

**MAIN CHALLENGES AND ACTIVITIES TO BE ADDRESSED IN THE
COMMON STRATEGIC FRAMEWORK
FOR RESEARCH AND INNOVATION**

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1. THE HEALTH CHALLENGE

This societal challenge is to improve health and well-being, allowing European citizens to live longer and in better health.

The corresponding research and innovation activities will generate knowledge on human disease, health and well-being, active and independent living, and underpin the translation of this knowledge into products and services for the improvement of human health and well-being.

The specific challenges are to:

- *Combat and cure diseases*: investigating their causes, diagnosis, mechanisms, treatment and cure (including personalised medicine); including drug discovery, innovative therapies and medical technologies, improvements in medical practice and health.
- *Stay healthy and active longer*: investigating human growth and development, active and healthy ageing, disease and disability prevention, healthy lifestyle, nutrition, the impact of environmental factors on health and well-being, vaccine and diagnostics development.
- *Improve health and social well-being*: strengthening research in health systems, investigating health intervention, preparedness for emerging epidemics, the socio-economic impacts of health and disease, assistive and independent living solutions (e.g. for disabled, social inclusion), ethics, service innovation, and societal uptake of innovation. Application and application-driven research of information and communication technologies to empower individuals to improve and manage their health status, and for governments to improve health and social care provision, including ICT-enabled-health (e.g. in chronic disease management, personalised medicine, patient guided services, independent living) will also be supported.
- *Provide better tools for health innovation*: developing and supporting biological (bio-banks, cohorts, animal models, patient specific models etc) and data resources (bio-informatics, databases, registries, etc), genomics and imaging (high throughput sequencing, identification, etc), medical research facilities and support for regulatory sciences (for biological safety, clinical trials, cell & gene therapy, specialist manufacturing, etc), as well as all medical infrastructures.

Across these specific challenges, activities to convert knowledge into innovation will include: proof of concept and proof of principle activities (including validation, standardisation and clinical trials), SME-specific actions, including targeted financing for SMEs, methods for assessing innovative methodologies, processes and products, technology transfer and intellectual property management. Involvement of, and partnerships with, industry, service providers and public authorities will be addressed in this context.

Strategic international initiatives will be pursued on: EDCTP-2, the partnership with Member States on clinical trials for HIV, malaria, tuberculosis, and other neglected diseases in sub-Saharan Africa; and an international consortium on research on rare diseases, in partnership with the US NIH, Canada, Japan, and EU Member States to arrive by 2020 at a diagnostic for all rare diseases, and 200 new therapies for rare diseases.

2. FOOD SECURITY AND BIO-BASED ECONOMY CHALLENGE

The societal challenge is secure supplies of safe high quality food for European citizens, sustainable management of important bio resources, reduced fossil sources dependency, and increased innovation in the European bio-based economy.

The research and innovation activities will help to meet food and feed security and safety, wellbeing and energy targets by focusing on a consistent set of challenges cutting across various EU Policies.

The specific challenges are:

- *Sustainable supplies of food, feed and bio-resources*: Smart use of biological resources (micro-organisms, plants, animals, biomass, forests, waste) and improved quality of the production medium (soil, water, air); increasing yields while preserving ecosystems and genetic diversity, and more knowledge intensive farm and forest management, under changing climates ; determining the conditions and limits for a balanced set of interlinked products and services from agriculture, forestry, water, bio-energy, and related ecosystems.
- *Safe, nutritious and affordable food*: breeding of fortified crops, high-tech processing, food industry management processes, more resilient, sustainable and lower waste food chain with reduced food loss or food packaging; consumer behaviour; dietary, food safety and other solutions to meet healthy living targets and wellness of the consumers.
- *Unlocking the potential of Marine resources*: aquaculture (species diversification, disease prevention, nutrition and selective breeding), greening the fisheries sector (in particular innovative methodologies to reduce discards and applying the ecosystem approach to fisheries management), monitoring technologies; marine biodiversity and marine biotechnology for new products and services; innovative quality seafood products, traceability and safety.
- *Competitive and Sustainable Bio-based Industries*: development of processes for the strategic use of renewable biological raw materials (biomass) and waste to replace fossil sources; transition to low carbon and resource-efficient industries by using the research and innovation in biotechnology, developing bio-based products for industries and consumers with novel qualities or improved sustainability and for bio-energy. Opening new markets for biotechnology innovation: supporting standardisation and life cycle oriented development of bio-based products, as well as commercial up-scaling of biorefinery processes through pilot and demonstration plant activities.

Across these challenges activities to foster innovation will include: operational links with relevant research infrastructures, enabling SME access to results and knowledge, technology transfer and standardisation schemes, and addressing industry and farmers' demand for scale-up, proof of concept and demonstration facilities, and field trials to obtain results and speed up knowledge transfer.

