European Commission

RTD info

MAGAZINE FOR EUROPEAN RESEARCH

Special Edition

November 2002

ISSN 1024-0802

The priorities of the Sixth Framework Programme 2002-2006

LIFE SCIENCES, GENOMICS AND BIOTECHNOLOGY FOR HEALTH

4 The new picture of health
Genome sequencing, including of human beings, is bringing new prospects for molecular biology and genetics which are as yet difficult to gauge. 'Post-genomics' – and research on stem cells in particular – is likely to have many and sometimes unexpected benefits for human health.

6 A European priority
Research in the field of post-genomics and biotechnologies for health not only meets the expectations of European society but also the hopes of developing countries where health conditions must not deteriorate any further.

INFORMATION SOCIETY TECHNOLOGIES

8 The 'all-communicating' world
Our domestic appliances, our environment and our health, our way of working and learning… The information and knowledge-based society is immersing us in an 'e-civilisation'.

9 The age of ambient intelligence
How research is helping to create an intelligent and interactive environment which places the human being at the centre of developments in information technologies.

NANOTECHNOLOGIES AND NANOSCIENCES, KNOWLEDGE-BASED MULTIFUNCTIONAL MATERIALS AND NEW PRODUCTION PROCESSES AND DEVICES

12 The nano revolution
Mastering the arrangements between atoms to form nanosystems is leading to applications which herald a new and innovative age of technology.

14 A critical need for a European dimension
A concerted European approach is essential to achieve the major fundamental and applied research effort needed to make the most of the opportunities of the 'nano' age.

AERONAUTICS AND SPACE

16 Onward and upward
Safety, profitability and sustainability are the three leitmotifs of aeronautics research. Europe possesses real potential in this promising field, as it does in space research.

17 Striving for excellence
Public and private research combine with particular effectiveness in the aeronautics and space sector. This added value of coordination is in line with the priorities of the Sixth Framework Programme and the spirit of the European Research Area.

FOOD QUALITY AND SAFETY

20 The paradox of progress
The agri-foodstuffs sector is subject to increasingly stringent regulations, standards, monitoring procedures and quality control. Yet recent years have brought some dramatic failings in the form of BSE, dioxins, listerioris and salmonella. A brief analysis of a crisis of confidence which sometimes runs deep.

22 From the farm to the fork
The spotlight on the Union's responsibility at every stage of the agri-foodstuffs chain and future research prospects in this field.

SUSTAINABLE DEVELOPMENT, GLOBAL CHANGE AND ECOSYSTEMS

24 Earth in the balance
Sustainable development is crucial to humanity's future. This is why it is a vital dimension of the work of scientists and researchers in all fields.

25 Time to decide
Energy and transport – the two most strategic elements of sustainable development – are a priority sector within the Union's scientific policy, together with (strategic) research on global change.

CITIZENS AND GOVERNANCE IN A KNOWLEDGE-BASED SOCIETY

28 The return of the human sciences
The contribution of human and social sciences in fields as diverse as health, information technologies or the environment. Plus the new light they are shedding on multidisciplinary research.

30 How can progress be controlled?
Restoring relations between science and the citizen, between research and society.

32 A marked interest
Table of 'expressions of interest' – suggestions for integrated projects and networks of excellence – submitted by the European research players with a view to the new Framework Programme.

A magazine providing information on European research, *RTD info* is published in English, French and German by the Information and Communication Unit of European Commission's Research DG .
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84 000 copies of this issue were published.
All issues of *RTD info* can be consulted on-line at the Research DG's website
europa.eu.int/comm/research

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The priorities of the knowledge-based society

SIXTH FRAMEWORK PROGRAMME

In the interests of efficiency and to avoid the risk of duplication or of spreading the research effort too thinly, the Union's 2002-2006 Sixth Framework Programme for Research will concentrate the greater part of its efforts on seven priority fields, presented in this special issue of RTD *info*. These priorities are fields which offer great potential in the context of the knowledge-based economy and society. By concentrating its research effort in this way, Union action can provide real added value by encouraging the complementarity and multidisciplinarity of European resources and capacities in science and technology.

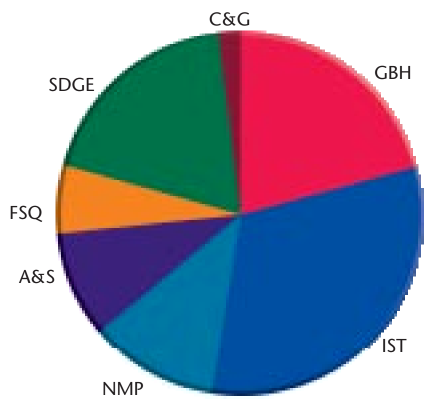
With increased resources – €17.5 billion, a 17% increase at fixed prices – and an innovative approach, the main focus of the 2002-2006 Framework Programme is to create the European Research Area (ERA). Its priority objective is to promote much greater integration of the European research effort and capacity and to implement a coherent and concerted approach at Union level as a basis for developing genuine joint strategies.

While ensuring that a number of traditional actions under previous Framework Programmes for R&D continue (see box), the new programme is structured around the three main targets of **concentrating and integrating** European research, **structuring** the European Research Area and **strengthening its foundations**.(1)

The first of these target areas will be allocated three-quarters of the total budget. Eighty-five per cent – or €11.3 billion – will be allocated to the seven priority fields (see graph).

(1) This target area, allocated €320 million, is essentially aimed at actions designed to strengthen a mutual opening up and coordination between national programmes, a key element at the heart of the ambitions to create the ERA.

Budget breakdown (€11.3 billion) between the priority fields



Life science, genomics and biotechnology for health	20.9%
Information society technologies	32.1%
Nanotechnologies and nanosciences, multi-functional materials, production processes	11.5%
Aeronautics and space	9.5%
Food safety and quality	6.1%
Sustainable development, global change and ecosystems	18.8%
Citizens and governance in a knowledge-based society	2.0%

Traditional support

The innovations introduced by the Sixth Framework Programme have not, however, been at the expense of the traditional 'horizontal' policies which will be allocated €5.9 billion. This aid will go to human resources and mobility – a crucial field for the ERA – specific measures (co-operative and collective research) for SMEs, support for international co-operation, help for research infrastructures, studies on anticipating the Union's needs in science and technology, and the mission of the Joint Research Centre (mainly to support Community policy).

In addition to the seven priority themes presented in this issue, the Sixth Framework Programme includes an eighth traditional sector of research on nuclear safety, in line with the Union's responsibilities under the Euratom Treaty. This has a budget of €1.2 billion, 60% of which is for the development of the international ITER fusion reactor project, the rest for research on nuclear waste management, radioprotection and the JCR's activities in this field.

The new picture of health

The accelerating pace of scientific and technological progress which made it possible, within just a decade, to complete the first full sequencing of the human genome – and of a growing number of other living organisms – is heralding a new era in molecular biology and genetics, in particular for human medicine. However, it is going to take a very large-scale and long-term research effort if the promises of this 'post-genomic age' are to be realised.

At the end of 2000, the race between the vast international public consortium behind the *Human Genome* project and the private company Celera, headed by the American Craig Venter, resulted in a joint first – the announcement, amid much media fanfare, of the sequencing of the more than 3 billion nucleotide 'letters' which make up the human DNA macromolecule. The event was rightly heralded as a significant step towards a revolutionary new scientific age of the 21st century. It is an achievement which brings extraordinary new prospects for the world of medicine.

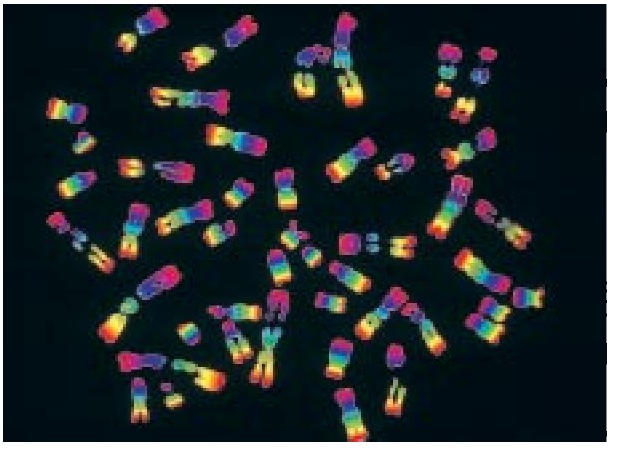
A complete genomic mapping of man opens the door to the identification of his genes and subsequently to all the proteins these genes code for the complete functioning of the human body. This new biological 'tool' therefore has the potential to change completely our whole approach to the treatment of disease, making it possible to modify deficient genes (gene therapy) or produce new medicines – as is already the case for insulin administered to diabetics.

From the quantitative to the qualitative

The job of decoding the complete genome is now giving way to the so-called post-genomic approach. This involves a long and delicate hypothetical and deductive study of the hundreds of millions of data stored in US, European and Japanese databanks. Work is already well under way on this and scientific journals are constantly announcing new genetic lines of inquiry on the basis of the initial indicators obtained from studies or experiments involving a particular sequence. The potential applications concern the most diverse diseases – cancer, diabetes, cardio-vascular complaints, children's diseases and rare, communicable or neuro-degenerative diseases.

Post-genomics also brings the prospect of surprises and unexpected discoveries which could overturn some accepted ideas and provide new and unsuspected insight into the fundamental mechanisms of life. The most recent and surprising of these concerned the number of genes which govern the human body. It was assumed to be several hundred million. The real figure has now had to be drastically revised downward to about 30 000 – which is about the same number as in a 'lower' micro-organism such as yeast.

The genetic iceberg This disconcerting discovery suggests that identifying all these genes is most probably the tip of the knowledge iceberg. The real key lies in the incredible complexity of the manufacture of the hundreds of thousands of proteins, characterised by their subtle three-dimensional deployment. This in turn brings us to a new science, the daughter of post-genomics: *proteomics*. The mystery also remains regarding the innumerable alignments of the letters – whose significance is not known – which make up the global sequencing of the human genome and of which genes are just a small part.



Human caryotype.
© INSERM

Stem cells cause a stir

The discovery of stem cells – just four years ago – and the promise they hold, has caused quite a stir in the world of biology and medicine. These originally undifferentiated cells develop in the human egg from the moment it is fertilised. They are a double exception to the usual laws of biology in that they can reproduce exceptionally quickly while, at the same time, being able to produce, as the embryo develops, specialised cells which make up all the developing organs. It is this extraordinary mutability observed at the very origins of life which has given rise to the hope that stem cells can be used for therapeutic purposes. Control of this biological *pluri*- or *totipotence* could open up a new and revolutionary era in regenerative medicine.

Such hopes face a very real ethical problem, however, given the very special nature of the 'living material' on which they are based: the human embryo. This is a subject on which people have very strong feelings and is at present the subject of much debate, especially at European level.(1) This is why the possibility is currently being explored of identifying the existence of 'adult' stem cells in certain mammals, which would remove many of the ethical objections.

When and how could the fruits of this fundamental research find applications in the medical field? This is difficult to predict. But the accelerating pace of research on the life sciences – and the mobilisation of resources to fuel it – could mean that we should expect some surprising announcements.

