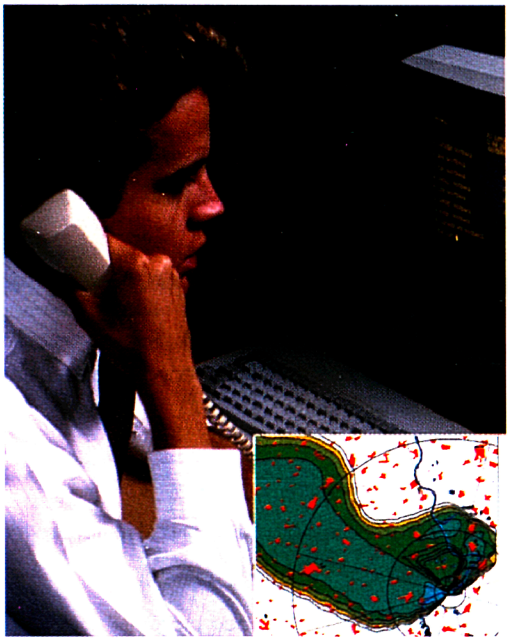
  Work will be directed towards the development of improved methods for assessing, managing and enhancing the safety of the entire cycle, including existing reactors, especially the prevention and management of accidents and a scientifically founded approach to the management and disposal of radioactive waste (technological aspects of severe accidents, strategies and methods for the prevention, mitigation and management of accident and post-accident situations; research for a consensus on the management and the disposal of radioactive waste; test and demonstration of the technical feasibility of deep disposal in underground repositories; development of best practices and maintaining and updating databases, including those related to the decommissioning of nuclear facilities).

- ***Safety and efficiency of future systems***

  Research will focus on sustainable improvement of the safety and competitiveness of future systems and facilities, including advanced and more efficient fuels and innovative or fundamentally new concepts for energy generation (innovative reactor designs and waste management concepts; new fuels, including better utilisation of fissile material; optimisation of the fuel cycle as a whole, covering safety, health and environmental aspects; enhanced passive safety features and control systems; longer service life for materials, and equipment with less need for inspection and maintenance).

- ***Radiation protection***

  Research should help operators and regulatory authorities protect workers and the public during operations in the nuclear fuel cycle, manage nuclear accidents, and restore contaminated environments (risk management and optimisation of protection; real-time occupational-exposure monitoring at work; information exchange and monitoring strategies for emergency management; etc.).

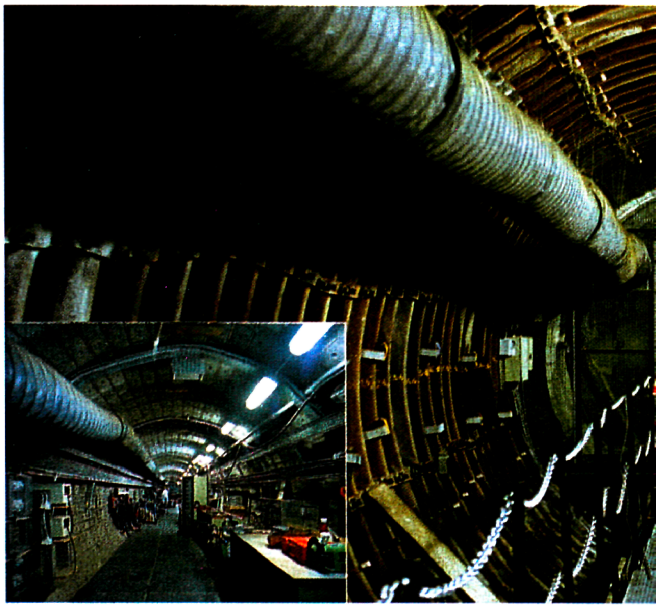


## A management system for accidents

Researchers working together on a Community project have designed the *Rodos* decision-support system, which allows remote management of a nuclear accident during its early phases. The system has been installed for pre-operational purposes in emergency centres in Hungary, Poland, Slovakia and Ukraine, with the aid of ECHO and the *Tacis* programme.

## Underground research laboratories

In the process of developing deep disposal systems for long-lived radioactive waste, research and development work performed in underground research laboratories (URL) makes an essential contribution. The EU is at present supporting research in three URLs, with the work being coordinated in a cluster. The work involves experiments using different processes, which it is important to understand in order to assess performance and safety for the real repositories. It also includes the development of excavation techniques (with low disturbance of the rock) and waste handling.



