

# **PRIORITY THEMATIC AREAS<sup>1</sup> OF RESEARCH IN FP6**

## **Table of Contents**

### **1. Integrating and Strengthening the European Research Area**

- 1.1.1 Genomics and biotechnology for health
- 1.1.2 Information Society technologies
- 1.1.3 Nanotechnologies and nanosciences, knowledge-based multi-functional materials and new production processes and devices
- 1.1.4 Aeronautics and space
- 1.1.5 Food Quality and Safety
- 1.1.6 Sustainable development, global change and ecosystems
- 1.1.7 Citizens and Governance in a Knowledge-based society

### **2. Nuclear Energy**

- 2.2 Management of radioactive waste
- 2.3 Radiation protection

---

<sup>1</sup> This note is based on the text of the Amended proposal for a Council Decision concerning the specific programmes implementing the Sixth Framework Programme of the European Community for research, technological development and demonstration activities. (COM(2002) 43 final) to be found at:  
[http://ftp.cordis.lu/pub/rttd2002/docs/fp6sp\\_amended\\_0102.pdf](http://ftp.cordis.lu/pub/rttd2002/docs/fp6sp_amended_0102.pdf)

# 1. Integrating and Strengthening the European Research Area

When preparing EoI attention should be given to the characteristics of FP6 set out in the Framework Programme and Specific Programmes documents (see footnotes to Section 2 of *Annex I*). Particular attention is drawn to aspects underpinning the structuring effects of the European Research Area which apply across the Framework Programme:

- Participation of small and medium sized enterprises (SMEs) will be encouraged. (Note that at least 15% of the Financial Amount available for the Thematic Priorities is intended for SMEs)
- The principle of sustainable development, will be duly taken into account. Furthermore, consideration of the ethical requirements, and social, legal and wider cultural aspects of the research and its potential applications, as well as socio-economic impacts of scientific and technological development and foresight, will where relevant form a part of the activities. Better links between science and society will be encouraged in line with the Commission's Science and Society Action Plan, including promoting scientific education and culture, bringing science policy closer to citizens, promoting gender equality, and putting responsible science at the heart of policy making.
- International co-operation represents an important dimension of the Framework Programme with participation of researchers, teams and institutions from third countries in projects within the different thematic priority fields, related to issues arising at world level and being subjects of international efforts

## 1.1.1 Genomics and biotechnology for health

The sequencing of the human genome and many other genomes heralds a new age in human biology, offering unprecedented opportunities to improve human health and to stimulate industrial and economic activity. In making its contribution to realising these benefits, this theme will focus on integrating post-genomic research into the more established biomedical and biotechnological approaches, and will facilitate the integration of research capacities (both public and private) across Europe to increase coherence and achieve critical mass. Integrated multidisciplinary research, which enables a strong interaction between technology and biology, is vital in this theme for translating genome data into practical applications. In addition, an essential element will be to involve key stakeholders, for example, as appropriate industry, healthcare providers and physicians, policy makers, regulatory authorities, patient associations, and experts on ethical matters, etc in implementing the theme. Gender equity in the research will also be ensured<sup>2</sup>.

This thematic priority area will stimulate and sustain multidisciplinary basic research to exploit the full potential of genome information to underpin applications to human health. The emphasis will be put on research aimed at bringing basic knowledge through to application, to enable real and consistent progress in medicine and improve the quality of life. This research may also have implications for research on areas such as agriculture and environment, which are addressed under other thematic priorities.

It will be an integral component of the European Community effort to enhance the European biotechnology industry in line with the conclusions of the Stockholm Council. It will endeavour to create strong links with all activities that improve the framework conditions for innovation in the health sector of the biotechnology industry, especially in SMEs, including stimulating entrepreneurship and opportunities for investment through venture capital and the involvement of the European Investment Bank. Attention will also

---

<sup>2</sup> *Causes, clinical manifestation, consequences and treatment of disease and disorders often differ between women and men. Therefore, all activities funded within this thematic priority must take the possibility of gender differences into account in their research protocols, methodologies and analysis of results.*

be paid to the identification of regulatory bottlenecks in the development of new applications for genomics, to the anticipation at the earliest possible stage of the ethical implications and to the broader implications of developments in genomics research for society and citizens.

This thematic priority area will also foster the implementation and development of the health strategy of the European Community.

Throughout the thematic priority, international collaboration will be encouraged. Where appropriate, due account will be given to the European Community's commitment to poverty reduction in developing countries and the importance that improved health will bring to the process – in line with Article 177 of the Treaty and with the European Community's accelerated actions to combat HIV/AIDS, malaria and tuberculosis.

*Research priorities*

### ***1.1.1.i Advanced genomics and its applications for health***

#### ***1.1.1.i.a Fundamental knowledge and basic tools for functional genomics in all organisms***

The strategic objective of this line is to foster the basic understanding of genomic information, by developing the knowledge base, tools and resources needed to decipher the function of genes and gene products relevant to human health and to explore their interactions with each other and with their environment. Research actions will encompass the following:

- ***Gene expression and proteomics:*** The objectives are to enable researchers to better decipher the functions of genes and gene products as well as to define the complex regulatory networks (biocomplexity) that control fundamental biological processes.

*Research will focus on: developing high throughput tools and approaches for monitoring gene expression and protein profiles and for determining protein function and protein interactions.*

- ***Structural genomics:*** The objectives are to enable researchers to determine, more effectively and at a higher rate than is currently feasible, the 3-D structure of proteins and other macromolecules, which is important for elucidating protein function and essential for drug design.

*Research will focus on: developing high throughput approaches for determining high-resolution 3-D structures of macromolecules.*

- ***Comparative genomics and population genetics:*** The objectives are to enable researchers to use well-characterised model organisms for predicting and testing gene function and to take full advantage of specific population cohorts available in Europe to determine the relationship between gene function and health or disease.

*Research will focus on: developing model organisms and transgenic tools; developing genetic epidemiology tools and standardised genotyping protocols.*

- ***Bioinformatics:*** The objectives are to enable researchers to access efficient tools for managing and interpreting the ever-increasing quantities of genome data and for making it available to the research community in an accessible and usable form.

*Research will focus on: developing bioinformatic tools and resources for data storage, mining and processing; developing computational biology approaches for in silico prediction of gene function and for the simulation of complex regulatory networks.*

- ***Multidisciplinary functional genomics approaches to basic biological processes:*** The objectives are to enable researchers to study fundamental biological processes by integrating the above innovative approaches.

*Research will focus on: elucidation of the mechanisms underlying fundamental cellular processes, to identify the genes involved and to decipher their biological functions in living organisms.*

#### ***1.1.1.i.b Applications of knowledge and technologies in the field of genomics and biotechnology for health***

The strategic objective of this line is to foster the competitiveness of Europe's biotechnology industry by exploiting the wealth of biological data produced by genomics and advances in biotechnology. Research actions will encompass the following:

- ***Technological platforms for developments in the fields of new diagnostic, prevention and therapeutic tools:*** The objectives are to foster academic and industrial collaboration through technological platforms where multidisciplinary approaches using cutting edge technologies arising from genomic research may contribute to health care progress and cost reduction through more precise diagnosis, individualised treatment and more efficient development pathways for new drugs and therapies, and other novel products of the new technologies.

*Research will focus on: rational and accelerated development of new, safer, more effective drugs including pharmacogenomics approaches; development of new diagnostics; development of new in vitro tests to replace animal experimentation; development and testing of new preventive and therapeutic tools, such as somatic gene and cell therapies (in particular stem cell therapies) and immunotherapies; innovative research in post-genomics, which has high potential for application.*

With a view to ensuring socially responsible choices, public acceptance and an efficient development pathway for these new technologies, an active and early involvement in the above activities of regulators, experts on ethics, patients and society at large will be necessary.

#### ***1.1.1.ii Combating major diseases***

##### ***1.1.1.ii.a Application-oriented genomic approaches to medical knowledge and technologies***

The strategic objective of this line is to develop improved strategies for the prevention and management of human disease and for living and ageing healthily. It will concentrate exclusively on integrating genomic approach through all relevant organisms into more established medical approaches for investigating disease and health determinants. The emphasis will be put on translational research aimed at bringing basic knowledge through to clinical application. Research actions will focus on the following:

- ***Combating, cardiovascular disease, diabetes, and rare diseases:*** The objectives are to improve the prevention and management of important causes of mortality and ill health in Europe and to pool Europe's research resources for tackling rare diseases.

*Research will focus on: integrating clinical expertise and resources with relevant model systems and advanced tools in functional genomics to generate breakthroughs in the prevention and management of these diseases.*

- **Combating resistance to antibiotics and other drugs:** The objectives are to confront the major threat to public health caused by drug resistant pathogens.