(1) In December 2001, the European Commission organised a comprehensive exchange of opinions on stem cells and the therapies for the future, during a conference attended by scientists, politicians and representatives of civil society.
europa.eu.int/comm/research/quality-of-life/stemcells.html

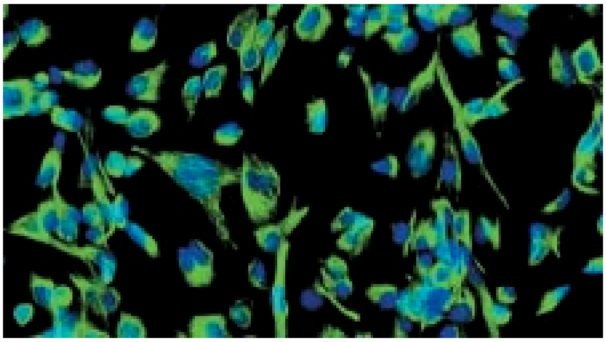
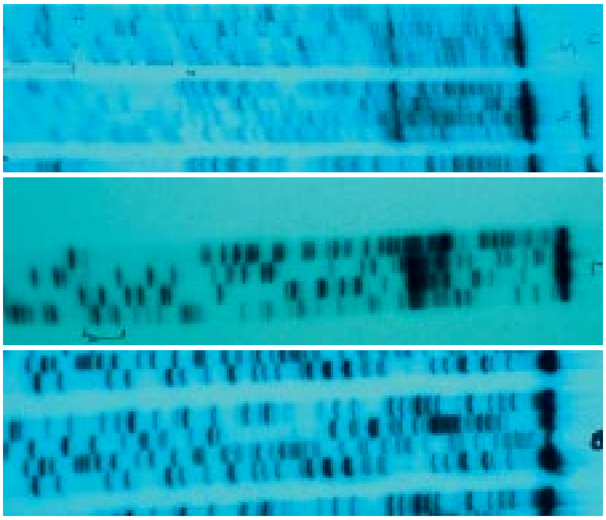


Image of a remarkably homogenous line of human neural stem cells obtained by cloning. **Each cell (the cell nuclei are indicated in blue) shows the characteristic neural stem cell filamentous marker, nestine (in green). The research is being carried out by the Ectins project with the particular goal of introducing a gene to certain cell lines to achieve the continuous *in vitro* proliferation required for industrial production.**



Identification of the exact position of the polymorphism using manual DNA sequencing.
© INSERM

LIfe and the computer

The rapid progress in the field of genomics would not have been possible without the support of major advances in software and complex algorithms. This progress has enabled supercomputers to count, compare and classify the huge mass of results obtained by biochemical analyses – also automated – based on the four DNA nucleotides. Relying on the development of a new generation of microprocessors known as *DNA chips, bio-informatics* has become a booming scientific technology, progress in which will be crucial for the post-genomic and proteomic era. In Europe, the hub of this new discipline, in its own right, is the infrastructure provided by the European Bioinformatics Institute of Hinxton (UK). This institute was set up under the auspices of the European Molecular Biology Laboratory (EMBL), one of three databanks – along with the GenBank in the USA and the DNA Data Bank of Japan – housing the data collected by the Human Genome project.

To find out more

www.ebi.ac.uk/

A European priority

Selecting genomics and biotechnology for health as one of the priority themes of the Sixth Framework Programme is in line with a major political and strategic choice the Union made recently in meeting the challenges of the new knowledge-based economy.(1) This is also a response to the expectations of society, at global as well as European level. Halting the deteriorating health situation in those developing countries afflicted by communicable diseases has become a key condition for a sustainable world.

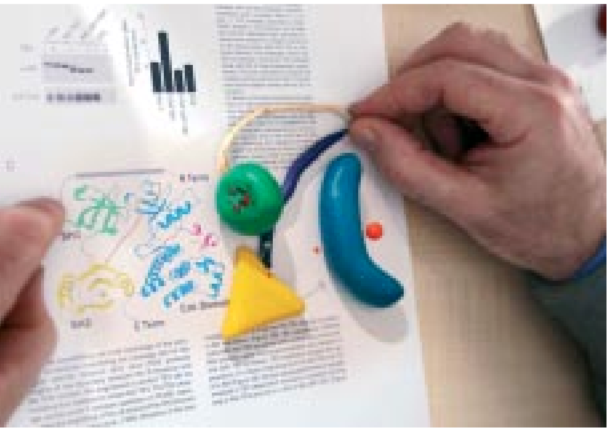


Diagram of the molecular structure of the Abl protein, whose genetic deficiencies can cause several forms of fatal leukaemia. This discovery by a team from the European Molecular Biology Laboratory (EMBL – Heidelberg, DE) offers new prospects for molecular engineering solutions able to repair this defect.

European research has an undeniable capacity for excellence in the field of the life sciences, as demonstrated by its very active participation in most of the major genome sequencing achievements of the past decade – human, yeast, the bacteria *Bacillus subtillus* and the plant *Arabidopsis thaliana*. This high level of scientific quality has been achieved through close co-operation between multinational teams in a spirit which prefigures that of the European Research Area.

The Pasteur model The present post-genomic era requires a continuation of this cross-border co-operation. It must combine fundamental research with a spirit of innovation able to translate scientific progress into concrete applications, the latter an area in which Europe has always lagged behind the United States.

This aptitude for 'transferring' research results – now known as 'translational research' – is characteristic of the arrival of the knowledge-based economy. It must be based on an increasingly active involvement of scientists in creating new highly specialised companies in which their know-how is a vital asset. New diagnostic tools or treatments based on sometimes very recent breakthroughs in fundamental research are never 'commonplace' innovations in the way everyday consumer products can be. A high level of expertise and an acute sense of economic realities are necessary accompaniments to the extremely sophisticated process involving their development and complex path to the market. In his day, Louis Pasteur was very much the 'researcher-entrepreneur'. It is a model which is more necessary now than ever before in exploiting the vast amount of knowledge which will bring in a new age of medicine.

Clinical research close to the patient

The priority given to European research in the health sector is not limited, however, to advances in genomics and biotechnologies alone. A second approach aims to focus scientific and technological co-operation and coordination on combating a number of diseases by including not only 'upstream' research into the development of new treatments, but also the essential stage of clinical trials, a field in which the Union previously had had no direct intervention. This applies in particular to one of the major public health concerns in Europe today: the fight against cancer. The European Organisation for Research and Treatment of Cancer (EORTC) and its 2 500 doctors from 360 hospitals is particularly important in this area of clinical research in Europe. The clinical phase, which precedes and concludes the final development of any treatment, plays a key role as it is at this stage that the quality of life of the patient must be taken into account.

Special Union support will also go to research on the world's three major communicable diseases – Aids, malaria and tuberculosis – which are causing particular devastation in the poorest developing countries.

(1) See the action plan Life sciences and biotechnology: a strategy for Europe*, adopted by the Union in the first half of 2002.*
europa.eu.int/comm/biotechnology/introduction_en.html

To find out more

RTD info has devoted a number of dossiers and articles to research in the field of health. These include details of several European projects and links to many research organisations.

- *RTD info 35* (September 2002): Article on the European EDPTC initiative (clinical research on Aids, malaria and tuberculosis in Africa)
- *RTD info 33* (April 2002): Cancer dossier
- *RTD info 32* (December 2001): Stem cells dossier
- *RTD info 28* (December 2000): Neurosciences dossier
- *RTD info 27* (September 2000): Genomics dossier

europa.eu.int/comm/research/rtd-info/previous_en.html

Website on research during the Fifth Framework Programme
Catalogue of projects:
www.cordis.lu/life/src/proj_browse.htm

Website of the Environment and health key action
europa.eu.int/comm/research/quality-of-life/ka4/index_en.html

Life sciences, genomics and biotechnology for health*

OBJECTIVES

- To help Europe exploit, by means of an integrated research effort, breakthroughs achieved in decoding the genomes of living organisms, more particularly for the benefit of public health and to increase the competitiveness of the European biotechnology industry. This research could also have an impact in fields such as the environment and agriculture.
- To bring basic knowledge through to the application stage (new diagnostic tools and treatments to help combat diseases which are still not under control, and representing major potential markets).
- To combat, particularly in the clinical field, cancer, children's diseases, diseases associated with ageing, and communicable diseases linked to poverty.

SUPPORT FOR RESEARCH

Community action will concentrate on **two major fields**:

Advanced genomics and applications for health

- Fundamental knowledge and basic tools for functional genomics in all organisms:
  - gene expression and proteomics;
  - structural genomics;
  - comparative genomics and population genetics;
  - bio-informatics;
  - multidisciplinary approaches in functional genomics to the study of fundamental biological processes.
- The application of knowledge and technologies in the field of genomics and biotechnology for health: technological platforms for developments of new tools in the fields of new diagnostics, prevention and therapy (including pharmacogenemic approaches, stem cell research and alternative methods to animal testing).

Combating major disease

- Approaches oriented towards medical applications of genomics knowledge and technologies, including the use of animal and plant genomics where relevant, especially in the following fields:
  - combating diabetes, diseases of the nervous system (such as Alzheimer's disease, Parkinson's disease and new variant Creutzfeldt-Jakob disease (including, where relevant, mental illness), cardio-vascular diseases and rare diseases;
  - combating resistance to antibiotics and other drugs;
  - studying human development, the brain and the ageing process.
- A broader approach, not limited to genomics and other fields of fundamental research, will be pursued with regard to:
  - cancer: the development of patient-oriented strategies, from prevention to diagnosis and treatment, including three inter-linked components:
    - developing networks and initiatives to coordinate national research activities
    - supporting clinical research aimed at validating new and improved interventions
    - supporting translational research.
  - fighting the three infectious diseases linked to poverty (Aids, malaria, tuberculosis) which are the priority for disease control at both Union and international level.

BUDGET

€2 255 million

** This presentation is a summary of the official text of the adoption of the Sixth Framework Programme.*

To find out more

www.cordis.lu/rtd2002/fp-activities/genomics.htm

The 'all-communicating' world

In less than 20 years, the phenomenal progress in information technologies and telecommunications has immersed us in an all-communicating world. Computers, telephones, televisions, domestic appliances and cars are packed full of electronics for the exchange of data and information and providing 'intelligent' services designed for maximum efficiency and user comfort. Work, business, administration, health, culture, education... the 'e' prefix has been appended to just about every area of human activity. The information and knowledge society is changing our lifestyles and even our psychological and social behaviour.

93% of Europe's schools are connected to the Internet. But the computer can also become a learning tool in itself. That is the case for a new kind of education based on 'twinned objects' (Brevie project) in which students learn to bridge the real and the virtual.
www.brevie.uni-bremen.de

Nevertheless, it remains difficult to predict where this spectacular progress in electronics and data processing is going to take us next. A little over a century ago, the Western Union saw no future for such an 'unreliable' invention as the telephone. Just 25 years ago, the head of Digital Equipment saw no valid reason to want to own a personal computer. In the late 1980s, few prospective studies predicted the imminent arrival of such a revolutionary and all-pervasive device as the Internet would prove to be by the mid-1990s.

On the other hand, the bright future awaiting high-definition satellite TV has failed to materialise. More recently, the premature enthusiasm for the wireless Internet and the 'bubble' which grew up around the concept of the 'new economy' show that even when developments do come, the path is not always smooth.

In a sector which cultivates the immaterial, there is sometimes a cruel gap between the potential promised by technological progress, the valuation of the innovation and the marketing of new products and applications.

Miniaturisation, convergence and power However, one law has proved pertinent: that of the visionary Gordon Moore, drawn up in 1965, who prophesised that the performance of electronic components (memory and processors) would double every 18-24 months, at a fixed cost. Between 1970 and 2002, for example, the number of transistors per cm² on an electronic chip increased from 2 300 to 24 million, with transistors measuring 0.1μ square. Although the race for miniaturisation and power is certainly not over yet, the experts do believe that, within the next 15 years, the increase in microprocessor density is likely to come up against a physical limit: the size of atoms. We will then enter the true age of nanoelectronics.

This increased capacity to process and store information is of course at the heart of the digital revolution. It is thanks to this – coupled with the Internet as a data transfer support – that data, sounds, pictures and text can be converted into the same binary language. This 'homogeneity' opens the door to a convergence of previously isolated applications, such as the telephone, radio, publishing, television and computing. The creation of transmitting infrastructures, offering increased capacities for sending these considerable information packages, is currently the crucial development which will enable us to benefit to the full from this new potential.

To find out more

europa.eu.int/information_society/index_en.htm

The age of ambient intelligence

For maximum economic and social impact, research on information society technologies must concentrate on the future so-called convergence generation. This involves integrating network access and interfaces into the everyday environment by making available a multitude of services and applications through easy and 'natural' interactions. This vision of 'ambient intelligence' (interactive intelligent environment) places the user, i.e. the human being, at the centre of the future development of the knowledge-based society.

