



Environment, Energy, Europe

An Investment
for Now and
the Future



ENERGY, ENVIRONMENT
AND SUSTAINABLE DEVELOPMENT



Reconciling economic growth with environmental protection requires greater scientific understanding of the environment, more advanced energy technologies and substantial changes to industry and society. This brochure provides an overview of the European Union's Energy, Environment and Sustainable Development (EESD) research programme, which aims to provide some of the answers.

After an introduction outlining the importance of research in this area for Europe, and an overview of the programme, the brochure describes each *key action* - the new, multi-disciplinary, problem-solving approach to research introduced in the Fifth Framework Programme - in turn, highlighting in schematic form its main priorities and concepts. A description of the generic research and support for infrastructure included in the programme follows, while a history of related research and some case studies are presented in parallel. The brochure also provides an overview of the whole Fifth Framework Programme and details of where the reader can obtain further information.

European Commission

A great deal of additional information on the European Union is available on the Internet. It can be accessed through the Europa server (<http://europa.eu.int>). Cataloguing data can be found at the end of this publication.

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Environment, Energy, Europe – an Investment for Now and the Future

Securing a better world for present generations without compromising the future requires an integrated, Europe-wide approach to economic growth and environmental protection.

Developing a clean, efficient and secure energy supply, promoting more environmentally-friendly uses of energy, improving the way natural resources are managed, and making industry, utilities and society more environmentally benign are all important investments in Europe's future.

We need to understand our environment better, how it relates to society, how this new knowledge can be implemented, and we need to develop the tools and technologies to take us towards this future.

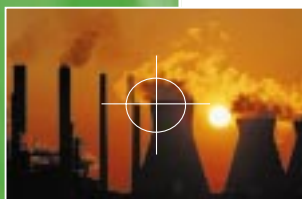
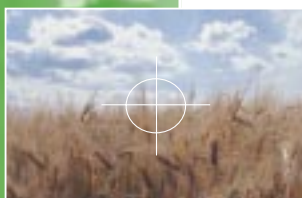
Sharing the Burden

Environmental problems do not respect national borders, so the European Union has a critical role in finding their solutions. The EU's technical skill and scientific talent must be focused on Europe-wide problems, ranging from managing our cities to developing new forms of renewable energy. Europe-wide eco-standards must be set for both industry and society in general to improve everything from the health of our rivers to the cleanliness of our beaches. And the EU's international commitments to reduce the emissions of greenhouse gases must be met for the security of the planet.

Underpinning the EU's approach is the concept of 'eco-efficiency' – to produce and use more and better services and products with less material, energy and waste. The result will be twofold. First, waste and pollution will be minimised, improving the health of the environment and everyone living and operating within it. Second, new opportunities will be created for business, both through making it more efficient and through promoting new technologies for this rapidly growing global market.

EU research programmes have played a vitally important part in this approach since they were launched in the 1980s. The European Union's Fifth Framework Programme for Research and Technological Development (1998-2002) focuses on those areas where European co-operation can make the most impact. Each area is covered by a 'key action', a results-oriented initiative capable of assembling a critical mass of resources from the public and private sectors across Europe. These key actions are underpinned by more generic research and activities designed to help Europe make the most of its R&D infrastructure.

The Energy, Environment and Sustainable Development (EESD) programme – one part of the Fifth Framework Programme – illustrates this perfectly, creating a single, integrated platform for stimulating a pan-European approach to the closely related areas of environmental and energy research. The Nuclear Energy programme, separate because of its distinct legal basis in the Euratom Treaty but implemented in close coordination with the EESD programme, aims to help exploit the full potential of nuclear energy in a sustainable manner.





A Focused Approach

The EESD programme concentrates on a limited number of critical issues through eight key actions.

Possibly one of the most important issues for the entire planet is reducing greenhouse gas emissions. The European Union has set the pace – while the Kyoto Protocol of December 1997 commits the entire industrialised world to cut emissions to 5.2% under 1990 levels by 2012, the EU and a few other European countries⁽¹⁾ are committed to 8%, more than the USA, Japan or any other signatory. Energy, therefore, has particular importance in the EESD programme. It is an issue with a number of facets, ranging from reducing energy consumption to ensuring a secure, diverse and low-cost supply. The programme devotes one key action to improving efficiency of energy use, while three others focus on energy generation, ranging from the traditional (e.g. oil, gas, nuclear fission) through the renewables (e.g. windmills, small hydro) to the options for the long term (nuclear fusion).

Key Actions for Key Environments

Greenhouse gases, however, are not the only global environmental problem. The destruction of habitats and key natural resources poses comparable threats to the future wellbeing of the planet and its inhabitants.

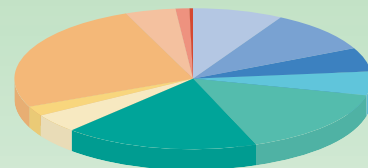
The programme deals with all of these issues. One key action, for example, will investigate global challenges. Studying the effects of climate change and biodiversity loss here in Europe, this key action will play a significant part in Europe's contribution to international research programmes.

Other key actions focus on particularly important environments and resources. With almost half the Union's population living within 50km of the sea, one key action focuses on studying and protecting the marine ecosystem. By the same token, another will tackle the urban environment – home to 80% of the population – as well as the protection of Europe's cultural heritage. Finally, one more key action will focus on that most precious of resources – fresh water, the quality, supply and sound management of which is basic to life itself.

The key actions are complemented by activities underpinning environmental management in general. Technologies ranging from earth observation by satellite to predicting and managing natural and manmade disasters will be developed, the socio-economic implications of scientific and technical solutions will be investigated, and access to Europe's R&D infrastructure improved. A common theme is the need to involve people in the equation. Wherever possible, the principal stakeholders – private-public sector partnerships, end-users from business, policy-makers and more – will be involved in both the projects themselves and in the overall orientation of the programme. Projects will be multidisciplinary and multisectoral, and range from basic research to demonstration projects. They will also emphasise the participation of small and medium sized enterprises (SMEs) to encourage the transfer of scientific results into industrial products and practices.