# Horizontal programme 1

The globalisation of the economy is a fact. But the globalisation of science and technology is also a process which seems to be inescapable and which is accelerating fast. The large-scale projects developing on the international scene are increasingly numerous. Scientific facilities, for example, such as astronomical observatories, particle accelerators, and nuclear fusion reactors, are increasingly the subject of international collaboration - for construction, use and operation. And the development of new technologies, too, is increasingly carried out through transnational partnerships.

The principal aim of this horizontal programme is to make known the quality of Community research, by the opening it up to the world. More precisely, these activities should help:

- European research centres and companies gain access to scientific and technological knowledge based outside the European Union;
- implement strategically important activities with non-European countries;
- prepare for the accession of new Member States;
- increase the opportunities for researcher training;
- improve coordination with other Community programmes and other European organisations and initiatives for cooperation, such as COST and Eureka.

It should be noted that the other programmes of the Fifth Framework Programme also incorporate international cooperation activities. A system of fellowships will be established for young doctoral-level researchers from developing countries, including Mediterranean countries and emerging economies.

The programme's activities cover the following categories of countries outside the EU.

- ***Countries preparing for accession***

  The objective is to speed up the reform of science structures in these countries (Bulgaria, Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, Slovenia) and to safeguard their highly qualified human resources (promoting existing centres of excellence centres: networking, organisation of conferences, visiting scientists, etc.; measures to strengthen participation in the other programmes of the Fifth Framework Programme; etc.).

- ***NIS and those Central and Eastern European Countries not included above***

  The objective is to develop the scientific and technological system of these countries and to preserve their research excellence, which should help stimulate their economic development (joint research projects and concerted actions, in particular on environmental and health problems such as desertification, air pollution, and water quality; cooperation in fields where they have recognised excellence, e.g. physics, mathematics, lasers, and aerospace technologies).

- ***Mediterranean partner countries***

  The objective of the actions envisaged is to strengthen the research and technology dimension of the Euro-Mediterranean partnership (integrated coastal zone management in the Mediterranean; management of water and other natural resources; preservation and restoration of cultural heritage; etc.).

- ***Developing countries***

  The objective of this part of the programme is to tackle research problems linked directly to development challenges of long-term mutual interest. The subjects covered will be selected from the following fields in conjunction with groups of countries and regions, taking into account the development policy objectives of the Community and internationally agreed development targets: mechanisms and socio-economic and political conditions for sustainable development; sustainable management and use of natural resources; health improvement.

◆ ***Emerging economies and industrialised countries.***

These countries are both competitors and partners for the EU in the global market place. The activities will therefore promote political dialogue on research, access to know-how and opportunities for cooperation. Activities will consist mainly of implementing scientific and technological cooperation agreements in certain countries.

◆ ***Coordination with Community activities and European initiatives.***

An objective of the programme is to improve coordination with the other specific programmes of the Fifth Framework Programme and the external technical assistance programmes of the European Union such as Phare, Tacis, MEDA, the EDF and the programmes for Asia and Latin America, in order to strengthen the synergies and cooperation with the countries concerned.

In addition, methods will be implemented to ensure complementarity between the actions of the framework programme, on the one hand, and COST and Eureka, on the other. Cooperation will be strengthened with international organisations concerned with science and technology, which will increase the overall coherence of research in Europe and optimise the use of European scientific infrastructure. The programme will also seek to identify fields where increased coordination between the Community and the Member States is warranted.

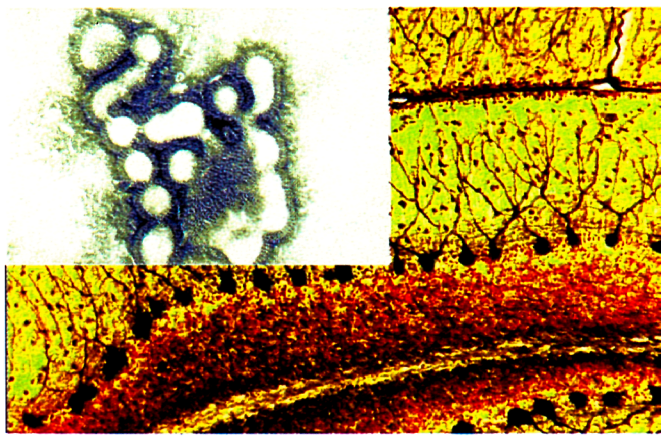
## Examples of projects from the Fourth Framework Programme


### Recycling 50 tonnes of Russian military plutonium

In April 1996, the G7 countries and Russia decided to strengthen cooperation with a view to processing the plutonium resulting from the dismantling of Russia's nuclear weapons. The European Union is actively assisting in the implementation of this agreement through the financing of projects run by the ISTC (International Science And Technology Centre) in Moscow, which supports the retraining of Russian military researchers in civilian activities. By 1998, more than 21 000 Russian scientists had benefited from the ISTC programme.