The actions of the Sixth Framework Programme will support the technological priorities to make this 'ambient intelligence' possible. They will aim to mobilise researchers around targeted initiatives to achieve medium- and long-term objectives while at the same time meeting the new needs and demands of markets, public policy and citizens. The very substantial support being given to this area of the knowledge-based society – 20.7% of the budgets specifically allocated to research – aims to achieve a critical mass of resources by integrating public and private investment at European level.

European strengths European industry has scored some major successes in the field of mobile telephony – in particular in developing the Global System for Mobile Communication (GSM) standard. It is also in a strong position because of technological progress in the fields of broad band(1) and multi-platform access, in particular digital television and third generation mobile communication systems.(2)

Other innovations are also taking shape, thanks in part to optical fibre technology. A team of British researchers into photonics has just broken the terabit (Tbit) per second(3) barrier, while optical multiplexing technology brings the prospect of a theoretical transmission rate of 200Tbit/s. Also, the development of rapid optoelectronic routers and switches will permit connections between these *information highways* and local networks.

However, due to their prohibitive cost, these technologies cannot be used everywhere. This is why it is also important to develop the full potential of existing fixed networks (xDSL technologies), the local radio loop (BLR or high-speed wireless access) and satellites which are essential for serving zones with little or no network coverage. Wireless systems, whether UMTS (third-generation mobile telephony), W-LAN or Wi-Fi technologies, also offer potential for local applications.

Interfaces and applications All these new and developing infrastructures must be accompanied by developments in interface technologies – the 'man-machine' interface. They also require user-friendly applications in all areas: security and protection of private life, education and training, access for elderly or disabled people, teleworking, electronic commerce and administration, on-line health care and intelligent transport.

A final area of research will be devoted to leading-edge research on the components and micro-systems of the future.

(1) According to a study carried out by the European Competitive Telecommunications Group (ECTA), nearly 6 million Europeans have an ADSL Internet connection. By 2004 there are likely to be 27 million.
(2) European companies have already invested €120 billion in multimedia mobile telephony (3G).
(3) 1 Tbit/s = 10^{12} bit/s. This capacity is the equivalent of 1 000 billion bits a second, the equivalent of 15 million telephone conversations.

Challenges

This interlocking of information and communication presents a number of challenges.

• **Interoperability** – Given the multitude of transmission networks and communication platforms (PC, TV, personal assistant, mobile telephone, etc.), the question of network architecture and integration is crucial for telecommunication operators seeking to provide their customers with uninterrupted access of a high quality, whether through a fixed or mobile point of access.

• **Saturation** – The constant increase in volume of information and users requires the development of new protocols (such as the Ipv6, new-generation Internet protocol). European research also needs high-capacity networks, whether in terms of transmission (GEANT project) or calculation (the GRID distributed calculation project).

• **Security** – Information and telecommunication networks are at the centre of economic activity, communicating vast quantities of confidential information. Yet they are uniquely sensitive to pirating and sabotage which is why the search for maximum security is key to their viability. New solutions can now be envisaged with the development of quantum cryptography.

Each of these data storage silos can contain up to 6 000 cassettes of 10, 20, 25 or 50 GB capacity. The data transfer speed can be as much as 12 Mbytes/sec.
© CERN

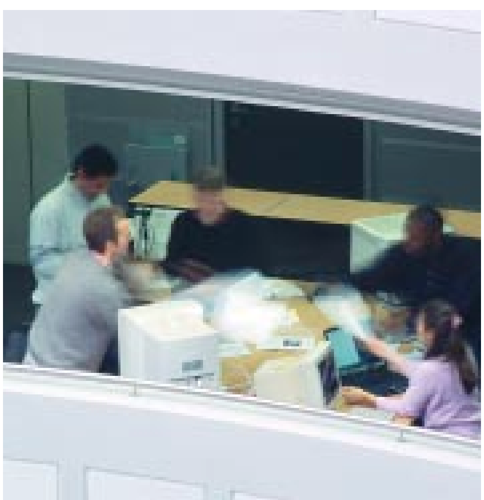
*e*Europe, the backdrop to research aims

In March 2000, the Lisbon European Council adopted the development of the information society as a key priority in the strategy to make Europe 'the most competitive knowledge-based society in the world'. This took practical shape in the ***e*****Europe 2002** initiative, launched by the European Commission to promote 'the information society for all'. This operational action plan, which set three objectives – a cheaper, faster and more reliable Internet; stimulation of Internet use; and investment in people and skills – gave rise to a major coordination effort between the Member States to speed up changes to the legislation, reductions in connection prices, an increased supply of public and private services, and access to rapid Internet links.

By mid-May 2002, 40.4% of Europeans and 93% of schools were connected to the Internet, 55% of public services were accessible on-line, and more than 35% of doctors were using the web for professional ends. Europe is gradually catching up with its main rival, the United States, where the federal government and venture capitalists have invested massively in information society technologies.

In June of this year, the Commission launched a new action plan, known as ***e*****Europe 2005**, designed to fuel the dynamic further. Its objectives, as ratified by the Seville European Council, are to encourage the essential parallelism between the costly implementation of communication infrastructures and the generation of advanced services – *e*-business, *e*-government, *e*-learning, *e*-health, etc. – which will use them and make them pay.

It is against this background that the Sixth Framework Programme plans to pursue its research priorities in information society technologies.



Young researchers working on the DATAGRID project, at CERN in Geneva. With funding of nearly €100 million under the Sixth Framework Programme, the development of this new Internet connection infrastructure will enable 'big science' computers to share and cumulate their computing power.
© CERN

To find out more

- europa.eu.int/information_society/eeurope/index_en.htm

Information Society Technologies (IST)*

OBJECTIVES

- To stimulate the development in Europe of hardware and software technologies and applications at the heart of the creation of the information society.
- To increase the competitiveness of European industry and give European citizens in all EU regions the chance to benefit fully from the development of the knowledge-based society.

SUPPORT FOR RESEARCH

The action undertaken will therefore focus on **four technological priorities**:

Reintegrating research into technological areas of priority interest for citizens and businesses

- Research on technologies guaranteeing the security and confidentiality of computing systems and the privacy of citizens.
- The development of 'ambient intelligence' systems offering improved access to the information society for all (notably, elderly and disabled people), as well as interactive and intelligent systems for health, mobility, security, leisure, tourism, culture and the environment.
- The development of electronic and mobile commerce – in particular technologies for secure transactions and infrastructures – as well as new tools and new methods of working, technologies for learning and systems for knowledge capitalisation, integrated business management and on-line administration.
- Development of large-scale distributed systems and platforms, including global resource information database (GRID) systems, in areas such as the environment, energy, health, transport and industrial design.

Communication and computing infrastructures

- Research on the new generation of wireless and mobile communications systems and networks; satellite communications systems; all-optical and broad-band technologies, in particular for audiovisual applications, as well as the integration, management and interoperability of communication networks. These developments will be of particular use in preparing the next Internet generation.
- Development of software architecture technologies, distributed and embedded systems supporting the development of multifunctional and complex services involving many actors, engineering and the control of complex and large-scale systems.

Components and microsystems

- The design and production of nano-, micro- and optoelectronic and photonic components (including those for information storage), pushing back the limits of miniaturisation and minimising power consumption, costs and environmental impact.
- Multidisciplinary research on nano-electronics, microtechnologies, displays, microsystems, new materials, computing models and concepts of information processing.

Information management and interfaces

- The development of knowledge representation and management systems based on context and semantics, including cognitive systems, as well as tools for creating, organising, navigating, retrieving, sharing, preserving and disseminating digital content.
- The development of multisensorial interfaces based on voice, gestures, touch, virtual environments and multilinguistic and multicultural items.

BUDGET

€3 625 million

** This presentation is a summary of the official text for the adoption of the Sixth Framework Programme.*

To find out more

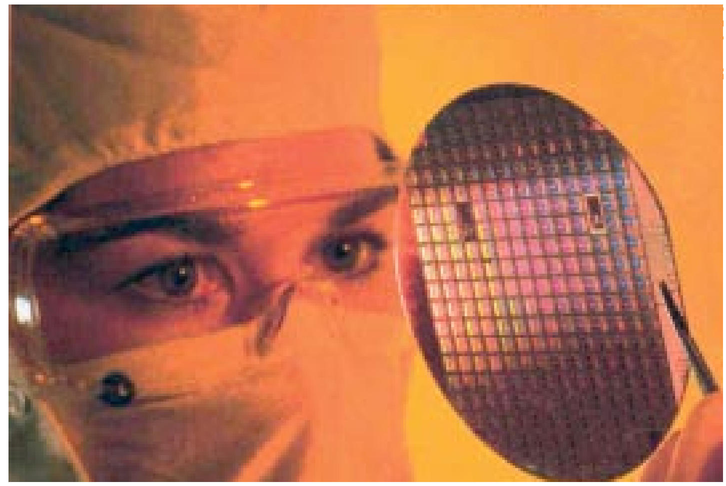
www.cordis.lu/rtd2002/fp-activities/information_society.htm

The nano revolution

Nanotechnologies are something of a Holy Grail for many of today's research project teams, whether they are working on inanimate matter or living organisms. Manipulating arrangements between atoms to form nanosystems – with unique physical, chemical and biological properties – opens the door to applications which mark the beginning of a truly innovative technological era.

The terms *nanosciences* and *nanotechnologies* made their first tentative appearance two decades ago. These neo-concepts owe much to the revolutionary development of the first Scanning Tunnel Microscope or STM. This invention was the first step along the road to technologies able to act at the nanoscopic level – i.e. one billionth of a metre or a nanometer, which is 80 000 times smaller than the width of a human hair – and to 'manipulating' atoms directly.

This feat achieved by two physicists, Gerd Binnig from Germany and Heinrich Röher from Switzerland, for which they were awarded the Nobel Prize in 1986, set the seal on a surprising rapprochment between fundamental research – working at the frontiers of the exploration of matter – and practical applications in a field which is growing all the time.



The key to a new world Since that time the nanosciences have been the subject of a growing research effort. They offer an approach able to change radically the way in which scientists – physicists, chemists and biologists – have studied the atomic and molecular world. Previously the approach had been '*top down*', taking reality and macroscopic laws as the point of departure to penetrate into increasingly microscopic levels. The nanosciences adopt a '*bottom-up*' approach, taking atoms as the point of departure from which to 'artificially' create molecular nanosystems with very specific properties. However, this methodology poses a fundamentally new scientific challenge as it requires a command of interactions between atoms. What is more, such interactions are not governed by the principles of traditional physics but by the complex laws of quantum mechanics.

In meeting this challenge, the nanosciences bring the promise of radical change to the whole way in which our technological environment is currently designed and structured.

- **Electronics** – Present microelectronic processes are progressively approaching the limits of the possible in terms of the miniaturisation of chips and increase in computing power – which would mark the end of Moore's famous Law on the exponential growth of performances. The nanotechnologies are breaking through this barrier with the promise of the molecular and quantum computer of the future.

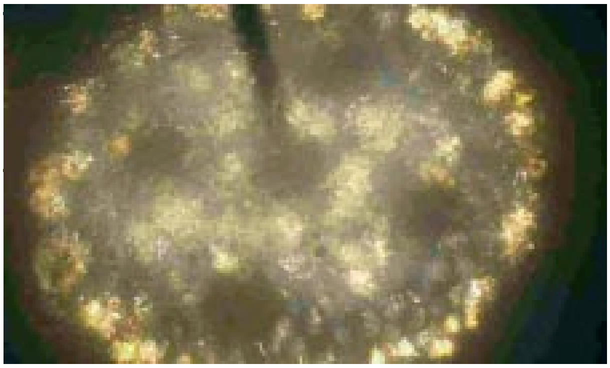
- **The life sciences** – The nanosynthesisis of the fundamental molecules of the living organism (proteins, nucleic acids, lipids, etc.) brings previously unknown possibilities in biomedicine and biopharmacy, and for the whole post-genomic sector.

- **Materials** – Innovations of all kinds are possible at the industrial level. One example concerns the constructions made from carbon atom structures or fullerenes, some of which resemble a football, which could be capable of containing hydrogen and be used as nano fuel cells or nano-tubes with unique properties of mechanical resistance. Also, reinforced polymers made of nano-particles could be used to produce vehicle components offering maximum security at a reduced weight – and thus reduced energy consumption. Furthermore, applications in the field of surface treatments could make it possible to obtain quite specific physical (lubrication, hardness) or chemical (reactivity, catalytic properties) effects.