*Research will focus on: exploitation of the knowledge of microbial genomes and on host-pathogen interactions for the development of vaccines and alternative therapeutic strategies to circumvent the problem of antimicrobial and other drug resistance; development of strategies for optimal usage of antimicrobials; support to the European Community network for epidemiological surveillance and control of communicable diseases.*

- **Studying the brain and combating diseases of the nervous system:** The objectives are to use genome information to understand better the functioning and dysfunctioning of the brain, in order to gain new insight into mental processes, to combat neurological disorders and diseases, and to improve brain repair.

*Research will focus on: understanding the molecular and cellular bases of brain function, damage, plasticity and repair, learning, memory and cognition; developing strategies for prevention and management of neurological and mental disorders and diseases.*

- **Studying human development and the ageing process:** The objective is to better understand human development, with special emphasis on the ageing process, in order to develop the evidence base for improving public health strategies to promote healthy living and healthy ageing.

*Research will focus on: understanding human development from conception to adolescence; exploring the molecular and cellular determinants of healthy ageing including their interactions with environmental, behavioural and gender factors.*

#### **1.1.1.ii.b Combating cancer**

The objective is to develop improved patient-oriented strategies, from prevention to diagnosis and treatment, for combating cancer. The research will therefore concentrate on translating the new knowledge being created by genomics and other fields of basic research into applications that improve clinical practice and public health.

The patient-oriented approach will include three interlinked components. Research will focus on:

- *Establishing facilities for the exploitation of research on cancer in Europe; encouraging the development of evidence-based guidelines for good clinical practice and improved public health strategies by accelerating the translation of existing research results into applications.*
- *Supporting clinical research, particularly clinical trials, aimed at validating new and improved interventions.*
- *Supporting translational research aimed at bringing basic knowledge through to applications in clinical practice and public health.*

#### **1.1.1.ii.c Confronting the major communicable diseases linked to poverty**

The strategic objective of this line is to confront the global emergency caused by the three major communicable diseases - HIV/AIDS, malaria and tuberculosis – through the development of effective disease interventions, particularly for use in developing countries. It is envisaged that developing countries will be significant partners in the implementation of this line and, as appropriate, participate directly in specific activities within it, in particular through the clinical trials programme

*Research will focus on: developing promising candidate interventions (vaccines, therapies and HIV microbicides) against the target diseases by sponsoring research over the full spectrum from basic molecular research, taking advantage of microbial genomics, through to pre-clinical testing and proof-of-principle; establishing a clinical trials programme to unite and support Europe's clinical trial activities specifically targeted at interventions for use in developing countries; establishing an AIDS Therapy Trials Network in Europe to improve the coherence and complementarity of clinical trials of AIDS therapies for European use.*

The research activities carried out within this thematic priority area will include exploratory research at the leading edge of knowledge on subjects closely related to one or more topics within it. Two complementary approaches will be utilised: one receptive and open – the other proactive.

### **1.1.2 Information Society technologies**

Information society technologies (IST) are transforming the economy and society. Not only are they creating new ways of working and new types of business, but provide solutions to major societal challenges such as healthcare, environment, safety, mobility and employment, and have far reaching implications on our everyday life. The IST sector is now one of the most important of the economy, with an annual turnover of EUR 2000 billion, providing employment for more than 12 million people in Europe.

*The IST thematic priority will contribute directly to realising European policies for the knowledge society as agreed at the Lisbon Council of 2000, the Stockholm Council of 2001, and reflected in the e-Europe Action Plan. It will ensure European leadership in the generic and applied technologies at the heart of the knowledge economy. It aims to increase innovation and competitiveness in European businesses and industry and to contribute to greater benefits for all European citizens.*

*Successes, like those achieved in Europe in mobile communications or consumer electronics, will not be repeated unless a real effort is made to achieve critical mass in key domains of IST research. The actions will therefore mobilise the community of researchers around medium to long term objectives, facilitating the integration of public and private effort on a European scale, to build essential competencies and strengthen innovation. They will involve high-risk and long term RTD such as the development of the next generation of mobile and wireless systems beyond 3G.*

Although substantial advances have been achieved, we are still far from taking full advantage of the potential of knowledge-based services in real life. Products and services are still hard to use and out of reach for many people, and the “digital divide” is widening within Europe and across the world. *Research will focus on the future generation of technologies in which computers and networks will be integrated into the everyday environment, rendering accessible a multitude of services and applications through easy-to-use human interfaces. This vision of "ambient intelligence" places the user, the individual, at the centre of future developments for an inclusive knowledge-based society for all.*

The IST priority in support of the eEurope action plan, will help build an information and knowledge based society across Europe, encouraging the participation of least developed

regions. It will also include activities linking the EU effort to the international context. The aim is to achieve thematic area global consensus when appropriate e.g. through the Intelligent Manufacturing Systems (IMS) initiative or the dialogue on dependability issues, to integrate further the research of the Newly Associated States within the EU effort and to facilitate co-operation with developing countries.

In addition to the above, the priority thematic area will support research to investigate and experiment with future visions and emerging technologies at the frontier of knowledge in the IST field.

Within the context of the priorities identified below, the priority thematic area will also include activities relating to the further development of Géant and GRIDs.

#### *Research priorities*

##### **1.1.2.i Applied IST research addressing major societal and economic challenges**

The objective is to extend the scope and efficiency of IST-based solutions addressing major societal and economic challenges, and to make them accessible in the most trusted and natural way, anywhere and anytime to citizens, businesses and organisations.

- **Technologies for trust and security:** The objective is to develop technologies for key security challenges posed by the “all-digital” world and by the need to secure the rights of individuals and communities.

*Research will focus on basic security mechanisms and their interoperability, dynamic security processes, advanced cryptography, privacy enhancing technologies, technologies to handle digital assets and technologies for dependability to support business and organisational functions in dynamic and mobile systems.*

- **Research addressing societal challenges:** The focus is on “ambient intelligence” for a broader inclusion of citizens in the Information Society, for more effective health, security, mobility and environment management and support systems, and for the preservation of cultural heritage, integration of multiple functionalities across these different domains will be also supported.

*Research activities on “e-inclusion” will concentrate on systems enabling access for all, on barrier-free technologies for full participation in the information society and on assistive systems that will restore functions or compensate for disabilities thereby enabling a higher quality of life for citizens with special needs and their carers. In the area of **health**, the work will focus on intelligent systems aimed at supporting health professionals, at providing patients with personalised healthcare and information, and at stimulating health promotion and disease prevention in the general population. Research will also address intelligent systems to enhance **the protection of people and property** and for securing and safeguarding civil infrastructures.*

*In the area of **mobility**, research will focus on vehicle infrastructure and portable systems to provide integrated safety, comfort and efficiency and allow for the provision of advanced logistics infomobility and location based services. Research in the area of **environment** will focus on knowledge-based systems for natural resource management and for risk prevention and crisis management including humanitarian mine clearance. In the area of **leisure**, research will focus on intelligent and mobile systems and application for entertainment and tourism. For **cultural heritage**, the effort will focus on intelligent systems for*

*dynamic access to and preservation of tangible and intangible cultural and scientific resources.*

- **Research addressing work and business challenges:** The objective is to provide businesses, individuals, public administrations, and other organisations with the means to fully contribute to, and benefit from, the development of a trusted knowledge-based economy, whilst at the same time improving the quality of work and working life and support life-long continuous learning to improve work skills. Research will also aim at a better understanding of the socio-economic drivers and impact of IST development.

*Research in **e-business and e-government** will focus on providing European organisations, private and public, and especially SMEs, with interoperable systems and services to enhance innovation capacities, value creation and competitive performance in the knowledge economy and on supporting new business ecosystems. Research in organisational knowledge management will aim at supporting organisational innovation and responsiveness through elicitation, sharing, trading, and delivery of knowledge. Work on **electronic and mobile commerce** will target interoperable, multimodal applications and services across heterogeneous networks. It will include anytime-anywhere trading, collaboration, workflow, and electronic services covering the whole value creation cycle of extended products and services.*

*Research into **eWork systems** will focus on new workplace designs incorporating innovative technologies to facilitate creativity and collaboration, on increasing resource-use efficiency and on extending work opportunities to all in local communities. Work on **eLearning** will focus on personalised access to, and delivery of, learning as well as on advanced learning environments at school, university, in the **workplace** and in lifelong learning in general, taking advantage of the development of ambient intelligence.*

- **Complex problem solving in science, engineering, businesses and for society:** The objective is to develop technologies for harnessing computing and storage resources which are distributed in geographically dispersed locations, and for making them accessible, in a seamless way, for complex problem solving in science, industry, business and society. Application fields include environment, energy, health, transport, industrial engineering, finance and new media.