### A European "first" in the fight against parasitic infections

Under a Community project involving teams from several Member States and Brazil, researchers showed the genetic basis for a pre-disposition to *schistosomiasis* (an illness transmitted by nematode worms) by identifying a gene on chromosome 5 that controls resistance to the illness. Another gene which determines susceptibility to fibrosis of the liver was also identified. These openings could lead to the development of new therapeutic approaches.



**Contact: inco@dg12.cec.be**

# Horizontal programme 2

Innovation can be seen as the art of transforming knowledge into wealth. Europe's scientific potential and aptitude for research are both recognised as amongst the best in the world. However, to take full advantage of them, in terms of growth and job creation, innovation must be encouraged. Indeed, this is essential if market opportunities are to be exploited and competitive challenges met. In information technology, for example, 78% of revenues come from products that did not exist two years ago.

When considering innovation, small and medium-sized enterprises (SMEs) play a particularly important role. Not only do they account for more than 99% of all companies and 67% of European employment, they are, in fact, a real driving force behind the European economy, innovating twice as much (per employee) as large companies.

With this in mind, the programme will pursue the following two broad objectives:

- to ensure the dissemination and exploitation of the results generated by framework programme projects and stimulate technology transfer by coordinating the activities promoted by the thematic programmes' innovation units;
- to coordinate the implementation of the specific measures designed to encourage SMEs to participate in the programmes (subsidies for the preparatory phase, and cooperative research - CRAFT).

More specifically, the following actions will be carried out by the programme.

## Promoting innovation

- ***Making better use of the results of Community research***
  Mechanisms to facilitate the protection of acquired knowledge, and the exploitation or transfer of technologies and results; organisation of exchanges of information and good practices; etc.
- ***New approaches to technology transfer***
  Validation of technology-transfer methods; promoting the take-up of new technologies and analysing the process; international dissemination and exploitation of results not coming from the thematic programmes; etc.
- ***Studies and good practices***
  Promotion of good innovation practices; analysis and benchmarking of innovation performance and policies; etc.

## Encouraging SME Participation

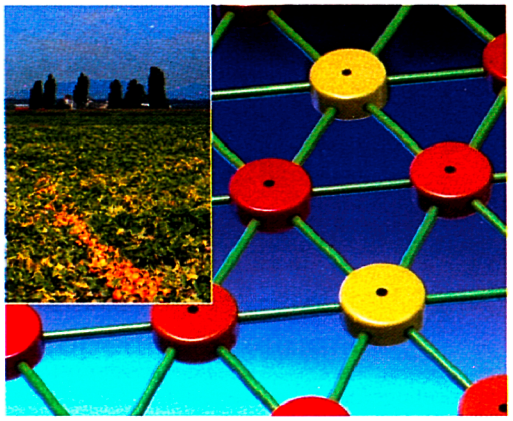
- ***A single complementary entry point,*** to facilitate the participation of SMEs in Community programmes, complementing existing support networks, such as Innovation Relay Centres and CRAFT national focal points in Member States.
- ***Joint support and assistance instruments,*** to simplify and harmonise SME participation conditions through the fullest possible use of the most suitable electronic means: electronic information packages and electronic submission of proposals, "help line", specialised Intranet networks, etc
- ***Economic and technological intelligence,*** to help SMEs identify their needs, anticipate technological trends, and direct them towards the most suitable Community instruments.

## Joint Innovation/SME activities

- ***European support network for the promotion of research, technology transfer and innovation,*** the aim being to make companies aware of Community research programmes, encourage transnational transfers of technologies, and promote the dissemination and exploitation of the results of Community research, etc.