- **Machines** – The dynamic properties of some atomic structures bring the prospect of nano-engines, nano-pumps and nano-propellors with remarkable benefits in terms of sustainable development and energy savings.

- **Environment** – Research is already under way on nano purification systems and nano-sensors – a detection function which could be applied to all fields of metrology.

Measuring nano-currents
Physicists and metrologists are co-operating on the European Count project with the aim of reducing electrical currents to the 'nano-ampere' scale. This is essential in the race for further miniaturisation and the reduced spread of heat in electronic nano-circuits. To do so requires the development of reliable and continuous detection of minuscule electron flows.



Anticorrosive nano-composites
Launched earlier this year, the Nanomag project has big ambitions: to enable transport vehicle manufacturers to include more magnesium alloys in their products by developing anticorrosive films based on nano-composites. This would bring considerable weight reduction benefits, although obstacles remain in achieving the corrosion resistance.

Nano-robots
Set up in April 2002, Robosem – a partnership between the scientific and industrial players in six countries (AU, CH, DE, ES, FI, FR) – is developing nano-tools for assembly purposes using Scanning Tunnel Microscope (SEM) technology. The field of application is the automated development of microsystems and test procedures on nanomaterials. In pharmacogenomics, researchers are studying the possibility of extracting the RNA messenger from a group of cells or even an individual cell.

Three questions for Harry Kroto

What do you see as the priorities for research on nano-technologies?

Clearly with nanosciences we are entering the field of quantum physics while applications in the area of the life sciences involve biologists. But the sector most concerned is chemical research. The foundations of this new discipline lie in constructing new molecules on a nanoscopic scale. For that you need a veritable army of teachers and students trained in this new approach, and this poses particularly complex problems. There is an urgent need to increase awareness of these new areas of scientific research.

In what areas of our everyday lives could the nano-technologies have a rapid and significant impact?

First of all on computing. We will soon be carrying around nano-PCs with a vastly improved performance compared with today's laptops. One of the fascinating properties of nanotechnologies is that they enable us to develop systems in which energy expenditure is reduced to an infinitesimal level. Then there is the field of materials – aeronautics, for example. We will be building jumbo jets which are ultra-resistant as well as being ultra-light. In medicine, the nanotechnologies will revolutionise non-invasive surgery.

How does Europe rank in this fast-growing global field of science and technology?

Our continent has a great deal of potential. Our problem, in this sector as in others, is the entrepreneurial spirit. The United States has a formidable advantage because it has a stronger tradition of SMEs which are able to take risks with the possibility of failing and then rebuilding. This must be an inspiration for us.

Sir Harry Kroto (University of Sussex, Brighton, UK) was joint winner of the 1996 Nobel Prize in Chemistry for the invention of fullerenes.

www.sussex.ac.uk/Users/kroto/harry1.html

A critical need for a European dimension

The hopes raised by nanotechnologies require a vast fundamental and applied research effort if they are to be realised. Multidisciplinary studies must also be carried out by a wide range of specialists. Only a proactive European approach will enable the EU to acquire an autonomous command of the opportunities created by this third industrial revolution which we will surely witness over the next two to three decades.

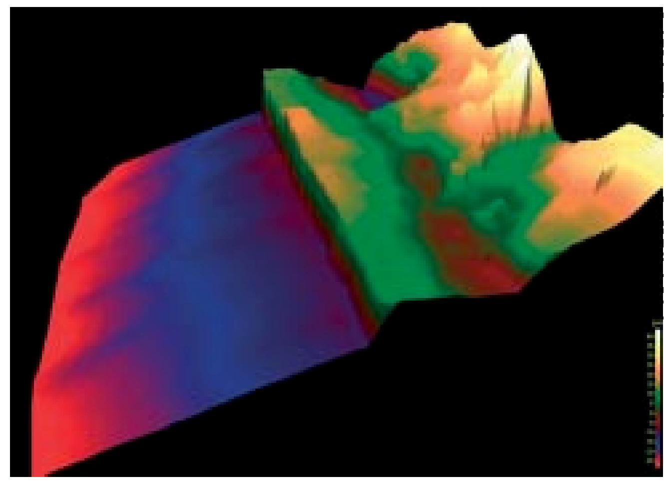
It was not long ago that fundamental research was sometimes seen as an expensive luxury. It was quite the thing to declare that the need for a return on public investment meant that priority must be given to developing concrete applications as close to the market as possible. Nanotechnologies give the lie to this rather blinkered dogma by ushering in a new era marked by the marriage of fundamental physics and applied technology.

Developing nanosystems requires the services of seasoned experts in the subtleties of the atomic world, as well as engineers able to develop highly technical systems for the purposes of experimentation. The sheer scale of the potential field of applications also requires an extraordinary deployment of experts from many different fields – electronics, chemistry, biology, physics, materials science, micromechanics, metrology, etc. – working closely together in teams.

Mobilising human and financial resources

This multidisciplinary mobilisation of the most diverse scientific and industrial skills, coupled with the need for increased investment, is only possible within a framework such as the European Research Area (ERA). No single European country can hope to meet such a challenge on its own. In the United States, a vast co-operative network of *nanotech* superpoles stretches from coast to coast, with government funding to the tune of €650 million for 2002 to fuel the efforts of universities and the private sector.

In Europe too, the transcontinental fabric is now being woven. A recent survey identified 86 cross-border co-operation initiatives involving nearly 2 000 academic and private partners, plus investments estimated at €300 million for the current year (two-thirds provided by the national public authorities). A good example is the impressive Minatec pole recently set up in Grenoble. In addition to the very best French expertise, Swiss, Belgian and Irish research centres and business consortiums all contribute to the network[1].



Projet Robosem.

The Union plays the nanotech card

Under the Fifth Framework Programme (1998-2002), Union support for nanotechnology projects was in the region of €150 million.[2] Identified as a strategic priority under the new Sixth Framework Programme, this sector – as well as specific activities related to multifunctional materials and new production process and devices – will receive a significant financial boost. Over the five-year period, the Union plans to award nanotechnology funding to the tune of €1.3 billion in total. The specific allocation of these funds to integrated projects and networks of

To find out more about the latest developments in the nanotechnologies in Europe

- www.cordis.lu/nanotechnology
- europa.eu.int/comm/research/growth/gcc/pressroom-nanotechnology.html

excellence – not forgetting the investment by the partners in company research – should ensure that nanotechnologies become firmly anchored in the ERA.

At the same time, research on the *nanotech* issue will also be carried out in other priority fields – genomics and biotechnology for health, information society technologies, aeronautics and space, food safety and sustainable development.

(1) Notably Thales Electron Device, STMicroelectronics, Philips Medical Systems, Siemens Medical Solutions, Motorola.
(2) This figure relates to projects supported under the four thematic programmes (Quality of life, Information society, Sustainable growth, Environment, energy and sustainable development). The nanotechnologies were also an important theme in the actions for the mobility and training of researchers and are central to several coordination networks under the pan-European COST initiative.

Nanotechnologies and nanosciences, knowledge-based multifunctional materials and new production processes and devices*

OBJECTIVES

- To help provide Europe with the critical mass of capacities to develop and exploit those high technologies at the basis of the products, services and production processes of the future, which are essentially knowledge based.
- To develop intelligent materials for applications in sectors such as transport, energy, electronics and biomedicine representing a potential market of several billion euro.
- To develop flexible, integrated and clean systems requiring a substantial research effort in the application of new production and management technologies.

SUPPORTING RESEARCH

Community action will concentrate on **three major fields**:

Nanotechnologies and nanosciences
- long-term interdisciplinary research: understanding phenomena, command of processes and the development of research tools;
- supramolecular and macromolecular architecture;
- nanobiotechnologies;
- nanometric-scale engineering techniques for creating materials and components;
- development of manipulation and control devices and instruments;
- applications in fields such as health, chemicals, energy and the environment.

Knowledge-based multifunctional materials
- development of fundamental knowledge;
- technologies associated with the production and transformation of knowledge-based multifunctional materials and biomaterials;
- support engineering.

Production processes and methods
- flexible and intelligent production processes and systems using advances in virtual production technologies, decision-aiding interactive systems, high-precision engineering and innovative robotics;
- systemic research (including on biological processes) for sustainable waste management, risk control, reduced consumption of basic products and less pollution;
- concepts for life cycle optimisation of industrial systems, products and services, in particular with a view to eco-efficiency and reduced emission of substances which are harmful to the environment.

BUDGET

€1 300 million

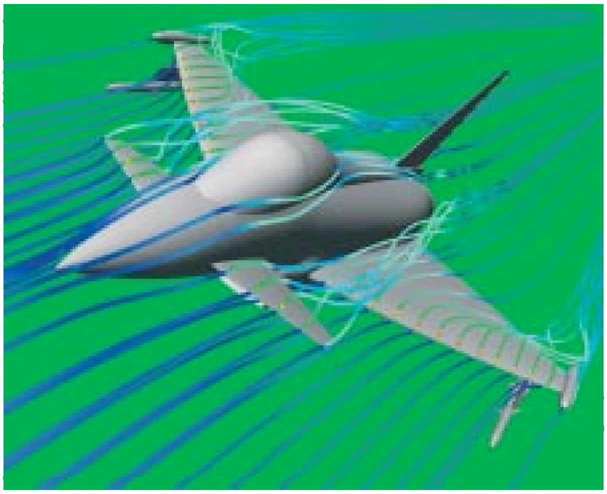
** This presentation is a summary of the official text for the adoption of the Sixth Framework Programme.*

To find out more

- www.cordis.lu/rtd2002/fp-activities/nanotechnologies.htm
- ftp.cordis.lu/pub/nanotechnology/docs/nano_leaflet_052002_en.pdf

Onward and upward

Safety, profitability, sustainability: these are the three priorities of the aeronautics industry – and of the research which is shaping the growth of a sector rich in economic potential. Meanwhile space – where the applications are still of a relatively recent generation – has definite development potential for the information society and environmental monitoring, as well as being a powerful strategic tool for political security. In all these areas, research is continuing apace.



Mathematical modelling for the study of aerodynamics.
© BAE

While it is sensitive to such traumatic events as those of 11 September 2001, which brought a temporary setback for the airlines, as globalisation continues to accelerate, aeronautics will most certainly remain one of the most dynamic sectors of the global economy during the decades to come. Air traffic is set to triple in volume by 2020, with passenger traffic increasing at a rate of 5% a year and cargo traffic at 6%. This will generate a world-wide demand for about 15 500 new aircraft at an estimated value of € 1.3 trillion.

New priorities The major challenge facing the aviation industry today is to meet this growing demand for mobility while at the same time meeting the new imperative of sustainable development. Although much has been achieved over the past 30 years, thanks in particular to the Airbus programme, the priorities have changed: the watchwords are no longer 'higher, further and faster' but 'safer, cleaner, quieter' – plus increased accessibility.

A new generation of aircraft must be developed to meet these economic, environmental and safety concerns which are generally shared by passengers and anyone living in the vicinity of an airport. In January 2001, European aircraft manufacturers drew up *specifications* (1) for air transport in 2020, which can be summed up in five major goals:

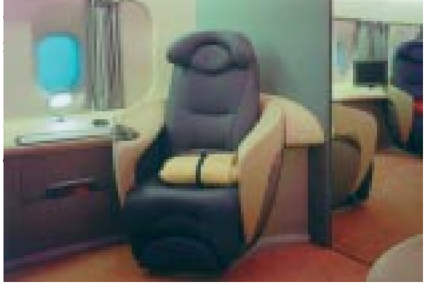
- to reduce accidents by one-fifth;
- to reduce aircraft noise pollution by half;
- to reduce carbon dioxide emissions per kilometre-passenger by half (while reducing fuel consumption);
- to reduce nitrogen oxide emissions by 80%; and
- to develop an air traffic control system able to manage 16 million flights a year with airports operational 24 hours a day and offering increased comfort for passengers.