*Research will focus on new computational models, including computing and information GRIDs, peer-to-peer technologies and the associated middleware to make use of large scale highly distributed computing and storage resources and to develop scalable, dependable and secure platforms. It will include novel collaborative tools and programming methods supporting interoperability of applications and new generations of simulation, visualisation and datamining tools.*

#### **1.1.2.ii Communication, computing and software technologies**

The objectives are to consolidate and further develop European strengths in areas such as mobile communications, consumer electronics and embedded software and systems, and to improve the performance, cost-efficiency, functionality and adaptive capabilities of communications and computing technologies. Work will also lead to the next generation Internet.

- **Communication and network technologies:** The objective is to develop the new generations of mobile and wireless systems and networks that allow optimal service connection anywhere as well as all-optical networks to increase network transparency and capacity, solutions to improve network interoperation and adaptability, and technologies for personalised access to networked audio-visual systems.

*Work on terrestrial and satellite<sup>3</sup> based, **mobile and wireless systems and networks beyond 3G** will focus on the next generation of technologies, ensuring co-operation and seamless inter-working at service and control planes of multiple wireless technologies over a common IP (Internet Protocol) platform as well as novel **spectral efficient protocols**, tools and technologies, to build wireless re-configurable IP enabled devices, systems and networks.*

*Research in **all optical networks** will focus on the management of optical wavelength channels enabling flexibility and speed in service deployment and provisioning and solutions for fibre to the LAN. Research on **interoperable network solutions**, including end-to-end network management will support generic services provision and interworking, and interoperation between heterogeneous networks and platforms. It will include programmable networks to provide adaptive and real-time allocation of network resources and enhanced service management capabilities by customers.*

*Research will also address the enabling technologies for personalised access to **networked audio-visual systems** and applications as well as cross-media service platforms and networks, trusted digital TV architectures and appliances able to process, encode, store, sense and display hybrid 3D multimedia signals and objects.*

- **Software technologies, embedded systems and distributed systems** The objective is to develop new software technologies, multifunctional service creation environments as well as tools for the control of complex distributed systems for the realisation of an ambient intelligence landscape and for coping with the expected growth and spread of applications and services.

*Research will focus on **new technologies for software and systems** that address composability, scalability, reliability and robustness as well as autonomous self-adaptation. It will include middleware for the management, control and use of fully distributed resources. Work on **multifunctional service creation environments** and new component frameworks will aim at the development of service functionality, including meta-information, semantics and taxonomy of the building blocks.*

*New strategies, algorithms, and tools for systematic and accurate design, prototyping and **control of complex distributed systems** will be addressed. Work will include networked embedded systems, distributed sensing, computing, storage resources and related intercommunication. Dynamic resources allocation will be a key feature as well as cognitive techniques for generic object and events recognition.*

### **1.1.2.iii Components and microsystems**

---

<sup>3</sup> The activity on satellite communications is done in coordination with the activities in priority 1.4 “aeronautics and space”.

- **Micro, Nano and Opto-electronics** The objective is to reduce the cost, increase the performance and improve reconfigurability, scalability, adaptability and self-adjusting capabilities of micro-, nano- and opto-electronic components and systems-on-a-chip.

*Research will focus on **pushing the limits of CMOS** process and equipment technologies and enhancing device functionality, performance and integration of functions. It will address alternative process technologies, device types, materials and architectures to meet demands of communication and computing. Particular emphasis will be put on RF, mixed-signal and low power design. Work on **optical, opto-electronic, and photonic functional components**, will address devices and systems for information processing, communication, switching, storage, sensing and imaging. Research on **electron based nano-devices**, as well as on molecular electronics devices and technologies, will target those that promise broad functionality and have integration- and mass fabrication potential.*

- **Micro and Nano Technologies, Microsystems, Displays:** The objective is to improve the cost-efficiency, performance and functionality of subsystems and microsystems and to increase the level of integration and miniaturisation allowing for improved interfacing with their surrounding and with networked services and systems.

*Research will focus on new applications and functions that take advantage of multi-disciplinary interactions (electronics, mechanics, chemistry, biology, etc.) combined with the use of micro and nano-structures and new materials. The aim is to develop innovative, cost-effective and reliable **microsystems** and reconfigurable, miniaturised subsystem modules. Work will also include low cost, information-rich and higher resolution **displays** as well as advanced **sensors** including low cost vision and bio-metric sensors, and haptic devices. Work on **nano-devices and nano-systems** will address the exploitation of basic phenomena, processes and structures that promise novel or improved sensing or actuating functionality as well as their integration and fabrication.*

#### **1.1.2.iv Knowledge and interface technologies**

The objective is to improve usability of IST applications and services and access to the knowledge they embody in order to encourage their wider adoption and faster deployment.

- **Knowledge technologies and digital content:** The objective is to provide automated solutions for creating and organising virtual knowledge spaces (e.g. collective memories) so as to stimulate radically new content and media services and applications.

*Work will focus on technologies to support the process of **acquiring and modelling, navigating and retrieving, representing and visualising, interpreting and sharing knowledge**. These functions will be integrated in new semantic-based and context-aware systems including cognitive and agent-based tools. Work will address extensible knowledge resources and ontologies so as to facilitate service interoperability and enable next-generation Semantic-web applications. Research will also address technologies to support the **design, creation, management and publishing of multimedia content**, across fixed and mobile networks and devices, with the ability to self-adapt to user expectations.*

*The aim is to stimulate the creation of rich interactive content for personalised broadcasting and advanced trusted media and entertainment applications.*

- **Intelligent interfaces and surfaces:** The objective is to provide more effective ways of accessing ubiquitous information and easier and natural interaction modes with intelligence that surrounds us.

*Research will focus on **interfaces and interactive surfaces** that are natural, adaptive and multi-sensorial, for an ambient landscape that is aware of our presence, personality and needs, and which is capable of responding intelligently to speech, gesture or other senses. The aim is to hide the complexity of technology by supporting a seamless interaction between humans, between humans and devices, virtual and physical objects and the knowledge embedded in everyday environments. This includes research on virtual and augmented reality*

*Work will also address technologies for **multilingual and multicultural access and communication** that support timely and cost effective provisions of interactive information-rich services meeting the personal, professional and business requirements of all members of linguistically and culturally diverse communities.*

**1.1.2.v IST future and emerging technologies:** in this area, the objective is to help new IST-related science and technology fields and communities to emerge, some of which will become strategic for economic and social development in the future and will feed into the mainstream IST activities in the future. To ensure openness to unforeseeable ideas, critical mass of research where strategic focus is needed, and seamless coverage of the IST frontier, two complementary approaches will be utilised: one receptive and open - the other proactive.

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

The twofold transition toward a knowledge-based society and of sustainable development demands new paradigms of production and new concepts of product-services. European production industry as a whole needs to move from resource-based towards knowledge-based, more environment-friendly approaches, from quantity to quality, from mass produced single-use products to manufactured-on-demand multi-use, upgradable product-services; from “material and tangible” to “intangible” value-added products, processes and services.

These changes are associated with radical shifts in industrial structures, involving a stronger presence of innovative enterprises, with capabilities in networks and mastering new hybrid technologies combining nanotechnologies, material sciences, engineering, information technologies, bio and environmental sciences. Such an evolution implies a strong collaboration across traditional scientific frontiers. Leading edge industrial developments involve also a strong synergy between technology and organisation, the performance of both being highly dependent on new skills.

Successful technological solutions have to be sought more and more upstream in the design and production processes; new materials and nanotechnologies have a crucial role to play in this respect, as drivers of innovation. This requires changes of emphasis in Community research activities from short to longer term and in innovation which must move from incremental to breakthrough strategies. Community research will benefit greatly from an international dimension.

## *Research priorities*

### **1.1.3.i Nanotechnologies and Nanosciences**

Nanotechnologies represent a new approach to materials science and engineering. Europe enjoys a strong position in the nanosciences, that needs to be translated into a real competitive advantage for European industry. The objective is twofold: to promote the creation of an RTD-intensive European nanotechnology related industry, and to promote the uptake of nanotechnologies in existing industrial sectors. Research may be long-term and high risk, but will be oriented towards industrial application. An active policy of encouraging industrial companies and SMEs, including start-ups, will be pursued, amongst others through the promotion of strong industry/research interactions in consortia undertaking projects with substantial critical mass.

- ***Long-term interdisciplinary research into understanding phenomena, mastering processes and developing research tools:*** The objectives are to expand the generic underlying knowledge base of application oriented nanoscience and nanotechnology, and to develop leading edge research tools and techniques.