- ***Electronic information services and other means of distribution,*** where the objective is particularly to consolidate the CORDIS information service.
- ***Intellectual property,*** which envisages the creation of an information system on patents, and a help-desk for participants in Community programmes, etc.
- ***Access to private innovation financing,*** in particular by the development of an information and assistance service to facilitate access to sources of private financing, the organisation of transnational investment forums to facilitate contacts with financial circles; etc.
- ***Mechanisms facilitating the creation and development of innovative companies,*** the aim of which is to encourage private investment (particularly venture capital) in these companies.

## Examples of projects from the Fourth Framework Programme



### Networked innovation

In 1993, a German SME developed a new type of detector which enables farmers to measure the humidity of the soil, a vital parameter for crops. With a view to distributing this detector, this SME contacted the European technology transfer network, the "Value Relay Centres", supported by the European Union. The members of the network informed their respective contacts about this invention and quickly two companies, one based in France and the other in Denmark, noticed that there was a demand for this type of detector. They therefore signed a contract in order to market it. But that is not all: these two companies also saw that the technology developed could be used for other applications. These are being developed today.

### "Electronic noses"

How to test the olfactory quality of food? Until very recently, industry had to use human specialists, "noses", whose performance, although very good in general, is not suited to the requirements of industrial production. After working together with seven other SMEs, a French company put an "electronic nose" on the market; it is able to analyse, store the results, and detect possible product defects, all at the same time - a new technology, tailored to the needs of each industry. From a staff of five in 1994, the SME's workforce rose to about forty in 1998, and has now been floated on the Paris Stock Exchange's *Nouveau Marché*, exporting 45% of its production to the United States.

**Contacts: innovation@dg13.cec.be and sme@dg12.cec.be**

# Horizontal programme 3

In the past, the driving economic forces behind society were agriculture and, more recently, industry. More and more, however, in developed economies today it is knowledge that is driving the economy – and shaping society – bringing with it new production methods and new types of organisation.

This development means that, more than ever, Europe's best assets , in research as in other fields, are its human resources: the quality of its researchers, its engineers, and its technicians. Equally important is the research work which should enable us to understand the crucial problems which confront a changing European society, such as the socio-economic impact of new technologies.

The aim of this programme is to meet this double need: to build up human research resources and develop the socio-economic knowledge base. To this end, a key action has been implemented (see page 68), as well as the following activities.

- ***Training and mobility of researchers***

  The aim is to create a dynamic high-quality European Research Area by stimulating training-through-research, equal opportunities, and international cooperation. This will be accomplished through two major actions: the Research Training Networks (networking of laboratories to encourage the training of researchers, in particular in emerging scientific fields and especially in relation to industry) and the Marie Curie Fellowships (individual grants for researchers).

- ***Access to research infrastructures***

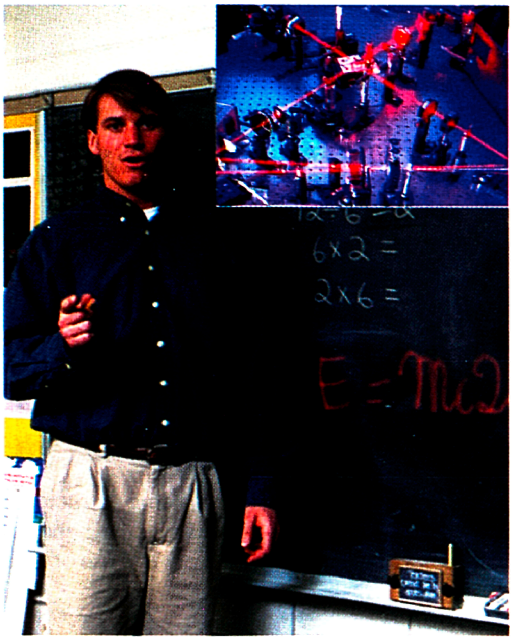
  This will allow European researchers to have access to large research facilities, which often belong to a particular country and are therefore available mainly - if not exclusively - to teams from that country. To this end, three specific actions have been implemented: new opportunities for transnational access to major research infrastructures, infrastructure cooperation networks, research projects connected with research infrastructure.

- ***Promoting scientific and technological excellence***

  This area consists of the following three actions: high-level scientific meetings (euro-conferences, practical courses, etc.), distinctions for exceptional research work (in particular the Descartes Prize, which will be awarded for outstanding scientific and technological achievements resulting from European collaborative research), raising public awareness (European Science and Technology Week, etc.).

- ***Development of scientific and technological policies in Europe***

  In order to increase the EU's ability to anticipate the major scientific and technological issues, the following two actions will be undertaken: strategic analysis of specific political issues (analysis and synthesis on the implications for research policies of scientific and technological change, globalisation, changes in social demand, etc.) and the compilation of a common, European base of science, technology and innovation indicators.

