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Subject: Proposal for a Regulation of the European Parliament and the Council
establishing Horizon 2020 - The Framework Programme for Research and
Innovation (2014-2020)
- Partial general approach

Delegations will find attached the partial general approach on the proposal for a Regulation of the European Parliament and the Council establishing Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020), as reached by the Competitiveness Council meeting on 31 May 2012.

Proposal for a Regulation of the European Parliament and the Council establishing Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020)

(text with EEA relevance)

**TITLE I
ESTABLISHMENT**

Article 1

Subject matter

This Regulation establishes Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) ("Horizon 2020") and determines the framework governing Union support to research and innovation activities, strengthening European scientific and technological base and fostering benefits for society as well as better exploitation of the industrial potential of policies of innovation, research and technological development.

Article 2

Definitions

For the purposes of this Regulation the following definitions apply:

- a) '*research and innovation activities*' mean the whole spectrum of activities of research, technological development, demonstration and innovation, including the promotion of cooperation with third countries and international organisations, dissemination and optimisation of results and stimulation of the training and mobility of researchers in the Union;
- b) '*direct actions*' mean research and innovation activities undertaken by the Commission through its Joint Research Centre;
- c) '*indirect actions*' mean research and innovation activities to which the Union provides financial support and which are undertaken by participants;

- d) *'public-private partnership'* means a partnership where private sector partners, the Union and, where appropriate, other partners, such as public sector bodies, commit to jointly support the development and implementation of a research and innovation programme or activities;
- e) *'public-public partnership'* means a partnership where public sector bodies or bodies with a public service mission at regional, national or international level commit with the Union to jointly support the development and implementation of a research and innovation programme or activities.

Article 3

Establishment of Horizon 2020

Horizon 2020 is hereby established for the period from 1 January 2014 to 31 December 2020.

Article 4

Union added value

Horizon 2020 shall play a central role in the delivery of the Europe 2020 strategy for smart, sustainable and inclusive growth by providing a common strategic framework for the Union's research and innovation funding, thus acting as a vehicle for leveraging private and public investment, creating new job opportunities and ensuring Europe's long-term sustainable growth and competitiveness as well as addressing societal challenges across the Union.

Article 5

General objective, priorities and specific objectives

1. Horizon 2020 shall contribute to building a society and an economy based on knowledge and innovation across the whole Union by leveraging additional research, development and innovation funding. Thereby, it shall support the implementation of the Europe 2020 strategy and other Union policies, as well as the achievement and functioning of the European Research Area (ERA). The first set of relevant performance indicators are set out in the introduction of Annex I.

2. This general objective shall be pursued through three mutually reinforcing priorities dedicated to:

excellent science;

industrial leadership;

societal challenges.

The specific objectives corresponding to each of those three priorities are set out in Parts I to III of Annex I, together with the broad lines of the activities.

3 The Joint Research Centre shall contribute to the general objective and priorities set out in paragraphs 1 and 2 by providing scientific and technical support to Union policies in collaboration with relevant national and regional research stakeholders, where appropriate. The broad lines of the activities are set out in Part IV of Annex I.

4. The European Institute of Innovation and Technology (EIT) set up by Regulation (EU) No 294/2008 of the European Parliament and of the Council¹ shall contribute to the general objective and priorities set out in paragraphs 1 and 2 with the specific objective of integrating the knowledge triangle of research, innovation and higher education. The relevant performance indicators for the EIT are set out in the introduction of Annex I and the broad lines of that specific objective and the activities are set out in Part V of Annex I.

5. Within the priorities and broad lines referred to in paragraph 2, account may be taken of new and unforeseen needs that arise during the period of implementation of Horizon 2020. This may, if duly justified, include responses to emerging opportunities, crises and threats, to needs relating to the development of new Union policies, and to the piloting of actions foreseen for support under future programmes.

¹ OJ L 97, 9.4.2008, p. 1

Article 6

Budget

1. [The financial envelope for the implementation of Horizon 2020 shall be EUR 87740 million, of which a maximum of EUR 86198 million shall be allocated to activities under Title XIX of the Treaty on the Functioning of the European Union (TFEU).

2. The amount for activities under Title XIX of the TFEU shall be distributed among the priorities set out in Article 5(2) as follows:
 - (a) Excellent science, EUR 27818 million;
 - (b) Industrial leadership, EUR 20280 million;
 - (c) Societal challenges, EUR 35888 million.

The maximum overall amount for the Union financial contribution from Horizon 2020 to the non-nuclear direct actions of the Joint Research Centre shall be EUR 2212 million.

The indicative breakdown for the specific objectives within the priorities and the maximum overall amount of the contribution to the non-nuclear direct actions of the Joint Research Centre are set out in Annex II.]

3. The EIT shall be financed through a maximum contribution from Horizon 2020 of [EUR 3194 million] as set out in Annex II. A first allocation of [EUR 1542 million] shall be provided to the EIT for activities under Title XVII of the TFEU. A second allocation of up to [EUR 1652 million] may be provided, subject to a positive result of the review set out in Article 26 (1). This additional amount may be provided, as indicated in Annex II, from the amount for the specific objective "Leadership in enabling and industrial technologies" within the priority on industrial leadership set out in paragraph 2(b) and from the amount for the priority on societal challenges set out in paragraph 2(c).

This funding in multiannual allocations shall be as follows:

- (a) the first allocation shall cover the ongoing developments of the current Knowledge and Innovation Communities (hereinafter KICs) and seed money for the launch of the second wave of new KICs;
- (b) the second allocation may cover the ongoing developments of the KICs already launched and the seed money for the launch of the new KICs.

The second allocation may be made available subject to the positive result of the review set out in Article 26(1) taking into account in particular:

- (a) the agreed timing of the creation of the new KICs;
- (b) the programmed financial needs of the existing ones according to their specific development;

4. The financial envelope of Horizon 2020 may cover expenses pertaining to preparatory, monitoring, control, audit and evaluation activities which are required for the management of Horizon 2020 and the achievement of its objectives, in particular studies and meetings of experts, as far as they are related to the objectives of Horizon 2020, expenses linked to information technology networks focusing on information processing and exchange, together with all other technical and administrative assistance expenses incurred by the Commission for the management of Horizon 2020.

Where necessary and duly justified, appropriations may be entered in the budget beyond 2020 to cover technical and administrative assistance expenses, in order to enable the management of actions not yet completed by 31 December 2020.

5. In order to respond to unforeseen situations or new developments and needs, and to take into account the provisions of paragraph 3 of this Article, the Commission may, following the interim evaluation of Horizon 2020 as referred to in Article 26(1)(a) , within the annual budgetary procedure review the amounts set out for the priorities in paragraph 2 and the indicative breakdown by specific objectives within these priorities set out in Annex II and transfer appropriations between the priorities and specific objectives up to a maximum of 7.5% of the total initial allocation of each priority and up to a maximum of 7.5% of the initial indicative breakdown of each specific objective. This does not concern the amount set out for the direct actions of the Joint Research Centre in paragraph 2 or the contribution to the EIT set out in paragraph 3.

Article 7

Association of third countries

1. Horizon 2020 shall be open to the association of:
- (a) acceding countries, candidate countries and potential candidates, in accordance with the general principles and general terms and conditions for the participation of those countries in Union programmes established in the respective framework agreements and decisions of association councils or similar agreements;
 - (b) selected third countries that fulfil all of the following criteria:
 - (i) have a good capacity in science, technology and innovation;
 - (ii) have a good track record of participation in Union research and innovation programmes;
 - (iii) have close economic and geographical links to the Union;

- (iv) are European Free Trade Association (EFTA) members or countries or territories listed in the Annex to Regulation (EU) No XX/2012 of the European Parliament and the Council establishing a European Neighbourhood Instrument²;
- (v) have fair and equitable treatment of Intellectual Property Rights.

(c) countries or territories associated to the Seventh Framework Programme.

2. Specific terms and conditions regarding the participation of associated countries in Horizon 2020, including the financial contribution based on the gross domestic product of the associated country shall be determined by international agreements between the Union and the associated countries.

² OJ L [], [], p. []

TITLE II
IMPLEMENTATION

CHAPTER I
IMPLEMENTATION, MANAGEMENT AND FORMS OF SUPPORT

Article 8

Implementation by means of a specific programme and the contribution to the European Institute of Innovation and Technology

Horizon 2020 shall be implemented through a consolidated specific programme. This programme shall specify the objectives and the detailed rules for implementation. Horizon 2020 shall also be implemented through a financial contribution to the EIT.

The specific programme shall set out one Part for each of the three priorities set out in Article 5(2) and one Part for the non-nuclear direct actions of the Joint Research Centre.

Effective coordination between the three main priorities of Horizon 2020 shall be required.

Article 9

Management

1. Horizon 2020 shall be implemented by the Commission in accordance with Regulation (EU) No XXXX/2012 [New Financial Regulation].
2. The Commission may also entrust part of the implementation of Horizon 2020 to the funding bodies referred to in Article [55(1)(b)] of Regulation (EU) No XXXX/2012 [New Financial Regulation].

Article 10
Forms of Union support

1. Horizon 2020 shall support indirect actions through one or several of the forms of funding provided for by Regulation (EU) No XX/2012 [New Financial Regulation], in particular grants, prizes, procurement and financial instruments.
2. Horizon 2020 shall also support direct actions undertaken by the Joint Research Centre.
3. Where the direct actions undertaken by the Joint Research Centre contribute to initiatives established under Article 185 or Article 187 TFEU, this contribution shall not be considered as part of the financial contribution allocated to these initiatives.

Article 11
Rules for participation and dissemination of results

The rules for participation and dissemination of results laid down in Regulation (EU) No XX/2012 [Rules for participation and dissemination] shall apply to indirect actions.

CHAPTER II PROGRAMMING

SECTION I GENERAL PRINCIPLES

Article 12

External advice and societal engagement

1. For the implementation of Horizon 2020, account shall be taken of advice and inputs provided by: advisory groups of independent, high level experts set up by the Commission; dialogue structures created under international science and technology agreements; forward looking activities; targeted public consultations (including, where appropriate, national and regional authorities or stakeholders); and transparent and interactive processes that ensure responsible research and innovation is supported.

Advice on the identification and design of strategic priorities by the European Research Area Committee (ERAC), other ERA-related Groups and the Enterprise Policy Group (EPG) shall, where appropriate, also be taken into consideration.

2. Full account shall also be taken of the research and innovation agendas established by, inter alia, European Technology Platforms and European Innovation Partnerships.

Article 12a

Synergies with national programmes and joint programming

1. For the implementation of Horizon 2020, account shall be taken of the need to build appropriate synergies and complementarities between national and European research and innovation programmes, in particular in areas where coordination efforts are made through the Joint Programming Initiatives.

2. Union support to Joint Programming Initiatives may be considered through the instruments referred to in Article 20, subject to the conditions and criteria laid down for such instruments.

Article 13

Cross-cutting issues

1. Linkages and interfaces shall be implemented across and within the priorities of Horizon 2020. Particular attention shall be paid in this respect to areas relating to bridging from discovery to market application; to social and economic sciences and humanities; to climate change and sustainable development; to fostering the functioning and achievement of the ERA and of the Innovation Union; to framework conditions in support of the Innovation Union; to contributing to the Digital Agenda; to widening participation across the EU in research and innovation; to international networks for excellent researchers and innovators such as COST; to cooperation with third countries; to responsible research and innovation including gender; to SME involvement in research and innovation and the broader private sector participation; to enhancing the attractiveness of the research profession and to facilitating cross-border and cross-sector mobility of researchers.

Particular attention shall also be paid to the cross-sectoral dimension of some research and innovation areas of Horizon 2020, such as the development and application of key enabling and industrial technologies as well as future and emerging technologies.

2. Where an indirect action is supported which is of high relevance to several of the priorities set out in Article 5(2) or to several specific objectives within those priorities, the financial amount for that action may be combined from the amounts allocated to respectively each priority or specific objective concerned.

Article 14

Evolving nature of science, technology, innovation, economies and society

Horizon 2020 shall be implemented in a manner ensuring that the priorities and actions supported are relevant to changing needs and take account of the evolving nature of science, technology, innovation, economies and society, where innovation includes business, organisational and societal aspects. Proposal for changes to the priorities and actions under Horizon 2020 will take into account the external advice from groups referred to in Article 12 as well as the recommendations from the interim evaluation referred to in Article 26.

Article 15

Gender equality

Horizon 2020 shall ensure the effective promotion of gender equality and the gender dimension in research and innovation content.

Article 15a

Researchers' careers

Horizon 2020 shall be implemented in accordance with the Regulation (EU) No xx/2013 [Rules for Participation], which shall contribute to the reinforcement of a single market for researchers and attractiveness of researchers' careers across the Union in the context of the European Research Area, by taking into account the transnational character of the majority of the actions supported under it.