(1) Switzerland, Norway, Iceland, Czech Republic, Slovakia, Slovenia, Roumania, Bulgaria, Estonia, Latvia, Lithuania, Monaco and Lichtenstein.

Budget Breakdown



Energy, Environment and Sustainable Development

| | |
|--|-------|
| ■ Sustainable management and quality of water | €254m |
| ■ Global change, climate and biodiversity | €301m |
| ■ Sustainable marine ecosystems | €170m |
| ■ The city of tomorrow and cultural heritage | €170m |
| ■ Cleaner energy systems, including renewables | €497m |
| ■ Economic and efficient energy for a competitive Europe | €547m |
| ■ Generic Research | €135m |
| ■ Support for Research Infrastructures | €69m |

Nuclear Energy

| | |
|--|-------|
| ■ Controlled Thermonuclear Fusion | €788m |
| ■ Nuclear Fission | €142m |
| ■ Generic Research (EURATOM) | €39m |
| ■ Support for Research Infrastructures (EURATOM) | €10m |

Total budget €3 104m

Building on Decades of R&D

The European Union has been sponsoring environmental and energy R&D since the early 1970s.

The early 1990s saw environmental considerations come to the fore in all EU research programmes, with each programme assessing the environmental impact of each proposed research project, including reduced energy use, as a matter of course.

Energy and environment R&D per se was left

to a number of focused specific programmes. The Fourth Framework Programme (1994-1998), for example, allocated ECU 1 billion to its **Environment and Climate** specific programme. This programme involved research into the natural environment and the changes associated with it, such as global change. In addition, it focused on technologies for environmental monitoring, clean-up of damage and risk management.



History



Sustainable management and quality of water

Life cannot exist without water. A steady water supply of consistent quality is essential for everyone's wellbeing and the efficient functioning of society in general. Although significant progress has been made in reducing water pollution and waste, much remains to be done to protect this precious resource.

This key action focuses on an integrated approach to water management issues. The interactions between water catchment areas, wetlands, rivers, canals and pollution sources, such as industrial zones and cities, will be studied, as will methods for sustainably matching supply and demand.

Information and communication systems will also be developed, both to translate this understanding into efficient water management and to help cope with emergencies as diverse as industrial accidents and flooding.



Technologies to treat and prevent pollution, reduce water consumption and improve water reuse will be developed and their use promoted, particularly in Europe's arid regions.

Integrated management at catchment scale

- development of tools, methods and management schemes
- socio-economic aspects

integrated management tools, guidelines for rational use, cost-benefit analysis, policy instruments and institutional mechanisms, decision support systems

Treatment and purification technologies

- management of water in the city
- waste water treatment and re-use

improve urban water management systems, innovative treatment techniques, sustainable reuse, environmental and health impacts

Monitoring and early warning systems

- pollution surveillance and control
- improved flood and drought forecasting

improved measuring methods, monitoring strategies, generic sensing devices and early warning systems

Ecological quality

- ecosystem functioning
- ecological quality targets

quantification of key processes, ecosystem quality indicators, maintenance and restoration methods

Pollution prevention

- contaminated land, landfills and sediments
- diffuse pollution

cost-effective remediation techniques, guidelines for good agricultural practices to reduce diffuse pollution

Water-deficient regions

- water management tools and technological developments
- saline water intrusion

guidelines for rational surface and groundwater management, methods to prevent saline water intrusion, alternative supply and water conservation techniques, desalination

A second programme concentrating on the oceans and seas was run in parallel. The ECU 243 million **Marine Science and Technology (MAST)** programme aimed to cultivate a better understanding of the seas as a total system, and to develop technologies to improve the exploration, harnessing, management and protection of marine processes and ecosystems.

Energy Research

Environmental protection was also foremost in three specific programmes directed

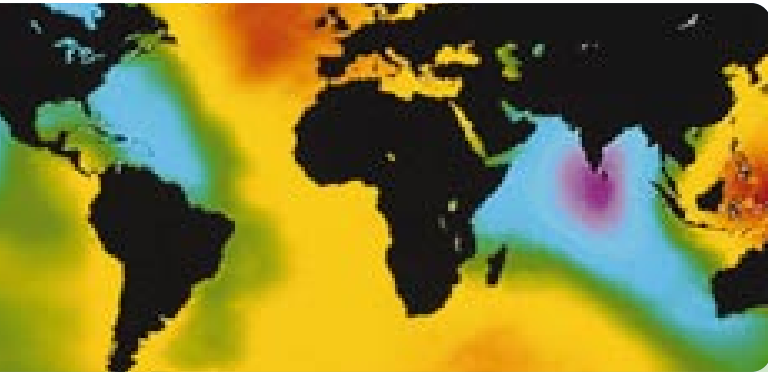
towards research into the optimal and safe use of various forms of energy. The Fourth Framework Programme's **non-nuclear energy** programme, JOULE-THERMIE, was the European Union's first integrated programme of projects on new energy technologies, encompassing both R&D and demonstration. A budget of ECU 1 billion underlined the importance of this research, which focused on alternative sources of energy, such as solar and wind power and geothermal energy. Two other specific programmes, **Nuclear Fission Safety** (ECU 441 million) and

Controlled Thermonuclear Fusion

(ECU 895 million), continued to develop Europe's internationally-recognised expertise in their fields. While the former focused on safety issues from reactor design through to waste management, the fusion research programme had two objectives: EU involvement in the construction of an experimental reactor, known as ITER (International Thermonuclear Experimental Reactor), and preparing for a demonstration reactor (DEMO) capable of generating significant quantities of electricity.



Global change, climate and biodiversity



Global change influences policies ranging from renewable energies to transport management, industrial emissions to forestry. This key action will provide a scientific, technological and socio-economic basis for strategies to address issues such as the effects of climate change, desertification and biodiversity loss.

Forewarned is forearmed – a better understanding of global change problems such as climate, ozone depletion, loss of biodiversity and the disruption of ocean circulation is essential.