Strategic international cooperation will be pursued i) with industrialised countries, particularly in the frame of established international fora related to the bio-based economy (i.e. EU-Australia-Canada-New Zealand International Knowledge-Based Bio-Economy Forum and EC-US Task Force on Biotechnology), with a focus on sharing scientific excellence, ii) with BRICS, as major agricultural producers, focusing on cutting edge technologies for food security and safety, reduced water and environmental impacts, and energy security; and iii) with developing countries on the Millennium Development Goals of tackling hunger and ensuring environmental sustainability.

3. THE SECURE, CLEAN AND EFFICIENT ENERGY CHALLENGE

The objective is to drive the development and market take-up of the low carbon energy technologies (and non-technological solutions) that will constitute the backbone of a smart, integrated, decarbonised European energy system by 2050, with concrete milestones to be achieved by 2020. The clear societal challenge is to ensure EU security of energy supply and combat climate change and to stimulate growth and jobs in Europe serving a vast and growing global market.

The SET-Plan should be transformed for the period to 2020 into a truly European Energy Technology Policy that steers innovation and manages and orients resources according to its programmatic lines. The energy technologies needed to achieve our objectives have already been identified and agreed in the context of the SET-Plan (European Industrial Initiatives and Joint Programmes of the Research Alliance) and include the new priorities identified in the Communication on "Energy 2020 - A strategy for competitive, sustainable and secure energy".

These technology priorities are:

- *Energy efficiency* in end-use sectors, and local/distributed power and heat production, such as in buildings and smart cities and communities; ICT solutions for energy efficient buildings;
- *Renewable energy* for electricity and heat/cooling generation, such as wind, solar, use of bio-energy, geothermal and marine energy;
- *Advanced nuclear fission* (incl. radiation protection and waste management);
- *Fusion energy* (ITER¹), the fusion R&D programme and the Broader Approach);
- *Alternative transport drive-trains* such as fuel cells and hydrogen;
- *Smart grids*, including utility-scale energy storage;
- *Carbon Capture and Storage* (CCS) in the power and energy intensive industries.

Bringing these next generation technologies to cost-competitive maturity levels is only possible if we adopt an integrated innovation approach in Europe encompassing all actions in frontier research, technology development and large-scale demonstration, creating the bridge between R&D on the one hand and commercialisation on the other. It should also create inroads into industrial value creation (exploitation and deployment, regulatory framework and standard setting for the creation of new markets).

Strategic international cooperation will be pursued (i) with Joint collaborative R&D programmes between the European Energy Research Alliance and US DOE labs on smart grids, energy storage, smart communities and materials for energy, in the context of the technology working group of the EU-US Energy Council. (ii) with Joint collaborative R&D programmes for Industrial Initiatives under the SET plan with key interested countries (e.g. China for CCS).

¹ In line with the Budget Review such facilities would be provided for through a dedicated budget line.

4. THE SMART, GREEN AND INTEGRATED TRANSPORT CHALLENGE

With its natural propensity for application, transport R&I will play a crucial role in delivering the results that are necessary to combat climate change and to achieve the Europe 2020 goals for a smart, sustainable and inclusive growth.

The specific challenges are:

- *Resource efficient transport respecting the environment*: Infrastructures, vehicles and engines which are energy efficient and reduce dependency on fossil fuels; advanced *alternative fuels infrastructures* (monitoring and reducing the environmental impact of transport means and systems); achieving an efficient, integrated and user-friendly transport system, based on full *integration of information flows, management systems, infrastructure networks and mobility services*; minimising energy consumption of transport by *optimising mobility needs*, including in urban areas; and developing intelligent transport systems and services to achieve *efficient operations*.
- *Less congestion despite increase in mobility*: *Intelligent management of passenger travel and freight transport* with fully interoperable planning, information and pricing systems Europe wide; ensure flexibility and *quick reaction to crisis events* (e.g. extreme weather conditions); *door-to-door intermodal travel and freight delivery systems and services* (improve safety and security; fast, inexpensive and non intrusive security checks in transport terminals); and *radically more automated air traffic management technologies and systems*, interoperable with systems outside Europe.
- *Global leadership for the European transport manufacturing industry*: *Innovative, eco-friendly and safe vehicles and vessels* for road, rail, sea and air incorporating low or zero emission propulsion units and intelligent control systems; *autonomous and efficient maintenance services*; *new or unconventional transport systems and vehicles*; *fast design techniques* relying on simulation tools allowing to facilitate the *standardization and certification* process of the vehicles, vessels, aircraft and related infrastructure, allowing for reduced development costs and time to market; *safe and securely manageable control systems* enabling the exchange of information among vehicles, vessels and ; aircrafts, and with the *control and navigation services*; and *proof-of-concept demonstrators* to assess the feasibility of the above new technologies at component, vehicle and system level and to mitigate technological risks.