Article 16
Ethical principles

1. All the research and innovation activities carried out under Horizon 2020 shall comply with ethical principles and relevant national, Union and international legislation, including the Charter of Fundamental Rights of the European Union and the European Convention on Human Rights and its Supplementary Protocols.

Particular attention shall be paid to the principle of proportionality, the right to privacy, the right to the protection of personal data, the right to the physical and mental integrity of a person, the right to non-discrimination and the need to ensure high levels of human health protection.

2. Research and innovation activities carried out under Horizon 2020 shall have an exclusive focus on civil applications.
3. The following fields of research shall not be financed:
 - (a) research activity aiming at human cloning for reproductive purposes;
 - (b) research activity intended to modify the genetic heritage of human beings which could make such changes heritable³;
 - (c) research activities intended to create human embryos solely for the purpose of research or for the purpose of stem cell procurement, including by means of somatic cell nuclear transfer.

³ Research relating to cancer treatment of the gonads can be financed.

4. Research on human stem cells, both adult and embryonic, may be financed, depending both on the contents of the scientific proposal and the legal framework of the Member States involved. No funding shall be granted for research activities that are prohibited in all the Member States. No activity shall be funded in a Member State where such activity is forbidden.
5. The fields of research set out in paragraph 3 may be reviewed within the context of the interim evaluation set out in Article 26(1) in the light of scientific advances.

Article 17

Complementarity with other Union programmes

Horizon 2020 shall be implemented in a way which is complementary to other Union funding programmes and policies, including the Structural Funds, the Common Agricultural Policy, the Programme for the Competitiveness of Enterprises and SMEs (COSME), Erasmus for all and Life+.

SECTION II

SPECIFIC FIELDS OF ACTION

Article 18

Small and medium-sized enterprises

1. Particular attention shall be paid to ensuring the adequate participation of, and innovation impact on, small and medium-sized enterprises (SMEs) as well as private sector in general in Horizon 2020. Quantitative and qualitative assessments of SME participation shall be undertaken as part of the evaluation and monitoring arrangements.

2. Further to the establishment of better conditions for SMEs to participate in Horizon 2020, specific actions shall be undertaken within the specific objective "Leadership in enabling and industrial technologies" set out in Point 1 of Part II of Annex I and each of the specific objectives under the priority "Societal challenges" set out in Points 1 to 7 of Part III of Annex I. These specific actions shall take the form of a dedicated SME instrument that is targeted at all types of SMEs with an innovation potential, in a broad sense, and shall be implemented in a consistent manner and tailored to the needs of SMEs as set out under the specific objective "Innovation in SMEs" in Point 3.3.(a) of Part II of Annex I.
3. The integrated approach set out in paragraphs 1 and 2 should lead to a minimum of 20% of the total combined budget for the specific objective on "Leadership in enabling and industrial technologies" and the priority "Societal challenges" going to SMEs.

Article 18a

Collaborative projects and partnership programmes

Horizon 2020 should be implemented primarily through transnational collaborative projects, delivered through calls for proposals in the Horizon 2020 Annual Work Programmes. These projects will be complemented by public-private and public-public partnerships. The partnerships will be designed with the involvement of Member States and shall develop principles for their internal management.

Article 19
Public-private partnerships

1. Horizon 2020 may be implemented through public-private partnerships where all the partners concerned commit to support the development and implementation of research and innovation activities of strategic importance to the Union's competitiveness and industrial leadership or to address specific societal challenges. Public-private partnerships shall be implemented in such a way that they do not impede the full participation of the best European players.

2. Involvement of the Union in those partnerships shall make use of the pre-existing and lean governance structures and may take one of the following forms:
 - (a) financial contributions from the Union to joint undertakings established pursuant to Article 187 TFEU under the Seventh Framework Programme, subject to the amendment of their basic acts; to new public-private partnerships set up established pursuant to Article 187 TFEU; and to other funding bodies referred to in Article [55(1)(b)(v) or (vii)] of Regulation (EU) No XX/2012 [New Financial Regulation]. This form of partnerships shall only be implemented where the scope of the objectives pursued and the scale of the resources required justify it;
 - (b) entering a contractual agreement between the partners referred to in paragraph 1, which specifies the objectives of the partnership, respective commitments of the partners, key performance indicators, and outputs to be delivered, including the identification of research and innovation activities that require support from Horizon 2020.

The public-private partnerships shall make public funds accessible through transparent processes and mainly through competitive calls, with rules for participation in compliance with those of Horizon 2020. Exceptions to the use of competitive calls should be duly justified.

3. Public-private partnerships shall be identified in an open and transparent way based on all of the following criteria:
 - (a) the added value of action at Union level;
 - (b) the scale of impact on industrial competitiveness, job creation, sustainable growth and socio-economic issues, including societal challenges;
 - (c) the long-term commitment from all partners based on a shared vision and clearly defined objectives;
 - (d) the scale of the resources involved and the ability to leverage additional investments in research and innovation;
 - (e) a clear definition of roles for each of the partners and agreed key performance indicators over the period chosen.

Where appropriate, complementarity to priorities, activities and involvement of Member States shall be ensured in public-private partnerships.

Article 20

Public-public partnerships

1. Horizon 2020 shall contribute to the strengthening of public-public partnerships, as and when appropriate, where actions at regional, national or international level are jointly implemented within the Union.

Particular attention shall be paid to joint programming initiatives between Member States.

2. Public-public partnerships may be supported either within, or across, the priorities set out in Article 5(2), in particular through:

- (a) an ERA-NET instrument using grants to support public-public partnerships in their preparation, establishment of networking structures, design, implementation and coordination of joint activities as well as Union topping up of no more than one joint call a year and of actions of a transnational nature;
- (b) Union participation in programmes undertaken by several Member States in accordance with Article 185 TFEU where it is justified by the scope of objectives pursued and the scale of resources required.

For the purposes of point (a), top-up funding shall be conditional on a prior indicative financial commitments in cash or in kind of the participating entities to the joint calls and actions. The ERA-NET instrument may include, where possible, an objective to harmonise rules and implementation modalities of the joint calls and actions. It may also be used in order to prepare for an initiative pursuant to Article 185 TFEU.

For the purposes of point (b) such initiatives shall only be proposed in cases where there is a need for a dedicated implementation structure and where there is a high level of commitment of the participating countries to integration at scientific, management and financial levels. In addition, proposals for initiatives referred to in point (b) shall be identified on the basis of all of the following criteria:

- (a) a clear definition of the objective to be pursued and its relevance to the objectives of Horizon 2020 and broader Union policy objectives;
- (b) indicative financial commitments of the participating countries, in cash or in kind including prior commitments to align national and/or regional investments for transnational research and innovation and, where appropriate, to pool resources;

- (c) the added value of action at Union level;
- (d) the critical mass, with regard to the size and the number of programmes involved, the similarity or complementarities of activities and the share of relevant research they cover;
- (e) the efficiency of Article 185 TFEU as the most appropriate means for achieving the objectives.

Article 21

International cooperation with third countries and international organisations

1. Entities established in third countries and international organisations shall be eligible to participate in indirect actions of Horizon 2020 under the conditions set out in Regulation (EU) XX/XX [Rules for Participation]. International cooperation with third countries and international organisations shall be promoted across and within Horizon 2020 to achieve, in particular, the following objectives:
 - (a) strengthening the Union's excellence and attractiveness in research and innovation as well as its economic and industrial competitiveness;
 - (b) tackling effectively common societal challenges;
 - (c) supporting the Union's external and development policy objectives, complementing external and development programmes. Synergies with other Union policies will be sought.
2. Targeted actions with the objective of promoting cooperation with specific third countries or groups of third countries shall be implemented on the basis of a strategic approach as well as common interest, priorities, and mutual benefit, taking into account their scientific and technological capabilities and market opportunities, and the expected impact.

Reciprocal access to third country programmes should be encouraged. In order to maximise impact, coordination and synergies with initiatives of Member States and associated countries shall be promoted. The nature of the cooperation may vary according to the specific partner countries.

Cooperation priorities shall take into account developments in Union policy, opportunities for cooperation with third countries, and fair and equitable treatment of intellectual property rights.

3. In addition, horizontal and cross-cutting activities to promote the strategic development of international cooperation shall be implemented under Horizon 2020.

Article 22

Information, communication, exploitation and dissemination

The Commission shall implement information and communication actions concerning Horizon 2020, including communication measures concerning supported projects and results. In particular, it shall provide timely and thorough information to Member States.

Budget allocated to communication under Horizon 2020 shall also contribute to covering the corporate communication of the Union's political priorities as far as they are related to the general objective of this Regulation.

Activities to disseminate information and carry out communication activities shall be an integral task under all of the actions supported by Horizon 2020.

In addition, the following specific actions shall be supported:

- (a) initiatives aimed at widening awareness and facilitating access to funding under Horizon 2020, in particular for those regions or types of participant that have a relatively low participation;
- (b) targeted assistance to projects and consortia to provide them with access to the necessary skills to optimise the communication, exploitation and dissemination of results;
- (c) actions which bring together results from a range of projects, including those that may be funded from other sources, to provide user-friendly databases and reports that summarise key findings;
- (d) dissemination to policy makers, including standardisation bodies, to promote the use of policy relevant results by the appropriate bodies at international, Union, national and regional level;
- (e) initiatives to foster dialogue and debate on scientific, technological and innovation related issues with the public, and to take advantage of social media and other innovative technologies and methodologies.

CHAPTER III CONTROL

Article 23

Control and audit

1. The control system set up for the implementation of this Regulation shall be designed so as to provide reasonable assurance of achieving adequate management of the risks relating to the effectiveness and efficiency of the operations as well as the legality and regularity of the underlying transactions, taking into account the multi-annual character of programmes as well as the nature of the payments concerned.
2. The control system shall ensure an appropriate balance between trust and control, taking into account administrative and other costs of controls at all levels, especially for participants, so that the objectives of Horizon 2020 can be achieved and the most excellent researchers and the most innovative enterprises can be attracted to it.

3. As part of the control system, the audit strategy for expenditure on indirect actions under Horizon 2020 shall be based on the financial audit of a representative sample of expenditure across the whole framework programme. This representative sample shall be complemented by a selection based on an assessment of the risks related to expenditure.

Audits of expenditure on indirect actions under Horizon 2020 shall be carried out in a coherent manner in accordance with the principles of economy, efficiency and effectiveness in order to minimize the audit burden of the participants.

[Article 24

Protection of the financial interests of the Union

1. The Commission shall take appropriate measures ensuring that, when actions financed under this Regulation are implemented, the financial interests of the Union are protected by the application of preventive measures against fraud, corruption and any other illegal activities, by effective checks and, if irregularities are detected, by the recovery of the amounts wrongly paid and, where appropriate, by effective, proportionate and deterrent penalties.
2. The Commission or its representatives and the Court of Auditors shall have the power of audit, on the basis of documents and on-the-spot checks and inspections, over all grant beneficiaries, contractors, subcontractors and other third parties who have received Union funds under Horizon 2020.

Without prejudice to paragraph 3, audits by the Commission may be carried out up to four years after the final payment.

3. The European Anti-Fraud Office (OLAF) may carry out on-the-spot checks and inspections on economic operators concerned directly or indirectly by such funding in accordance with the procedures laid down in Council Regulation (Euratom, EC) No 2185/96⁴ with a view to establishing whether there has been fraud, corruption or any other illegal activity affecting the financial interests of the Union in connection with a grant agreement or grant decision or a contract concerning Union funding.
4. Without prejudice to paragraphs 1, 2 and 3, cooperation agreements with third countries and international organisations and grant agreements and grant decisions and contracts resulting from the implementation of this Regulation shall expressly empower the Commission, the Court of Auditors and the OLAF to conduct such audits, on-the-spot checks and inspections.]

CHAPTER IV

MONITORING AND EVALUATION

Article 25

Monitoring

1. The Commission shall annually monitor the implementation of Horizon 2020, its specific programme and the activities of the EIT This shall include information on cross-cutting topics such as social and economic sciences and humanities, sustainability and climate change, including information on the amount of climate related expenditure, SME participation, private sector participation, gender equality, widening participation and progress against performance indicators. The monitoring shall also include information on the extent of funding for public-private and public-public partnerships, including Joint Programming Initiatives. The monitoring on funding for public-private partnerships shall, where appropriate, be undertaken in close consultation with the participants.
2. The Commission shall report and make publicly available the results of that monitoring.

⁴ OJ L 292, 15.11.1996, p. 2.