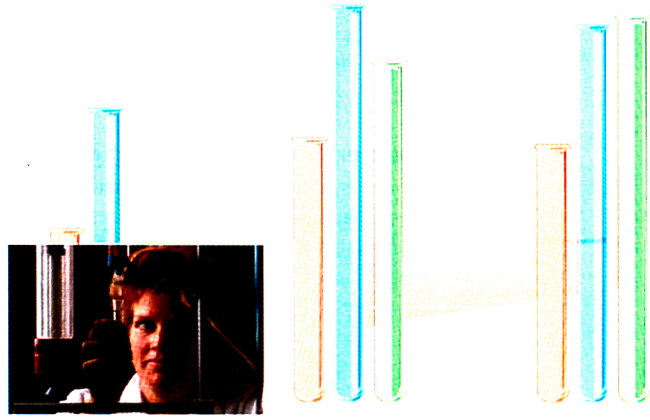



## Was Einstein wrong?

A scientific team supported by the Training and Mobility of Researchers programme has demonstrated the phenomenon of *quantum teleportation*. Under certain conditions, it seems as though a photon is able to communicate the nature of its quantum state, remotely and instantaneously. This seems to violate the law that nothing can travel faster than light, but actually has an explanation, of course. However, this phenomenon could bring about the development of a whole new generation of "quantum computers".

## A comparative analysis of European performance

In 1997, the Commission published its *Second European Report on Scientific and Technological Indicators*, which presents a detailed comparison of research and innovation activities and performance across Europe, also examining the individual situation of the fifty countries which spend the most on research and development throughout the world. The report notes relative stagnation in European R&D efforts, in relation to the other world economic powers, and calls for sustained investment in the fields of research, innovation and human resources. A "regional paradox" also emerges: in the less-well-developed European regions, investment in R&D is not rewarded by proportional economic results.



The aim of this key action is to marshal the strong European research base in economic and social sciences for research on a limited number of relevant topics, in order to identify not only tendencies and economic and social needs, but also the present and future challenges facing European society, thereby supporting policy-making.

More precisely, the objective is to improve our understanding of the structural changes taking place in European society, in order to identify ways of managing this change and to involve European citizens more actively in shaping their own futures. This involves determining the main trends responsible for these changes, analysing the relationships between technology, employment and society, and the impact of new technologies on working conditions, and re-evaluating participation mechanisms for collective action, etc.

## Scientific and technological objectives

- ***Societal trends and structural changes***

  Research will seek to explain the complex interactions between societal trends, changes in family structures, economic changes, labour market institutions, cultural patterns and value systems. Analysis will include xenophobia, racism and migration and provide a better understanding of changing patterns of work and use of time, the new types of employment, and the implications for education and training, etc.

- ***Technology, society and employment***

  Here the work will concern interactions between the various parties involved in technological development, the relationships between technology and employment - especially between information and communications technologies and the new ways of organising work - on the role of innovation in education and training, as well as how education and training can stimulate innovation, promote employment, etc.

- ***Governance and citizenship***

  Research will be devoted to the various types of economic and social regulation in Europe, regulation by public authorities and private initiatives, the evolution of welfare systems, the study of the concept of citizenship concept across Europe, and the influence of the various components of culture and of educational models on the development of values, etc.

- ***New development models fostering growth and employment***

  The objective is to explore new sustainable-development models to foster growth, job creation, equal opportunities, the reduction of inequalities, and an improved quality of life. It will investigate the dynamics of the creation and distribution of wealth, organisational innovations, new types of work and employment, the development of non-profit mutual-support actions; etc.

## Where do low wages lead?

What is the contribution to the European economy of "odd jobs", of all those occasional, part-time and underpaid jobs? Whom do they concern? Are jobs like this better than no job at all? And to what extent do they lead to poverty and exclusion? Fourteen research teams joined forces in a thematic network supported by the European Union to devote themselves to the study of the mechanisms likely to lead those in low-wage jobs to social exclusion. The data collected (with difficulty) by the network showed that people in low-wage jobs find it hard to improve their situation. The research also identified an almost inevitable "progress" from badly paid employment to no employment at all; low wages, in Europe at least, lead more surely to unemployment than to a fair wage for an honest job.