Across these challenges innovation activities will focus on:- bringing R&I to the market through demonstration projects, market take up actions and appropriate support for standardisation, regulation and innovative procurement strategies; and initiatives such as the Clean Sky and SESAR JTIs and the European Green Cars PPP promise to deliver results in terms of innovative marketable products and services.

Strategic international cooperation large-scale initiatives will be pursued with leading countries, such as the US, e.g. on the use of new generation aviation biofuels and on transport electrification (including technology demonstration, pre-standardisation and certification activities).

5. THE RESOURCE EFFICIENCY AND CLIMATE CHALLENGE

The challenge is to achieve a resource efficient, low carbon economy that meets the needs of a growing population within the ecological limits of a finite planet.

Multidisciplinary research and innovation is needed to decouple economic growth from energy and resource use and to reduce environmental and climate impacts. A decisive technological and societal shift is needed to maintain present levels of well-being, keep global warming below 2°C and help our society adapt to climate change. The activities will support Europe 2020 priorities, in particular on resource efficiency, environmental and climate policies.

The specific challenges are:

- *Sustainable management of natural resources and ecosystems*: enhanced understanding and valuation of strategic land-based and marine resources, ecosystems and ecosystem services (including water, air, soil, biodiversity); knowledge on natural tipping points and ecosystem resilience; enhanced monitoring of the state of the environment and progress towards resource efficiency; integrated knowledge of pollution (air, soil, noise, chemicals, etc.); tools and methods for improved marine spatial planning and land use planning; know-how and approaches to restore biological resources, including through green infrastructure; scenarios, cost benefit analysis and integrated modelling to underpin policy choices for the transition to a resource efficient economy; and better forecasting and management of natural disasters.
- *Fighting and adapting to climate change*: improved knowledge of climate processes; seamless climate change forecasting systems (short to long term); integrated modelling for mitigation and adaptation; enhanced monitoring and data infrastructures; assessing cost-effective mitigation and low-carbon development options in function of greenhouse gas emission pathways and temperature scenarios; integrated analysis of available policy options for emission reductions and for reaching climate targets for various geographical scales and sectors, including economic instruments; reuse of CO₂; evaluating full costs and benefits of climate change impacts and of adaptation measures, considering social and institutional aspects; assessing adverse effects, vulnerabilities and risks of climate change on various sectors, including on cities.
- *Eco-innovation, sustainable production and consumption*: to develop world leading technological, commercial, institutional and social solutions that improve resource productivity, ensure smarter use of energy and resources and decrease pollution across the entire lifecycle; to develop energy and resource efficient design and decision support tools (e.g. modelling, simulation, enterprise management systems) to optimise energy and resource performance; to develop approaches with lowered environmental impact, moving towards a circular / near-zero waste economy, based on comprehensive life cycle assessments of products and services; to promote non-technological eco-innovation and sustainable consumer behaviour.

Across this challenge, innovation will be supported through: demonstration, prototypes, validation, standardisation activities, public engagement, and will be linked with support for market replication and access to finance for low-carbon and innovative businesses. Open access to data will stimulate the smart use of strategic resources. New environmental services and new opportunities in global markets will be fostered.

To promote a global framework for resource efficiency and low carbon economies, strategic international cooperation will be pursued: with other resource-dependent industrialised countries (e.g. US, Japan); with the GEO/GEOSS Initiative on global earth observations; with the global research programmes and the relevant funding agencies on climate and biodiversity to feed in notably the activities of the Intergovernmental Panel for Climate Change (IPCC), the United Nations Framework Convention on Climate Change (UNFCCC) technology mechanism, and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

6. THE INCLUSIVE, INNOVATIVE AND SECURE SOCIETIES CHALLENGE

The societal challenge is to facilitate understanding of changes in society and to provide knowledge to underpin and improve decision-making in Europe for citizens' benefit. The focus will be on Europe 2020 priorities of smart, sustainable and inclusive growth, including the provision of evidence for economic, employment, social and environmental policies. The research and innovation activities will mobilise a broad range of social sciences and humanities, ICT and other technologies, and support social innovation and the engagement of citizens and improved public administrations. They will include activities aiming to improve the **security of European citizens and of the European economy** and the uptake of security solutions by potential users. They will contribute to EU policies, including the Common Foreign Policy and EU policies on internal security and disaster response.