Article 26
Evaluation

1. Evaluations shall be carried out in a sufficiently timely manner to feed into the decision-making process.
 - (a) Not later than end 2017, the Commission shall carry out, with the assistance of independent experts selected on the basis of a transparent process, a review of the EIT, taking into account the evaluation provided for in Article 16 of the Regulation XX/2012 [revised EIT Regulation]. The second allocation of funds to the EIT as set out in Article 6(3) may be made available subject to a positive result of this review. The review shall assess the progress of the EIT against all of the following:
 - (i) the level of consumption and the efficiency in the use of the first allocation of funds set out in Article 6(3), differentiating between the amount of money used for the development of the first wave of KICs and the effect of the seed money for the second phase, and the ability of the EIT to attract funds from the partners in the KICs and especially from the private sector, as set out in Regulation XX/2012 [revised EIT Regulation];
 - (ii) the contribution of the EIT and the KICs to the priority on societal challenges and the specific objective on "leadership in enabling and industrial technologies" of the programme Horizon 2020 and the performance assessed on the basis of the indicators defined in Annex I.
 - (iii) the contribution of the EIT and the KICs to the integration of higher education, research, innovation;
 - (iv) the ability of the KICs to integrate relevant new partners where they can provide added value.

- (b) Not later than end 2017, and taking into account the ex-post evaluation of the Seventh Framework Programme to be completed by the end of 2015 and the review of the EIT, the Commission shall carry out, with the assistance of independent experts, selected on the basis of a transparent process, an interim evaluation of Horizon 2020, its specific programme, including the European Research Council, and the activities of the EIT, on the achievements (at the level of results and progress towards impacts) of the objectives of Horizon 2020 and continued relevance of all the measures, the efficiency and use of resources, the scope for further simplification, and Union added value. That evaluation shall also take into consideration aspects relating to access to funding opportunities for participants in all regions, for the private sector, notably SMEs and for promoting gender balance. That evaluation shall additionally take into account the contribution of the measures to the Union priorities of smart, sustainable and inclusive growth, results on the long-term impact of the predecessor measures, and the degree of synergy and interaction with other Union funding programmes, including the Structural Funds.
- (c) Not later than end 2023, the Commission shall carry out, with the assistance of independent experts, selected on the basis of a transparent process, an ex-post evaluation of Horizon 2020, its specific programme and the activities of the EIT. This shall cover the rationale, implementation and achievements, as well as the longer-term impacts and sustainability of the measures, to feed into a decision on a possible renewal, modification or suspension of a subsequent measure.
2. The performance indicators for the general objectives and for the EIT, as set out in the introduction of Annex I to this Regulation, and for the specific objectives as established in the specific programme, including relevant baselines, shall provide the minimum basis for assessing the extent to which the objectives of Horizon 2020 have been achieved.
3. Where appropriate and available, Member States shall provide the Commission with data and information necessary to permit the monitoring and evaluation of the measures concerned.
4. The Commission shall communicate the conclusions of those evaluations of Horizon 2020, accompanied by its observations, to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions.

TITLE III
FINAL PROVISIONS

Article 27

Repeal and transitional provisions

1. Decision No 1982/2006/EC is repealed with effect from 1 January 2014.
2. However, actions initiated under Decision No 1982/2006/EC and financial obligations related to those actions shall continue to be governed by that Decision until their completion.
3. The financial allocation referred to in Article 6 may also cover the technical and administrative assistance expenses necessary to ensure the transition between this programme and the measures adopted under Decision No 1982/2006/EC.

Article 28

This Regulation shall enter into force on the third day following that of its publication in the *Official Journal of the European Union*.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels,

For the European Parliament

The President

For the Council

The President

ANNEX I

Broad lines of the specific objectives and activities

Horizon 2020 has the general objective to build a society and an economy based on knowledge and innovation across the whole Union, while contributing to sustainable development. It will support the Europe 2020 strategy and other Union policies as well as the achievement and functioning of the European Research Area.

The performance indicators for assessing progress against this general objective are:

- the Europe 2020 R&D target (3 % of GDP);
- [the Europe 2020 innovation headline indicator].

This general objective shall be pursued through three distinct, yet mutually reinforcing, priorities, each containing a set of specific objectives. They will be implemented in a seamless manner in order to foster interactions between the different specific objectives, avoid any duplication of effort and reinforce their combined impact.

The Joint Research Centre shall contribute to the general objective and priorities of Horizon 2020 with the specific objective of providing customer-driven scientific and technical support to Union policies.

The European Institute of Innovation and Technology (EIT) shall contribute to the general objective and priorities of Horizon 2020 with the specific objective of integrating the knowledge triangle of research, innovation and higher education. The indicators for assessing the performance of the EIT are:

- organisations from universities, business and research integrated in the Knowledge and Innovation Communities;
- collaboration inside the knowledge triangle leading to the development of innovative products and processes.

This Annex sets out the broad lines of those specific objectives and activities referred to in Article 5(2), (3) and (4).

Cross-cutting issues and support measures in Horizon 2020

Cross-cutting issues, an indicative list of which is found in Article 13 of the Horizon 2020 Framework Regulation, will be promoted between specific objectives of the three priorities as necessary to develop new knowledge, key competences and major technological breakthroughs as well as translating knowledge into economic and societal value. Furthermore, in many cases, interdisciplinary solutions will have to be developed which cut across multiple specific objectives of Horizon 2020. Horizon 2020 will provide incentives for such cross-cutting actions, including by an efficient bundling of budgets.

Social sciences and humanities

Social sciences and humanities research will be fully integrated into each of the pillars of Horizon 2020 and each of the specific objectives. In relation to the societal challenges, social sciences and humanities are mainstreamed as an essential element of the activities needed to tackle each of the societal challenges to enhance their impact. The specific objective of the societal challenge 'Europe in a changing world: Inclusive, innovative and reflective societies' will support social sciences and humanities research by focusing on inclusive, innovative and reflective societies.

Science and society

The relationship between science and society as well as the promotion of Responsible Research and Innovation and science education and culture shall be deepened and public confidence in science reinforced by activities of Horizon 2020 favouring an informed engagement of citizens and civil society in research and innovation matters.

Gender

Promoting gender equality in science and innovation is a commitment of the EU. In Horizon 2020, gender will be addressed as a cross-cutting issue in order to rectify imbalances between women and men, and to integrate a gender dimension in research and innovation programming and content.

Small and medium-sized enterprises (SMEs)

Horizon 2020 will encourage and support the participation of SMEs in an integrated way across all specific objectives. In accordance with Article 18 of Horizon 2020 Framework Regulation, measures as set out in the specific objective 'Innovation in SMEs' (dedicated SME instrument) shall be applied in the specific objective 'Leadership in enabling and industrial technologies' and Part III 'Societal challenges'.

Widening the participation

The research and innovation potential of the Member States, despite some recent convergence, remain very different, with large gaps between “innovation leaders” and “modest innovators”. Activities shall help close the research and innovation divide in Europe and specific measures shall be taken to unlock excellence in low performing RDI regions, thereby widening participation in Horizon 2020 and contributing to the realisation of the European Research Area.

International Cooperation

International cooperation with third countries and international, regional or global organisations is necessary to effectively address many specific objectives defined in Horizon 2020. International cooperation is essential for frontier and basic research in order to capture the benefits from emerging science and technology opportunities. Cooperation is necessary for addressing the societal challenges and enhancing the competitiveness of European industry. Promoting researchers and innovation staff mobility at an international level is also crucial to enhance this global cooperation. International cooperation in research and innovation is a key aspect of the Union's global commitments. International cooperation will, therefore, be promoted in each of the three priorities of Horizon 2020. In addition, dedicated horizontal activities will be supported in order to ensure the coherent and effective development of international cooperation across Horizon 2020.

Sustainable development and climate change

Horizon 2020 will encourage and support activities towards exploiting Europe's leadership in the race to develop new processes and technologies promoting sustainable development, in a broad sense, and combating climate change. Such horizontal approach, fully integrated in all Horizon 2020 priorities, will help the EU to prosper in a low-carbon, resource constrained world while building a resource efficient, sustainable and competitive economy.

Bridging from discovery to market application

Bridging actions throughout Horizon 2020 are aimed at bringing discovery to market application, leading to exploitation and commercialisation of ideas whenever appropriate. The actions should be based on a broad innovation concept and stimulate cross-sectoral innovation.

Digital Agenda

Successful delivery of the Digital Agenda flagship initiative will spur innovation, economic growth and improvements in daily life for both citizens and business. Wider and more effective use of digital agenda technologies will thus enable Europe to address its key challenges.

Cross-cutting support measures

The cross-cutting issues will be supported by a number of transversal support measures, including support to: enhancing the attractiveness of the research profession, including the general principles of the European Charter for researchers; strengthening the evidence base and the development of and support for ERA (including the five ERA initiatives) and the Innovation Union; improving framework conditions in support of the Innovation Union, including the principles of the Commission Recommendation on the management of intellectual property⁵ and exploring the possibility of setting up an European Intellectual Property Rights valorisation instrument; administration and coordination of international networks for excellent researchers and innovators (such as COST).

⁵ Commission Recommendation on the management of intellectual property in knowledge transfer activities and Code of Practice for universities and other public research organisations (C(2008) 1329, of 10.4.2008).

PART I. PRIORITY 'EXCELLENT SCIENCE'

This Part aims to reinforce and extend the excellence of the Union's science base and to consolidate the European Research Area in order to make the Union's research and innovation system more competitive on a global scale. It consists of four specific objectives:

- (a) *The European Research Council (ERC)* shall provide attractive and flexible funding to enable talented and creative individual researchers and their teams to pursue the most promising avenues at the frontier of science, on the basis of Union-wide competition.
- (b) *Future and emerging technologies* shall support collaborative research in order to extend Europe's capacity for advanced and paradigm-changing innovation. It shall foster scientific collaboration across disciplines on radically new, high-risk ideas and accelerate development of the most promising emerging areas of science and technology as well as the Union wide structuring of the corresponding scientific communities.
- (c) *Marie Skłodowska-Curie actions* shall provide excellent and innovative research training as well as attractive career and knowledge-exchange opportunities through cross-border and cross-sector mobility of researchers to best prepare them to face current and future societal challenges.
- (d) *Research infrastructure* shall develop European research infrastructure for 2020 and beyond, foster their innovation potential and human capital, and complement this with the related Union policy and international cooperation.

Each of these has been proven to have high Union added value. Together, they form a powerful and balanced set of activities which, in concert with activities at national and regional levels, span the breadth of Europe's needs regarding advanced science and technology. Bringing them together in a single programme will enable them to operate with greater coherence, in a rationalised, simplified and more focused way, while maintaining the continuity which is vital to sustain their effectiveness.

The activities are inherently forward-looking, building skills in the long term, focusing on the next generation of science, technology, researchers and innovations and providing support for emerging talent from across the whole of the Union and associated countries, as well as worldwide. In view of their science-driven nature and largely ‘bottom-up’, investigator-driven funding arrangements, the European scientific community will play a strong role in determining the avenues of research followed under the programme.

PART II. PRIORITY 'INDUSTRIAL LEADERSHIP'

This Part aims to speed up development of the technologies and innovations that will underpin tomorrow’s businesses and help innovative European SMEs to grow into world-leading companies. It consists of three specific objectives:

- (a) *Leadership in enabling and industrial technologies* shall provide dedicated support for research, development and demonstration on ICT, nanotechnology, advanced materials, biotechnology, advanced manufacturing and processing and space. Emphasis will be placed on interactions and convergence across and between the different technologies.
- (b) *Access to risk finance* shall aim to overcome deficits in the availability of debt and equity finance for R&D and innovation-driven companies and projects at all stages of development. Together with the equity instrument of the Programme for the Competitiveness of Enterprises and SMEs, it shall support the development of Union-level venture capital.
- (c) *Innovation in SMEs* shall stimulate all forms of innovation in SMEs, targeting those with the potential to grow and internationalise across the single market and beyond.

The activities shall follow a business-driven agenda. The budgets for the specific objectives ‘Access to risk finance’ and ‘Innovation in SMEs’ will follow a demand-driven, bottom-up logic, without predetermined priorities. These shall be complemented by the use of financial instruments and a dedicated SME instrument following a policy driven logic within the Part on 'Societal challenges' and the specific objective ‘Leadership in enabling and industrial technologies’.

Horizon 2020 will take an integrated approach to the participation of SMEs, which should lead to a minimum of 20% of the total combined budgets for all specific objectives on societal challenges and the specific objective 'Leadership in enabling and industrial technologies' being devoted to SMEs.

The specific objective 'Leadership in enabling and industrial technologies' shall follow a technology-driven approach to develop enabling technologies that can be used in multiple areas, industries and services. Applications of these technologies to meet societal challenges shall be supported together with the Societal challenges.

PART III. PRIORITY 'SOCIETAL CHALLENGES'

This Part responds directly to the policy priorities and societal challenges identified in the Europe 2020 strategy and aiming to stimulate the critical mass of research and innovation efforts needed to achieve Union's policy goals. Funding shall be focused on the following specific objectives:

- (a) Health, demographic change and well-being;
- (b) European Bioeconomy Challenges: Food security, sustainable agriculture and forestry, marine and maritime and inland water research;
- (c) Secure, clean and efficient energy;
- (d) Smart, green and integrated transport;
- (e) Climate action, resource efficiency and raw materials;
- (f) Europe in a changing world - Inclusive, innovative and reflective societies;
- (g) Secure societies - Protecting freedom and security of Europe and its citizens.