It will also form the foundation for European Union policies, and fulfil the EU's obligations stemming from international commitments to sustainable development. Research will be wide-ranging in scope, from ecosystem interactions between land, water, atmosphere and oceans to assessing the impact of human activities on the environment – and the changing environment's future impact on humanity – as well as improving observation and monitoring techniques.

Detecting and predicting global change

- Natural and man-made changes to the atmosphere, ozone depletion and climatic change

atmospheric composition change, depletion of stratospheric ozone, prediction of climatic change, abrupt climate change

Strategies for responding to global change

- Global and regional scenarios and strategies to prevent, mitigate and adapt to global change

mitigation and adaptation to global change, biodiversity and economic development, combating land degradation and desertification, EU and international environmental policies

Understanding ecosystems

- Ecosystems on land, in rivers and lakes and in the sea

ecosystem vulnerability, ecosystems, carbon and nitrogen cycles, biodiversity and conservation of biodiversity

European support for global observation

- observing systems for climate, land and oceans

better use of existing data and observing systems, new long-term observation capacity

Case Study Environment & Climate

Groundwater management

A major theme running through many EC-funded projects is the management and protection of groundwater.

The over-exploitation of groundwater resources due to the increasing demand for water from agriculture, industry and for public supply has become a pan-European problem. In response to that problem, one research project has developed guidelines for the assessment, remediation and sustainable management of such resources in Europe. Meanwhile, another project has investigated the origins of palaeowaters (i.e.





Sustainable marine ecosystems

If we are to preserve and sustain the invisible world deep within our oceans, we must take immediate action to remove threats to the planet's finely balanced marine ecosystems.

As European seas are among the most heavily used in the world, it is essential for the EU to have sustainable development policies and co-ordinated national marine policies. To minimise human impact, this key action will investigate marine processes and ecosystems in a concerted effort to facilitate sustainable use of the sea.

Alongside increasing threats from tourism, shipping and offshore exploitation, natural coastal phenomena such as flooding and erosion must also be monitored and managed. Marine observations systems must be



improved and offshore operations made safer and more environmentally friendly.

Marine processes, ecosystems and interactions

- enhancement of scientific knowledge to promote sustainable management policies

extreme environments, sedimentary systems, contaminant delivery and cycling

Assessment of anthropogenic effect

- human activity on biodiversity and marine ecosystems
- exploring, characterising and monitoring marine environments

species introduction, biogeochemical cycling, recovery of degraded systems, biotechnical applications, surveying, deep-sea platforms

Coastal phenomena

- monitoring, managing and alleviating pollution, flooding and erosion

morphological changes, risk analysis, sea states propagation, river mouth/tidal stability, estuarine-coastal interaction, minimising disturbance, fate of pollutants

Offshore activities

- pilot systems for operational offshore forecasting
- sustainable marine observation system

measurement techniques for ocean parameters, mathematical models for impact assessment, best practice, international regulations

non-renewable groundwater), their present distribution, and former climatic and environmental conditions, and their potential as sources of good-quality drinking water unaffected by the industrial era. Another approach to the problem has been to develop and field-test water supplies based on desalinated brackish groundwater – instead of seawater – coupled with treated wastewater.

An increasing number of projects have addressed groundwater contamination and the rehabilitation of contaminated sites. These included the development of models to predict the risk of contamination from various sources of pollution linked to agriculture, and research into the rehabilitation of contaminated sites – with the involvement of industry. A lot of effort is also being put into

investigating various pathways of soil contaminants, the related risks, and the development of monitoring and rehabilitation techniques as well as decision-support systems, which will allow sites to be prioritised appropriately and the most appropriate techniques to be identified.



The city of tomorrow and cultural heritage

Today almost 80% of Europe's citizens live in cities. Growing cities have tended to focus on economic expansion with too little regard for social wealth and environmental equilibrium.

With the high level of Europe's urbanisation it is imperative to devote more effort to the sustainable development of cities. While urban policy is normally for the Member State and the cities themselves, EU-level initiatives can act more globally as a catalyst in helping the development of

new tools and technologies needed in the medium and longer term. The overall goal of this key action is to help European cities and the associated urban regions to achieve sustainable economic development and competitiveness, improved management and integrated planning policy, and to help safeguard and improve the quality of life and cultural identity of citizens. This key action concentrates on issues where research can make a substantial difference to urban sustainability – tools for city planning and management; protection, conservation and enhancement of cultural heritage; built environment; and urban transport.

City management

- better understanding of urban decision making to support new approaches for sustainable development

best practice for city management, waste strategies, quality of life, job creation

Cultural heritage

- protecting and enhancing European cultural heritage to benefit citizens and for sustainable tourism

damage assessment, sustainable conservation tools, exploitation and integration in the urban context

Sustainable built environment

- affordability and sustainability for all stages of construction and reconstruction processes, particularly groups of buildings
- mitigating risks of natural and man-made disasters

definition, specification and realisation of tools for revitalisation of neighbourhoods, rehabilitation of decontaminated and other brownfield sites

Sustainable urban transport

- accessibility and mobility with reduced urban pollution and congestion

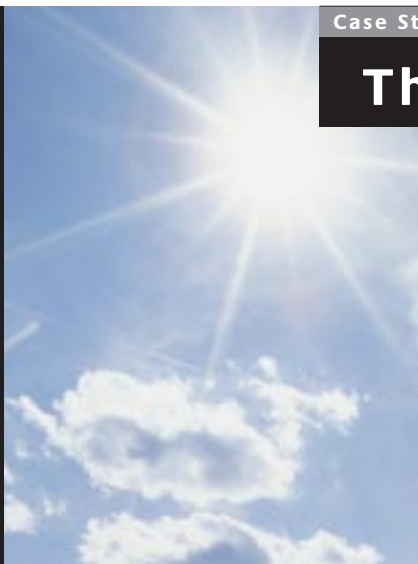
tools to integrate land use and transport planning, comparative assessment and demonstration of new transport technologies and infrastructure

Case Study Environment & Climate

The Diminishing Ozone Layer

Global environmental problems such as ozone depletion require global scientific co-operation. EU research programmes play a leading international role.