The specific challenges are:

- *Inclusive societies*: new approaches to smart, sustainable and inclusive growth patterns in Europe including social innovation, cultural transformations, values and humanities; improved dissemination and take up of research results across Europe; social impacts of different socio-economic models; repercussions of global changes on the EU. **Socio-economic research** will be related to major cross-cutting policy changes in fields like health, energy, environment, migration (definitions of economic value, internalising external costs, valuing the future, role of institutions, behavioural economics, etc).
- *Socially responsible research and innovation*: interactions between societal actors and innovators, ethical acceptability, sustainability and engagement of society with new technologies and innovations. Efficient and effective public services and citizen participation in the context of policy development, decision-making, public service definition and delivery, sharing information and responsibilities; enabled by ICT, social and political sciences and application driven research and pilots.
- *Secure societies*: advanced means to fight against organised crime and terrorism; security of borders and of vital supply and trade routes; crisis and disaster management, including humanitarian aid; protection of infrastructures that are key to societies and economies; security systems' interoperability and dual-use technologies, as well as security and society (e.g. capabilities and processes needed to ensure the safety of citizens and ensure their fundamental human rights, including privacy, in the light of emerging technologies).
- *Digital and cyber security*: detection and prevention of cyber-crime; protection of critical ICT infrastructure; trustworthy digital society (secure and dependable networked service and computing environments, safer online content and privacy-friendly applications, electronic identification and authentication, critical information infrastructure protection etc.).
- *Enhanced knowledge for EU research and innovation policies*: evidence to support the design, implementation, evaluation and trans-national coordination of policies affecting research and innovation, including new indicators, forward-looking activities and impact assessment methods.

Social innovations and demonstrators (e.g. new types of 'social platforms' or 'social innovation labs' which aim at scaling up social innovations) will be supported. Across this challenge, cooperation with third countries will be essential for facilitating the promotion of European perspectives in global for a.

7. FUTURE AND EMERGING TECHNOLOGIES

The objective of Future and Emerging Technologies (FET) is to support exploratory research to open-up new and alternative ideas, concepts or paradigms of risky or non-conventional nature. FET aims to go beyond the conventional boundaries of research and innovation and ventures into uncharted areas with high potential impact on science, technology and innovation. FET exploits deep synergies at the boundaries between multiple disciplines such as ICT, physics, biology, chemistry, nanoscience, neuro- and cognitive science, ethology, social science, economics, arts and humanities. In addition, it cuts across and provides new scientific foundations to tackle grand challenges.

FET would consist of:

- *large-scale research partnerships* (FET Flagships) addressing grand scientific challenges requiring **cooperation** among a range of scientific disciplines, communities and programmes. FET Flagships will aim at unprecedented discoveries with transformative impact on science, technology and society, for instance, building a fully accurate digital model of the brain to develop new brain-inspired computing architectures and to understand functions and diseases such as Alzheimer or Parkinson, or overcoming the physical limitations of silicon to enable a new wave of technologies and applications. FET Flagships require a federated and sustained effort between national and European programmes.
- *small-scale, bottom-up actions* aiming at generating fresh ideas based on more open agendas, as well as by actions in support of novel themes and interdisciplinary communities aiming to set up new large-scale actions within FET or in other parts of the Common Strategic Framework.

FET will offer a strong response to the following key challenges:

- advancing the frontier of science and technology into novel and uncharted areas (out of the main stream) with high potential impact on innovation and transformative impact in science, technology, education and society;
- building of critical mass in provoking breakthrough scientific discoveries and in creating world-class science excellence centres in Europe, through closer linkages and synergies between EU and national activities;
- reduced complexity through a strong, bottom-up element allowing for an efficient harvesting of truly innovative ideas and the emergence of truly multi-disciplinary communities;
- creating a bridging mechanism between the unconstrained and bottom-up activities of individual research teams (supported through the European Research Council) and the collaborative activities guided by societal and industrial agendas;
- easier access and empowerment for those (often young) researchers and entrepreneurs with radically new ideas, which would otherwise find it hard to participate in the established networks typical of mainstream collaborative research;

8. LEADERSHIP IN ENABLING AND INDUSTRIAL TECHNOLOGIES

The objective is to maintain and build global leadership in enabling technologies that underpin industrial competitiveness across a range of existing and emerging sectors, and can be applied to address multiple existing and future societal challenges. The application of these enabling technologies to the societal challenges will be supported under the relevant challenges, and through relevant research infrastructures (in particular e-infrastructure).

The development of enabling technologies will emphasise R&D, large-scale pilots and demonstration, test beds and living labs. The aim is to strengthen the industrial basis, reinforce European clusters of excellence, creating business eco-systems and open technology platforms, offering possibilities for new products, applications and services to be developed, manufactured and brought to the market, new SMEs to be started and new Intellectual Property to be generated. Pre- and co-normative activities in support of standardisation and interoperability, safety and pre-regulatory activities will also be promoted.