All the activities shall take a challenge-based approach, focusing on policy priorities without predetermining the precise choice of technologies or solutions that should be developed. The emphasis shall be on bringing together a critical mass of resources and knowledge across different fields, technologies and scientific disciplines in order to address the challenges. The activities shall cover the full cycle from research to market, with a new focus on innovation-related activities, such as piloting, demonstration activities, test-beds, support for public procurement, design, end-user driven innovation, social innovation and market take-up of innovations.

The Joint Research Centre's activities shall be an integral part of Horizon 2020, in order to provide robust, evidence-based support for Union policies. This shall be driven by customer needs, complemented by forward-looking activities.

The EIT shall play a major role by bringing together excellent research, higher education and innovation thus integrating the knowledge triangle. The EIT shall do so primarily through the Knowledge and Innovation Communities (KICs). In addition it shall ensure that experiences are shared beyond the KICs through targeted dissemination and knowledge sharing measures, thereby promoting a faster uptake of innovation models across the Union.

PART I
EXCELLENT SCIENCE

1. EUROPEAN RESEARCH COUNCIL (ERC)

1.1 Specific objective

The specific objective is to reinforce the excellence, dynamism and creativity of European research.

Europe has set out its ambition to move to a new economic model based on smart, sustainable and inclusive growth. This type of transformation will need more than incremental improvements to current technologies and knowledge. It will require much higher capacity for science-based innovation fuelled by radical new knowledge, allowing Europe to take a leading role in creating the scientific and technological paradigm shifts which will be the key drivers of productivity growth, competitiveness, wealth, sustainable development and social progress in the future. Such paradigm shifts have historically tended to originate from the curiosity-driven basic research before going on to lay the foundations for whole new industries and sectors.

World-leading innovation is closely associated with excellent science. Once the undisputed leader, Europe has fallen behind in the race to produce the very best cutting-edge science and has played a secondary role to the United States of America in the major post-war technological advances. Although the Union remains the largest producer of scientific publications in the world, the United States of America produces twice as many of the most influential papers (the top 1 % by citation count). Similarly, international university rankings show that US universities dominate the top places. And 70% of the world's Nobel Prize winners are based in the USA.

One part of the challenge is that, while Europe and the United States of America invest similar amounts in their public-sector science bases, the Union has nearly three times as many public-sector researchers, resulting in significantly lower investment per researcher. Moreover, US funding is more selective about allocating resources to the leading researchers. This helps to explain why the Union's public-sector researchers are, on average, less productive and, altogether, make less combined scientific impact than their far less numerous US counterparts.

Another major part of the challenge is that in many European countries the public sector still does not offer sufficiently attractive conditions for the best researchers. It can take many years before talented young researchers are able to become independent scientists in their own right. This leads to a dramatic waste of Europe's research potential by delaying and in some cases even inhibiting the emergence of the next generation of researchers, who bring new ideas and energy, and by enticing excellent researchers starting their career to seek advancement elsewhere.

Furthermore, these factors compound Europe's relative unattractiveness in the global competition for scientific talent. The ability of the US system to offer more resources per researcher and better career prospects explains how it continues to attract the best researchers from across the world, including tens of thousands from the Union.

1.2 Rationale and Union added value

The ERC was created to provide Europe's best researchers, both women and men, with the resources they need to allow them to compete better at global level, by funding individual teams on the basis of pan-European competition. It operates autonomously: an independent Scientific Council made up of scientists, engineers and scholars of the highest repute and expertise establishes the overall scientific strategy and has full authority over decisions on the type of research to be funded. These are essential features of the ERC, guaranteeing the effectiveness of its scientific programme, the quality of its operations and peer-review process and its credibility in the scientific community.

Operating across Europe on a competitive basis, the ERC is able to draw on a wider pool of talents and ideas than would be possible for any national scheme. The best researchers and the best ideas compete against each other. Applicants know they have to perform at the highest level, the reward being flexible funding on a level playing field, irrespective of local bottlenecks or the availability of national funding.

Frontier research funded by the ERC is thereby expected to have a substantial direct impact in the form of advances at the frontiers of knowledge, opening the way to new and often unexpected scientific and technological results and new areas for research which, ultimately, can generate the radically new ideas which will drive innovation and business inventiveness and tackle societal challenges. This combination of excellent individual scientists with innovative ideas underpins every stage of the innovation chain.

Beyond this, the ERC has a significant structural impact by generating a powerful stimulus for driving up the quality of the European research system, over and above the researchers and projects which the ERC funds directly. ERC-funded projects and researchers set a clear and inspirational target for frontier research in Europe, raise its profile and make it more attractive for the best researchers at global level. The prestige of hosting ERC grant-holders and the accompanying ‘stamp of excellence’ are intensifying competition between Europe’s universities and other research organisations to offer the most attractive conditions for top researchers. And the ability of national systems and individual research institutions to attract and host ERC grant-winners sets a benchmark allowing them to assess their relative strengths and weaknesses and reform their policies and practices accordingly. ERC funding is therefore in addition to ongoing efforts at Union, national and regional levels to reform, build capacity and unlock the full potential and attractiveness of the European research system.

1.3 Broad lines of the activities

The fundamental activity of the ERC shall be to provide attractive long-term funding to support excellent investigators and their research teams to pursue ground-breaking, high-gain/high-risk research.

ERC funding shall be awarded in accordance with the following well-established principles. Scientific excellence shall be the sole criterion on which ERC grants are awarded. The ERC shall operate on a ‘bottom-up’ basis without predetermined priorities. The ERC grants shall be open to individual teams of researchers of any age, gender, and from any country in the world, working in Europe. And the ERC shall aim to foster healthy competition across Europe.

The ERC shall give particular priority to assisting the best starting researchers with excellent ideas to make the transition to independence by providing adequate support at the critical stage when they are setting up or consolidating their own research team or programme. The ERC will also continue to provide appropriate levels of support for established researchers.

The ERC shall also give support, as necessary, to emerging new ways of working in the scientific world with the potential to create breakthrough results and facilitates exploration of the commercial and social innovation potential of the research which it funds.

By 2020, the ERC therefore shall aim to demonstrate: that the best researchers are participating in the ERC’s competitions, that ERC funding has led to scientific publications of the highest quality, and to research results with high societal and economic potential impact and that the ERC has contributed significantly to making Europe a more attractive environment for the world’s best scientists. In particular, the ERC shall target a measurable improvement in the Union’s share of the world’s top 1 % most highly cited publications. In addition it shall aim at a substantial increase in the number of excellent researchers from outside Europe whom it funds. The ERC shall share experience and best practices with regional and national research funding agencies in order to promote the support of excellent researchers. In addition, the ERC shall further raise the visibility of its programmes outside Europe-

The ERC's Scientific Council shall continuously monitor the ERC's operations and consider how best to achieve its objectives by means of grant schemes that emphasise effectiveness, clarity, stability and simplicity, both for applicants and in their implementation and management, and, as necessary, to respond to emerging needs. It shall endeavour to sustain and further refine the ERC's world-class peer-review system which is based on fully transparent, fair and impartial treatment of proposals so that it can identify ground-breaking scientific excellence and talent regardless of a researcher's gender, nationality or age. Finally, the ERC shall continue conducting its own strategic studies to prepare for and support its activities, maintain close contacts with the scientific community, the regional and national funding agencies and other stakeholders and look to make its activities complement research conducted at other levels.

2. FUTURE AND EMERGING TECHNOLOGIES (FET)

2.1. Specific objective

The specific objective is to foster radically new technologies by exploring novel and high-risk ideas building on scientific foundations and contribute to the European next generation industries. By providing flexible support to goal-oriented and interdisciplinary collaborative research on various scales and by adopting innovative research practices, the aim is to identify and seize opportunities of long-term benefit for citizens, the economy and society.

FET shall promote research and technology beyond what is known, accepted or widely adopted and shall foster novel and visionary thinking to open promising paths towards powerful new technologies, some of which could develop into leading technological and intellectual paradigms for the decades ahead. FET shall foster efforts to pursue small-scale research opportunities across all areas, including emerging themes and grand scientific and technological S&T challenges that require close collaboration between programmes across Europe and beyond. This approach shall be driven by excellence and extends to exploring pre-competitive ideas for shaping the future of technology, enabling society and industry to benefit from multi-disciplinary research collaboration that needs to be engaged at European level by making the link between research driven by science and research driven by societal challenges or by industrial competitiveness.

The activities within the FET programme should be complementary to the activities within the priorities of the other parts of Horizon 2020 and, where possible, synergies will be sought.

2.2. Rationale and Union Added Value

Radical breakthroughs with a transformative impact increasingly rely on intense collaboration across disciplines in science and technology (for instance, information and communication, biology, chemistry, earth system sciences, material sciences, neuro- and cognitive sciences, social sciences or economics) and with the arts, behavioral sciences and humanities. This may require not only excellence in science and technology but also new attitudes and novel interactions between a broad range of players in research.

While some ideas can be developed on a small scale, others may be so challenging that they require a large collaborative effort over a substantial period of time. Major economies worldwide have recognised this, and there is growing global competition to identify and pursue emerging technological opportunities at the frontier of science which can generate a considerable impact on innovation and benefits for society. To be effective, these types of activities may need to be built up quickly to a large scale by a common European effort around common goals to build critical mass, foster synergies and obtain optimum leveraging effects.

The FET programme shall address the entire spectrum of science-driven innovation: from bottom-up, small-scale early explorations of embryonic and fragile ideas to building new research and innovation communities around transformative emerging research areas and large collaborative research initiatives built around a research agenda aiming to achieve ambitious and visionary goals. These three levels of engagement each have their own specific value, while being complementary and synergistic. For example, small-scale explorations can reveal needs for developing new themes that can lead to large-scale action based on appropriate roadmaps. They may involve a wide range of research players, including young researchers and research-intensive SMEs, and stakeholder communities (civil society, policymakers, industry and public researchers), clustered around research agendas as they take shape, mature and diversify.

2.3. Broad lines of activities

While the FET programme aims to be visionary, transformative and unconventional, its activities shall follow different logics, from completely open to varying degrees of structuring of topics, communities and funding.

The activities shall give firmer shape to different logics for action, on the appropriate scale, identifying and seizing opportunities of long-term benefit for citizens, the economy and society:

- (a) *By fostering novel ideas ('FET Open')*, FET shall support early stage science and technology research exploring new foundations for radically new future technologies by challenging current paradigms and venturing into unknown areas. A bottom-up selection process widely open to any research ideas shall build up a diverse portfolio of targeted projects. Early detection of promising new areas, developments and trends, along with attracting new and high-potential research and innovation players, will be key.
- (b) *By nurturing emerging themes and communities ('FET Proactive')*, FET shall, in close association with the societal challenges and industrial leadership themes, address a number of promising exploratory research themes with the potential to generate a critical mass of inter-related projects that, together, make up a broad and multi-faceted exploration of the themes and build a European pool of knowledge.
- (c) *By pursuing grand interdisciplinary S&T challenges ('FET Flagships')*, FET shall, taking into full account the outcome of FET preparatory projects, support ambitious large-scale, science and technology driven research aiming to achieve a scientific and technological breakthrough in areas identified as relevant in an open and transparent manner involving the Member States and relevant stakeholders. Such activities could benefit from the coordination between European and national agendas. The scientific advance should provide a strong and broad basis for future technological innovation and economic application, plus novel benefits for society. These activities shall be realised using the existing funding instruments.

3. MARIE SKŁODOWSKA-CURIE ACTIONS

3.1. Specific objective

The specific objective is to ensure optimum development and dynamic use of Europe's intellectual capital in order to generate and transfer new skills and innovation and, thus, to realise its full potential across all sectors and regions.

Well-trained, motivated, dynamic and creative researchers are the essential element for the best science and the most productive research-based innovation.

Although Europe hosts a large and diversified pool of skilled human resources for research and innovation, this needs to be constantly replenished, improved and adapted to the rapidly evolving needs of the labour market. Today only 46% of this pool works in the business sector, which is much lower than in Europe's main economic competitors, e.g. 69% in China, 73% in Japan and 80% in the United States. In addition, demographic factors mean that a disproportionate number of researchers will reach retirement age in the next few years. This, combined with the need for many more high-quality research jobs as the research intensity of the European economy increases, will be one of the main challenges facing European education, research and innovation systems in the years ahead.

The necessary reform must start at the first stages of the researchers' careers, during their doctoral studies or comparable post-graduate training. Europe must develop state-of-the-art, innovative training schemes, consistent with the highly competitive and increasingly inter-disciplinary requirements of research and innovation. Significant involvement of businesses, including SMEs and other socio-economic actors, will be needed to equip researchers with the innovation skills demanded by the jobs of tomorrow. It will also be important to enhance the mobility of these researchers, as it currently remains at too modest a level: in 2008, only 7% of European doctoral candidates were trained in another Member State, whereas the target is 20% by 2030.