*Research will focus on: molecular and mesoscopic scale phenomena; self-assembling materials and structures; molecular and bio-molecular mechanisms and engines; multi-disciplinary and new approaches to integrate developments in inorganic, organic and biological materials and processes.*

- ***Nanobiotechnologies:*** The objective is to support research into the integration of biological and non-biological entities, opening new horizons in many applications, such as for processing and for medical and environmental analysis systems.

*Research will focus on: lab-on-chip, interfaces to biological entities, surface modified nano-particles, advanced drug delivery and other areas of integrating nano-systems or nanoelectronics with biological entities; processing, manipulation and detection of biological molecules or complexes, electronic detection of biological entities, micro-fluidics, promotion and control of growth of cells on substrates.*

- ***Nanometre-scale engineering techniques to create materials and components:*** The objective is to develop novel functional and structural materials of superior performance, by controlling their nano-structure. This will include technologies for their production and processing.

*Research will focus on : nano-structured alloys and composites, advanced functional polymeric materials, and nano-structured functional materials.*

- ***Development of handling and control devices and instruments:*** The objective is to develop a new generation of instrumentation for analysis and manufacture at the nano-scale. A guiding target will be a feature size or resolution of the order of 10nm.

*Research will focus on : a variety of advanced techniques for nano-scale manufacture (lithography or microscopy based techniques); breakthrough technologies, methodologies or instruments exploiting the self-assembling properties of matter and developing nano-scale machines.*

- ***Applications in areas such as health, chemistry, energy, optics and the environment:*** The objective is to foster the potential of nanotechnologies in breakthrough applications through the integration of research developments in materials and technological devices in an industrial context.

*Research will focus on: computational modelling, advanced production technologies; development of innovative materials with improved characteristics.*

### **1.1.3.ii Knowledge-based Multifunctional Materials**

New, high knowledge-content materials, providing new functionalities and improved performance, will be critical drivers of innovation in technologies, devices and systems, benefiting sustainable development and competitiveness in sectors such as transport, energy, medicine, electronics, and construction. To assure Europe's strong positions in emerging technology markets, which are expected to grow by one or two orders of magnitude within the next decade, the various actors need to be mobilised through leading edge RTD partnerships, including high risk research and through integration between research on materials and industrial applications.

- ***Development of fundamental knowledge:*** The objective is to understand complex physico-chemical and biological phenomena relevant to the mastering and processing of intelligent materials with the help of experimental, theoretical and modelling tools. This will provide the basis for synthesising larger complex or self-assembling structures with defined physical, chemical or biological characteristics.

*Research will focus on: long-term, trans-disciplinary and high industrial risk activities to design and develop new structures with defined characteristics; development of supra-molecular and macromolecular engineering, focusing on the synthesis, exploitation and potential use of novel highly complex molecules and their compounds.*

- ***Technologies associated with the production, transformation and processing of knowledge-based multifunctional materials, and biomaterials:*** The objective is the sustainable production of new “smart” materials with tailor-made functionalities and for building up macro-structures. These novel materials, serving multisectorial applications should incorporate in-built characteristics to be exploited under predetermined circumstances as well as enhanced bulk properties or barrier and surface characteristics for higher performance.

*Research will focus on: new materials; engineered and self-repairing materials; crosscutting technologies including surface science and engineering.*

- ***Engineering support for materials development:*** The objective is to bridge the gap from “knowledge production” to “knowledge use”, thus overcoming the EU industry’s weaknesses in the integration of materials and manufacturing. This will be achieved by the development of new tools enabling the production of new materials in a context of sustainable competitiveness.

*Research will focus on: inherent aspects of optimising materials design, processing and tools; testing, validation and up-scaling; incorporation of life-cycle approaches, obsolescence, bio-compatibility and eco-efficiency.*

### **1.1.3.iii New Production Processes and Devices**

New production concepts which are more flexible, integrated, safe and clean will depend on breakthrough organisational and technological developments, supporting new products, processes and services, and at the same time decreasing (internal and external) costs. The objective is to provide the industrial systems of the future with the necessary tools for efficient life-cycle design, production, use and recovery as well as appropriate organisational models and improved knowledge management.

- ***Development of new processes and devices and flexible and intelligent manufacturing systems.*** The objective is to encourage industry's transition towards more knowledge-based production and systems organisation and to considering production from a more holistic perspective, encompassing not only hardware and software, but also people and the way in which they learn and share knowledge.

*Research will focus on: innovative, reliable, smart and cost-effective manufacturing processes, and systems, and their incorporation into the factory of the future: integrating hybrid technologies based on new materials and their processing, micro-systems and automation, high-precision production equipment, as well as integration of ICT, sensing and control technologies, and innovative robotics.*

- ***Systems approach and hazard control.*** The objective is to contribute to an improved sustainability of industrial systems and a substantial and measurable reduction in environmental and health impact, through new industrial approaches, as well as enhancement of resource efficiency and reduction in consumption of primary resources.

*Research will focus on: development of new devices and systems for clean, and safe production; non-polluting, sustainable waste management and hazard reduction in production and manufacturing, including bio-processes; enhancing company responsibility on products, resource consumption and industrial waste management; studying “production-use-consumption” interactions, as well as socio-economic implications.*

- ***Optimising the life-cycle of industrial systems, products and services.*** Products and production should become increasingly life-cycle and service oriented, in addition to the requirements of intelligence, cost-effectiveness, safety and cleanliness. The key challenge is therefore new industrial concepts based on life-cycle approaches, which must allow new products, organisational innovation and the efficient management of information and its transformation into useable knowledge within the value chain.

*Research will focus on: innovative product-services systems that optimise the “design-production-service-end-of-life” value chain through the development of and experimentation with hybrid technologies and new organisational structures.*

The research activities carried out within this thematic priority area will include exploratory research at the leading edge of knowledge on subjects closely related to one or more topics within it. Two complementary approaches will be utilised: one receptive and open – the other proactive.

#### 1.1.4 Aeronautics and space

Over the last decades, Europe's outstanding technological and industrial capabilities in aeronautics and the exploitation of space have made many and various contributions to the standard of living of its citizens and the development and growth of its economies, as well as to those outside Europe. The economic benefits they bring can be seen in highly skilled employment and the balance of trade surplus, and they can have a strong leverage effect in upgrading the competitiveness of other related economic sectors.

Although aeronautics and space are distinct domains, they share common features, being extremely R&D intensive, with long development lead-times and very large investment requirements. Fierce competition, strategic significance, and increasingly severe environmental constraints combine to make it necessary to strive continually towards higher levels of technological excellence by consolidating and concentrating RTD efforts with the ultimate aim of better serving society.

Aeronautics research will be planned against a Strategic Research Agenda (SRA) agreed by all stakeholders at European level in the context of the new *Advisory Council for Aeronautics Research in Europe*, which will also be the planning base for national programmes. The result will be a greater level of complementarity and co-operation between the national and Community efforts in the field. The European Strategy for Space will serve as a reference in planning space research, with the objective of gathering key players on projects of common interest and close liaison will be ensured with RTD activities carried out by other actors, such as space agencies, Eurocontrol and industry. Furthermore, the application of relevant Treaty articles will be explored to support, as appropriate, these initiatives.

##### *Research priorities*

##### **1.1.4.i Aeronautics**

In their report "Vision 2020", leaders of the sector in Europe have highlighted the need to optimise the Community and national research efforts around a common vision and a strategic research agenda. Consistent with this, research will concentrate on the following 4 main strands. The scope of the research action will be commercial transport aircraft including their systems and components, as well as the on-board and ground-based elements of air-traffic management systems.

- ***Strengthening competitiveness***: The objective is to enable the 3 sectors of the manufacturing industry: airframe, engines and equipment, to increase their competitiveness, by reducing, in the short and long term, respectively, aircraft development costs by 20% and 50%, and aircraft direct operating cost by 20% and 50%, and improving passenger comfort.

*Research will focus on: integrated design systems and processes for the realisation of the extended multi-site enterprise concept, as well as for more intelligent production technologies; new aircraft configurations, advanced aerodynamics, materials and structures, engine technologies; mechanical, electrical and hydraulic systems; improved cabin-environmental conditions and utilisation of multimedia services to improve passenger comfort.*

- ***Improving environmental impact with regard to emissions and noise***. Concerning emissions, the objectives are to meet Kyoto goals and to compensate for the increase in future air traffic, by reducing fuel consumption and emissions of CO<sub>2</sub> by 50% in the long term and of NO<sub>x</sub> by 20% and 80%, in the short and long term, respectively. Concerning noise, to limit the noise nuisance outside the airport boundary, the target is to reduce noise levels by 4-5 dB in the short term and 10 dB in the long term.