The 'Ozone Hole' – a thinning of the stratospheric layer of ozone which shields all living organisms from solar ultra-violet (UV) radiation – may well be one of the first global environmental problems to be widely understood by the general public. It has led to the Montreal protocol, effectively banning significant emissions of chlorofluorocarbons, historically widely used in aerosol propellants, air conditioning systems and insulation foams.





Cleaner energy systems, including renewables

Making energy generation cleaner and more efficient will require both the development of renewable sources and improved use of fossil fuels.



Large-scale electricity generation

- reduced emissions from coal, biomass and other fuels
- more efficient, less damaging heat and power production
- combined heat and power cogeneration

cogeneration, combustion and thermochemical conversion, gasification, efficient gas turbines and motors, diesel engines

Conversion technologies for renewables

- development, demonstration and deployment
- conversion technologies for established and new renewable energy sources (such as fuel cells)
- decentralised generation

fuel cells, biomass for integrated energy generation systems, on-shore and off-shore wind energy, photovoltaic and solar thermal technologies, other renewable energy options

Integration of new energy sources

- integration of renewables into established grids
- removal of non-technical barriers

hybrid systems, visual and noise pollution

Power production

- cost-effective reduction of pollution from power production

emission abatement technologies for power stations, hot gas cleaning, basic scientific research

The basic aim of this key action is to minimise the environmental impact of energy production and use. To this end it will investigate cleaner energy sources and reduce the adverse effects of fossil fuels.

The cost and environmental impact of energy conversion processes will also be tackled, making all systems more efficient and cleaner.

Renewable energy sources, such as biomass, wind and solar, will be a particular focus, as will promising energy conversion technologies such as fuel cells. Systems will be deployed in grid-connected and stand-alone applications, and barriers to their widespread introduction – such as their integration into the energy grid – reduced.

The phenomenon itself, however, is only partly understood. The European Commission has funded research in this field for many years, from an array of small projects to major international flagship campaigns like the Third European Stratospheric Experiment on Ozone (Theseo) 1998-2000. Theseo is a truly international study, involving over 500 participants from 20 different European countries, as well as Canada, Japan, Russia and the United States. Using high-altitude balloons and aircraft, ground stations and satellites, Theseo shed light on the chemical processes in the stratosphere that control the ozone layer. For

example, it studied local polar stratospheric clouds, which, when chlorine and bromine compounds are present, are responsible for reducing the ozone layer's thickness over the Arctic and Europe by up to 60%. Theseo reinforced concerns that, due to global climate change, Arctic ozone levels may continue to decline despite the reduction in stratospheric chlorine levels resulting from the Montreal Protocol.

As the ozone layer is thinning, the levels of particularly harmful UV-B radiation are increasing over populated regions of Europe. Other projects have therefore investigated

the climatology of atmospheric UV radiation and its possible effects on agriculture, the ecosystems and human health, particularly in relation to immune system problems and cancer.

Although our understanding of the critical atmospheric processes has increased dramatically, we still do not know enough. New numerical models, for example, have correctly calculated the *relative* variations in ozone loss observed over the Arctic, but consistently underestimate the *actual* amount of ozone lost. More research is therefore vital in order to predict how ozone levels could recover in the future.



Economic and efficient energy for a competitive Europe



Whatever the source, the more efficient production and use of energy is essential for industry, society and the environment.

This key action aims to provide Europe with a reliable, clean, efficient, safe and economic supply of energy. Technologies will be developed to substantially reduce both the overall cost of energy and the amount of energy needed by industry and society. Research will contribute to improved efficiency and reduced costs throughout the energy cycle – production,

storage, distribution and final use – with the energy requirements of the built environment, transport and industry sectors being a particular focus. Areas targeted will therefore range from the extraction of fossil fuels to the deployment of renewable energies, from intelligent energy networks to the socio-economic aspects of supply and demand.

Rational and efficient end-use

- sustainable energy systems
- supply and demand in the built-up environment

integration of lighting, space heating and cooling in buildings; vehicle performance and transport infrastructure; industrial processes

Transmission and distribution

- improved flexibility, reliability and competitiveness for energy transmission and distribution networks
- integration of new supplies into EU energy networks

intelligent networks; long-distance gas transmission; optimised network management and control systems; district heating; superconductivity

Fossil fuel production

- efficient identification of EU resources
- exploitation of cheaper, more competitive sources

characterisation and management of reserves; hostile subsea locations; geothermal energy; hydrocarbon recovery from coal beds

Improved efficiency

- maximising deployment of renewables by reducing costs
- enhancing understanding of their availability

biomass exploitation; waste management; photovoltaic cells; wind turbines

Case Study JOULE-THERMIE

Fuel from the Farm

European research into alternative renewable energy is bringing an unlikely community into the world of power generation: farmers.

The EU has funded a number of research projects into 'bio-fuel' – gas or liquid fuel derived from widely available renewable resources such as woodchip waste and cereal crops. This 'biomass' is a particularly interesting energy source from the environmental point of view, as it is both infinitely renewable and 'greenhouse neutral' - the CO₂ the crop releases as it is burnt is balanced by an equal amount removed from the air as it grew. As an added bonus, many kinds of biomass could





Macro- and Micro-scale Storage

- optimisation of intermittent storage facilities for renewable energy
- developments for downsizing of electronics

liquefied gas; hydrogen cells; zero-emission vehicles; advanced batteries

Supply and Demand Scenarios

- analysis of cost effectiveness and efficiency of all energy sources
- strategies for production, use and policy development

regional planning; social and environmental needs; modelling; impact analysis; liberalised energy markets

Key Action 7

Nuclear Fission

The nuclear industry is a significant supplier of energy in Europe. Although it doesn't produce greenhouse gases, it has its own environmental issues.