**Contact: improving@dg12.cec.be**

# The Joint Research Centre

Since 1957, the Joint Research Centre (JRC) has provided the European Community with the expertise and facilities for the implementation of major scientific and technological projects.

The JRC, which can be seen as "Europe's laboratory", is composed of eight specialised institutes, located in five countries (Ispra in Italy, Seville in Spain, Petten in the Netherlands, Karlsruhe in Germany, and Geel in Belgium). Its mission is to provide scientific and technical support for the conception, implementation, and monitoring of EU policies. Due to its high level of expertise, it serves as a reference point for science and technology in the European Union, and by virtue of its independence, it serves the Member States and their citizens.

In the context of the Fifth Framework Programme, the actions of the JRC revolve around the following topics.

- ***Serving the citizen***

  The objective is to protect the individual, provide them with information, maintain their health, and keep them safe (consumer protection: methods for quality and safety analysis of food and animal feed, methods for monitoring and detection of genetically modified organisms, etc.; medical and health applications: anti-cancer therapies, etc.; information society: system reliability and survivability etc.; citizens' safety – man-made and natural hazards: safety at work, land-mine clearance techniques, etc.).

- ***Enhancing sustainability***

  The JRC will contribute to the understanding of the issues involved in - and the implementation of - the Community's Environmental Action Programme (integration of environmental protection in other Community policies; pollution; global change; energy and transport; agriculture, sustainable rural development and fisheries).

- ***Underpinning European competitiveness***

  The JRC will continue to support the promotion and development of norms, standards, codes of practices, and reference tools, as well as the transfer of technologies developed by its researchers (study of the relationships between technology, employment and competitiveness; normative support to the international trading system, in particular the characterisation, production and storage of reference materials; innovation and technology transfer, including studies on the European innovation system, support for a European Earth-observation industry, and exploitation of JRC-developed technologies; support for the EU's enlargement process by hosting scientists from future Member States; etc.).

- ***Nuclear fission safety***

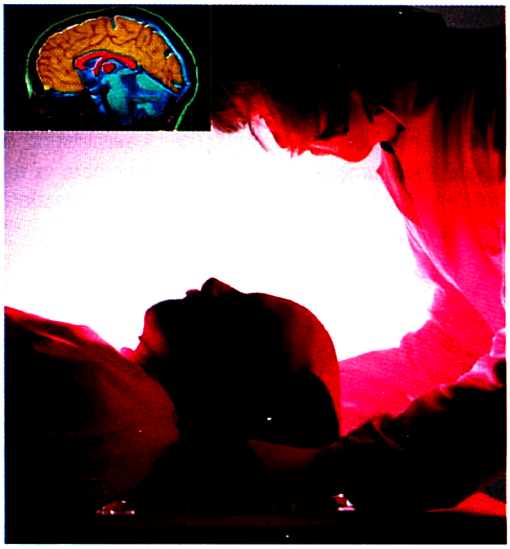
  The unique facilities of the JRC bring a real added value in the areas of the ageing of materials and components; improvement of in-service inspection techniques; fuel cycle safety, in particular basic research on actinides; study of irradiated fuels; and the study of serious accidents.

- ***Nuclear safeguards***

  The JRC's impartiality is essential to combat illicit trafficking in nuclear materials and damage to the environment (development and improvement of measurement techniques; sealing and confinement techniques; development of dedicated information technologies; fight against illicit trafficking and environmental damage involving radioactive materials; etc.).

- ***Decommissioning of JRC installations and waste management***

  Work will cover the development of a long-term plan, the construction of an installation for the treatment of liquid waste, the start of decommissioning and dismantling operations of obsolete facilities and management of waste arising from these activities.



## A new treatment for cancer

The high-flux reactor (HFR) of the Joint Research Centre in Petten, a facility which is unique in Europe, has made it possible to develop a promising new treatment to cure *glioblastoma multiform*, a particularly virulent type of brain cancer, which responds badly to traditional treatments and affects some 15 000 Europeans each year. The new treatment makes it possible to target the cancerous cells precisely. The patient is injected with a boron compound, which is selectively absorbed by the cancer cells, and then irradiated by a neutron beam. The neutrons activate the boron nuclei, producing alpha particles, which in turn destroy the malignant cells, without damaging the healthy adjoining cells.