This reform must continue through every stage of researchers' careers. It is vital to increase the mobility of researchers at all levels, including mid-career mobility, not only between countries but also between the public and private sectors. This creates a strong stimulus for learning and developing new skills. It is also a key factor in cooperation between academics, research centres and industry across countries. The human factor is the backbone of sustainable cooperation which is the key driver for an innovative and creative Europe able to face challenges to society, and key to overcoming fragmentation of national policies. Collaborating and sharing knowledge, via individual mobility at all stages of a career and via exchanges of highly skilled research and innovation staff, are essential for Europe to re-take the path to sustainable growth and to tackle societal challenges.

If Europe is to match its competitors in research and innovation, it must entice more young women and men to embark on research careers and provide highly attractive opportunities and environments for research and innovation. The most talented individuals, from Europe and elsewhere, should see Europe as a pre-eminent place to work. Gender equality, high-quality and reliable employment and working conditions plus recognition are crucial aspects that must be secured in a consistent way across the whole of Europe.

3.2. Rationale and Union added value

Neither Union funding alone nor Member States individually will be able to address this challenge. Although Member States have introduced reforms to improve their tertiary education institutions and modernise their training systems, progress is still uneven across Europe, with big differences between countries. Overall, scientific and technological cooperation between the public and private sectors generally remains weak in Europe. The same applies to gender equality and to the efforts to attract students and researchers from outside the ERA. Currently around 20% of the doctoral candidates in the Union are citizens of third countries, whereas about 35% in the United States of America come from abroad. To speed up this change, a strategic approach that goes beyond national borders is required at Union level. Union funding is crucial to create incentives for and encourage the indispensable structural reforms.

The European Marie Skłodowska-Curie actions have made remarkable progress to promote mobility, both transnational and intersectoral, and to open research careers at European and international levels, with excellent employment and working conditions following the principles of the European Researchers Charter and Code. There is no equivalent in Member States as far as their scale and scope, funding, international character, generation and transfer of knowledge are concerned. They have strengthened the resources of those institutions able to attract researchers internationally and thereby encouraged the spread of centres of excellence around the Union. They have served as a role model with a pronounced structuring effect by spreading their best practices at national level. The bottom-up approach taken by Marie Skłodowska-Curie actions has also allowed a large majority of those institutions to train and upgrade the skills of a new generation of researchers able to tackle societal challenges.

Further development of the Marie Skłodowska-Curie actions will make a significant contribution to development of the European Research Area. With their Europe-wide competitive funding structure, Marie Skłodowska-Curie actions will encourage new, creative and innovative types of training such as industrial doctorates, involving education, research and innovation players who will have to compete globally for a reputation of excellence. By providing Union funding for the best research and training programmes following the Principles for Innovative Doctoral Training in Europe, they will also promote wider dissemination and take-up, moving towards more structured doctoral training.

Marie Skłodowska-Curie grants will also be extended to the temporary mobility of experienced researchers, engineers from public institutions to the private sector or vice versa, thereby encouraging and supporting universities, research centres and businesses, other socio-economic actors to cooperate with one another on a European and international scale. With the aid of their well-established, transparent and fair evaluation system, Marie Skłodowska-Curie actions will identify excellent talents in research and innovation in an international competition which gives prestige and therefore motivation for researchers to advance their career in Europe.

The societal challenges to be addressed by highly skilled researchers and innovation staff are not just Europe's problem. These are international challenges of colossal complexity and magnitude. The best researchers in Europe and the world need to work together across countries, sectors and disciplines. Marie Skłodowska-Curie actions will play a key role in this respect by supporting staff exchanges that will foster collaborative thinking via the international and intersectoral knowledge-sharing that is so crucial for open innovation.

The co-funding mechanism of the Marie Skłodowska-Curie actions will be crucial to expand Europe's pool of talents. The numerical and structural impact of Union action will be increased by leveraging regional, national and international funding, both public and private, to create new programmes and to adapt existing ones to international and intersectoral training, mobility and career development. Such a mechanism will forge stronger links between research and education efforts at national and Union levels.

All the activities under this challenge will contribute to creating a whole new mindset in Europe that is crucial for creativity and innovation. Marie Skłodowska-Curie funding measures will strengthen pooling of resources in Europe and thereby lead to improvements in coordination and governance of researchers' training, mobility and career development. They will contribute to the policy goals outlined in the Innovation Union, Youth on the Move and the Agenda for New Skills and Jobs and will be vital to turn the European Research Area into reality. The Marie Skłodowska-Curie actions will therefore be developed in close synergy with other programmes supporting these policy objectives, including the Erasmus for All programme and the Knowledge and Innovation Communities of the EIT.

3.3. Broad lines of the activities

(a) Fostering new skills by means of excellent initial training of researchers

The goal is to train a new generation of creative and innovative researchers, able to convert knowledge and ideas into products and services for economic and social benefit in the Union.

Key activities shall be to provide excellent and innovative training to early-stage researchers at post-graduate level via interdisciplinary projects or doctoral programmes involving universities, research institutions, research infrastructures, businesses, SMEs, other socio-economic groups from different countries, Member States, associated countries and/or third countries. This will improve career prospects for young post-graduate researchers in both the public and private sectors.

(b) Nurturing excellence by means of cross-border and cross-sector mobility

The goal is to enhance the creative and innovative potential of experienced researchers at all career levels by creating opportunities for cross-border and cross-sector mobility.

Key activities shall be to encourage experienced researchers to broaden or deepen their skills by means of mobility by opening attractive career opportunities in universities, research institutions, research infrastructures, businesses, SMEs and other socio-economic groups all over Europe and beyond. This should enhance the innovativeness of the private sector and promote cross-sector mobility. Opportunities to restart a research career after a break and to (re-)integrate researchers into a longer term research position in Europe, including in their country of origin, after a trans-national/international mobility experience, shall also be supported.

(c) Stimulating innovation by means of cross-fertilisation of knowledge

The goal is to reinforce international cross-border and cross-sector collaboration in research and innovation by means of exchanges of research and innovation personnel in order to be able to face global challenges better.

Key activities shall be to support exchanges of research and innovation staff among a partnership of universities, research institutions, research infrastructures, businesses, SMEs and other socio-economic groups, both within Europe and worldwide. This will include fostering cooperation with third countries.

(d) Increasing the structural impact by co-funding the activities

The goal is, by leveraging additional funds, to increase the numerical and structural impact of Marie Skłodowska-Curie actions and to foster excellence at national level in researchers' training, mobility and career development.

Key activities shall be, with the aid of a co-funding mechanism, to encourage regional, national and international organisations, both public and private, to create new programmes and to adapt existing ones to international and intersectoral training, mobility and career development. This will increase the quality of research training in Europe at all career stages, including at doctoral level, will foster free circulation of researchers and scientific knowledge in Europe, will promote attractive research careers by offering open recruitment and attractive working conditions and will support research and innovation cooperation between universities, research institutions and enterprises and cooperation with third countries and international organisations.

(e) Specific support and policy action

The goals are to monitor progress, identify gaps in the Marie Skłodowska-Curie Actions and to increase their impact. In this context, indicators shall be developed and data related to researchers' mobility, skills and careers analysed, seeking synergies and close coordination with the policy support actions on researchers, their employers and funders carried out under the specific objective 'Europe in a changing world - Inclusive, innovative and reflective societies'. The activity shall further aim at raising awareness of the importance and attractiveness of a research career and at disseminating research and innovation results emanating from work supported by Marie Skłodowska-Curie actions.

4. RESEARCH INFRASTRUCTURES

4.1 Specific objective

The specific objective is to endow Europe with world-class research infrastructures which are accessible to all researchers in Europe and beyond and fully exploit their potential for scientific advance and innovation.

Research infrastructures are key determinants of Europe's competitiveness across the full breadth of scientific domains and essential to science-based innovation. In many fields research is impossible without access to supercomputers, radiation sources for new materials, clean rooms for nanotechnologies, databases for genomics and social sciences, observatories for Earth sciences, broadband networks for transferring data, etc. Research infrastructures are necessary to carry out the research needed to address grand societal challenges. They propel collaboration across borders and disciplines and create a seamless and open European space for online research. They promote mobility of people and ideas, bring together the best scientists from across Europe and the world and enhance scientific education. Their construction and continued operation challenges researchers and innovative companies to develop state of the art technology. In this way, they strengthen Europe's high tech innovative industry. They drive excellence within the European research and innovation communities and can be outstanding showcases of science for society at large.

Europe must establish an adequate, stable base for building, maintaining and operating research infrastructures if its research is to remain world-class. This requires substantial and effective cooperation between Union, national and regional funders for which strong links with the cohesion policy will be pursued to ensure synergies and a coherent approach.

This specific objective addresses a core commitment of the *Innovation Union* flagship initiative, which highlights the crucial role played by world-class research infrastructures in making ground-breaking research and innovation possible. The initiative stresses the need to pool resources across Europe, and in some cases globally, in order to build and operate research infrastructures. Equally, the *Digital Agenda for Europe* flagship initiative emphasises the need to reinforce Europe's e-infrastructures and the importance of developing innovation clusters to build Europe's innovative advantage.

4.2. Rationale and Union added value

State-of-the-art research infrastructures are becoming increasingly complex and costly, often requiring integration of different equipment, services and data sources and extensive transnational collaboration. No single country has enough resources to support all the research infrastructures it needs. The European approach to research infrastructures has made remarkable progress in recent years with continuously developing and implementing the ESFRI roadmap for infrastructures, integrating and opening national research facilities and developing e-infrastructures underpinning a digital European Research Area. The networks of research infrastructures across Europe strengthen its human resource base by providing world-class training for a new generation of researchers and engineers and promoting interdisciplinary collaboration. Synergies with Marie Skłodowska-Curie actions will be encouraged.

Further development and wider use of research infrastructures at European level will make a significant contribution to development of the European Research Area. While the role of Member States remains central in developing and financing research infrastructures, the Union plays an important part in supporting infrastructure at European level by fostering the emergence of new facilities, opening up and supporting broad access to national and European infrastructures, and making sure that regional, national, European and international policies are consistent and effective. It is necessary to avoid duplication of efforts, to foster coordinated and effective use of the facilities and where appropriate to pool resources so that Europe can also acquire and operate research infrastructures at world-class level.

The efficiencies of scale and scope achieved by a European approach to construction, use and management of research infrastructures, including e-infrastructures, will make a significant contribution to boosting Europe's research and innovation potential.

4.3. Broad lines of the activities

The activities shall aim at developing the European research infrastructures for 2020 and beyond, fostering their innovation potential and human resources and reinforcing European research infrastructure policy.

(a) Developing the European research infrastructures for 2020 and beyond

The aims shall be to facilitate and support: (1) the preparation, implementation and operation of the ESFRI and other world-class research infrastructures, including their development of regional partner facilities, when there exists a strong added value for Union intervention; (2) the integration of and access to national research infrastructures of pan-European and regional interest, so that European scientists can use them, irrespective of their location, to conduct top-level research; (3) the development, deployment and operation of e-infrastructures.

(b) Fostering the innovation potential of research infrastructures and their human resources

The aims shall be to encourage research infrastructures to act as early adopters of technology, to promote R&D partnerships with industry, to facilitate industrial use of research infrastructures and to stimulate the creation of innovation clusters. This activity shall also support training and/or exchanges of staff managing and operating research infrastructures.

(c) Reinforcing European research infrastructure policy and international cooperation

The aim shall be to support partnerships between relevant policymakers and funding bodies, mapping and monitoring tools for decision-making and also international cooperation activities.

The objectives set under lines (b) and (c) shall be pursued by dedicated actions, as well as within the actions developed under line (a) whenever appropriate.

PART II

INDUSTRIAL LEADERSHIP

1. LEADERSHIP IN ENABLING AND INDUSTRIAL TECHNOLOGIES

The specific objective is to maintain and build global leadership in enabling technologies and space research and innovation, which underpin competitiveness across a range of existing and emerging industries and sectors.

The global business environment is changing rapidly and the Europe 2020 goals for smart, sustainable and inclusive growth present challenges and opportunities to European industry. Europe needs to accelerate innovation, transforming the knowledge generated to underpin and enhance existing products, services and markets; and to create new ones while maintaining focus on sustainability. Innovation should be exploited in the widest sense, going beyond technology to include business, organisational and social aspects.

To stay at the forefront of global competition with a strong technological base and industrial capabilities, increased strategic investments in research, development, validation and piloting are required in Information and Communication Technologies (ICT); Nanotechnologies; Advanced Materials; Biotechnology; Advanced Manufacturing and Processing; and Space.