Operational safety

- maintaining and improving existing facilities
- prolonging the life-span of reactors
- severe accident management
- evolutionary concepts

safe residual life-spans, effects of ageing, improved inspection and monitoring, occupational exposure, man-machine interface

Fuel cycle safety

- cost-effective management and disposal of radioactive waste
- assessing and managing nuclear fuel cycle safety
- adoption of best safety practice and enhancement of public confidence

waste minimisation, chemical separation and transmutation, deep disposal, repository performance, quality assurance

Reactor safety and protection

- improved safety and competitiveness of future installations
- new concepts for energy generation
- managing nuclear emergencies and restoring contaminated environments

integrated risk management, 'user-friendly' reactors, occupational exposure, passive safety, information exchange

The key action will focus on ensuring the safety of Europe's nuclear power plants, the people who work inside them and the general environment and population, as well as improving the global competitiveness of the industry. Research will therefore tackle issues as diverse as prolonging the life-span of reactors and the safe disposal of radioactive waste, from radiation protection to management strategies for severe accidents. New concepts for energy generation will also be explored.

provide a major stimulus to rural economies across the continent, while the technologies can be exported around the world.

Prototype Pyrolyser

Simply burning the biomass is not, however, very efficient, which is why the Italian and German partners in one JOULE project⁽¹⁾ developed an innovative bio-mass powered reactor to generate electricity for farms and small communities.

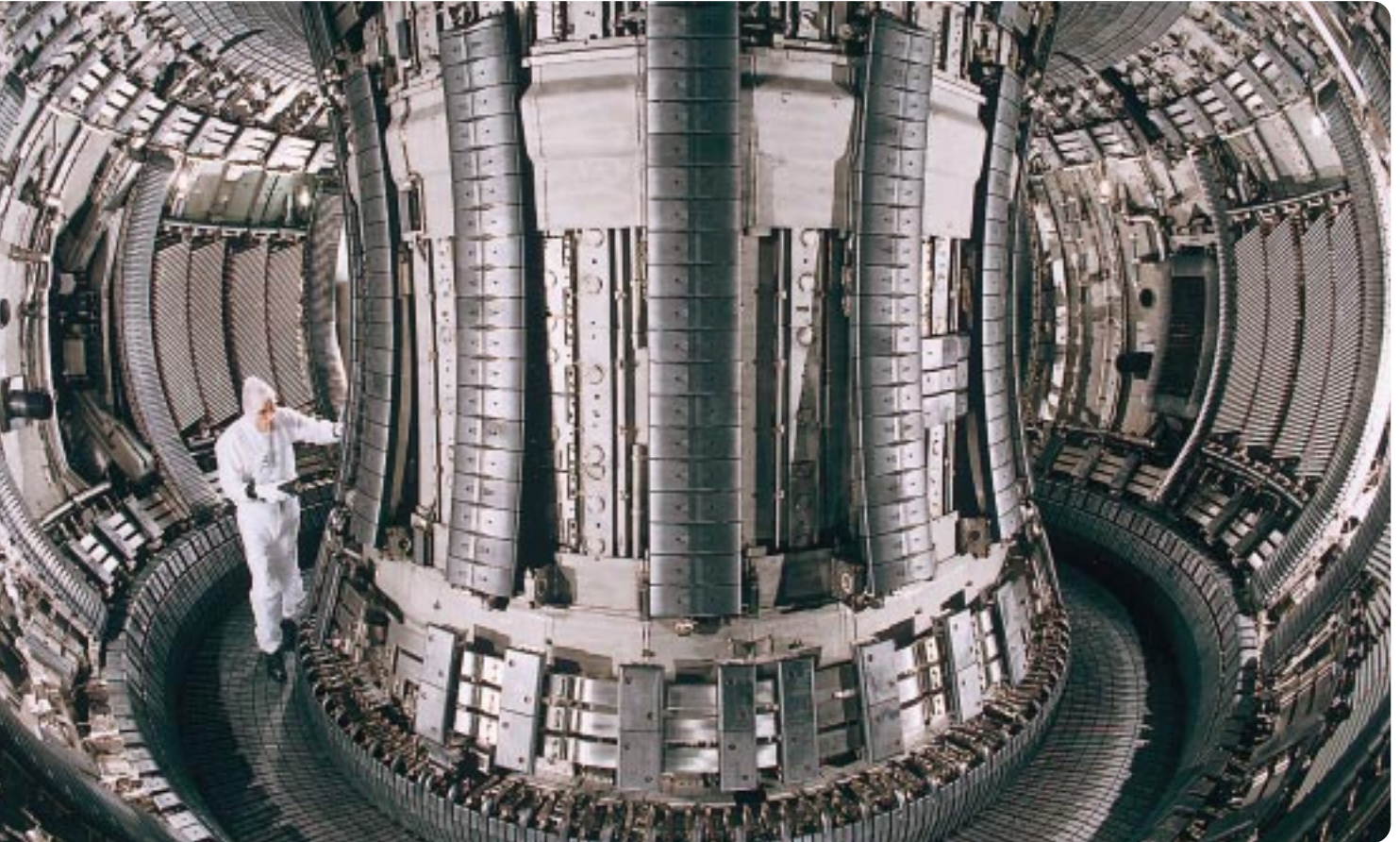
The reactor uses the pyrolysis process, in which the biomass is heated to 500°C. Instead of burning, however, it produces vapours which condense into a dark, brown liquid that can substitute for fuel oil. This bio-fuel has a much higher energy density than that produced using classical gasification methods, and can be stored for long periods and easily pumped and transported. The partners studied various crops, finding that sorghum was ideal, and confirmed that

the fuel can be burnt in gas turbines, diesel engines and Stirling engines, as well as in conventional, oil-fired boilers. They proved their point by building one of the world's first prototype systems of this kind – a pyrolyser coupled to a 100-150 kWe generator – which converted 55-65% of the biomass into fuel.

(1) Advanced small electricity farm generator optimised for herbaceous crops.



Controlled Thermonuclear Fusion



Efforts towards obtaining useful power from the nuclear fusion reaction began at the end of the 1950s. This key action represents another four years of Europe's continuing effort to fulfil the promise – a virtually inexhaustible energy supply with significant environmental and safety advantages. Research at Europe's cutting-edge JET facilities will continue, as will Europe's contribution to engineering design activities within the International Thermonuclear Experimental Reactor (ITER) project. The wider socio-economic context of fusion will also be addressed.