Information and Communication Technologies (ICT)

The activities would focus on:

- *Micro, nano and photonics technologies, components and embedded systems engineering*, including also micro-nano-bio systems, organic and large area electronics, underlying technologies for the Internet of Things, smart integrated systems and complex systems engineering.
- *Technologies for manufacturing and the integrated enterprise*, to reinforce the competitiveness of EU enterprises by leveraging ICT tools for design and engineering, prototyping by supporting the emergence of smart, digital and virtual factories and enterprises and by improving the technological base of manufacturing.
- *Future internet infrastructures, technologies and services*, including R&I on networks, software and services, trust and security, communication and all optical networks, immersive multimedia and multi-operators low-cost sensor platforms.
- *Advanced computing systems and technologies* to leverage European assets in processor and system architecture, interconnect and data localisation technologies, cloud computing, parallel computing and simulation software for all market segments of computing, including compute-intensive application areas.
- *Robotics and smart spaces*, cognitive systems, advanced interfaces, and sentient machines.
- *ICT for digital content and creativity*: new technologies for language, learning, interaction, content access and understanding; intelligent information management systems; digital preservation; visual computing.
- *Research at the frontiers of ICT* such as transformative computational science, bio-chemistry based information science or neuro-morphic computation, disruptive ICT-based materials and components, novel computing paradigms such as quantum computing, bio-ICT convergence; novel brain-machine confluence; science of complex techno-social systems etc.
- Included are also *ICT research infrastructures for large-scale experimentation* such as living labs and *infrastructures for underlying key enabling technologies* and their

integration in advanced products and innovative smart systems, including equipment, tools, clean rooms and access to foundries for prototyping.

Nanotechnologies

Significant growth is expected for products and processes based on nanotechnologies. The emphasis would be on the widespread but responsible diffusion of nanotechnologies into the economy, to enable benefits and applications with high impact. The activities would focus on:

- *Nanomaterials and nanosystems enabling sustainable solutions in several areas:* a clean environment; energy conversion, storage and efficiency; green manufacturing and transport; medical imaging, diagnostics and therapy.
- *Ensuring the safety of nanotechnology applications* through validated scientific platforms for the assessment of hazard, exposure, and risk, allowing standardisation and regulation to be developed at the same pace as the development of nanotechnologies, without stifling innovation and promoting positive public perception.
- *Synthesis and manufacturing of nanoparticles, components and systems*, focusing on scalability, flexibility, predictability, low cost and safety; lab to pilot lines for more efficient transition of knowledge into industrial innovation.
- *Techniques, measuring methods and equipment* necessary for the development of complex nanomaterials and nanosystems.

Advanced materials

Advanced materials with new functionalities and improved performance are indispensable for industrial competitiveness and sustainable development. The general aim is to produce high added-value materials and products at a competitive cost, with minimal environmental impact and minimal consumption of raw materials and energy (based on complete life-cycle analyses). The activities would focus on:

- *Cross-cutting and enabling materials technologies* for innovation in all industrial sectors, e.g. self-healing, self-repairing or biocompatible materials.
- *Materials development and transformation*, scaling up to enable industrial manufacturing of future products.
- *Management of materials components*, e.g. joining, adhesion, separation, assembly, self-assembly and disassembling, characterisation, standardisation and quality control.
- *Materials for sustainable industry*, e.g. materials for low-carbon energy supply and production chains, process intensification, depollution and high added-value materials from waste such as CO₂.

Materials for creative industries, opening up new business opportunities for Europe, including materials by design and the development of converging technologies for materials.

Biotechnology

The activities would make use of nature's toolkit by focusing on:

- *Biotechnological processing:* use of micro-organisms and biocatalysts as resource efficient, environmentally friendly alternatives to conventional processes, substituting fossil resources by renewable ones in biorefinery processes.

- *Screening of terrestrial and marine biodiversity and discovery of new organisms and biochemical pathways:* to increase production and processing efficiencies and improving overall sustainability of human activities.
- *Cutting-edge research in emerging biotechnologies:* Systems biology, synthetic biology and bioinformatics, including convergence with other enabling technologies, as drivers to advance existing biotechnology applications and explore new ones (e.g. synthetic cell factories, artificial photosynthesis). This will include research on meta-genomics, metabolomics, proteomics, systems and synthetic biology, nano-biotechnology, bacterial cell-cell and plant-cell communication

Production (manufacturing and processing)

The emphasis will be on sustainable and competitive manufacturing and processing. The general objective is to enable a shift from a cost-based competitive advantage to one based on high added value, using trans-sectoral enabling production technologies. The activities would focus on:

- *Technologies for the Factories of the Future:* Development and integration of the adaptive production equipment of the future, with special emphasis on the needs of European SMEs, in order to achieve advanced and sustainable manufacturing systems.
- *Technologies enabling Energy-efficient buildings:* Development of green construction technologies and of energy-efficient systems and materials in new and renovated buildings, and also at district level, to reduce energy consumption and CO2 emissions.
- *Green technologies in the process industries:* Research to drastically reduce the environmental footprint of process industries, such as chemical, pulp and paper, or metals and steel processing, optimising their industrial transformation and the use of resources throughout the value chain.
- *The availability of raw materials* (both at world level and more specifically in Europe) is also crucial for the competitiveness of European industry: extraction and processing; reduction of waste and recycling; and the substitution of critical materials will be addressed.
- *New, sustainable business models:* Concepts and methodologies for "knowledge-based production" with more customised approaches that can adapt to the requirements of globalised value chains, changing markets, and emerging and future industries.

Space technologies

Space research would complement operational space programmes and focus on:

- *Space technology development:* development of advanced satellite and sensor technologies and research related to innovation. This includes research on emerging applications in the area of reducing vulnerability to space hazards (methods for monitoring and removal of space debris, forecasts of space weather, prevention of Near Earth Object impacts), all of which have direct importance to the security of citizens and the economy.
- *Space science and applications:* exploitation of space mission data and research on enabling technologies including life-support systems, recycling, automation and robotics, novel energy sources and storage, propulsion and navigation, sensors and small missions such as cubesats.

9. INNOVATION IN SMALL AND MEDIUM ENTERPRISES

The objective is to increase the levels of innovation in SMEs, covering their different innovation needs over the whole innovation cycle, thereby creating more fast-growing, internationally active SMEs.

This will be achieved through mainstreaming SME aspects in all parts of the Common Strategic Framework and thereby underpinning the objectives of the Small Business Act. SMEs will be supported throughout the CSF, in particular those parts dedicated to societal challenges, where SMEs have a key role to play (without a specific quantitative target). Where appropriate specific SME dedicated calls with ring-fenced budgets or specific eligibility criteria may be organised.

In addition, the following SME specific activities would be part of the CSF:

- *Support for research intensive SMEs*: The Eurostars Joint Programme could be reoriented along the lines stated in its interim evaluation. This an initiative based on Article 185 TFEU currently undertaken by 27 EU Member States and 6 Associated Countries, in the context of EUREKA. It provides combined EU and national financial support to market-oriented research projects initiated and driven by R&D performing SMEs. The bottom-up nature of the scheme fits the specific needs of these R&D performing SMEs.
- *Support for non-research intensive SMEs*: Whereas the current Eurostars initiative only supports technology-driven innovation carried out by research intensive SMEs, there is a need to support other forms of innovation and in particular for small companies which have no or little in-house R&D capacity to develop and implement innovation projects. It is therefore proposed to create a second initiative based on article 185 TFEU for this group of companies, provided there is sufficient interest and commitments from the Member States.

Furthermore, a reinforced link with the Enterprise Europe Network (not to be funded by the CSF) is aimed at. The support could range from improved information and advice services on opportunities resulting from the Single Market as well as third country markets, from the research and innovation activities of the CSF; to tailor-made services such as business review, mentoring, coaching and partner search activities for SMEs wishing to develop projects notably under the CSF; as well as providing links to relevant support available in national and regional (including Structural Fund) programmes. In particular, **this network could also provide innovation support services** such as for feasibility assessments, technology transfer, IPR management, access to finance guidance, etc. This support will be a pragmatic upgrade of the current Enterprise Europe Network and reinforced by relevant activities currently carried out by the FP7 National Contact Points, without duplicating the efforts of Member States in this area.

10. ACCESS TO RISK FINANCE

The objective is to support the achievement of R&I policy objectives by helping remedy market deficiencies in access to risk finance for a diverse range of innovative beneficiaries and projects across the innovation cycle. A particular priority is to attract more private funds for investments in research and innovation in Europe. Activities will primarily be implemented through a debt financial instrument based on an expansion in scope and scale of the FP7 Risk Sharing Finance Facility (RSFF) and an equity financial instrument developed from the CIP (GIF), together with a set of accompanying measures. Building on the set of common rules established in the future EU Equity and debt platforms, these two financial instruments will be implemented via a mandate to, or a partnership with, the European Investment Bank Group and/or to other financing partners with the status of international financial institutions, and/or national intermediaries.