The European Transonic Windtunnel (ETW) test chamber in Cologne.
© ETW

Space services The space sector is of course facing challenges of a different kind. Satellite applications are now proving to be tools which can be used in everyday applications in many economic sectors – meteorology, agriculture, fishing, transport, telecommunications – as well as in implementing environmental, defence and joint security policy.

However, the present generation of satellites is based on devices developed over the past two decades and would benefit from upgrading. Whether in radionavigation (for transport in particular), earth observation (for environmental and security needs) or telecommunications, there is a vast potential to develop new systems equipped with much more efficient technological facilities.

(1) European aeronautics: a vision for 2020. Meeting society's needs and winning global leadership.



Complete with lounge, study and bedroom… The aircraft of the future.
© Airbus

Airbus wing assembly.
© BAE

Flight simulator for the Airbus system.
© BAE

Striving for excellence

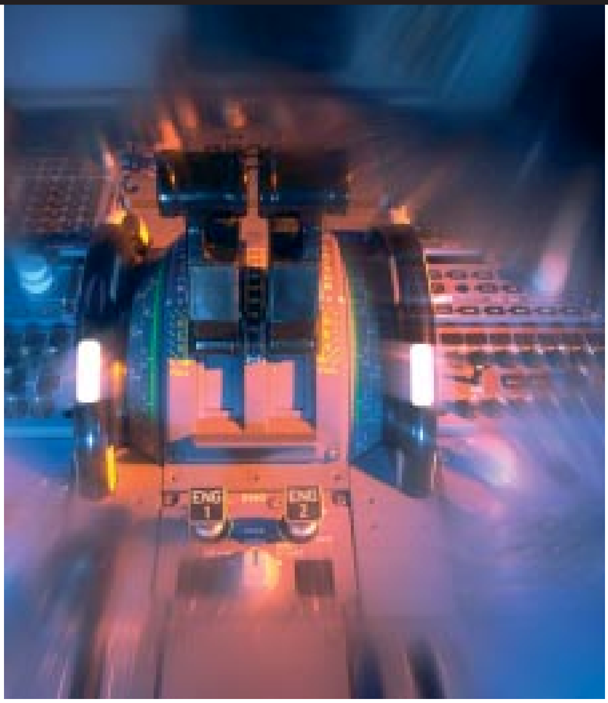
Aeronautics and space are two exemplary sectors in which Europe has demonstrated its originality, scientific and technological competence and economic efficiency. Airbus (50% of aircraft orders worldwide) and Ariane (50% of the satellite launching market) are proof of this fact. These success stories are the result of continuous private- and public-sector investment – and the constant coordination which must accompany it. It is this latter mission which the European Union has identified as a priority for its Sixth Framework Programme.

To consolidate its leading position on the global market, the European aeronautics industry must increase its research effort, which currently lags far behind that of the United States. The US federal government allocates twice as much to civilian aeronautics research as the EU – and that is not including R&D for the military sector where US expenditure is 14 times that of Europe.

If the Union is to avoid a return to the 1970s and an overwhelming US domination of the crucial medium- and long-haul markets, it must develop a genuine European aeronautics industry. It is an effort well worth making given that the sector is already Europe's leading exporter, with exports worth more than €22 billion net in 1999, and some 7 000 companies generating a revenue of over €66 billion. These directly employ around 400 000 mainly highly skilled workers and have indirectly created another 1.5 million jobs.

Vital coordination Ploughing 15% of its turnover back into R&D (about €9 billion a year), the industry cannot risk wasting its resources through duplication and a failure to coordinate its activities which are currently divided between a number of national centres and programmes. A recent estimate put total public and private financing needs at over €100 billion.

Through its 300 projects the Union currently finances almost 30% of total civil research in the sector. The Sixth Framework Programme will be allocating it €1.075 billion compared with 700 million under the previous programme. In addition to investments, European industry will also need regulatory and strategic support to create a genuine industrial platform for aeronautics at EU level.



© Airbus

First division European co-operation in the space sector, in particular within the European Space Agency (ESA), has clearly demonstrated its potential. Ariane is a major league player on the incredibly complex and competitive launcher market while, at the same time, guaranteeing the Union independent access to space. In 2000, the European satellite industry, which employs over 33 000 people and records a turnover of €5.5 billion a year, won more than 50% of commercial contracts worldwide.

Autonomy is the central concern of the vast Galileo programme, developed in co-operation with the ESA. This new positioning and navigation system provided by a constellation of several dozen satellites (see box) offers a more advanced, efficient and reliable alternative to the American GPS system, which currently has a monopoly. This ambitious industrial project was designed to meet a vast range of civil needs – air traffic control, road, rail and sea traffic management (in the interests of intermodality in particular), the tracking of dangerous substances, rescue operations, etc. – and offers the prospect of creating 150 000 highly skilled jobs and generating revenue of around €10 billion a year.

By combining space, land and air technologies, the GMES offers equally exciting prospects for everything related to environmental monitoring, the management of natural risks, civil protection and common foreign and security policy (CFSP). Finally, the space component is set to be an inherent part of future telecommunication networks, for access to mobile and broad band networks for example.

The drive to integrate industrial capacities and development activities which ensured European success on the launcher market must now be matched by a similar drive for integration in the field of research on satellite service markets. The huge industrial, economic and strategic stakes certainly justify optimal co-operation between European and national programmes and players.

To find out more

European aeronautics:
A Vision for 2020
- europa.eu.int/comm/research/growth/aeronautics2020/pdf/aeronautics2020_en.pdf

And also the following sites

- europa.eu.int/comm/research/growth/gcc/projects/aero-eu-policy.html
- europa.eu.int/comm/research/growth/gcc/ka04.html#top
- europa.eu.int/comm/space/

© ESA

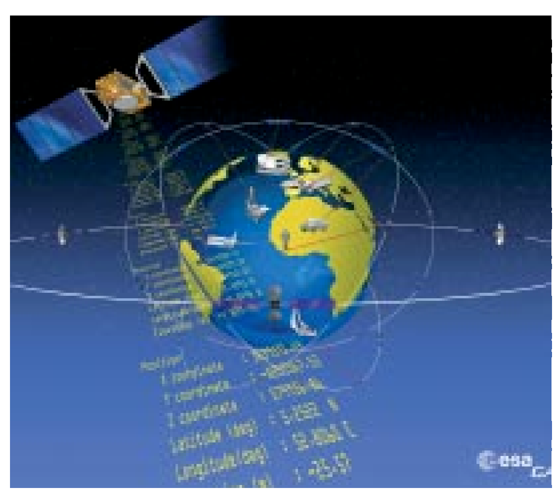
The technological ambitions of Galileo

Managed and controlled by civilian players, this future European satellite radio-navigation system is set to be open, global and fully compatible with the GPS, while offering its users a precision in the range of 5-10 metres, compared to 70 metres for the GPS. It will use a constellation of 30 satellites in medium orbit (23 000 kilometres altitude) linked to a network of terrestrial command stations and centres required for the provision of services.

The start-up costs for the system through to 2008 are estimated at €3.25 billion. Much of the financing will be raised via an open public-private partnership scheme. Almost €80 million have already been allocated from European funds for the study phase, now nearing completion. The development phase will run until 2006 with joint Union/ESA public funding of €1.1 billion. In March 2001, a group of industrialists (service providers, operators, space system and parts manufacturers) agreed to set up a joint company with an investment of €200 million. They will play an active role in defining the services offered by Galileo.

The satellite deployment phase will run from 2006-2007 with financing of €2.1 billion, most of which will be raised by the private sector. The system will enter the operational phase in 2008 with maintenance costs estimated at €220 million a year.

europa.eu.int/comm/space/galileo_en.html
www.europa.eu.int/comm/energy_transport/en/gal_how2_en.html
www.galileo-pgm.org/



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A new Community chapter

Since September 2000, Union representatives have opened a new chapter aimed at providing Europe with a genuinely common strategy. It will be achieved by working in close co-operation with the ESA in particular. This decision is inspired by the growing importance of space applications in all the economic, social and cultural activities of the modern world.

Achilleas Mitsos, Director-General for Research and coordinator of space policy at the Commission, explains that: 'The objective is to define, with all the players concerned – and first and foremost the ESA – the main lines of a European policy for space which is fully accepted and supported by all the Member States. The Union's role is first of all to ensure support for initiatives taken by the sector's players, whether private or public. This support will be in pursuit of two objectives which have so far been central to the European space effort, namely to develop the technological and industrial base for an autonomous economic exploitation of applications and, at the same time, to achieve a very high level of scientific knowledge for an understanding of our planetary system and space exploration. The Union will provide a common reference system for these players to guarantee the availability of a space infrastructure and efficient derived services. Space science must be better integrated in the European research effort and the appropriate political and regulatory conditions must be provided to ensure the development of the sector and commercial markets.'

Launched in July 2001, the Artemis (Advanced Relay and Technology Mission Satellite) communication satellite is an intercommunication relay station operating between terrestrial emitting stations and mobile posts. Its new laser transmitting technology also enables it to test inter-satellite communications.
© ESA

To find out more

Commission Communication 'Europe and Space: Turning to a new chapter'
europa.eu.int/comm/space/doc_pdf/esa_en.pdf

Aeronautics and Space*

OBJECTIVES

- To strengthen, by integrating its research efforts, the scientific and technological bases which underpin the competitiveness of the European aeronautics and space industry.
- To help exploit the potential of European research in this sector with a view to improving safety and environmental protection.

SUPPORTING RESEARCH

Aeronautics

The Community's action will concentrate on **three major areas**:

- Increased competitiveness of the European industry in terms of the production of civil aircraft, engines and equipment.
- Reduced environmental impact of aviation (fuel consumption, emissions of CO_2, NO_X and other chemical pollutants, noise pollution).
- Increased capacity and safety of the air transport system, in support of a 'Single European Sky' (air traffic control and management systems).

Space

The Community's activities will encourage close co-operation with the European Space Agency (ESA), other national space agencies and industrial research centres to strengthen the coherence of the very major investments necessary. **Three areas** have been identified:

- Research on satellite-based information systems and services relevant to the **Galileo** satellite navigation project.
- The design and development of satellite applications for the Global Monitoring for Environment and Security (**GMES**) platform, taking into account the needs of users.
- Advanced research needed to integrate the space segment and the earth segment in the field of communications.

BUDGET

€1 075 million

** This presentation is a summary of the official text for the adoption of the Sixth Framework Programme.*

To find out more

www.cordis.lu/rtd2002/fp-activities/aeronautics.htm

The paradox of progress

Due to progress in science and technology – and the increasingly stringent legislation that has resulted – today's agri-foodstuffs sector must respect ever stricter standards and increasingly rigorous quality control and monitoring procedures. Yet paradoxically, over the past decade there has also been an increasing number of food alerts – BSE, dioxin, listeria, salmonella – creating a genuine crisis of confidence among consumers. Research on food safety and quality must therefore be a priority.

Bio-packaging
It is not just the content – the container, too, must pass all the tests. Various research projects, in particular on bio-films made from natural polymers, are developing packagings providing increased safety, especially for 'ready-to-use' products.

The paradox stems from changes resulting from two factors. While the globalisation of supply and commerce provides for a very varied range of produce in the shops, it inevitably increases the risk of poor quality. Also, the economic pressure for ever growing rationalisation of the complete agri-foodstuffs chain – from the farm to the supermarket shelf, including processing and transport – results in produce being sold in bulk. When there is a problem at any stage of this chain, the threat of contamination can consequently assume alarming proportions with the potential of placing large sections of the population at risk.

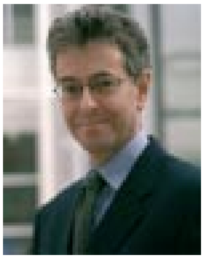
Increasing by stealth Although safer and subject to stricter control, the agri-foodstuffs sector is increasingly exposed to 'industrial' risks. Apart from the very particular cases of BSE (or mad cow disease), which originated in the United Kingdom, or the Belgian 'accident' concerning dioxin contamination, attributable to the gross negligence of a supplier of animal feed, scientists are most concerned by the much stealthier and generalised increase in the frequency of illnesses linked to microbiological contamination by *Salmonella*, *Campylobacter* and *Listeria*.