The successful mastering, integration and deployment of enabling technologies by European industry is a key factor in strengthening Europe's productivity and innovation capacity and ensuring Europe has an advanced, sustainable and competitive economy, global leadership in hi-tech application sectors and the ability to develop effective solutions for societal challenges. The pervasive nature of such activities can spur further progress through complementary inventions, applications and services, ensuring a higher return on investment in these technologies than in any other field.

These activities will contribute to the objectives of the Europe 2020 Flagship initiatives on Innovation Union, Resource Efficient Europe, An industrial policy for the globalisation era, and A Digital Agenda for Europe as well as Union space policy objectives.

Complementarities with other activities in Horizon 2020

The activities under 'Leadership in Enabling and Industrial Technologies' will be primarily based on research and innovation agendas mainly defined by industry and business (including SMEs) together with the research community and Member States in an open and transparent manner and have a strong focus on leveraging private sector investment.

The integration of enabling technologies in solutions for the societal challenges shall be supported together with the relevant challenges. Applications of enabling technologies that do not fall under the societal challenges, but are important for reinforcing the competitiveness of European industry, shall be supported under 'Leadership in Enabling and Industrial Technologies'. Appropriate coordination should be sought with the Excellent Science and Societal Challenges pillars.

A common approach

The approach shall include both agenda-driven activities and more open areas to promote innovative projects and breakthrough solutions covering the whole value chain, including R&D, large-scale pilots and demonstration activities, test beds and living labs, prototyping and product validation in pilot lines. Activities shall be designed to boost industrial competitiveness by stimulating industry, and in particular SMEs, to make more research and innovation investment. Adequate focus will be given to small and medium scale projects.

An integrated approach to Key Enabling Technologies

A major component of 'Leadership in Enabling and Industrial Technologies' are *Key Enabling Technologies* (KETs), defined as micro- and nanoelectronics, photonics, nanotechnology, biotechnology, advanced materials and advanced manufacturing systems⁶. These multi-disciplinary, knowledge and capital-intensive technologies cut across many diverse sectors providing the basis for significant competitive advantage for European industry, for stimulating growth and for creating new jobs. An integrated approach, promoting the combination, convergence and cross-fertilisation effect of KETs in different innovation cycles and value chains can deliver promising research results and open the way to new industrial technologies, products, services and novel applications (e.g. in space, transport, agriculture, fisheries, forestry, environment, food, health, energy etc.). The numerous interactions of KETs and other industrial enabling technologies will therefore be exploited in a flexible manner, as an important source of innovation. This will complement support for research and innovation in KETs that may be provided by national or regional authorities under the Cohesion Policy Funds within the framework of smart specialisation strategies.

Innovation requires enhanced cross-technology research efforts. Therefore, multidisciplinary and multi-KET projects should be an integral part of the Industrial Leadership pillar. The Horizon 2020 implementation structure supporting KETs and cross-cutting KET activities (multi KETs) should ensure synergies and effective coordination, among others, with societal challenges. In addition, synergies will be sought, where appropriate, between KET activities and the activities under the Cohesion Policy framework, as well as with the European Institute of Innovation and Technology (EIT).

⁶ COM(2009)512

For all the enabling and industrial technologies, including the KETs, a major aim will be to foster interactions between the technologies, and with the applications under the societal challenges. This shall be fully taken into account in developing and implementing the agendas and priorities. It requires that stakeholders representing the different perspectives are fully involved in priority setting and implementation. In certain cases, it will also require actions that are jointly funded by the enabling and industrial technologies, and by the relevant societal challenges. This could include joint funding for public-private partnerships that aim to develop technologies and apply them to address societal challenges.

ICT plays an important role as it provides the key basic infrastructures, technologies and systems for vital economic and social processes and new private and public products and services. European industry needs to remain at the cutting edge of technological developments in ICT, where many technologies are entering a new disruptive phase, opening up new opportunities.

Space is a rapidly growing sector which delivers information vital to many areas of modern society, meeting its fundamental demands, addresses universal scientific questions, and serves to secure the Union's position as a major player on the international stage. Space research underpins all activities undertaken in space, but is currently addressed in programmes run by Union member states, the European Space Agency (ESA) or in the context of the Seventh Framework Programme. Union level investment in space research will continue (cf. Article 189 TFEU) in order to maintain the competitive edge, to safeguard Union space infrastructures and programmes such as GMES and Galileo and to sustain a future role for Europe in space. In addition, innovative downstream services and user-friendly applications using space derived information represent an important source of growth and job creation.

Partnering and added value

Europe can achieve critical mass through partnering, clusters and networks, standardisation, promoting cooperation between different scientific and technological disciplines and sectors with similar research and development needs, leading to breakthroughs, new technologies and innovative product, service and process solutions.

The development and implementation of research and innovation agendas including through public–private partnerships, but also by the building of effective industry-academia links, the leveraging of additional investments, the access to risk finance, standardisation and the support to pre-commercial procurement and the procurement of innovative products and services are all aspects that are essential in addressing competitiveness.

In this regard, strong links with the EIT are also needed to produce and promote entrepreneurial top talents and to speed up innovation by bringing together people from different countries, disciplines and organisations.

Union level collaboration can also support trade opportunities through the development of European or international standards for new emerging products and services and technologies. Activities in support of standardisation and interoperability, safety and pre-regulatory activities will be promoted.

1.1. Information and Communication Technologies (ICT)

1.1.1. Specific objective for ICT

In line with the Digital Agenda for Europe⁷, the specific objective of ICT research and innovation (R&I) is to enable Europe to support, develop and exploit the opportunities brought by ICT progress for the benefits of its citizens, businesses and scientific communities.

As the world's largest economy and representing the largest share of the world's ICT market, today at more than EUR 2600 billion, Europe should have legitimate ambitions for its businesses, governments, research and development centres and universities to lead European and global developments in ICT, to grow new business, and to invest more in ICT innovations.

⁷ COM(2010) 245

By 2020, Europe's ICT sector should supply at least the equivalent of its share of the global ICT market, today at about one third. Europe should also grow innovative businesses in ICT so that one third of all business investment in ICT R&D in the EU, today at more than EUR 35 billion per year, is made by companies created within the last two decades. This would require an increase in public investments in ICT R&D in ways that leverage private spending, towards the goal of amplifying investments in the next decade, and significantly more European poles and clusters of world-class excellence in ICT.

To master increasingly complex and multidisciplinary technology and business chains in ICT, partnering, risk-sharing and mobilisation of critical mass across the Union are needed. Union level action should help industry address a single market perspective and achieve economies of scale and scope. Collaboration around common, open technology platforms with spill-over and leverage effects will allow a wide range of stakeholders to benefit from new developments and create further innovations. Partnering at Union level also enables consensus building, establishes a visible focal point for international partners, and will support the development of Union- and world-wide standards and interoperable solutions.

1.1.2. Rationale and Union added value

ICT underpins innovation and competitiveness across a broad range of private and public markets and sectors, and enables scientific progress in all disciplines. Over the next decade, the transformative impact of digital technologies, ICT components, infrastructures and services will be increasingly visible in all areas of life. Practically, unlimited computing, communication and data storage resources will be available to every citizen in the EU. Vast amounts of information and data will be generated by sensors, machines and information-enhanced products, making action at a distance a commonplace, enabling global deployment of business processes and sustainable production sites allowing the creation of a wide range of services and applications.

Many critical commercial and public services and all key processes of knowledge production in science, learning, business and the culture and creative sector as well as the public sector will be provided through ICT. ICT will provide the critical infrastructure for production and business processes, communication and transactions. ICT will also be indispensable in contributing to key societal challenges , as well as societal processes such as community formation, consumer behaviour, and public governance, for example by means of social media.

The Union support to ICT research and innovation makes a significant contribution to the development of the next generation technologies and applications as it makes up a large part of total spending on collaborative, mid-to-high risk R&I in Europe. Public investment in ICT research and innovation at Union level has been and remains essential to mobilise the critical mass leading to breakthroughs and to a wider uptake and better use of innovative solutions, products and services. It continues to play a central role in developing open platforms and technologies applicable across the Union, in testing and piloting innovations in real pan-European settings and in optimising resources when addressing Union competitiveness and tackling common societal challenges. Union support to ICT research and innovation is also enabling high-tech SMEs to grow and capitalise on the size of Union-wide markets. It is strengthening collaboration and excellence amongst Union scientists and engineers, reinforcing synergies with and between national budgets, and acting as a focal point for collaboration with partners outside Europe.

Successive evaluations of ICT activities in the Union's Framework Programme for research and innovation have shown that focused ICT research and innovation investment undertaken at Union level has been instrumental in building industrial leadership in areas like mobile communications, safety-critical ICT systems, and to address challenges like energy-efficiency, health, food security, transport or demographic change. Union investments in ICT research infrastructures have provided European researchers with the world's best research networking and computing facilities.

1.1.3. Broad lines of the activities

A number of activity lines shall target ICT industrial and technological leadership challenges and cover generic ICT research and innovation agendas, including notably:

- (a) *A new generation of components and systems*: Engineering of advanced, embedded and energy and resource efficient components and systems;
- (b) *Next generation computing*: Advanced computing systems and technologies, including cloud computing;
- (c) *Future Internet*: Infrastructures, technologies and services;
- (d) *Content technologies and information management*: ICT for digital content and creativity;
- (e) *Advanced interfaces and robots*: Robotics and smart spaces;
- (f) *Micro- and nanoelectronics and photonics*: Key enabling technologies related to micro- and nanoelectronics and to photonics.

These six major activity lines are expected to cover the full range of needs, taking into account the competitiveness of European industry on a global scale. These would include industrial leadership in generic ICT-based solutions, products and services needed to tackle major societal challenges as well as application-driven ICT research and innovation agendas which will be supported together with the relevant societal challenge. In view of the ever increasing advancement of technology in all areas of life, the interaction between humans and technology will be important in this respect, and part of the application-driven ICT research mentioned above.

These six activity lines shall also include ICT specific research infrastructures such as living labs for experimentation, and infrastructures for underlying key enabling technologies and their integration in advanced products and innovative smart systems, including equipment, tools, support services, clean rooms and access to foundries for prototyping.

1.2. Nanotechnologies

1.2.1. Specific objective for nanotechnologies

The specific objective of nanotechnologies research and innovation is to secure Union leadership in this high growth global market, by stimulating scientific and technological advancements and investment in nanotechnologies and their uptake in high added-value, competitive products and services across a range of applications and sectors.

By 2020, nanotechnologies will be mainstreamed, that is seamlessly integrated with most technologies and applications, driven by consumer benefits, quality of life, health care, sustainable development and the strong industrial potential for achieving previously unavailable solutions for productivity and resource efficiency.

Europe must also set the global benchmark on safe and responsible nanotechnology deployment and governance ensuring high industrial returns and societal impact combined with high standards of safety and sustainability.

Products using nanotechnologies represent a world market which Europe cannot afford to ignore. Market estimates of the value of products incorporating nanotechnology as the key component reach EUR 700 billion by 2015 and EUR 2 trillion by 2020, with a corresponding 2 and 6 million jobs respectively. Europe's nanotechnology companies should exploit this double digit market growth and be capable of capturing a market share at least equal to Europe's share of global research funding (i.e. a quarter) by 2020.

1.2.2. Rationale and Union added value

Nanotechnologies are a spectrum of evolving technologies with proven potential, having revolutionary impact in for example materials, ICT, transport mobility, life sciences, healthcare, treatment and consumer goods once the research is translated into breakthrough products and production processes.

Nanotechnologies have a critical role to play in addressing the challenges identified by the Europe 2020 strategy for smart, sustainable and inclusive growth. The successful deployment of these key enabling technologies will contribute to the competitiveness of Union industry by enabling novel and improved products or more efficient processes and provide responses to today's and future societal challenges.

The global research funding for nanotechnologies has doubled from around EUR 6.5 billion in 2004 to around EUR 12.5 billion in 2008, with the Union accounting for about a quarter of this total. The Union has recognised research leadership in nanosciences and nanotechnologies with a projection of some 4000 companies in the Union by 2015. This research leadership must be maintained and amplified and further translated into practical use and commercialisation.

Europe now needs to secure and build on its position in the global market by promoting wide scale cooperation in and across many different value chains and between different industrial sectors to realise the process scale-up of these technologies into viable commercial products. The issues of risk assessment and management as well as responsible governance are emerging as determining factors of future impact of nanotechnologies on society, the environment and the economy.

Thus, the focus of activities shall be on the widespread and responsible application of nanotechnologies into the economy, to enable benefits with high societal and industrial impact. To ensure the potential opportunities, including setting-up new companies and generating new jobs, research should provide the necessary tools to allow for standardisation and regulation to be correctly implemented.

1.2.3. Broad lines of the activities

- (a) Developing next generation nanomaterials, nanodevices and nanosystems
Aiming at fundamentally new products enabling sustainable solutions in a wide range of sectors.