## Strategies and systems for detecting anti-personnel mines

The JRC has set up a test facility for establishing standards for the validation mine-detector sensors, e.g. metal detectors, ground-penetrating radar, and infrared sensors. This installation has been used by various manufacturers, as well as within the framework of feasibility studies for multi-sensor systems for the detection and identification of anti-personnel mines. The standards defined will be used during subsequent tests as well as for mine-clearance projects supported by the Commission in countries where these mines are particularly numerous.

# How to take part in the research programmes of the European Union

## Who can take part in the research programmes of the European Union?

Any legal entity established in a Member State or Associated State which is involved in research, the dissemination of research results, or the exploitation of these results. Other countries outside the European Union may participate in the Fifth Framework Programme, but the Commission reserves the right to decide on a case-by-case basis. Organisations based outside the European Union are advised to check the rules for their country.

## How do you submit a Community research project?

Typically, the sequence of events is as follows.

- ***The "call for proposals"***

  Calls are published in the *Official Journal of the European Communities*, on the CORDIS Web site (http://www.cordis.lu/) and in *RTD info*, a magazine published by the Commission. NB: the CORDIS RAPIDUS service is a good way to receive automatic notification of calls and other events that interest you.

- ***Preparing the proposal***

  Each call has an associated information pack, which defines the objectives of the call, the criteria to be satisfied, the documents to be completed, etc. Information packs may be downloaded from the CORDIS Web site, where a paper copy can also be requested. It should be noted that, for the majority of the calls, the proposal must involve at least two organisations from two Member States (or one Member State and one Associated State, or one of these and the Joint Research Centre). In certain cases, the Commission may offer a pre-proposal checking service.

- ***Getting the proposal to Brussels***

  Proposals must be sent directly to Brussels. Be careful: almost 10% of proposals received by the Commission are eliminated because they arrive late, are not signed, are not complete, etc.

- ***How are the research proposals selected?***

  The majority of calls result in far more proposals than the budget available can fund. A selection must therefore be made. The single most important selection criterion is the quality of the proposals. The information pack, and particularly the section on evaluation, defines what is meant by quality. The evaluation of proposals is carried out with the aid of independent experts. Each application is normally evaluated by at least three experts, first from the scientific and technical point of view (on an anonymous basis), then as regards the proposed consortium and management. Socio-economic and ethical considerations are also evaluated (sometimes by a second group of independent experts).

## What happens next?

If the research proposal is accepted, project implementation follows a typical pattern.

- ***Contract negotiation***

  An agreed research proposal always needs a contract between the consortium and the Commission. To speed things up, it is important that contractors agree among themselves (especially on intellectual property considerations) and an intra-consortium agreement is thus highly desirable.

- ***The research***

  Once the contract has been signed by all parties, research work can start the following month, unless a different starting date has been agreed. The payment of the European Union's share of project funding is usually made in several instalments. It should be noted that for "shared-cost projects", i.e. the vast majority of Community projects, that share is normally limited to 50% of eligible costs. On the other hand, the knowledge resulting from the work carried out under the project belongs entirely to the project partners.

- ***Obligations during the project***

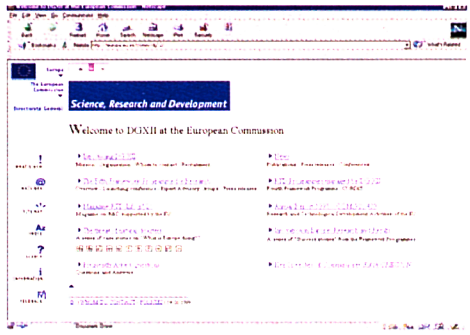
  Throughout the project, annual reports are generally required. The final payment request is submitted for Commission approval based on a final report. Contractors are also required either to use the results of the research (by exploiting them or carrying out further research) or disseminate them. For this reason, a "technology implementation plan" must be drawn up before the end of the project.

# Sources of information

## *General Information*

RTD info - a quarterly magazine published in English, French and German; free subscriptions on request via fax (+32-2-29 58220) or electronic mail (info@dg12.cec.be)

Internet: the *Europa* site (http://europa.eu.int/comm/dg12/)




## *More detailed information*

*CORDIS focus* - a fortnightly news bulletin; free subscription on request via fax (+ 352-4301-32054) or electronic mail (RTD-helpdesk@lux.dg13.cec.be)

*Innovation & Technology Transfer* - free subscription on request via fax (+ 352-4301-32054) or electronic mail (RTD-helpdesk@lux.dg13.cec.be)

Internet: the CORDIS site (http://www.cordis.lu/)