The activities supported are:

Debt finance for risky investments in research and innovation activities: covering loans, guarantees counter-guarantees and other forms of risk finance (e.g. mezzanine funding), for public and private entities including, micro-enterprises, SMEs, mid-sized and large corporate, universities and research institutes, infrastructure projects (including R&I infrastructures), public private partnerships and special purpose entities. These activities will consist of:

- *Demand-driven approach* (no pre-allocation per themes), with specific support for SMEs and MidCaps (including support to an integrated scheme² for innovative SMEs and MidCaps with a high growth potential);
- *Policy-driven approach:* targeting sectors crucial to sustainable growth and competitiveness with specific needs (cf. major societal and industrial challenges, other EU flagships).

Equity finance for early and growth stages investments:

- *Early stage and seed investments:* covering equity investments in knowledge transfer organisations, university seed funds, cross-border seed funds, business angel co-investments, intellectual property assets, and early stage Venture capital funds.
- *Development of EU venture capital:* covering funds-of-funds operating across borders and investing in sectorally focused venture capital funds to increase considerably the volume of investment in the growth of innovative enterprises across borders.

² Work is underway on an integrated scheme "FRISBEE: Facility for Research and Innovation by Small and medium Business Enterprises in Europe" which could support individual innovative SMEs and mid-caps with European growth potential, via grants, loans, mezzanine instruments, guarantees and equity in any helpful combination and at any stage or stages of a firm's innovation activities. This draws elements of the successful US SBIR scheme. Access to VC and debt financing for such firms will not be limited to EU-level debt and equity financial instruments, but will also be possible via existing national or regional ones.

11. EUROPEAN RESEARCH COUNCIL

The objective of the ERC is to reinforce excellence, dynamism and creativity in European research and improve the attractiveness of Europe for the best researchers from both European and third countries, as well as for industrial research investment. The European science base is among the most productive in the world, but it does not contain sufficient pockets of world class excellence where ground-breaking results are generated which are vital to ensure innovation and competitiveness in the long run. Without excellent basic research, new products, services and business opportunities would not be possible.

The ERC provides a Europe-wide competitive funding structure for frontier research executed by individual teams. Scientific excellence is the sole criterion on the basis of which ERC grants are awarded. Host institutions must guarantee that the Principal Investigator can independently direct the research and manage its funding. Grants are portable between institutions enabling researchers to negotiate more attractive conditions.

- **ERC Starting Grants** boost the independent careers of excellent researchers by providing adequate support at the critical stage where they are starting or consolidating their own independent research team or programme. Europe offers insufficient opportunities for young investigators to become independent research leaders. This structural problem leads to a dramatic waste of research talent in Europe. It limits or delays the emergence of the next-generation of researchers, who bring new ideas and energy, and it encourages highly talented researchers at an early stage of their career to seek advancement elsewhere.
- **ERC Advanced Grants** encourage substantial advances at the frontier of knowledge by supporting excellent, leading advanced investigators to pursue ground breaking, high-risk/high gain research. The long-term funding provided by the ERC schemes provides the conditions under which advanced researchers can carry out exciting and ambitious projects.
- **ERC SYNERGY Grants** (to be introduced on a pilot basis in 2012) will enable small groups of 2 – 4 Principal Investigators and their teams to bring together complementary skills, knowledge, and resources, in order to jointly address research problems at the frontier of knowledge.
- **Proof of concept funding** will give ERC grant holders the opportunity to apply for additional funding to establish the innovation potential of ideas arising from their ERC-funded frontier research projects. This "proof of concept" funding aims to cover gaps which can occur at the earliest stages of an innovation, and can be used for activities such as technical validation, market research, clarifying IPR position and strategy or investigating commercial and business opportunities.

ERC funding strengthens the research base in leading research institutions, while at the same time supporting smaller but excellent institutions all over the EU and the associated countries to scale up the research profiles in which they are particularly strong. Competition between institutions to attract ERC grantees is leading to more attractive working environments for top researchers. The ERC also provides a benchmark for the performance of national research systems. Policy makers can look to the successful policies of others for lessons to improve their own system. In these ways the ERC provides a powerful dynamic for driving up the quality of the overall European research system and support the creation of an attractive and competitive European Research Area.

12. RESEARCH INFRASTRUCTURES

The objective is to support world-class research infrastructures which are necessary to meet the objectives of Europe 2020 and of its Innovation Union and Digital Agenda flagship initiatives. Research infrastructures enable ground-breaking research and innovation throughout the European Research Area, ease the access to the scientific data required for tackling major societal challenges and supporting smart, sustainable and inclusive growth.