Another problem is the exposure to chemical elements contained in food, whose source is much more difficult to trace. These may be natural toxic products (such as mycotoxins) or a whole range of contaminants (compounds originating in pesticides, dioxins, mercury, lead, and radionuclides).

Questioning the innovations There is, however, more to food safety than quality control and monitoring. Biotechnology has opened up a vast field of exploration into new methods of agricultural production, including the creation of genetically modified plants and nutritional inventions such as so-called 'functional' foods or 'pharmafoods'.

The GMO debate is currently raging between the promoters of these innovations, who justify them in the name of the progress they bring (in particular for solving environmental problems as well as problems of hunger and food shortages in the world's poorest countries), and their opponents, who condemn a profit motive and a lack of both health and environmental precautions. But the debate is going nowhere – a situation which created yet another reason for intensifying research. It is by further exploring the potential of biotechnology that an objective light can be shed on these issues.

The media spotlight Science has an uncomfortable role in food safety. Called in by politicians, especially at times of crisis, it is often asked to provide certainties and principles of precaution when all it can offer are presumptions. On this basis, it is then asked to approve intervention plans which can have very major economic and social repercussions. Finally, and above all, it is propelled into the media spotlight where the experts – sometimes unsure, sometimes contradicting one another – often fail to impress the public, which further fuels a growing distrust of science.



Sir John Krebs

Communication: a challenge and a duty

Consumer concerns about food safety and their level of confidence in the information provided on the subject are a major challenge for European politicians and scientists. In responding to this challenge, everything rests upon the reliability of the information provided by research. The important role awarded to food quality and safety in the Sixth Framework Programme is not only a very desirable development but also a very timely one, with a view to a coherent approach to this issue within the European Research Area.

The particularly complex scientific issues at stake in this sector require co-operative research and shared expertise if coherent answers are to be provided to the questions raised. The multinational and international projects and networking encouraged by the new Framework Programme for R&D meet this requirement. Increased coordination between research programmes will also make it possible to define the objectives of the scientists engaged in this work, while the mobility of researchers and access to resources will ultimately help to create a genuine community of researchers working in this area in Europe.

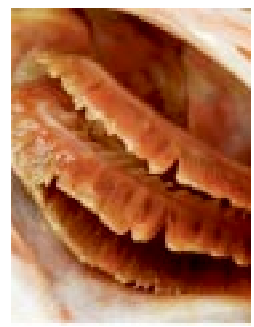
Organising such a vast and ambitious co-operative effort will require efficient management and the production of tangible statistics, the high quality of which must be demonstrated. The priority given to research on food safety and quality differs to other more exclusively technological research areas, as in this case the sector's 'final' customers are European consumers themselves. Integrating research in this context involves more than encouraging interaction between European researchers and multidisciplinary projects. At the end of the day, it is not enough to undertake 'good scientific research'. To increase food safety and consumer confidence, the results must be used effectively by translating them into policy, and must also be backed up by sufficient and open communication. This means that, apart from the limited community of researchers, the programme must be transparent to consumers and other users – from programme and project development through to accessing the results.

Sir John Krebs
President of the *Food Standards Agency (*UK)

Plant proteins
Rubisco, as found in luzerne, contains essential amino acids and could replace other food proteins.

Resistant plants
Research on plants which are resistant to nematodes, the minute worms which destroy their roots.

Freshness control
The QIM (quality index method) used in several European countries evaluates various characteristics (eyes, gills, skin) to evaluate the freshness of fish products.



Of major economic and social importance

The agriculture and food sectors are vitally important to the European economy as a whole. The food industry is a leading sector in the EU, with the highest annual production in the world at close to €600 billion, or about 15% of the total for the processing industry as a whole. It is the third industrial employer, employing over 2.6 million workers, 30% in small and medium-sized businesses. The agricultural sector has a total production of about €220 billion and provides the equivalent of 7.5 million full-time jobs.

Exports of agricultural products and food are worth about €50 billion a year. Given the economic stakes involved and the omnipresence of food in our lives, society in general, and the public authorities and producers in particular, have an obligation to attach the greatest possible importance to food safety.

From the farm to the fork

Since the devastation caused by the bovine spongiform encephalitis crisis, the Union has, so to speak, 'taken the bull by the horns' in carrying out a thorough review and draconian restructuring of its political responsibilities in the area of food safety. Research on this subject under the Sixth Framework Programme will be in line with this goal.

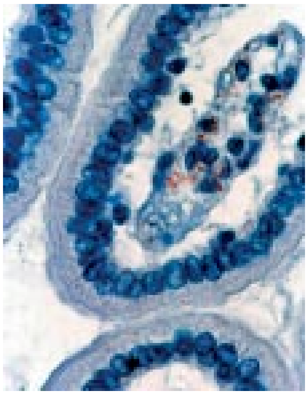
From TSE to BSE
Researchers are mobilising to understand the almost incomprehensible: the crossing of the species barrier and, subsequently, the nature and pathway of the prion. Right, human brain tissue showing spongiform degeneration due to new variant Creutzfeldt-Jakob disease.
© Robert Will, CJD Surveillance Unit, Edinburgh

In 1997, all the European Commission's powers of scientific consultation and decision-making in the field of food safety were brought together under the Directorate-General for Health and Consumer Affairs. Under the slogan of 'from the farm to the fork', this restructuring was designed to group and coordinate all the sensitive issues relating to food safety and quality at every stage of the agri-foodstuffs chain: animal health and feed, quality of crop production (including GMO innovations), safety of agricultural inputs (fertilisers, pesticides, etc.), quality and monitoring of processed foods and products (including rules on labelling), and the problem of food safety in international trade.

In January 2000, the Commission published a basic charter, the White Paper on Food Safety, which sets out a plan to reform the legislation into a coherent and transparent set of rules, reinforce controls and increase the capability of the scientific advice system. All existing legislation will be reviewed before 2007 to ensure compatibility with the new Community jurisdiction on food safety, which is now being developed.

Framework Programme support The jewel in the crown of this reform is the creation of the European Food Safety Authority (EFSA). This independent body, established in January 2002, is responsible for the scientific evaluation of risks, communicating directly with the general public and issuing health warnings if necessary (see box).

Under the Sixth Framework Programme, the choice of the priority theme *Food quality and safety* is designed to support this new agency in its essential work. Research priorities will be: the epidemiology of food-related diseases and allergies; the impact of diet on health; traceability processes throughout the production chain; methods of analysis, detection and control; the safest and most environment-friendly production methods; the effect of animal feed ingredients on human health; and environmental risks to health.



Listeria sequencing
Under the leadership of the Institut Pasteur, ten European laboratories have completed the entire sequencing of Listeria monocytogenes. This research project will permit a much earlier diagnosis of listeriosis, an illness of worrying frequency which kills 20-30% of sufferers.
© Institut Pasteur

Detection of GMOs
Evaluation and validation of methods of analysis, detection and traceability of GMOs carried out at the Joint Research Centre's Institute of Consumer Health and Protection at Ispra.

EFSA: the jewel in the crown

The European Food Safety Authority (EFSA) is a major tool in Community food safety policy, based on the principles of independence, scientific excellence and transparency. It is an autonomous body, acting independently of the Community institutions and with a considerable budget at its disposal. It has a wide brief to pursue a proactive policy of scientific evaluation, advice, information gathering, risk identification and communicating with the public, including issuing emergency health warnings if necessary. It is responsible for all matters which could have a direct or indirect effect in this field (including, for example, the health and welfare of animals, GMOs not destined for human or animal food, product labelling, nutrition, etc.). Although the Commission is its principal 'customer', the EFSA is available to respond to scientific questions from the European Parliament and Member States, and can undertake scientific investigations at its own initiative. Nevertheless, risk management, including legislation and controls, remains a matter for the European institutions – although an extension of the EFSA's powers in this direction cannot be ruled out at a later date.

Food quality and safety*

OBJECTIVES

- To establish the integrated scientific and technological bases needed to develop an environmentally friendly production and distribution chain of safer, healthier and more varied food – including crops, meat and sea food.
- To improve understanding of the link between food and health.
- To control food-related risks, relying in particular on biotechnology tools and the results of post-genomic research.
- To control health risks associated with environmental changes.

SUPPORT FOR RESEARCH

Community action will cover research in the following fields:

- Production methods and processes (including knowledge of biotechnolgies) for foodstuffs and animal feed which are safer, healthier, more nutritional, functional and varied, and environmentally friendly, based on systems such as integrated production, lower input farming and organic farming.
- The epidemiology of food-related diseases and allergies, including methods of analysis of food-related allergies, in particular the impact of diet on children's health.
- The impact on health of new and/or functional foods, products resulting from organic farming, foods containing genetically modified organisms, and those arising from recent biotechnology developments.
- 'Traceability' processes throughout the production chain, relating in particular to GMOs and similar products.
- Methods of analysis, detection and control of chemical contaminants and existing or emerging pathogenic micro-organisms (such as viruses, bacteria, yeasts, fungi, parasites, and new agents of the prion type, including the development of ante-mortem diagnostic tests for BSE and scrapie).
- The impact on human health of animal feed, in particular products containing GMOs, and the use of sub-products of various origin.
- Environmental health risks (chemical, biological and physical) linked to the food chain (including the cumulative risks of authorised substances, transmission routes to human beings, long-term effects and exposure to small doses, impact on particularly vulnerable groups, especially children), the impact of local ecological disasters and of pollution on food safety.

BUDGET

€685 million

** This presentation is a summary of the official text of the adoption of the Sixth Framework Programme.*
www.cordis.lu/rtd2002/fp-activities/food_safety.htm

To find out more

European White Paper on Food Safety
europa.eu.int/comm/dgs/health_consumer/library/pub/pub06_en.pdf

Dossier on food safety at the Europa Research website
europa.eu.int/comm/research/briefings/foodsafety_en.html

Site of the European Food Safety Authority
www.efsa.eu.int/index_en.html

Site of the pan-European conference on food safety and quality (organised by the FAO and WHO and held in Budapest in February 2002)
www.foodsafetyforum.org/paneuropean/index_en.htm

Site of the European ENTRANSFOOD network on GMOs
www.entransfood.nl/

Earth in the balance

Even if the results were mixed, the recent Earth Summit in Johannesburg proved that the concept of sustainable development is the touchstone for humanity's future. In the past, growth was 'fuelled' by scientific and technological progress. Today, the embracing of the 'sustainable' dimension requires a radical repositioning of the role of research.

Increasingly evident, environmental concerns – and the research devoted to them – have changed radically over the past three decades. Initially, research mainly measured and evaluated sensitive points of impact. Gaps in our knowledge had to be filled, air, water and soil pollution detected, and emergency preventive and repair action proposed.

A bigger field Gradually, the knowledge acquired reached a critical mass. Approaches became increasingly *eco-systemic*, focusing on the complex relationships governing natural systems. This continued to the point where the knowledge acquired was sufficient to detect and establish with certainty the worrying phenomenon of 'global change', with convincing evidence that the cause is human activity.

During this development, the very concept of 'environmental research' changed fundamentally into the much wider approach known as sustainable development. Scientific and technological concerns about *sustainability* have now penetrated all disciplines.

Research on the life sciences, agronomy, the exploitation of marine resources, new materials, industrial technologies, energy – in fact all the components of contemporary development – must now take into account the principle of *Sustainable Impact Assessment*. This is particularly necessary for the optimal management of resources, safeguarding biodiversity, and minimising pollution, the impact on ecosystems and global change.

The behavioural dimension Increasing importance is also being awarded to socio-economic studies and the human sciences. Technological changes with a view to sustainable development will only be possible if behaviour and lifestyles change. This is certainly the case in the rich countries where patterns of consumption are the main cause of global environmental imbalances. It is also true for those developing countries facing huge demands and needing to develop growth models which avoid the past mistakes of advanced societies – otherwise, they themselves will be the first to suffer the consequences of a deteriorating environment.