- (b) Ensuring the safe and sustainable development and application of nanotechnologies
Advancing scientific knowledge of the potential impact of nanotechnologies and nanosystems on health or on the environment, and providing tools for risk assessment and management along the entire life cycle, including standardisation issues.
- (c) Developing the societal dimension of nanotechnology
Focusing on governance of nanotechnology for societal and environmental benefit including communication strategies to ensure social engagement.
- (d) Efficient and sustainable synthesis and manufacturing of nanomaterials, components and systems
Focusing on new operations, smart integration of new and existing processes, including technology convergence such as nanobiotechnology as well as up-scaling to achieve high precision large scale production of products and multi-purpose plants that ensures the efficient transfer of knowledge into industrial innovation.
- (e) Developing and standardisation of capacity-enhancing techniques, measuring methods and equipment
Focusing on the underpinning technologies supporting the development and market introduction of safe complex nanomaterials and nanosystems.

1.3. Advanced materials

1.3.1. Specific objective for advanced materials

The specific objective of advanced materials research and innovation is to develop materials with new functionalities and improved in-service performance, for more competitive products that minimise the impact on the environment and the consumption of resources.

Materials are at the core of industrial innovation and are key enablers. Advanced materials with higher knowledge content, new functionalities and improved performance are indispensable for industrial competitiveness and sustainable development across a broad range of applications and sectors

1.3.2. Rationale and Union added value

New advanced materials are needed in developing better performing and sustainable products and processes. Such materials are a part of the solution to our industrial and societal challenges, offering better performance in their use, lower resource and energy requirements, and sustainability during the entire life-cycle of the products.

Application-driven development often involves the design of totally new materials, with the ability to deliver planned in-service performances. Such materials are an important element in the supply chain of high value manufacturing. They are also the basis for progress in cross-cutting technology areas (for example health care technologies, biosciences, electronics and photonics), and in virtually all market sectors. The materials themselves represent a key step in increasing the value of products and their performance. The estimated value and impact of advanced materials is significant, with an annual growth rate of about 6 % and expected market size of the order of EUR 100 billion by 2015.

Materials shall be conceived according to a full life-cycle approach, from the supply of available materials to end of life (cradle to cradle), with innovative approaches to minimise the resources (including energy) required for their transformation or to minimise negative impacts for humans and the environment. Continuous use, recycling or secondary end-of-life utilisation of the materials shall also be covered as well as related societal innovation, such as changes in consumer behaviour and new business models.

To accelerate progress, a multidisciplinary and convergent approach shall be fostered, involving chemistry, physics, engineering sciences, theoretical and computational modelling, biological sciences and increasingly creative industrial design.

Novel green innovation alliances and industrial symbiosis shall be fostered allowing industries to diversify, expand their business models, re-using their waste as a basis for new productions, e.g. CO₂ as carbon base for fine chemicals and alternative fuels.

1.3.3. Broad lines of the activities

(a) Cross-cutting and enabling materials technologies

Research on materials by design, functional materials, multifunctional materials with higher knowledge content, new functionalities and improved performance, and structural materials for innovation in all industrial sectors, including the creative industries.

(b) Materials development and transformation

Research and development to ensure efficient, safe and sustainable development and scale up to enable industrial manufacturing of future design based products towards a "no-waste" management of materials in Europe.

(c) Management of materials components

Research and development for new and innovative techniques and systems.

(d) Materials for a sustainable, resource-efficient and low-emission industry

Developing new products and applications, business models and responsible consumer behaviour that reduce energy demand, and facilitate low-carbon production.

(e) Preserving and making the best use of European heritage

Applying design and the development of converging technologies to create new business opportunities, including the preservation of materials with historical or cultural value.

(f) Metrology, characterisation, standardisation and quality control

Promoting technologies such as characterisation, non-destructive evaluation and predictive modelling of performance for progress and impact in materials science and engineering.

(g) Optimisation of the use of materials

Research and development to investigate alternatives to the use of materials, including contributing to solving the challenge of raw materials, and innovative business model approaches.

1.4. Biotechnology

1.4.1. Specific objective for biotechnology

The specific objective of biotechnology research and innovation is to develop competitive, sustainable and innovative industrial products and processes and contribute as an innovation driver in a number of European sectors, like agriculture, forestry, food, chemical and health as well as the knowledge-based bio-economy.

A strong scientific, technological and innovation base in biotechnology, will support European industries securing leadership in this key enabling technology. This position will be further strengthened by integrating the safety assessment and management aspects of the overall risks in the deployment of biotechnology.

1.4.2. Rationale and Union added value

Powered by the expansion of the knowledge of living systems, biotechnology is set to deliver a stream of new applications and to strengthen the Union's industrial base and its innovation capacity. Examples of the rising importance of biotechnology are in industrial applications including biopharmaceuticals and bio-chemicals, of which the market share of the latter is estimated to increase by up to 12 %-20 % of chemical production by 2015. A number of the so-called twelve rules of *Green Chemistry* are also addressed by biotechnology, due to the selectivity and efficiency of bio-systems. The possible economic burdens for Union enterprises can be reduced by harnessing the potential of biotechnology processes and bio-based products to reduce CO₂ emissions, estimated to range from between 1 to 2.5 billion tons CO₂ equivalent per year by 2030. In Europe's biopharmaceutical sector, already some 20 % of the current medicines are derived from biotechnology, with up to 50 % of new medicines.

Biotechnology will play a major role in the transition towards a bio-based economy by developing new industrial processes. Cutting edge technologies such as synthetic biology hold promise for sustainable and carbon neutral fuels, production of fine chemicals including pharmaceuticals, environment-friendly production methods, new health applications and bionanomaterials.

Biotechnology also opens new avenues for the development of a sustainable agriculture, aquaculture and forestry and for exploiting the huge potential of marine resources for producing innovative industrial, health and environmental applications. The emerging sector of marine (blue) biotechnology has been predicted to grow by 10 % a year.

Other key sources of innovation are at the interface between biotechnology and other enabling and converging technologies, in particular nanotechnologies and ICT, with applications such as sensing and diagnosing.

1.4.3. Broad lines of the activities

(a) Boosting cutting-edge biotechnologies as a future innovation driver

Development of emerging technology areas such as synthetic biology, bioinformatics and systems biology, which hold great promise for completely novel applications.

(b) Biotechnology-based industrial processes

Developing industrial biotechnology and industrial scale bio-process design for competitive industrial products and processes (e.g. chemical, health, mining, energy, pulp and paper, fiber-based products and wood, textile, starch, food processing) and its environmental dimension, including clean up operations.

(c) Innovative and competitive platform technologies

Development of platform technologies (e.g. genomics, meta-genomics, proteomics, metabolomics, molecular tools, expression systems, phenotyping platforms) to enhance leadership and competitive advantage in a wide number of economic sectors.

1.5. Advanced manufacturing and processing

1.5.1. Specific objective

The specific objective of advanced manufacturing and processing research and innovation is to transform today's industrial forms of production towards more knowledge intensive, sustainable, trans-sectoral manufacturing and processing technologies, resulting in more innovative products, processes and services. By enabling new, sustainable products, processes and services and their competitive deployment, advanced manufacturing and processing are also essential for achieving the objectives of the societal challenges.

1.5.2. Rationale and Union added value

The manufacturing sector is of high importance to the European economy, contributing to around 17 % of GDP and accounting for some 22 million jobs in the Union in 2007. With the lowering of economic barriers to trade and the enabling effect of communications technology, manufacturing is subject to strong competition and has been gravitating to countries of lowest overall cost. Due to high wages, the European approach to manufacturing therefore has to change radically to remain globally competitive and Horizon 2020 can help bring together all the relevant stakeholders to achieve this.

Europe needs to increase the investment at an Union level to maintain European leadership and competence in manufacturing technologies and make the transition to high-value, knowledge-intensive goods, creating the conditions and assets for sustainable, production and provision of lifetime service around a manufactured product. Resource intensive manufacturing and process industries need to further mobilise resources and knowledge at Union level and increase the investment in research, development and innovation to enable further progress towards a competitive low carbon, resource-efficient and sustainable economy and to comply with the agreed Union wide reductions in greenhouse gas emissions by 2050 for industrial sectors⁸.

⁸ COM(2011)112 final

With strong Union policies, Europe would grow its existing industries and nurture the emerging industries of the future. The estimated value and impact of the sector of advanced manufacturing systems is significant, with an expected market size around EUR 150 billion by 2015 and compound annual growth rate of about 5 %.

It is crucial to retain knowledge and competence in order to keep manufacturing and processing capacity in Europe. The emphasis of the research and innovation activities shall be on sustainable and safe manufacturing and processing, introducing the necessary technical innovation and customer-orientation to produce high knowledge content products and services with low material and energy consumption. Europe also needs to transfer these enabling technologies and knowledge to other productive sectors, such as construction, which is a major source of greenhouse gases (GHG) with building activities accounting for around 40 % of all energy consumption in Europe, giving rise to 36 % of the CO₂ emissions. The construction sector, generating 10 % of GDP and providing some 16 million jobs in Europe in 3 million enterprises, of which 95 % are SMEs, needs to adopt innovative materials and manufacturing approaches to mitigate its environmental impact.

1.5.3. Broad lines of the activities

(a) Technologies for Factories of the Future

Promoting sustainable industrial growth by facilitating a strategic shift in Europe from cost-based manufacturing to an approach based on the creation of high added value products and ICT-enabled intelligent and high performance manufacturing in an integrated system.

(b) Technologies enabling Energy-efficient buildings and systems

Reducing energy consumption and CO₂ emissions by the development and deployment of sustainable construction technologies and systems.

- (c) Sustainable, resource-efficient and low-carbon technologies in energy-intensive process industries

Increasing the competitiveness of process industries, by drastically improving resource and energy efficiencies and reducing the environmental impact of such industrial activities through the whole value chain, promoting the adoption of low-carbon technologies.

- (d) New sustainable business models

Deriving concepts and methodologies for adaptive, 'knowledge-based' business models in customised approaches.

1.6. Space

1.6.1. Specific objective for space

The specific objective of space research and innovation is to foster a cost-effective competitive and innovative space industry (including SMEs) and research community to develop and exploit space infrastructure to meet future Union policy and societal needs.

Strengthening the European space sector by boosting space research and innovation is vital to maintain and safeguard Europe's capability to use space in support of Union policies, international strategic interests and competitiveness amongst established and emerging space faring nations.

1.6.2. Rationale and Union added value

Space is an important, but frequently invisible enabler of diverse services and products crucial to modern day society, such as navigation and communication, as well as weather forecasts and geographic information derived from Earth Observation by satellites. Policy formulation and implementation at European, national and regional levels increasingly depend on space-derived information. The global space sector is rapidly growing and expanding into new regions (e.g. China, South America). European industry is at present a considerable exporter of first class satellites for commercial and scientific purposes. Increasing global competition is challenging Europe's position in this area. Thus Europe has an interest in ensuring that its industry continues to thrive in this fiercely competitive market. In addition, data from European science satellites and probes have resulted in some of the most significant scientific breakthroughs in the last decades in Earth sciences, fundamental physics, astronomy and planetology. In addition, innovative space technologies, e.g. robotics have contributed to the progress of knowledge and technology in Europe. With this unique capacity, the European space sector has a critical role to play in addressing the challenges identified by Europe 2020.

Research, technology development and innovation underpin capacities in space which are vital to European society. While the United States of America spends around 25 % of their space budget on R&D, the Union spends less than 10 %. Moreover, space research in the Union is addressed in the national programmes of Member States, ESA programmes and the EU Seventh Framework Programme.

To maintain Europe's technological and competitive edge and to capitalise on investments, Union level action is needed in conjunction with the space research activities of the Member States and ESA, which has managed industrial satellite development and deep space missions on an intergovernmental basis for the ESA Member States since 1975. Union level action is also needed to promote the participation of the best researchers from all Member States, and to lower the barriers for collaborative space research projects across national borders.

In addition, the information provided by European satellites will offer an increasing potential for further development of innovative satellite-based downstream services. This is a typical activity sector for SMEs and should be supported by research and innovation measures in order to reap the full benefits of this opportunity, and especially of the considerable investments made on the two Union flagships Galileo and GMES.

Space naturally transcends terrestrial boundaries, providing a unique vantage point of global dimension, thus giving rise to large scale projects which are carried out in international co-operation. To play a significant role in such international space activities in the next decades, both a common European space policy and European level space research and innovation activities are indispensable.

Space research and innovation under Horizon 2020 aligns with the Union space policy priorities and the needs of the European operational programmes as they continue to be defined by the Union Space Councils and the European Commission⁹.

The application of space technologies shall be supported through the respective Societal Challenges, where appropriate.

1.6.3. Broad lines of the activities

- (a) Enabling European competitiveness, non-dependence and innovation of the European space sector

This entails safeguarding and further developing a competitive and entrepreneurial space industry in combination with a world-class space research community to maintain and strengthen European leadership and non-dependence in space systems to foster innovation in the space sector, and to enable space-based terrestrial innovation, for example by using remote sensing and navigation data.