Since most of the Research Infrastructure activities are funded by Member States, the following catalysing and leveraging EU level activities are needed:

- *Optimizing existing facilities* through their *opening* to the full user community. This should strengthen the European Research Area, and enable world-class research to tackle societal and economic challenges such as in health, climate change and energy. Support to European research infrastructure networks will generate economies of scale and, through harmonisation of best practice, help sustain a European eco-system of research facilities;
- *Help developing ICT-based e-Infrastructures* (such as research and education networks, grid and cloud computing infrastructures, supercomputing facilities, application and simulation software, visualisation, data infrastructures). This will emphasise the creation of a single European space for online research and the provision of services to research and education communities as well as to industry, incl. SMEs. In addition, this will continue to support the development of harmonious e-infrastructure policies at the EU level, promote ICT innovation using e-infrastructures as test beds, and lead international cooperation activities in this area, in view of obtaining a global infrastructure for online science and education. This should foster 'e-Science' creating online environments for research, education and industry, and supporting the development of innovative clusters.
- *Support to the emergence of new Research Infrastructures* of pan-European interest and of a unique nature, which are beyond the capacities of individual countries, e.g. in areas such as energy supply, marine science, astronomy, nanotechnology or ICT. In line with the Innovation Union objective to implement 60% of European Strategic Forum on Research Infrastructures (ESFRI) projects already by 2015, the EU action should enhance pooling of resources to achieve this goal.
- *Foster the potential for innovation of research infrastructures*, in particular by reinforcing links with companies that drive innovation, through promoting interactions between users, promoting technology transfer, and strengthening European capabilities in scientific instrumentation.

At international level, further work will be in the context of the Carnegie Group and recognised by the G8 to support the development of global research infrastructures.

13. MARIE CURIE ACTIONS

The objectives of the Marie Curie Actions (MCAs), dedicated to researchers' training, mobility and career development, are to stimulate young people to embark on research careers, to improve career prospects for researchers in Europe, as well as to attract and to retain European and worldwide talents in Europe. MCAs will create and reinforce international links between universities, research institutes and companies through international and cross-sector mobility.

The activities will support:

- *Initial training of researchers*, covering the current Initial Training Networks as well as newly identified priorities related to doctoral training: European Industrial Doctorates and European Innovative Doctoral Programmes. The action will also be open to any additional innovative implementation mode. It will set EU standards for excellent research training of young researchers, combining the three "i" dimension (international, interdisciplinary and inter-sectoral) with transferable skills modules. It will equip the next generation of researchers with key skills that will prepare them for the jobs of tomorrow in both public and private sectors.
- *Career development of experienced researchers* with opportunities to broaden or deepen their individual competences in both public and private sectors including the acquisition of entrepreneurial skills for a better understanding of innovation. It will offer tailor-made research opportunities to the most promising researchers through international and/or intersectoral mobility, as well as possibilities to restart a research career after a break. It will aim at attracting to and retaining the best researchers in Europe.
- *Researchers' exchanges between institutions from different countries and/or sectors*, with the aim to create or strengthen, between European countries and worldwide, research collaborations on multidisciplinary innovative projects. The action will be open to both public and private organisations and to all countries. It will be implemented through short exchanges of researchers.

These activities will have the possibility to leverage additional financing from regional, national or private funds through a possible co-funding mechanism (building on the current mechanism).

All Marie Curie Actions will continue to be open to organisations and researchers from third countries.

14. EUROPEAN INSTITUTE OF INNOVATION AND TECHNOLOGY

The objective is to foster the integration of higher education, research and innovation (the knowledge triangle) of the highest standard across the European Union, thereby increasing levels of innovation and entrepreneurship. The activities will emphasise the transfer of its higher education, research and innovation activities to the business context and their commercial application, as well as to supporting the creation of start-ups, spin-offs and small and medium-sized enterprises. They should address strategic long-term challenges for innovation in Europe, particularly in inter-disciplinary areas including those identified at European level. The activities will be implemented by the European Institute of Innovation and Technology. The EIT will interact with relevant EU and national initiatives and programmes via the future Common Strategic Framework for EU Research and Innovation Funding (CSF), which responds to the call for making research and innovation funding more effective.

The activities of the European Institute of Innovation and Technology to be supported, in accordance with its Regulation, are:

- *Knowledge Innovation Communities*: in the priority fields of [climate change, renewable energy, next generation of information and communication technologies, ...]. This should contribute to addressing the major societal challenges. The EIT's role should include quality control measures; continuous monitoring and periodically evaluations; and ensure coordination between them and with other activities supported under the Common Strategic Framework;
- *EIT degrees and diplomas*: awarded by higher education institutions that are partner organisations and which may be labelled EIT degrees and diplomas;
- *Promotion and dissemination of good practice* for the integration of the knowledge triangle in order to develop a common innovation and knowledge transfer culture;

The EIT shall raise a significant and increasing proportion of funding for these activities from public and private sources, and from income raised through the EIT's own activities, in accordance with its Regulation. Importantly however, the **EIT will, through the KICS, strongly contribute to addressing the grand challenges.**