*Concerning emissions, research will focus on: low-emission combustion and propulsion concepts, engine technologies and related control systems, low-drag aerodynamic concepts, low-weight airframe structures and high temperature materials, as well as improved flight operational procedures. Research on noise will focus on: engine and power-plant technologies, aeroacoustics for airframe noise reduction, advanced noise-control systems as well as novel flight operational procedures in the vicinity of airports.*

- **Improving aircraft safety.** The objective is to obtain a two-fold reduction in accident rates in the short-term, and a five-fold reduction in the long term, in order to compensate for the growth in air transport movements.

*Concerning preventive safety, research will focus on: investigation of systemic safety models, improved fault-tolerant systems and human-centred cockpit design enabling a controllable situation awareness for the crew. Research on accident mitigation will focus on improved materials and structures as well as advanced safety systems.*

- **Increasing operational capacity and safety of the air transport system.** The objective is to optimise airspace and airport utilisation, and consequently reduce flight delays, through a seamlessly integrated European air traffic management system, which would facilitate the achievement of the “Single European-Sky” initiative.

*Research will focus on on-board and ground automation aids, communication, navigation and surveillance systems as well as flight operation procedures that will enable the introduction of new concepts including the free-flight concept in the future European ATM system.*

#### **1.1.4.ii Space**

The aim is to contribute to the implementation of the European Strategy for Space, notably by targeting and focusing efforts with ESA and Member States on a small number of joint actions of common interest. Emphasis will be put on activities complementing those of space agencies (integration of terrestrial and space systems/services and demonstration of end-to-end services). This will include the following areas of activity:

- **Galileo:** the European Satellite Navigation system GALILEO, developed by the Joint Undertaking in close co-operation with the European Space Agency, will be fully operational by 2008. The use of the services provided by this infrastructure will span over wide ranges of activities of European society. The availability of precise navigation and timing services will have profound impacts in many domains.

It is important to build the necessary expertise and knowledge in Europe in order to exploit this emerging technology in the most efficient way.

*Research will focus on: development of multisectorial concepts, systems and tools, user equipment including receivers, which will rely on precise navigation and timing service provision; spreading of high level, coherent and seamless quality services in all environments (cities, indoors and outdoors, land, sea, air, etc.), in synergy with other service provision (telecommunication, surveillance, observation, etc.).*

- **GMES**: the objective is to stimulate the evolution of satellite-based information services, by development of technologies to bridge the gap between supply and demand, and to build up a European capability in the field of monitoring for environment and security.

*Research will focus on: sensors, data, and information models, developed in Europe or elsewhere, as well as developing prototypes of operational services responding to specific types of demand (for example global environment, land-use, desertification, disaster management). Research, including on data acquisition, assembly and qualification of models combining spatial and terrestrial data in an integrated operational information system, would use existing satellite data, for example provided by Envisat, future EarthWatch projects and other systems.*

- **Satellite telecommunications**: Satellite communications should be integrated with the wider area of telecommunications systems, notably terrestrial systems<sup>4</sup>.

The research activities carried out within this thematic priority area will include exploratory research at the leading edge of knowledge on subjects closely related to one or more topics within it. Two complementary approaches will be utilised: one receptive and open – the other proactive.

### 1.1.5 Food Quality and Safety

This priority area is aimed at assuring the health and well-being of European citizens through a better understanding of the influence of food intake and environmental factors on human health and to provide them with safer, high-quality and health-promoting foods, including seafoods, relying on fully controlled and integrated production systems originating in agriculture, aquaculture and fisheries. By re-addressing the classical approach ‘from farm to fork’, this thematic priority area aims at ensuring that consumer protection is the main driver for developing new and safer food and feed production chains, i.e. ‘from fork to farm’, relying in particular on biotechnology tools taking into account the latest results of genomics research.

This end-user driven approach is reflected in the seven specific research objectives. Priority will be given to integrated research approaches crossing several specific objectives. Given that small enterprises constitute a major part of the food sector, the success of activities undertaken will rely on the adaptation of knowledge and processes to the specific characteristics of these enterprises.

*Research priorities*

- **Epidemiology of food-related diseases and allergies.** The objective is to examine the complex interactions between food intake and metabolism, immune system, genetic background and environmental factors to identify key risk factors and develop common European databases.

*Research will focus on : epidemiological studies of the effect of diet, food composition and lifestyle factors, on the health of consumers and specific population groups such as children, and the prevention or development of specific diseases, allergies and disorders; methodologies for measuring and*

---

<sup>4</sup> Considering the tight links between communications satellites and terrestrial technologies, the related work is presented in the context of the relevant actions of the “Information society technologies” thematic priority area.

*analysing food composition and dietary intake, risk assessment, epidemiological and intervention models; influences of genetic variability using advances in functional genomics.*

- **Impact of food on health:** The objective is to provide the scientific basis for improving health through diet, and the development of new health-promoting foods, considering for instance new products, products resulting from organic farming, functional foods, products containing genetically modified organisms, and those arising from recent biotechnology developments, by means of an improved understanding of food metabolism and by harnessing the opportunities now available from proteomics and biotechnology.

*Research will focus on: overall relationship between diet and health; health promoting and disease prevention properties of foods; effects of food components, pathogens, chemical contaminants and new agents of prion type on health; nutrient requirements and health promoting intervention strategies; determinants of consumer attitudes towards food products and production; methodologies for risk/benefit assessment of nutrients and of bioactive compounds; specificities of different population groups, particularly the elderly and children.*

- **“Traceability” processes all along the production chain.** The objective is to strengthen the scientific and technological basis for ensuring complete traceability for instance of genetically modified organisms, including those based on recent biotechnology developments from raw material origin to purchased food products, and thereby increase consumer confidence in the food supply.

*Research will focus on: development, validation and harmonisation of technologies and methodologies to ensure complete traceability throughout the food chain ; scale-up, implementation and validation of methods in whole food chains; assurance of authenticity; validity of labelling; application of HACCP to the whole food chain.*

- **Methods of analysis, detection and control:** The objective is to contribute to the development, improvement, validation and harmonisation of reliable and cost-effective sampling and measurement strategies for chemical contaminants and existing or emerging pathogenic micro-organisms (such as viruses, bacteria, yeasts, fungi, parasites, and new agents of the prion type including development of ante mortem diagnostic tests for BSE and scrapie) so as to control the safety of the food and feed supply and ensure accurate data for risk analysis.

*Research will focus on: methods and standards for analysing and detecting food-borne pathogens and chemical contaminants, including pre-normative aspects; modelling and approaches to improve existing prevention and control strategies; detection tests and geographical mapping of prions; transfer and longevity of prions.*

- **Safer and environmentally friendly production methods and healthier foodstuffs:** The objective is to develop lower input farming systems (agriculture and aquaculture) based on systems such as integrated production, lower-input methods including organic agriculture and the use of plant and animal sciences and biotechnologies and improved transformation processes aimed at producing

safer healthier nutritious, functional and varied foodstuffs, and animal feed, and improving the quality of food and feed through innovative technologies.

*Research will focus on: development of improved integrated production systems, lower-input farming, organic farming and GMO-based production as well as processing and distribution methods and innovative technologies for safer, nutritious and higher quality food and feed; individual and comparative assessment of safety, quality, environmental impact and competitiveness aspects of different production methods and foodstuffs; improvement of animal husbandry, waste-management and animal welfare from housing to slaughter; application of plant and animal sciences and biotechnologies, including the application of genomics, for the development of higher quality food raw materials and nutritious foods.*

- **Impact of animal feed, on human health:** The objective is to improve understanding of the role of animal feed, including products containing genetically modified organisms and the use of sub-products of different origins for that feed, in food safety, to reduce the use of undesirable raw materials and to develop alternative new animal feed sources.

*Research will focus on: epidemiological studies of animal-feed induced food-borne diseases; influence of raw materials, including waste and by-products of different origins, processing methods, additives and veterinary drugs used in animal feed on animal and human health; improved waste management, to ensure exclusion of specified high-risk and condemned materials from the feed chain; novel protein, fat and energy sources other than meat and bone meal for optimal animal growth, reproductive potential and food product quality.*

- **Environmental health risks** The objectives are to identify the environmental factors that are detrimental to health, understand the mechanisms involved and determine how to prevent or minimise these effects and risks.