Europe is a world leader in progress towards harnessing fusion, the power source which drives the sun. Continued efforts are required to make the dream a reality.

Next step activities

- finalising ITER design in view to its possible construction
- operation and extended use of JET facilities

fusion physics, prototype testing, procurement specifications

Concept improvements

- building, operating and upgrading magnetic fusion devices
- co-ordinating national civil research activities on inertial confinement

basic fusion device concepts, plasma diagnostics, remotely-located experiments, theoretical studies

Long-term technology

- tritium-breeding blankets and reference structural materials
- advanced low-activation and radiation-resistant material
- safety and environmental impact assessment
- DEMO reference design

blanket technologies, mock-up testing, advanced materials, reference materials, material testing, prospective and conceptual studies, safety and environment criteria, socio-economic evaluation



The fight against major natural and technological hazards

By understanding the mechanics of major hazards, Member States can be better prepared to manage them.

Although improved forecasting techniques can now give a degree of advanced warning about impending natural disasters, our knowledge of the mechanisms and events generating natural and technological hazards must be significantly improved. The aim is to develop technologies and methods for environmental impact assessment, risk forecasting, prevention, evaluation and mitigation.

R&D priorities will focus on the following key areas:

- analysis of factors increasing the level of natural risks;
- methods, models and tools for hazard vulnerability and risk assessment;
- effective tools and methods for information management;
- innovative methods and technologies to combat disasters and alleviate their consequences;
- improvement of the operational safety of hazardous installations.

Development of earth observation satellite technologies

A sustainable European facility to observe and monitor Earth from space will greatly enhance our understanding of the planet.

The development of earth observation satellite technologies will broaden our knowledge of the planet, thus facilitating its optimum conservation and management. R&D projects will provide applications, products and services for a wide range of users, especially in Member States, linked to environmental monitoring and management of resources, land use and ecosystems. Work will also focus on integrating earth observation with other relevant technologies such as airborne remote sensing, space telecommunications, navigation and global information systems.

Activities will focus on:

- pilot applications and methodological research to improve effectiveness of activities in priority EU policy areas;
- investigations into technical, legal and economic aspects;



- requirement and feasibility studies to specify new services and missions;
- preparations for self-sustaining operational service.

In addition, efforts will be made through promotion, education and training to make better use of existing and future earth observation data and information sources.



Socio-economic aspects of environmental change



People are central to change. Understanding the socio-economic aspects of sustainable development is therefore essential.

Models will be developed and applied to aid integration of sustainability into major EU policy areas such as industry, transport and tourism, and throughout the key actions of FP5. This integration will be achieved by the identification of the driving forces behind technological and environmental change, societal behaviour and global markets.

The priorities are:

- identifying and evaluating the relationship between socio-economic development and environmental change;
- assessing policies, institutions, demography, production and consumption, technological development, distribution, security, culture and ethics;
- methods and tools for integrating and promoting economic, social and environmental objectives;
- developing measures of sustainable development;
- design and assessing different routes to eco-efficiency;
- sustainable consumption;
- environmental governance principles.



Socio-economic aspects of energy

Energy has a key role within the perspective of sustainable development with impact on society, the economy and employment.

Tools will be developed to assess and monitor the socio-economic aspects of energy technologies and systems. A dual approach will be developed

of 'technology assessments' made at the project level and 'global systems analysis' at a more general level. Technology assessments will range in scope from social behaviour and acceptance through to comparative assessments, while systems analysis will centre on understanding the relationship between energy, environment, technologies and economic growth.

Radiation safety

Europe's knowledge and abilities in radiological sciences must be consolidated and advanced for safe and competitive production of nuclear energy.

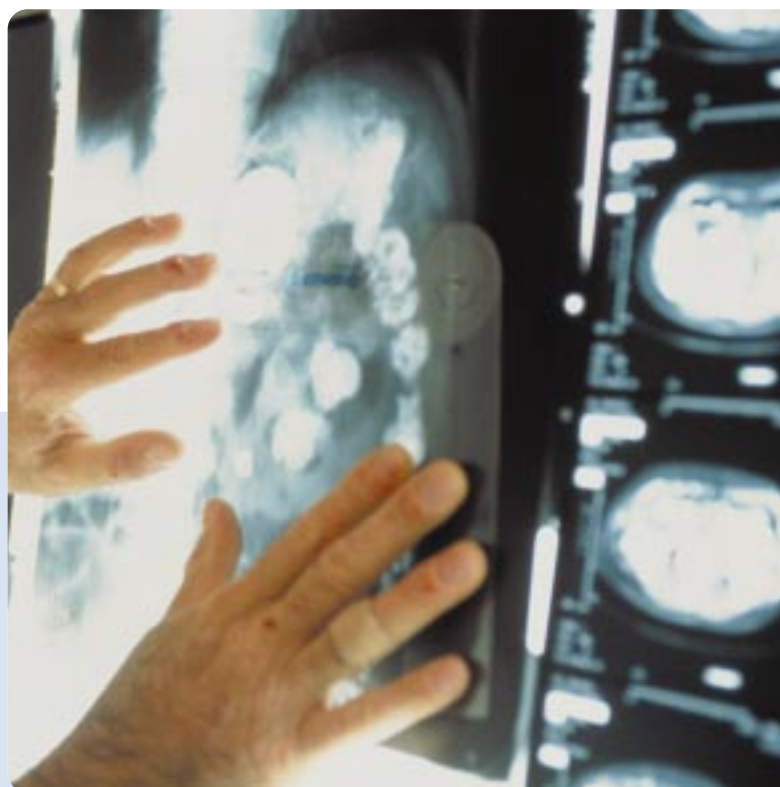
Radiation protection and health: Every effort will be made to maintain and improve the safety and efficacy of industrial and medical uses of radiation and to understand better how to estimate the risks of low and protracted doses of ionising radiation. Research topics include:

- biophysical and molecular-biological aspects of cancer induction;
- repair and health effects of DNA damage;
- epidemiology;
- treatment of radiation injury.