Sharing the workload

Sustainable development obviously concerns the whole planet and can only be effective if it is a joint effort. This is why in addition to pursuing its own efforts the Union must also open up to the wider world and to the developing countries in particular. This is being achieved through the dissemination of technology, exchanges of good practice, encouraging changes in energy consumption behaviour ('energy intelligence'), new approaches to mobility, and a more rational use of natural resources.

As Christian Patermann – director of the European research programme on the environment and sustainable development – stressed in connection with the Johannesburg Summit: 'Europe today is one of the very best laboratories where the scientific and technical tools for sustainable development are being forged. This label of excellence is a formidable opportunity to increase the influence of Europe's knowledge.' (1)

(1) See RTD info *34.*

The history of climate

The huge ice cap which covers the continent of Antarctica is a genuine 'hard disk' of information on the air and climate of the past. Over the next five years, experts on the European Epica project will be taking ice samples from depths of up to 800 metres, which should make it possible to build up a picture of the paleoclimate of 500 000 years ago. This will shed valuable new light on global and climate changes which are of interest to researchers studying phenomena such as desertification, rising sea levels and the melting of the permafrost.

www.antarctica.ac.uk

The hydrogen solution

Hydrogen fuel cells are a particularly promising new means of vehicle propulsion. The only gas they emit is steam. Below, a prototype of the Citaro bus, designed by Daimler Benz and used during the ‘car free day’ in Brussels last September. A number of European research projects are studying this pollution-free public transport options, in particular the Cute project (Clean Urban Transport for Europe) which is active in nine cities (Amsterdam, Barcelona, Hamburg, London, Luxembourg, Madrid, Porto, Stockholm and Stuttgart), and the Ectos project (Ecological City Transport System) which is looking at hydrogen transport and storage solutions following trials carried out in Reykjavik (Iceland).

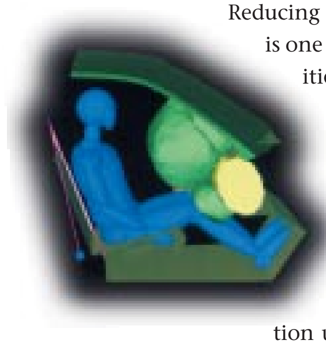
europa.eu.int/comm/energy_transport/en/prog_cut_en.html
www.fuel-cell-bus-club.com
www.newenergy.is/ectos.asp

Studying the ozone layer

In co-operation with Nasa, the huge Theseo-Solve project is studying the chemistry and physics of the atmosphere, with the help of the very best European experts. Over the last ten years, balloons and aircraft packed with measuring instruments have been taking measurements in the stratosphere to model depletion of the ozone layer at different altitudes.

www.nilu.no/projects/theseo2000/

Safety first



Reducing the number of road accidents is one of the Union's transport priorities. A number of research projects are currently looking at new means of both passive and active vehicle safety. Above, a protection simulation test at TNO Crash-Safety in Delft, which specialises in accident simulation using bioconform models and is coordinator of the Adria project to improve safety in the event of head-on collision (as provided by air bags, for example).

www.tno.nl

Time to decide

The Fifth Framework Programme already clearly identified sustainable development as a research priority. Since the Gothenburg Summit of June 2001, European leaders have adopted it as a key common component of all EU policies. In keeping with the new direction taken by scientific and technological research with a view to the European Research Area – aimed in particular at concentrating support in priority fields – pride of place is awarded to the two most strategic components of sustainable development: energy and transport. A third priority reaffirms the importance Europe attaches, at global level, to research on change worldwide.

There is one fundamental component which dominates the sustainable development equation: energy production and consumption, together with its principal associated sub-sector, transport. Transport alone accounts for one-third of European energy consumption and is responsible for almost 30% of total CO_2 emissions.

Energy The Union has decided to make a particularly committed effort in these two fields. On the energy front, the goal of sustainable development will be combined with the key strategic dimension of 'energy independence', the importance of which was set out in a recent Green Paper. Research here must answer two questions: first, how to exercise better control over the unavoidable use of fossil fuels – and in particular coal and its derivatives, guaranteeing increased security of supply? And secondly, how to encourage the increasingly vital use of renewable energies?

As regards the latter, two verdicts can be reached: one positive, the other negative. In the space of ten years (1989-1998), the contribution of renewable energies to primary energy supplies increased by 32% and to electricity generation by 29%, with some spectacular success stories such as wind power which experienced 2 000% growth! Yet at the same time, these 'clean and independent' energies are still not contributing enough and, if nothing is done to give them a new impetus, by 2030 they will account for just 9% of total consumption. This when the Union target is for them to meet 12% of European energy supplies by 2010.

Research must therefore continue on improving the available technologies, reducing their cost, improving their efficiency and, most importantly, incorporating them in the major electricity distribution networks. Photovoltaic solar energy, for example, is already benefiting from research to reduce the production cost of sensors and improve panel yield.

Hydroelectric power, which accounts for 13% of the Union's electricity production, stands to benefit from the development of micro-power stations. Using marine hydraulics to harness the power of waves and tides is another area of under-exploited potential. In the field of wind power, where there is now increasing emphasis on offshore sites, research on limiting noise pollution and achieving a more competitive cost per kilowatt hour is proving very promising.

Other essential areas of European energy research in the medium to long term include fuel cells, alternative fuels (of agri-forestry origin) and the clean burning of coal (with funding available following the expiry of the ECSC Treaty).

Sustainable mobility The Union's commitment is equally resolute in the field of mobility, as demonstrated by the recent adoption of the White Paper on European transport policy. The transport sector is responsible for 32% of energy consumption and 28% of total CO_2 emissions, the chief culprit in the latter case being road transport. The main challenge lies in the major urban areas where the excessive use of the private car is causing problems of air pollution and is more of an obstacle to mobility than anything else. On a more global level, and for goods transport in particular, a new balance must be achieved between road, rail and sea transport. The fields of research and innovation are many and varied, including environmental protection, competitiveness, safety and interoperability of modes of transport.

Global monitoring Over the past decade, European research has played a large part in identifying the phenomena of global change and their growing susceptibility to the influence of human activities. The Union is determined to adopt a responsible attitude in implementing the major international conventions which it largely inspired, namely the Kyoto Protocol on reducing greenhouse gas emissions, UN conventions on biological diversity (1992) and combating desertification (1994), and the Montreal Protocol (1987) on substances which deplete the ozone layer. It also aims to retain its research status and to continue to make a substantial contribution to this vital field of the Earth Sciences.

To find out more

The Green Paper *Towards a Europe strategy for the security of energy supplies*

europa.eu.int/comm/energy_transport/en/lpi_lv_en1.html

The White Paper *European transport policy for 2010: time to decide*

europa.eu.int/comm/energy_transport/en/lb_en.html

Can carbon be 'fixed'?

Can forests act as reservoirs, fixing the carbon dioxide emitted into the atmosphere, which is the main cause of climate warming? This key question is being studied by the CarboEurope initiative which is drawing on the expertise of eight multidisciplinary research projects, 190 scientists, 69 institutions and about 30 sites in the 15 EU Member States. These small sensors are placed at tree-top level and can calculate the net flow of carbon dioxide between the vegetation and the air.

www.bgc-jena.mpg.de/public/carboeur/carbo.html

Sustainable development, global change and ecosystems*

OBJECTIVES

- The development, dissemination and adoption of innovative technologies and sustainable solutions in energy production and consumption, in particular through increased use of renewable energies.
- The development and introduction of environment-friendly, safe and competitive mobility systems for passenger and goods transport, including all forms of surface transport, i.e. road, rail and sea.
- Improved understanding and forecasting capacities in regard to global changes, ecosystems and biodiversity as well as the creation of new management models.

SUPPORTING RESEARCH

Community action will concentrate on **three major fields**:

Sustainable energy systems

- Technological development and integration of renewable energy sources in the energy system, including storage, distribution and use.
- Energy savings and energy efficiency.
- Development of alternative motor fuels.
- Development of fuel cells and their application, in particular for transport and hydrogen storage.
- Reduced use and clean burning of fossil fuels, especially coal.

Sustainable surface transport

- New technologies and concepts for surface transport, including novel propulsion systems, in particular fuel cells.
- Advanced design and production techniques leading to improved quality, safety, recyclability, comfort and cost-effectiveness.
- Rebalancing, integration and interoperability of different modes of transport, in particular at urban and regional level.
- Increased safety and reduced traffic congestion, in particular in urban areas, by means of electronic and telematic solutions and advanced satellite navigation systems.

Global change and ecosystems

- Research into reducing greenhouse gas emissions – generated by energy, transport, industry and agriculture – and evaluation of solutions offered by carbon sinks.
- Research on ozone layer depletion.
- The water cycle, including soil-related aspects.
- Understanding and protection of marine and terrestrial biodiversity and genetic resources, sustainable management of the impact of human activities on ecosystems.
- Land management, in particular for the integrated management of coastal zones and integrated concepts for the multipurpose utilisation of agricultural and forestry resources.
- Operational forecasting and modelling, in particular of climate change.
- Risk assessment and methods for appraising environmental quality, including research on measurements.

BUDGET

€2 120 million

** This presentation is a summary of the official text for the adoption of the Sixth Framework Programme.*

The return of the human sciences

Studying the environment, health, information technologies, biology and other fields, the human and social sciences are well placed to play a key role in creating or recreating communication between decision-makers, researchers and citizens. There is also increasing recognition of the new and valuable light they can shed on research projects which are becoming increasingly multidisciplinary.

What is possible without knowledge? The most cultured countries are also the most technologically advanced. Economic growth and research activities go hand in hand and innovation is essential to improving the quality of life, whether in terms of health, the environment or creature comforts.

Vague and uncertain Yet such progress often meets with a confused response. Many of us see innovations as neither chosen nor wanted. Our understanding of their implications and potential risks remains vague and uncertain. Their effects – in terms of employment and social habits – can seem beyond our control. What is more, the funding they receive sometimes appears disproportionate given that other aspirations – such as jobs, security, sustainable development and world peace – seem to be largely ignored.

On the one hand there are the scientists who possess knowledge and influence, and the decision-makers who exercise power. On the other, the citizens over whom such power and influence are exercised. Or at least that is how some would see it. Fortunately, the reality is less black and white. More and more people, in particular through their work and their responsibilities, are asking questions about the relationship between knowledge and power, between science and society, about the whole the notion of governance whereby decision-makers impact on the public.

Shedding new light Efforts have already been made to answer these questions – such as by the key action on social and economic research under the Fifth Framework Programme – and a considerable body of knowledge has been built up. These experts in the human and social sciences seek to investigate social relationships, to identify the determining characteristics of a given age, place or microcosm, and to understand the meaning of identity or membership of a social group. Their work involves compiling statistics and comparing attitudes and responses.

For too long those working in these 'soft' or 'inexact' sciences were considered – save perhaps by economists studying the most concrete realities – to be working in the cultural rather than the scientific domain. Today there is growing recognition of their scientific rigour and vital contribution. Education, equality, ethics, communication, the impact of technologies, demographic change, the effects of poverty are all of concern to the social scientist.

There is also growing recognition that very often the human sciences shed new light on the approaches of the exact sciences, refining their findings. This is why multidisciplinary teams are becoming increasingly necessary and numerous.

Not to be missed: Ecsite
The *European collaborative for science, industry & technology exhibitions* – or Ecsite for short – is a network of science museums and centres from all over the world. Originally set up in Europe, it aims to facilitate the dissemination of scientific culture by arranging for exhibitions to visit various countries but also by encouraging debate on the best way to present and promote public understanding of science through the exchange of good practices.
Communication presented at various European science museums and centres – in this case at the Heureka Finnish Science Centre in Vantaa (Helsinki).
www.ecsite.net
www.heureka.fi

Urban democracy: Ulysses

In a field such as the environment, how can the necessary strategies be applied in a way that citizens are going to accept? How are people going to react if they are asked to reduce car use or turn down their heating? The way forward lies in dialogue and information. Models developed by researchers as an aid to decision-making in countering the greenhouse effect (integrated evaluation models) were presented to small groups of citizens in seven European towns (Barcelona, Venice, Frankfurt, Manchester, Zurich, Athens, Stockholm). By focusing on the key issues facing the particular region, Ulysses was able to gauge feelings and reactions. This approach enables regional politicians to present a case for effective policy on sustainable development.

www.zit.tu-darmstadt.de/ulysses/

Increasing awareness among young people

Why are young people shunning science courses? 'The studies are not attractive enough' (59.5%), 'the subject matter is too difficult' (55%), 'not very interesting' (49.6%), 'insufficient career prospects' (42.4%). A number of European actions are seeking to make young people more aware of and receptive to science. European Science and Technology Week, for example, is held every November and brings a range of events in towns throughout Europe, while the EU Contest for Young Scientists awards prizes to the often very impressive research projects submitted by secondary school students throughout Europe.