**a) Risks linked to the food-chain (chemical, biological and physical)**

**b) Combined exposures of authorised substances, including impact of local environmental disasters and pollution on the safety of foodstuffs, with emphasis being placed on cumulative risks, transmission routes to human beings, long-term effects and exposure to small doses, as well as the impact on particularly sensitive groups, and especially children**

*Research will focus on: identification of causal agents including contaminants, and physiological mechanisms, of environmental, and food-linked environmental hazards; understanding of exposure pathways, estimation of cumulative, low dose and combined exposures; long-term effects; definition and protection of susceptible sub-groups; environmental causes and mechanisms responsible for the increase in allergies; impact of endocrine disrupters; chronic chemical pollution and combined environmental exposures, transmission of illnesses linked to water (parasites, viruses, bacteria, etc).*

The research activities carried out within this thematic priority area will include exploratory research at the leading edge of knowledge on subjects closely related to one or more topics within

it. Two complementary approaches will be utilised: one receptive and open – the other proactive.

### **1.1.6 Sustainable development, global change and ecosystems**

The Treaty confirms Sustainable Development as a central objective of the European Community; this was emphasised by the recent European Council in Göteborg. In this context, global change, energy security, sustainable transport, sustainable management of Europe's natural resources, and their interaction with human activities motivate this research priority theme. The activities carried out within this priority aim at strengthening the scientific and technological capacities needed for Europe to be able to implement a sustainable development model in the short and in the long term, integrating its social, economic and environmental dimensions, and make a significant contribution to the international efforts to mitigate or even to reverse current adverse trends, to understand and control global change and preserve the equilibrium of ecosystems.

#### ***1.1.6.1 Sustainable energy systems***

Strategic objectives address the reduction of greenhouse gases and pollutant emissions, the security of energy supply, the increased use of renewable energy as well as to achieve an enhanced competitiveness of European industry. Achieving these objectives in the short term requires a large-scale research effort to encourage the deployment of technologies already under development and to help promote changes in energy demand patterns and consumption behaviour by improving energy efficiency and integrating renewable energy into the energy system. The longer term implementation of sustainable development requires also an important RTD effort to assure the economically attractive availability, of energy, and overcome the potential barriers to adoption of renewable energy sources and new carriers and technologies such as hydrogen and fuel cells that are intrinsically clean.

#### *Research priorities*

##### ***1.1.6.1.i Research activities having an impact in the short and medium term***

Community RTD activity is one of the main instruments which can serve to support the implementation of new legislative instruments in the field of energy and to change significantly current unsustainable patterns of development, which are characterised by growing dependence on imported fossil fuels, continually rising energy demand, increasing congestion of the transport systems, and growing CO<sub>2</sub> emissions, by offering new technological solution which could positively influence consumer/user behaviour, especially in the urban environment.

The goal is to bring innovative and cost competitive technological solutions to the market as quickly as possible through demonstration and other research actions aiming at the market, which involve consumers / users in pilot environments, and which address not only technical but also organisational, institutional, financial and social issues.

- ***Clean energy, in particular renewable energy sources and their integration in the energy system, including storage, distribution and use.***

The aim is to bring to the market improved renewable energy technologies and to integrate renewable energy into networks and supply chains, for example by supporting stakeholders who are committed to establishing “Sustainable Communities” employing a high percentage of renewable energy supplies. Such actions will adopt innovative or improved technical and/or socio-economic approaches to “green electricity”, heat, or biofuels and their integration into

energy distribution networks or supply chains, including combinations with conventional large scale energy distribution.

*Research will focus on: increased cost effectiveness, performance and reliability of the main new and renewable energy sources; integration of renewable energy and effective combination of decentralised sources, with cleaner conventional large-scale generation; validation of new concepts for energy storage, distribution and use.*

– ***Energy savings and energy efficiency, including those to be achieved through the use of renewable raw materials.***

The overall objective is to reduce the demand for energy by 18% by the year 2010 in order to contribute to meeting the EU's commitments to combat climate change and to improve the security of energy supply. Research activities will focus in particular on Eco-Buildings to generate energy savings and improve environmental quality as well as quality of life for occupants. "Polygeneration" activities will contribute to the Community target of doubling the share of cogeneration (CHP) in EU electricity generation from 9% to 18% by 2010, and improve the efficiency of combined production of electricity, heating and cooling services, by using new technologies such as fuel cells and integrate renewable energy sources.

*Research will focus on: improving savings and efficiency mainly in the urban context, in particular in buildings, through the optimisation and validation of new concepts and technologies, including combined heat and power and district heating/cooling systems; opportunities offered by on-site production and use of renewable energy to improve energy efficiency in buildings.*

– ***Alternative motor fuels.***

The Commission has set an ambitious target of 20% substitution of diesel and gasoline fuels by alternative fuels in the road transport sector by the year 2020. The aim is to improve the security of energy supply through reduced dependence on imported liquid hydrocarbons and to address the problem of greenhouse gas emissions from transport. In line with the Communication on alternative fuels for road transportation, short term RTD will concentrate on three types of alternative motor fuels that potentially could reach a significant market share: biofuels, natural gas and hydrogen.

*Research will focus on: the integration of alternative motor fuels into the transport system, particularly into clean urban transport; the cost-effective and safe production, storage, and distribution (including fuelling infrastructure) of alternative motor fuels; the optimal utilisation of alternative fuels in new concepts of energy efficient vehicles; strategies and tools to manage the market transformation process for alternative motor fuels.*

***1.1.6.1.ii Research activities having an impact in the medium and longer term***

In the *medium and longer term* the objective is to develop new and renewable energy sources, and new carriers such as hydrogen which are both affordable and clean and which can be well integrated in a long term sustainable energy supply and demand context both for stationary and for transport applications. Furthermore the continuing use of fossil fuels in the foreseeable future requires cost-effective solutions to the disposal of

CO<sub>2</sub>. The goal is to bring about further reduction in greenhouse gas emissions beyond the Kyoto deadline of 2010. The future large-scale development of these technologies will depend on significant improvement in their cost and other aspects of competitiveness against conventional energy sources, within the overall socio-economic and institutional context in which they are deployed.

- **Fuel cells, including their applications** : these represent an emerging technology which is expected, in the longer term, to replace a large part of the current combustion systems in industry, buildings and road transport, as they have a higher efficiency, lower pollution levels and a potential for lower cost. The long term cost target is 50 euro/kW for road transport and 300 euro/kW for high-durability stationary applications and fuel cell/electrolysers.

*Research will focus on: cost reduction in fuel cell production and in applications for buildings, transport and de-centralised electricity production; advanced materials related to low and high temperature fuel cells for the above applications.*

- **New technologies for energy carriers/transport and storage, in particular hydrogen**: The aim is to develop new concepts for long term sustainable energy supply where hydrogen and clean electricity are seen as major energy carriers. For H<sub>2</sub>, the means must be developed to ensure its safe use at an equivalent cost to that of conventional fuels. For electricity, decentralised new and in particular renewable energy resources, must be optimally integrated, within inter-connected European, regional and local distribution networks to provide secure and reliable high quality supply.

*Research will focus on : Clean cost-effective production of **hydrogen**; hydrogen infrastructure including transport, distribution, storage and utilisation; For electricity the focus will be on new concepts, for analysis, planning, control and supervision of electricity supply and distribution and on enabling technologies, for storage, interactive transmission and distribution networks.*

- **New and advanced concepts in renewable energy technologies**: Renewable energy technologies have, in the long term, the potential to make a large contribution to the world and EU energy supply. The focus will be on technologies with a significant future energy potential and requiring long-term research, by means of actions with high European added value in particular to overcome the major bottleneck of high investment costs, and to make these technologies competitive with conventional fuels.

*Research will focus on: for photovoltaics : the whole production chain from basic material to the PV system, as well as on the integration of PV in habitat and large scale MW-size PV systems for production of electricity. For biomass barriers in the biomass supply-use chain will be addressed in the following areas: production, combustion technologies, gasification technologies for electricity and H<sub>2</sub>/syngas production and biofuels for transport. For other areas the effort will be focused on integrating at European level specific aspects of RTD activities which require long term research.*

- **Capture and sequestration of CO<sub>2</sub>, associated with cleaner fossil fuel plants**: Cost effective capture and sequestration of CO<sub>2</sub> is essential to include the use of fossil fuels in a sustainable energy supply scenario, reducing costs to the order

of 30€ in the medium term and 20€ or less in the longer term per tonne of CO<sub>2</sub> for capture rates above 90%.