Environmental transfer of radioactive material:

The effects of exposure to sources of radiation must be better understood, assessed and managed to develop sound policy and good practice in managing the impact of natural and artificial sources. Priorities are:

- fluxes of radionuclides in ecosystems;
- vulnerability indicators;
- conceptual and methodological bases for restoring contaminated environments.



Internal and external dosimetry: Monitoring techniques will be developed to capitalise on advances in materials science and digital electronics. Research will concentrate on:

- dosimetry of complex radiation fields and incorporated radionuclides;
- retrospective dosimetry;
- innovative monitoring techniques.



Optimising Europe's Research Potential



Member States must share their expertise and facilities to maximise the benefits of European research and development.

Advanced facilities are a crucial resource in all research and development programmes. The programme will help ensure that Europe gets the best value out of its environmental and energy facilities. Apart from updating and improving existing facilities, some aspects of their operation will be co-ordinated to make them more accessible. In addition, both the upgrading of existing facilities and the development of new ones will be co-ordinated, ensuring that these are not duplicated unnecessarily within Europe and that Europe's facilities are made more compatible with each other. Research and training projects centred on a facility will also help to network research communities.

Earth Observation Infrastructure

In addition, Europe's research infrastructure will be reinforced in a number of key areas in the field of Earth Observation:

- **Climate and global change:** climate prediction and integrated assessment centres, super-computer facilities, climate and global change databases, simulation chambers, ground observation stations, aircraft-based observation systems, support for paleo-environmental data collection and taxonomy.
- **Marine research:** sample collection systems, marine databases, test basins, platforms and ocean forecasting centres, manned, robotic and automatic observation systems.
- **Natural hazards:** facilities and operational data networks on earthquakes, floods, tidal waves, volcanoes and forest fires.

Networking Nuclear Research

With many national nuclear research and energy generation programmes being downsized, Europe's nuclear industry must make more effective use of its resources.

Priorities include:

- **Large-scale facilities:** Services for investigating core degradation, containment and materials testing, underground laboratories for deep geological disposal of waste, and dosimetric and radio-biological experiments.
- **Networking, databases and tissue banks:** Existing facilities and databases will be reinforced and new ones created focusing on nuclear safety, waste management and disposal, decommissioning, emergency preparedness and response, radiation protection and more. A data bank of tissue and other biological samples from people affected by nuclear accidents will also be established.



What else is the EU doing?

This research programme is just one part of an integrated approach to tackling environmental concerns throughout the European Union.

The Commission's overall environmental policy is set out in the Fifth Environmental Action Programme. A cornerstone of this programme is achieving **sustainability** – meeting our generation's needs without compromising the ability of future generations to meet theirs.

As its title 'Towards Sustainability' implies, the programme sets long term objectives and focuses on a global approach. It is underpinned by two major principles:

- the environmental dimension must be integrated into all major policy areas. It specifically targets five sectors: industry, energy, transport, agriculture and tourism.
- the command-and-control approach must be replaced with a sharing of responsibility between the various parties involved – governments, industry and the public.

This approach was reinforced by the 1997 Treaty of Amsterdam, which represented a breakthrough in addressing environmental issues at the European level. The Treaty enshrined sustainable development as one of the EU's tasks and strengthened the principle that environmental protection must be integrated into all European policies and activities.

Realising these goals requires a wide range of instruments, of which research and development is just one.

One Environment, One Market

European legislation has been setting environmental standards across the continent since the early 1970s. This is achieved by creating a Single Market in environmentally friendly products and processes and thus stimulating their emergence. Over 200 pieces of legislation have been formulated in various sectors, such as air and water quality, noise, waste disposal, chemicals security and the protection of nature. This legislation ranges from limits on specific pollutants, imposed during the 1970s and 1980s, to the broader strategies of the 1990s, which focus more on regulating the consumption of natural resources.

Alongside the regulatory mandate, EU environmental policy is developing a wide range of activities and initiatives. These include improving environmental data – which led to the creation of the European Environmental Agency in 1994 – financial support mechanisms, information and education programmes, promoting ecolabels, and economic measures aimed at incorporating the 'true cost' of environmental protection into the prices of goods and services.

Cleaner, Greener Energy

Sustainable development is also one of the main priorities of EU energy policy, together with reducing Europe's dependence on external supplies and integrating the Community's individual national energy markets.

One of the most challenging issues in sustainable energy is the European commitment to reducing greenhouse gas emissions, as agreed at the Kyoto conference in 1997. This puts energy efficiency policy firmly at the top of the list of priorities. In addition, the EU runs a number of programmes devoted to promoting renewable energy strategies, as well as ensuring the safety and security of nuclear materials in Europe.



What is the Fifth Framework Programme?

The Environment, Energy and Sustainable Development programme is one of seven interrelated research programmes run by the European Commission over the period 1998-2002. Together, these programmes form the Fifth Framework Programme for Research and Technological Development.

The future competitiveness of Europe's companies, the health and well-being of its population and the security of its environment depend on many factors. Underlying them all, however, is the requirement for world-class research and development to provide the knowledge and technologies that European industry and society need. With a budget of just under 15 billion euros, the Fifth Framework Programme will help generate that knowledge by focusing Europe's considerable research resources on problems which are better tackled at a European level. Projects must include partners from at least two EU Member States, or from one Member State and one of the 16 Associated States⁽¹⁾. Organisations from some 30 other countries also have the right to participate at their own expense, with many able to apply for financial support from other EC programmes dedicated to their region.

Four Thematic Programmes

The Fifth Framework Programme is composed of seven programmes, of which four - the "thematic" programmes - fund R&D to solve problems in four strategically vital areas:

- **Quality of life and management of living resources:** improving our health, developing "bio-industries" and making the use of Europe's natural resources more sustainable.
- **User-friendly information society:** developing information and communication technologies for European industry and society.
- **Competitive and sustainable growth:** tackling the key challenges facing European industry - sustainable transport, efficient and quality-based production, materials for the 21st century, measurement for quality control and more.
- **Energy, environment and sustainable development:** making Europe's energy system, industry and society "eco-efficient", helping solve global environmental challenges, and reconciling economic development with environmental sustainability.