## *For any other information*

Contact DG XII's Communication Unit - telephone +32-2-29 91865; fax +32-2-29 58220; e-mail info@dg12.cec.be

# Fifth Framework Programme 1998-2002

| Key Actions and other activities | | Budget (euro) |
|---|---|---|
| **Quality of life and management of living resources** | | **2413 million** |
| 1. | Food, nutrition and health | 290 |
| 2. | Control of infectious diseases | 300 |
| 3. | The "cell factory" | 400 |
| 4. | Environment and health | 160 |
| 5. | Sustainable agriculture, fisheries and forestry | 520 |
| 6. | The ageing population and disabilities | 190 |
| | Generic RTD activities | 483 |
| | Support for research infrastructures | 70 |
| **User-friendly information society** | | **3600 million** |
| 1. | Systems and services for the citizen | 646 |
| 2. | New methods of work and electronic commerce | 547 |
| 3. | Multimedia content and tools | 564 |
| 4. | Essential technologies and infrastructures | 1363 |
| | Generic RTD activities | 319 |
| | Support for research infrastructures | 161 |
| **Competitive and sustainable growth** | | **2705 million** |
| 1. | Innovative products, processes and organisation | 731 |
| 2. | Sustainable mobility and intermodality | 371 |
| 3. | Land transport and marine technologies | 320 |
| 4. | New perspectives for aeronautics | 700 |
| | Generic RTD activities | 546 |
| | Support for research infrastructures | 37 |
| **Energy, environment and sustainable development** | | **2125 million** |
| A. | Environment and sustainable development | 1083 |
| 1. | Sustainable manangement and quality of water | 254 |
| 2. | Global change, climate and biodiversity | 301 |
| 3. | Sustainable marine ecosystems | 170 |
| 4. | The city of tomorrow and cultural heritage | 170 |
| B. | Energy | 1042 |
| 1. | Cleaner energy systems including renewables | 479 |
| 2. | Economic and efficient energy for a competitive Europe | 547 |
| | Generic RTD activities | 135 |
| | Support for research infrastructures | 69 |

| | | |
|---|---|---|
| **Euratom: Nuclear energy** | | **979 million** |
| 1. | Controlled thermonuclear fusion | 788 |
| 2. | Nuclear fission | 142 |
| | Generic RTD activities | 39 |
| | Support for research infrastructures | 10 |
| **Confirming the international role of Community research** | | **475 million** |
| 1. | Countries preparing for accession | 26 |
| 2. | NIS and those CEECs not included above | 112 |
| 3. | Mediterranean partner countries | 55 |
| 4. | Developing countries | 210 |
| 5. | Emerging economies and industrialised countries | 5 |
| 6. | Training | 15 |
| 7. | Coordination | 52 |
| **Promotion of innovation and encouragement of participation of SMEs** | | **363 million** |
| 1. | Promoting innovation | 119 |
| 2. | Encouraging SME participation | 44 |
| 3. | Joint Innovation/SME activities | 200 |
| **Improving human research potential and the socio-economic knowledge base** | | **1280 million** |
| 1. | Training and mobility of researchers | 858 |
| 2. | Access to research infrastructures | 182 |
| 3. | Promoting scientific and technological excellence | 50 |
| 4. | Improving the socio-economic knowledge base | 165 |
| 5. | Development of scientific and technological policies in Europe | 25 |
| **JRC: Direct actions** | | **1020 million** |
| 1. | Serving the citizen | 292 |
| 2. | Enhancing sustainability | 321 |
| 3. | Underpinning European competitiveness | 126 |
| 4. | Nuclear fission safety | 122 |
| 5. | Nuclear safeguards | 138 |
| 6. | Decommissioning of JRC installations and waste management | 21 |
| **Total:** | | **14960 million** |

European Commission

**EUR 18764 —** The Fifth Framework Programme — The research programmes of the European Union 1998-2002

Luxembourg: Office for Official Publications of the European Communities

1998 — 75 pp. — 17.6 x 25 cm

ISBN 92-828-5811-1

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Fax (32-2) 538 08 41
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URL: http://www.libeurop.be

**Moniteur belge/Belgisch Staatsblad**
Rue de Louvain 40-42/Leuvenseweg 40-42
B-1000 Bruxelles/Brussel
Tél. (32-2) 552 22 11
Fax (32-2) 511 01 84

## DANMARK

**J. H. Schultz Information A/S**
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