*Research will focus on: developing holistic approaches to near zero emission fossil fuel based energy conversion systems, low cost CO<sub>2</sub> separation systems, both pre-combustion and post-combustion as well as oxyfuel and novel concepts: development of safe, cost efficient and environmentally compatible CO<sub>2</sub> disposal options, in particular geological storage, and exploratory actions for assessing the potential of chemical storage.*

#### **1.1.6.2 Sustainable surface transport**

White Paper: “European transport policy for 2010: time to decide” forecasts a transport demand growth by 2010 in the European Union of 38% for freight and 24% for passenger transport (base-year 1998). The already congested transport networks will have to absorb the additional traffic, and the trend suggests that the proportion absorbed by the less sustainable modes is likely to grow. The objective is consequently both to fight against congestion and to decelerate or even reverse these-trends regarding the modal split by better integrating and rebalancing the different transport modes, improving their safety, performance and efficiency, minimising their impact on the environment and ensuring the development of a genuinely sustainable European transport system, while supporting European industry’s competitiveness in the production and operation of transport means and systems.

*Research priorities:*

**1.1.6.2.i Developing environmentally friendly transport systems and means of transport.** The objective is to reduce the contribution of surface transport (rail, road, waterborne) to CO<sub>2</sub> production and other emissions including noise, while increasing safety, comfort, quality, cost-effectiveness and energy-efficiency of vehicles and vessels. Emphasis will be given to clean urban transport and rational use of the car in the city.

- ***New technologies and concepts for all surface transport modes (road, rail and waterborne).***

*Research will focus on: high efficiency propulsion systems and their components, based on alternative and renewable fuels, taking into account the fuelling infrastructure; development of zero or near zero emission propulsion systems and components, in particular those integrating fuel cells, hydrogen combustion and their fuelling infrastructure into the transport system; integrated concepts for clean urban transport and rational use of the car in urban locations.*

- ***Advanced design and production techniques.***

*Research will focus on: “transport-specific” advanced design and production techniques, in particular for one-of-a-kind production environments, leading to improved quality, safety, recycling, comfort and cost-effectiveness of environmentally friendly vehicles (cars and trains) and vessels.*

**1.1.6.2.ii Making surface transport safer, more effective and more competitive.** The objectives are to assure transport of passengers and freight, taking into account transport demand and the need for rebalancing transport modes, while increasing

transport safety in line with the 2010 objectives for European transport policy (eg for road transport the objective would be to halve the number of fatalities).

– ***Rebalancing and integrating different transport modes.***

*Research will focus on: interoperable transport systems, to enable the interconnectivity of the transport networks, in particular enabling a competitive European railway system and the integration of a European vessel traffic information system; intermodal transport services, technologies (eg harmonisation of unit loads) and systems, and advanced logistics;*

– ***Increasing road, rail and waterborne safety and avoiding traffic congestion.***

*Research will focus on : strategies and technologies to increase road safety and to improve maritime safety; concepts and systems for advanced human-vehicle, vehicle-vehicle and vehicle-infrastructure interaction; large-scale integration and validation platforms for intelligent transport systems (e.g. transport pricing, transport and traffic management and transport information), including satellite navigation applications, new vehicle types and operational procedures to increase capacity and safety, while respecting the environment (in particular in urban and sensitive areas).*

### ***1.1.6.3 Global Change and ecosystems***

Global Change encompasses the complex dynamic changes over different time-scales in the physical, chemical and biological components of the Earth system (i.e. atmosphere, oceans and land) in particular those influenced by human activities. The objectives of this priority area are: (i) to strengthen the capacity to understand, detect and predict global change and develop strategies for prevention, mitigation and adaptation, in close liaison with the relevant international research programmes and in the context of relevant conventions such as the Kyoto Protocol and the Montreal Protocol; (ii) to preserve the ecosystems and protect biodiversity which would also contribute to the sustainable use of land and marine resources. In the context of global change, strategies for integrated, sustainable management of agricultural and forest ecosystems are of particular importance for the preservation of these ecosystems and will contribute substantially to the sustainable development of Europe. These objectives will be best achieved through activities aiming at the development of common and integrated approaches necessary to implement sustainable development, taking into account its environmental, economic and social aspects, as well as the impact of global change on all countries and regions of the world. It will foster the convergence of European and national research efforts for common definitions of thresholds of sustainability and estimation methods, and encourage international co-operation in order to achieve common strategies to respond to global change issues.

#### *Research priorities*

- ***Impact and mechanisms of greenhouse gas emissions and atmospheric pollutants on climate, ozone depletion and carbon sinks (oceans, forests and soil).*** The objective is to detect and describe global change processes, associated with greenhouse gas emissions and atmospheric pollutants from all sources, including those resulting from energy supplies, transport and agriculture, to improve prediction and assessment of their global and regional impacts, evaluate mitigation options and improve the access of European researchers to facilities and platforms for global change research.

*Research will focus on: understanding and quantification of changes in the carbon and nitrogen cycles; the role of all sources of greenhouse gases and atmospheric pollutants and their sinks in the biosphere; their effects on climate dynamics and variability, ocean and atmospheric chemistry, and their interactions; future stratospheric ozone levels and ultraviolet radiation; prediction of global climatic change and impacts; associated phenomena (e.g. El Niño, changes in sea level and ocean circulation); and mitigation and adaptation strategies.*

- **Water cycle, including soil-related aspects:** the objective is to understand the mechanisms and assess the impact of global change and in particular climate change on the water cycle, water quality and availability, as well as soil functions and quality to provide the bases for management tools for water systems to mitigate the impacts.

*Research will focus on: impact of climate change on the components of the hydrological cycle – land/ocean/atmosphere interactions, groundwater/surface water distribution, freshwater and wetland ecosystems, soil functioning and water quality; assessment of vulnerability of water/soil systems to global change; management strategies and their impacts; scenarios of water demand and availability.*

- **Biodiversity and ecosystems:** the objectives are to develop a better understanding of marine and terrestrial biodiversity and of ecosystem functioning, understand and minimise the impacts of human activities on them and ensure sustainable management of natural resources and terrestrial and marine ecosystems and the protection of genetic resources.

*Research will focus on: assessing and forecasting changes in biodiversity, structure, function and dynamics of ecosystems and their services; with emphasis on marine ecosystems' functioning; relationships between society, economy, biodiversity and habitats; integrated assessment of drivers affecting ecosystems' functioning and biodiversity, and mitigation options; risk assessment, management, conservation and rehabilitation options in relation to terrestrial and marine ecosystems.*

- **Mechanisms of desertification and natural disasters:** the objective is to understand the mechanisms of desertification and natural disasters, including their links with climatic change so as to improve risk and impact assessment and forecasting, and decision support methodologies.

*Research will focus on: large scale integrated assessment of land/soil degradation and desertification in Europe and related prevention and mitigation strategies; long term forecasting of hydro-geological hazards; natural hazard monitoring, mapping and management strategies; improved disaster preparedness and mitigation.*

- **Strategies for sustainable land management, including coastal zones, agricultural land and forests.** The objective is to contribute to the development of strategies and tools for sustainable use of land, with emphasis on the coastal zones, agricultural lands and forests, including integrated concepts for the multipurpose utilisation of agricultural and forest resources, and the integrated

forestry/wood chain in order to ensure sustainable development at economic, social, and at environmental levels.

*Research will focus on: development of the necessary tools for integrated management of coastal zones (ICZM); evaluation of positive and negative externalities under different production systems for agriculture and forestry; development of strategies for sustainable forest management considering regional specificity; strategies/concepts for sustainable management and multipurpose utilisation of forest and agriculture resources; cost-efficiency of new environmental-friendly processes and recycling technologies within the integrated forestry/wood chain.*

- ***Operational forecasting and modelling, including global climate change observation systems:*** the objective is to make systematic observations of atmospheric, terrestrial and oceanic parameters including those of climate so as to improve forecasting of the marine, terrestrial and atmospheric environment, consolidate long-term observations for the modelling and in particular prediction, establish common European data bases and contribute to international programmes.

*Research will focus on: observations of basic marine, terrestrial and atmospheric parameters necessary for global change research and management strategies, and of extreme events; large observing/monitoring/surveying/operational forecasting/modelling networks (taking into account the developments of GMES and providing the European dimension to G3OS).*

- ***Complementary research*** will focus on: development of advanced methods for risk assessment and methods for appraising environmental quality, including relevant prenormative research on measurements and testing for these purposes.

The research activities carried out within this thematic priority area will include exploratory research at the leading edge of knowledge on subjects closely related to one or more topics within it. Two complementary approaches will be utilised: one receptive and open – the other proactive.

### **1.1.7 Citizens and Governance in a Knowledge-based society**

The Lisbon European Council recognised that the transition towards a European knowledge based society will affect every aspect of people's lives. The overall objective is to provide a sound knowledge base for the management of this transition, which will be conditioned by national, regional and local policies, programmes and actions, as well as informed decision making by individual citizens, families and other societal units.