* Findings of the Eurobarometer poll 'Europeans, science and technology', 2001.

www.cordis.lu/scienceweek/home.htm

europa.eu.int/comm/research/youngscientists/index2.htm

Maurice Godelier, director of studies at the Ecole des hautes études en sciences sociales (Paris), is the author of a report on 'The status of human and social sciences in France and their role in creating the European Research Area,' an excerpt from which is published here.

Building bridges between disciplines

'The extremely rapid development of sciences such as biology, and also of technologies such as biotechnology, requires action by the human and social sciences at two totally different levels. On the one hand these developments raise new ethical and deontological questions to which lawyers and philosophers must give their replies; on the other, the rapid developments in biological and other sciences pose the problem of changing the way in which they are taught. Research is necessary to transform the content (thus the textbooks and manuals) of science courses in European countries which is very quickly outdated. Unfortunately, the European Commission has received few proposals in this area. For all these areas requiring co-operation between the human/social sciences and other sciences such as the life sciences, it is vital to increase the opportunities for communication between the disciplines. Yet there is a lack of communication between the human and social sciences and other scientific disciplines just about everywhere in Europe.'

Maurice Godelier

How can progress be controlled?

The **Science and Society action plan** is constructed around three major strategies:

- promoting scientific education and culture in Europe;
- developing scientific policies which are closer to the citizen; and
- placing a responsible science at the heart of public policies.

Science and society: promoting the initiatives

Under the Sixth Framework Programme the theme of *Science and society* is also present in another field of action: *Structuring the European Research Area.* Unlike the *Citizens and governance* thematic programme, whose objective is to support research, the activities in this case are aimed at:

- bringing research and society closer together (increasing awareness of scientists, involving citizens, etc.);
- a responsible analysis, in accordance with ethical values, of the implications of science and technology (evaluation, risk management, principle of precaution, dissemination of good practices, etc.); and
- strengthening dialogue between science and society (dissemination of scientific culture, stimulating the interest of young people, initiatives to promote the role of women in science and research, etc.).

This action will receive a budget of €80 million.

- www.cordis.lu/rtd2002/science-society/home.html
- europa.eu.int/comm/research/science-society/science-communication/links_en.html
- www.cordis.lu/improving/public-awareness/home.htm

'Human resources are Europe's main strength,' stressed the Lisbon European Council in March 2000. A few months later, the Commission published *Science, society and citizens in Europe*,(1) a document which was the basis for an exhaustive debate on the subject, broadcast live through an electronic forum.(2) On 26 June 2001, the Commission presented its Science and Society action plan.

The knowledge society is the embodiment of a change in civilisation whereby science and technology have become omnipresent and are developing at a disconcerting rate.

In this fast-changing context, the relationship between government and citizens is no longer the same – new modes of governance must be established and socio-economic progress must be rethought with a view to sustainability. Different relationships and a positive dialogue between the scientific community, companies and society's decision-makers are required.

A European perspective Before this new kind of governance can be established, high-quality and readily understandable information must be provided on the implications of scientific research as well as increased access to scientific culture. Progress in science and technology can then be democratically understood, evaluated, studied and debated.

This approach must be within a European perspective as, in a global economy, it is at this level that society's choices must be made. Governance within the Union must be based on the traditionally shared values of justice and solidarity while at the same time respecting cultural diversity and individual sensibilities – which will be even more of a consideration within an enlarged Europe.

Ethics and precaution It is especially necessary to take into account the ethical dimension. This requires public dialogue on subjects which lend themselves to debate, increased awareness of these issues among researchers, and accessible and more systematic communication of the implications at stake.

The role of scientists and the use of expertise are also increasingly significant to political decisions in fields where the principle of precaution must be respected – for example, consumer health, food safety, and nuclear waste. On all these cross-border issues, the Union needs reference frameworks and European standards and guidelines.

Bringing science closer to the citizen involves strengthening the democratic process and introducing new procedures for participation, like the consensus conferences that are currently being held in some countries. This need for wider participation also applies to other areas, such as increased equality between men and women in the field of research, science and technology.

Finally, given the complexity of relationships between science and society, there is a need for interdisciplinarity and forward studies permitting a better understanding of the problem as well as improved anticipation of emerging issues and future scenarios.

(1) SEC(2000)1973, 14 November 2000. www.cordis.lu/rtd2002/Science-society/home.htm
(2) This document contributed to the implementation of the White Paper on European Governance, adopted by the Commission on 25 July 2001.

Women and science: correcting the balance
***Gender mainstreaming*, or the systematic inclusion of the 'gender' dimension, is a policy which the Commission believes is particularly necessary in the field of research. It aims, for example, to ensure women make up 40% of all researchers funded by the Union's Marie Curie fellowships. The under-representation of women in research – and the higher up the hierarchical ladder you go the fewer women you find – is analysed in the report *National Policies on Women and Science in Europe*. This was produced by the Helsinki Group at the Commission's request and constitutes a searching inquiry – with comparative statistics, a list of good practices, etc. – into the 'wastage of female potential' in 30 countries.**
www.cordis.lu/improving/women/home.htm

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GMOs and BSE: what the Europeans think
The Eurobarometer surveys have traditionally gauged European opinion on a range of subjects. The 2001 survey among 16 000 citizens of the 15 Member States concerned two topical health issues: GMOs and BSE. Foods containing GMOs were seen as dangerous by 56.5% of interviewees, with the Dutch and Portuguese having the least reservations. A very large majority (94.6%) would like the right to be able to make a well-informed choice for GMOs. As to BSE or mad cow disease, 78.3% of the persons interviewed consider it poses a threat to humans, 74% hold the agri-foodstuffs industry responsible for BSE and 44.6% admit they are insufficiently informed to draw any meaningful conclusions.
europa.eu.int/comm/research/press/2001/pr0612en.html

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Citizens and governance in a knowledge-based society*

OBJECTIVES

- To mobilise European research capacities in the economic, political, social and human sciences for an improved understanding of the emergence of the knowledge-based society.
- To draw on a wealth and diversity of reflection to imagine new forms of relationships between the people of Europe and these people and their institutions.
- To study and manage the issues facing society and to which science can provide some of the answers.

SUPPORTING RESEARCH

Community action will concentrate on **two major fields**:

- the knowledge-based society and social cohesion; and
- citizenship, democracy and new forms of governance.

The advent of a knowledge-based society requires improved means of communicating and using knowledge and opportunities for lifelong learning. These developments will be within a socio-economic and demographic context which itself is being called into question.

Citizenship and governance must evolve with a view to increasing globalisation, European integration and Union enlargement and the emergence of new forms of cultural identity and social dialogue.

Specifically, the Union will support:

- transnational comparative studies and research and the coordinated development of statistics and qualitative and quantitative indicators;
- interdisciplinary research to support the policies of Member States;
- the creation and Europe-wide use of research infrastructures and data and knowledge bases.

BUDGET

€225 million

** This presentation is a summary of the official text for the adoption of the Sixth Framework Programme.*

To find out more

www.cordis.lu/rtd2002/fp-activities/citizens_governance.htm

A marked interest

Last spring, with the aim of testing the research priorities of the Sixth Framework Programme, the Commission invited European and international research players to submit their 'expressions of interest' in the form of suggestions for setting up integrated projects (IP) or networks of excellence (NoE) in these fields of research. The response was massive, with more than 12 000 presentations of potential research projects submitted by the Member States and 12 candidate countries.

The table below gives, per field and type of instrument, the overall statistics on 8 556 expressions of interest, the remainder having been rejected because they were incomplete or remain anonymous at the submitter's request (about 20%). **These can be consulted individually on the on-line database made available by the CORDIS service at: http://eoi.cordis.lu/search_ form.cfm.**

The exercise yielded valuable information which will help the Commission in launching future calls for proposals. Two-thirds of the expressions of interest concern the setting up of integrated projects, suggesting that the new concept of networks of excellence requires further promotion.(1) There is a relatively balanced spread between the sectors, although the level is rather low for aeronautics and space (but this is also a field receiving many requests for confidentiality). Two sectors, sustainable development (concentrating on energy, transport and global change),(2) and human and political science ('Citizens and governance') were the subject of a high number of suggestions, which could be reason to fear a proposals surplus. Finally, there was a particularly encouraging response from the candidate countries, their expressions of interest accounting for 15% of those received from the Member States.

(1) With the exception of France, where almost half the proposals concern the NoEs.

(2) Especially in Germany, where this research priority represents one-third of submissions.

	GBH		IST		NMP		A&S		FSQ		SDGE		C&G		Total
	IP	NoE	IP	NoE	IP	NoE	IP	NoE	IP	NoE	IP	NoE	IP	NoE	
Austria	24	6	28	19	30	7	5	1	5	1	69	18	29	11	253
Belgium	47	33	50	21	23	19	8	3	21	17	61	28	51	32	414
Denmark	34	17	21	5	11	1		1	30	6	52	16	18	11	223
Finland	16	3	48	17	27	11	1	1	9	4	39	12	16	8	212
France	84	72	103	96	48	67	18	10	37	18	140	98	37	46	874
Germany	156	69	180	55	150	71	16	4	64	19	356	78	75	58	1 351
Greece	17	7	47	19	10	5	1		12	3	46	14	11	5	197
Italy	124	64	163	60	63	45	18	9	49	21	163	43	53	38	913
Ireland	5	1	6	8	1	2			6	1	8	3	5	2	48
Luxembourg			2	1		1									4
Netherlands	55	26	54	25	35	20	1	6	26	9	117	45	27	34	480
Portugal	7	1	7	6	5	3			7	2	26	5	6	5	80
Spain	61	39	122	67	66	37	7	1	43	21	99	43	45	44	695
Sweden	49	21	44	19	33	29	5	1	18	3	79	35	8	11	355
UK	157	72	182	79	81	81	10	13	114	37	286	106	93	51	1 362
Total 15	**836**	**431**	**1 057**	**497**	**583**	**399**	**90**	**50**	**441**	**162**	**1 541**	**544**	**474**	**356**	**7 461**
Bulgaria	4	2	18	1	10	4	1	1	4		15	6	20	4	90
Cyprus	1			1	2	1		1						1	7
Czech Rep.	18	4	19	6	14	13			13	2	25	6	12	4	136
Estonia		1	3	1					1				4	2	12
Hungary	12	5	15	5	2	1			4		12	3	10	4	73
Latvia			2		3	2				2	2		1	1	13
Lithuania	5	2	12	3	11	5			1	3	14	1	11	1	69
Malta	2		2	2						1	1				8
Poland	77	18	37	31	68	42	2	2	38	14	118	26	18	11	502
Romania	9	4	8	4	14	3	3	2	5		26		7		85
Slovakia	6		3	2	6	4			6	1	11	4	8		51
Slovenia	9	1	8	4	10	1				1	3	2	6	4	49
Total 12	**143**	**37**	**127**	**60**	**140**	**76**	**6**	**6**	**72**	**24**	**227**	**48**	**97**	**32**	**1 095**

IP: Integrated projects, NoE: Networks of excellence, GBH: Genomics and biotechnology for health, ISTI: Information society technologies, NMP: Nanotechnologies and nanosciences, multi-functional materials, production processes, A&S: Aeronautics and space, FSQ: Food safety and quality, SDGE: Sustainable development, global change and ecosystems, C&G: Citizens and governance in a knowledge-based society

15

KI-AB-02-S02-EN-C