These programmes focus most of their resources on a limited number of **key actions**, each concentrating on a specific set of social and economic problems and bringing together academia, industry, users, and political and economic decision-makers. In addition, the programmes also fund more generic, longer-term research and support the optimal use and development of Europe's scientific infrastructure.

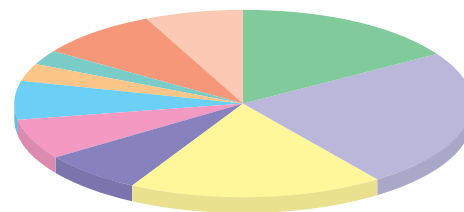
Three Horizontal Programmes

The thematic programmes are complemented by three "horizontal" programmes, which address issues common to all areas of science and technology.

- **Confirming the international role of Community research:** promoting cooperative R&D between EU companies and research institutes and Europe's partners throughout the world.
- **Promotion of innovation and encouragement of participation of SMEs:** strengthening Europe's "innovation infrastructure" and helping companies, particularly SMEs, get involved in and benefit from research.
- **Improving human research potential and the socio-economic knowledge base:** ensuring Europe makes the most of its human and scientific resources through research training, exchanges of scientists and research best practices, and linking research to society's needs.

The Fifth Framework Programme also partly funds the **Joint Research Centre (JRC)**, which provides the EC with independent scientific and technical support for conceiving, implementing and monitoring EU policies.

Budget Breakdown



Thematic programmes

| | |
|--|---------|
| Quality of Life and Management of Living Resources | €2 413m |
| User-friendly Information Society | €3 600m |
| Competitive and Sustainable Growth | €2 705m |

Energy, Environment and Sustainable Development

| | |
|--|---------|
| 1. Environment and Sustainable Development | €1 083m |
| 2. Energy | €1 042m |
| 3. Nuclear Energy | €979m |

Horizontal programmes

| | |
|---|---------|
| Confirming the International Role of Community Research | €475m |
| Promotion of Innovation, Encouragement of SMEs | €363m |
| Improving Human Research Potential | €1 280m |

Joint Research Centre

| | |
|-----------------------|---------|
| Joint Research Centre | €1 020m |
|-----------------------|---------|

TOTAL €14 960m

(1) As Associated States contribute to the Fifth Framework budget, their organisations may receive Community support for their project participation, on the same basis as EU Member States. They comprise 11 countries preparing to join the EU (Bulgaria, Republic of Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia), the EEA countries (Iceland, Norway and Liechtenstein) and Israel. Switzerland will associate during the Fifth Framework Programme - until then the Swiss authorities supply equivalent funding.



Further Information

Further information on the Environment, Energy and Sustainable Development programme can be obtained from:

Environment, Energy and Sustainable Development Help Desk:
Fax: +32 2 296 3024
eesd@cec.eu.int
<http://www.cordis.lu/eesd>

Information Online

The above home page is hosted by CORDIS, the Community R&D Information Service. The CORDIS home page (<http://www.cordis.lu>) is a practical, integrated source of information on European research and innovation, providing:

- **home pages** for all research programmes;
- the information needed to prepare and submit **proposals** for research projects;
- information on **opportunities for SMEs** and services dedicated to promoting innovation;
- **databases** on R&D news, partners, projects, research results, programmes, publications, events and much more;
- **"partner search"** services to help organisations locate partners for project proposals;
- an **update service (RAPIDUS)** which e-mails you information matching your own criteria, from calls for proposals in a particular area to profiles of organisations looking for research partners; and much more.

General information on the Fifth Framework Programme is also available on the home page of Research DG (<http://europa.eu.int/comm/research>).

Networking across Europe

CORDIS also provides further information on the Europe-wide networks dedicated to bringing European research and innovation to your region:

- **the National Contact Points network** provides local, personal access to information about the specific programmes, and support for organisations which wish to participate:

<http://www.cordis.lu/fp5/src/ncps.htm>

- a separate network exists to support SMEs:

<http://www.cordis.lu/sme/src/sme-ncps.htm>

- **the network of Innovation Relay Centres (IRCs)** promotes innovation, encourages the exchange of research results across Europe, and provides advice, consulting and training support - mainly to SMEs.

European Commission, Enterprise DG

Tel. +352 4301 38070

Fax. +352 4301 34009

innovation@cec.eu.int

<http://www.cordis.lu/irc/home.html>

Publications

A range of magazines is available from the Research DG Communications Unit and the Innovation Help Desk (see below - the ★ or ☆ tells you which) to keep researchers and industry regularly informed on European research and innovation.

★ **RTD Info:** a regular update on programme activities, calls and events, as well as information on research results - quarterly, in English, French and German.

☆ **Innovation & Technology Transfer:** everything the EU does in research, with an emphasis on innovation and technology transfer - bimonthly, in English, French, German, Italian and Spanish.

☆ **Euroabstracts:** provides a round-up of new publications on research and innovation from around Europe - bimonthly, in English only.

☆ **CORDIS Focus:** the latest news on EU research and research-related programmes and policies from the CORDIS News service - fortnightly, in English, French, German, Italian and Spanish.

The Research DG's Communications Unit can also provide the following general brochures:

★ **The Fifth Framework Programme:** a thorough, 75-page introduction to the programmes and their key actions, as well as opportunities for involvement.

★ **Programme Brochures:** this brochure is one of seven. The other brochures cover:

- Quality of life and management of living resources
- User-friendly information society
- Competitive and sustainable growth
- Confirming the international role of community research
- Promotion of Innovation and Encouragement of SME Participation
- Improving human research potential and the socio-economic knowledge base

★ **Research DG Communication Unit**

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E-mail: research@cec.eu.int

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Internet: <http://www.cordis.lu/innovation-smes/src/help-inn.htm>

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