Given the complexity, breadth and interdependence of these challenges and the issues involved, the research approach adopted must be based on greatly enhanced research integration, multi and transdisciplinary cooperation, and on the mobilisation of the social sciences and humanities research communities in Europe in addressing them. Activities will also facilitate the identification of medium to long term societal challenges arising from research in social sciences and humanities and will ensure the active participation of key societal stakeholders and the targeted dissemination of the work carried out. In order to support the development of comparative transnational and interdisciplinary research, while at the same time preserving the diversity of research methodologies throughout Europe, the collection and analysis of better and more genuinely comparable data and the coordinated development of statistics and qualitative and quantitative indicators in

particular in the context of the emerging knowledge society at the European level is essential.

Appropriate coordination of socio-economic research and foresight elements across all the Priorities of the Specific Programmes will be assured.

#### *Research priorities*

##### **1.1.7.i Knowledge-based Society and social cohesion**

The building of a European knowledge society is a clear political objective for the European Community. The research aims to provide the basis of understanding needed to ensure this takes place in a manner which accords with specific European conditions and aspirations.

- ***Improving the generation, distribution and use of knowledge and its impact on economic and social development.*** The objective is to improve significantly understanding of the characteristics of knowledge and its functioning as a public and private good, and to provide the bases for policy formulation and decision making.

*Research will focus on: characteristics of knowledge and its functioning in relation to the economy and society, as well as for innovation and for entrepreneurial activities; and the transformation of economic and social institutions; the dynamics of knowledge production, distribution and use, role of knowledge codification and impact of ICTs ; the importance of territorial structures and social networks in these processes.*

- ***Options and choices for the development of a knowledge-based society:*** The objective is to develop an integrated understanding of how a knowledge-based society can promote the societal objectives of the EU set at the Lisbon summit and subsequent European Councils of sustainable development, social and territorial cohesion and improved quality of life, with due consideration to the variety of social models in Europe.

*Research will focus on: features of a knowledge based society in line with European social models and the need to improve the quality of life; social and territorial cohesion, gender and intergenerational relations and social networks; implications of changes to work and employment, and the labour market; access to education and training, and life-long learning.*

- ***The variety of paths towards a knowledge society.*** The objective is to provide comparative perspectives across Europe and thus provide an improved basis for the formulation and implementation of transition strategies towards a knowledge society at the national and regional levels.

*Research will focus on: globalisation in relation to pressures for convergence; the implications for regional variation; challenges to European societies from a diversity of cultures and increased sources of knowledge; the role of the media in this context.*

##### **1.1.7.ii Citizenship, democracy and new forms of governance**

The work will identify the main factors influencing changes in governance and citizenship, in particular in the context of increased integration and globalization and from the perspectives of history and cultural heritage as well as the impacts of these

changes and the possible options to enhance democratic governance, resolve conflicts, protect human rights and take account of cultural diversity and multiple identities.

- ***The implications of European integration and enlargement for governance and the citizen:*** The objective is to clarify the key interactions between European integration and enlargement, and issues of democracy, institutional arrangements and citizens' well-being.

*Research will focus on: relationships between integration, enlargement and institutional change within the context of their historical evolution and with a comparative perspective; the implications of a changing global context and the role of Europe; the consequences of an enlarged European Union for the well-being of its citizens.*

- ***Articulation of areas of responsibility and new forms of governance:*** The objective are to support the development of forms of multi-level governance which are accountable, legitimate, and sufficiently robust and flexible to address societal change including integration and enlargement, and to assure the effectiveness and legitimacy of policy making.

*Research will focus on: the articulation of responsibilities between various territorial levels and between public and private sectors; democratic governance, representative institutions and roles of civil society organisations; privatisation, the public interest, new regulatory approaches, corporate governance; implications for legal systems.*

- ***Issues connected with the resolution of conflicts and restoration of peace and justice:*** the objectives are to support the development of institutional and social capacity in the field of conflict resolution, identify factors leading to success or failure in preventing conflict, and develop improved options for conflict mediation.

*Research will focus on: early identification of factors leading to conflict within and between countries; comparative analysis of procedures for prevention and mediation of conflicts and achievement of justice in different fields; Europe's role in regional and international arenas in these respects.*

- ***New forms of citizenship and cultural identities:*** The objectives are to promote citizens' involvement and participation in European policy making, to understand perceptions and impacts of citizenship and human rights provisions in Europe and to identify factors that allow mobility and coexistence of multiple identities.

*Research will focus on: relations between new forms of citizenship including rights of non-citizens; tolerance, human rights, racism and xenophobia; the role of the media in the development of a European public sphere; evolution of citizenship and identities in a context of cultural, and other diversities in Europe, taking into account population flows; social and cultural dialogue within Europe and with other world regions; implications for the development of a European knowledge based society.*

The research activities carried out within this thematic priority area will include exploratory research at the leading edge of knowledge on subjects closely related to one or more topics within

it. Two complementary approaches will be utilised: one receptive and open – the other proactive.

## 2. Nuclear Energy<sup>5</sup>

### 2.2 Management of radioactive waste

#### *Objectives*

The absence of a broadly agreed approach to waste management and disposal is one of the main impediments to the continued and future use of nuclear energy. In particular, this applies to the disposal of long-lived waste components in geological repositories, which will be required no matter what treatment method is chosen for the spent fuel and high level waste. Research alone cannot ensure societal acceptance; however, it is needed in order to develop and test the repository technologies, investigate suitable sites, promote basic scientific understanding relating to safety and safety assessment methods, and to develop decision processes that are perceived as fair and equitable by the stakeholders involved.

Research is also needed to explore the technical and economic potential of concepts for nuclear energy generation able to make better use of fissile material and generate less waste and of partitioning and transmutation to reduce the hazard of the waste; on an industrial scale.

#### *Research Priorities*

##### **2.2.i Research on geological disposal**

The aims are to establish a sound technical basis for demonstrating the safety of disposing spent fuel and long lived radioactive wastes in geological formations and underpin the development of a common European view on the main issues related to the disposal of waste.

- ***Improvement of fundamental knowledge, developing and testing technologies:*** research will focus on key physical, chemical and biological processes; interaction between the different natural and engineered barriers, their long-term stability and means of implementing disposal technologies in underground research laboratories.
- ***New and improved tools:*** research will focus on models for performance and safety assessment, and methodologies to demonstrate long term safety, including sensitivity and uncertainty analyses, and development and evaluation of alternative measures of performance and of better governance processes that properly address public concerns on waste disposal.

##### **2.2.ii Partitioning and transmutation and other concepts to produce less waste in nuclear energy generation**

The aims are to determine practical ways of reducing the amount and/or hazard of the waste to be disposed of by partitioning and transmutation and to explore the potential of concepts for nuclear energy to produce less waste.

---

<sup>5</sup> Nuclear fusion is not included in this document, as it is not expected that networks of excellence and integrated projects will be used for the thematic priority on nuclear fusion

- **Partitioning and transmutation:** research will focus on fundamental assessments of the overall concept; demonstration at pilot scale of the most promising partitioning technologies; further development of technologies for transmutation; and evaluation of their industrial practicability.
- **Concepts to produce less waste:** research will focus on exploring the potential for the more efficient use of fissile material in existing reactors and of other concepts to produce less waste in nuclear energy generation.

### 2.3 Radiation protection

#### *Objectives*

Radiation is used extensively in medicine and industry (including the generation of nuclear energy) and its safety is predicated on a sound radiation protection policy and its effective implementation. Community research underpins European policy and has contributed to the high levels of protection achieved in practice. These standards must be maintained and, in some cases, improved and research has a key role in this process. The main objective is to resolve uncertainties in the risk from exposures to radiation at low and protracted doses (ie, at levels typically encountered by the population and in workplaces) which remains a controversial scientific and policy issue, and has important implications for the use of radiation in both medicine and industry. Community research in other areas will focus on making better use of national efforts, principally through their more effective integration by networking and targeted research where this would either be complementary to, or provide synergy with, national programmes.

#### *Research priorities:*

- **Quantification of risks associated with low and protracted exposures:** research will focus on epidemiological studies of suitable exposed populations, complemented by cellular and molecular biology research on the interaction between radiation and the DNA, cells, organs and the body.
- **Medical exposures and natural sources of radiation:** enhancing the safety and efficacy of medical uses of radiation; better assessment and management of natural sources, in particular, naturally occurring radioactive materials.
- **Protection of the environment and radioecology:** conceptual and methodological basis for protection of the environment; better assessment and management of the impact of natural and artificial sources of radiation on man and the environment.
- **Risk and emergency management:** better approaches for risk governance; more effective and coherent emergency management in Europe, including rehabilitation of contaminated areas.
- **Protection of the workplace:** improved monitoring and management of occupational exposures in industries involving exposure to radiation.