⁹ COM(2011) 152

(b) Enabling advances in space technologies

This aims at developing advanced and enabling space technologies and operational concepts from idea to demonstration in space. This includes technologies supporting access to space, technologies for the protection of space assets from threats such as debris and solar flares, as well as satellite telecommunication, navigation and remote sensing. To develop and apply advanced space technologies requires the continuous education and training of highly skilled engineers and scientists as well as strong links between them and users of space applications.

(c) Enabling exploitation of space data

A considerably increased exploitation of data from European satellites (scientific, public or commercial) can be achieved if further effort is made for the processing, archiving, validation, standardisation and sustainable availability of space data as well as to support the development of new information products and services resulting from those data. Innovations in data handling and dissemination can also ensure a higher return on investment of space infrastructure, and contribute to tackling societal challenges, in particular if coordinated in a global effort such as through Global Earth Observation System of Systems (GEOSS), namely by fully exploiting the GMES programme as its main European contribution, the European satellite navigation programme Galileo or IPCC for climate change issues. A fast introduction of these innovations into the relevant application and decision-making processes will be supported. This includes as well the exploitation of data for further scientific investigation.

(d) Enabling European research in support of international space partnerships

Space undertakings have a fundamentally global character. This is particularly clear for activities such as Space Situational Awareness (SSA), and many space science and exploration projects. The development of cutting edge space technology is increasingly taking place within such international partnerships. Ensuring access to these constitutes an important success factor for European researchers and industry. The definition and implementation of long-term roadmaps and the coordination with international partners are key to this objective.

2. ACCESS TO RISK FINANCE

2.1. Specific objective

The specific objective is to help address market deficiencies in accessing risk finance for research and innovation.

The investment situation in the research and innovation (R&I) domain is dire, particularly for innovative SMEs and mid-caps with a high potential for growth. There are several major market gaps in the provision of finance, as the innovations required to achieve policy goals are proving too risky, typically, for the market to bear and therefore the wider benefits to society are not fully captured.

A facility for debt ('Debt facility') and a facility for equity ('Equity facility') will help overcome such problems by improving the financing and risk profiles of the R&I activities concerned. This, in turn, will ease access by firms and other beneficiaries to loans, guarantees and other forms of risk finance; promote early-stage investment and the development of existing and new venture capital funds; improve knowledge transfer and the market in intellectual property; attract funds to the venture capital market; and, overall, help catalyse the passage from the conception, development and demonstration of new products and services to their commercialisation.

The overall effect will be to increase the willingness of the private sector to invest in R&I and hence contribute to reaching a key Europe 2020 target: 3 % of Union GDP invested in R&D by the end of the decade with two-thirds contributed by the private sector. The use of financial instruments will also help achieve the R&I objectives of all sectors and policy areas crucial for tackling the societal challenges, for enhancing competitiveness, and for supporting sustainable, inclusive growth and the provision of environmental and other public goods.

2.2. Rationale and Union added value

A Union-level **Debt facility** for R&I is needed to increase the likelihood that loans and guarantees are made and R&I policy objectives achieved. The current gap in the market between the demand for and supply of loans and guarantees for risky R&I investments, addressed by the current Risk-Sharing Finance Facility (RSFF), is likely to persist, with commercial banks remaining largely absent from higher-risk lending. Demand for RSFF loan finance has been high since the launch of the facility in mid-2007: in its first phase (2007-2010), its take-up exceeded initial expectations by more than 50 % in terms of active loan approvals (EUR 7.6 billion versus a forecast EUR 5 billion).

Furthermore, banks typically lack the ability to value knowledge assets, such as intellectual property, and therefore are often unwilling to invest in knowledge-based companies. The consequence is that many established innovative companies — both large and small — cannot obtain loans for higher-risk R&I activities.

These market gaps stem, at root, from uncertainties, information asymmetries and the high costs of attempting to address these issues: recently established firms have too short a track record to satisfy potential lenders, even established firms often cannot provide enough information, and at the start of an R&I investment, it is not at all certain whether the efforts undertaken will actually result in a successful innovation.

Additionally, enterprises at the concept development stage or working in emerging areas typically lack sufficient collateral. Another disincentive is that even if R&I activities give rise to a commercial product or process, it is not at all certain that the company that has made the effort will be able to exclusively appropriate the benefits deriving from it.

In terms of Union added value, the Debt facility will help remedy market deficiencies that prevent the private sector from investing in R&I at an optimum level. Its implementation will enable the pooling of a critical mass of resources from the Union budget and, on a risk-sharing basis, from the financial institution(s) entrusted with its implementation. It will stimulate firms to invest more of their own money in R&I than they would otherwise have done. In addition, the Debt facility will help organisations, both public and private, to reduce the risks of undertaking the pre-commercial procurement or procurement of innovative products and services.

A Union-level **Equity facility** for R&I is needed to help improve the availability of equity finance for early and growth-stage investments and to boost the development of the Union venture capital market. During the technology transfer and start-up phase, new companies face a 'valley of death' where public research grants stop and it is not possible to attract private finance. Public support aiming to leverage private seed and start-up funds to fill this gap is currently too fragmented and intermittent, or its management lacks the necessary expertise. Furthermore, most venture capital funds in Europe are too small to support the continued growth of innovative companies and do not have the critical mass to specialise and operate transnationally.

The consequences are serious. Before the financial crisis, the amount invested in SMEs by European venture capital funds was about EUR 7 billion a year, while figures for 2009 and 2010 were within the EUR 3-4 billion range. Reduced funding for venture capital has affected the number of start-ups targeted by venture capital funds: in 2007, some 3 000 SMEs received venture capital funding, compared to only around 2 500 in 2010.

In terms of Union added value, the Equity facility for R&I will complement national and regional schemes that cannot cater for cross-border investments in R&I. The early-stage deals will also have a demonstration effect that can benefit public and private investors across Europe. For the growth phase, only at European level is it possible to achieve the necessary scale and the strong participation of private investors that are essential to the functioning of a self-sustaining venture capital market.

The **Debt and Equity facilities**, supported by a set of accompanying measures, will support the achievement of Horizon 2020's policy objectives. To this end, they will be dedicated to consolidating and raising the quality of Europe's science base; promoting research and innovation with a business-driven agenda; and addressing societal challenges, with a focus on activities such as piloting, demonstration, test-beds and market uptake.

In addition, they will help tackle the R&I objectives of other programmes and policy areas, such as the Common Agricultural Policy, climate action (transition to a low-carbon economy and adaptation to climate change), and the Common Fisheries Policy. Complementarities with national and regional financial instruments will be developed in the context of the Common Strategic Framework for Cohesion Policy, where an increased role for financial instruments is foreseen.

Their design takes account of the need to address the specific market deficiencies, characteristics (such as degree of dynamism and rate of company creation) and financing requirements of these and other areas without creating market distortions. The use of financial instruments must have a clear European added-value and should provide leverage and function as a complement to national instruments. Budgetary allocations between the instruments may be adapted during the course of Horizon 2020 in response to changing economic conditions.

The Equity facility and the SME window of the Debt facility will be implemented as part of two EU Financial Instruments that provide equity and debt to support SMEs' R&I and growth, in conjunction with the equity and debt facilities under the Programme for the Competitiveness of Enterprises and SMEs (COSME). Complementarity between the Horizon 2020 and the COSME Programmes will be ensured,

2.3. Broad lines of the activities

- (a) The Debt facility providing debt finance for R&I: 'Union loan & guarantee service for research and innovation'

The goal is to improve access to debt financing — loans, guarantees, counter-guarantees and other forms of debt and risk finance — for public and private entities and public-private partnerships engaged in research and innovation activities requiring risky investments in order to come to fruition. The focus shall be on supporting research and innovation with a high potential for excellence.

The target final beneficiaries shall potentially be legal entities of all sizes that can borrow and repay money and, in particular, SMEs with the potential to carry out innovation and grow rapidly; mid-caps and large firms; universities and research institutes; research infrastructures and innovation infrastructures; public-private partnerships; and special-purpose vehicles or projects.

The funding of the Debt facility shall have two main components:

- (1) **Demand-driven**, providing loans and guarantees on a first-come, first-served basis, with specific support for beneficiaries such as SMEs and mid-caps. This component shall respond to the steady and continuing growth seen in the volume of RSFF lending, which is demand-led. Under the SME window, activities shall be supported that aim to improve access to finance for SMEs and other entities that are R&D- and/or innovation-driven.
- (2) **Targeted**, focusing on policies and key sectors crucial for tackling societal challenges, enhancing industrial leadership and competitiveness, supporting sustainable, low-carbon, inclusive growth, and providing environmental and other public goods. This component shall help the Union address research and innovation aspects of sectoral policy objectives.

- (b) The Equity facility providing equity finance for R&I: 'Union Equity Instruments for research and innovation'

The goal is to contribute to overcoming the deficiencies of the European venture capital market and provide equity and quasi-equity to cover the development and financing needs of innovating enterprises from the seed stage through to growth and expansion. The focus shall be on supporting the objectives of Horizon 2020 and related policies.

The target final beneficiaries shall be potentially enterprises of all sizes undertaking or embarking on innovation activities, with a particular focus on innovative SMEs and mid-caps.

The Equity facility will focus on early-stage venture capital funds and funds-of-funds providing venture capital and quasi-equity (including mezzanine capital) to individual portfolio enterprises. The facility will also have the possibility to make expansion and growth-stage investments in conjunction with the Equity Facility for Growth under the Programme for the Competitiveness of Enterprises and SMEs, to ensure a continuum of support during the start up and development of companies.

The equity facility, which will be primarily demand-driven, shall use a portfolio approach, where venture capital funds and other comparable intermediaries select the firms to be invested in.

Earmarking may be applied to help achieve particular policy goals, building on the positive experience in the Competitiveness and Innovation Framework Programme with earmarking for eco-innovation.

The **start-up window**, supporting the seed and early stages, shall enable equity investments in, amongst others, knowledge-transfer organisations, seed capital funds, cross-border seed funds, business angel co-investment vehicles, intellectual property assets, platforms for the exchange and trading of intellectual property rights, and early-stage venture capital funds and funds-of-funds operating across borders and investing in venture capital funds.

The **growth window** shall make expansion and growth-stage investments in conjunction with the Equity Facility for Growth under the Programme for the Competitiveness of Enterprises and SMEs, including investments in funds-of-funds operating across borders and investing in venture capital funds, most of which will have a thematic focus that supports the goals of Europe 2020.

3. INNOVATION IN SMALL AND MEDIUM-SIZED ENTERPRISES

3.1 Specific objective

The specific objective is to stimulate growth by means of increasing the levels of innovation in SMEs, covering their different innovation needs over the whole innovation cycle for all types of innovation, thereby creating more fast-growing, internationally active SMEs.

Considering the central role of SMEs in Europe's economy, research and innovation in SMEs will play a crucial role in increasing competitiveness, boosting economic growth and job creation and thus in achieving the objectives of Europe 2020 and notably its flagship initiative Innovation Union.

However, SMEs have – despite their important economic and employment share and significant innovation potential – size-related problems to become more innovative and more competitive. Although Europe produces a similar number of start-up companies to the United States of America, European SMEs are finding it much harder to grow into large companies than their US counterparts. The internationalised business environment with increasingly interlinked value chains puts further pressure on them. SMEs need to enhance their innovation capacity. They need to generate, take up and commercialise new knowledge and business ideas faster and to a greater extent to compete successfully on fast evolving global markets. The challenge is to stimulate more innovation in SMEs, thereby enhancing their competitiveness and growth.

The proposed actions aim to complement national and regional business innovation policies and programmes, to foster cooperation between SMEs, including transnational cooperation, clusters and other innovation-relevant actors in Europe, to bridge the gap between research/development and successful market uptake, to provide a more business innovation friendly environment, including demand-side measures, and support taking into account the changing nature of innovation processes, new technologies, markets and business models.

Strong links with industry-specific Union policies, notably the Programme for the Competitiveness of Enterprises and SMEs and Cohesion Policy funds, will be established to ensure synergies and a coherent approach.

3.2. Rationale and Union added value

SMEs are key drivers of innovation thanks to their ability to quickly and efficiently transform new ideas in successful businesses. They serve as important conduits of knowledge spill-over bringing research results to the market. The last twenty years have shown that entire sectors have been renewed and new industries created driven by innovative SMEs. Fast growing enterprises are crucial for the development of emerging industries and for the acceleration of the structural changes that Europe needs to become a knowledge based and sustainable economy with sustained growth and high quality jobs.

SMEs can be found in all sectors of the economy. They form a more important part of the European economy than of other regions such as the United States of America. All types of SMEs can innovate. They need to be encouraged and supported to invest in research and innovation. In doing so they should be able to draw on the full innovative potential of the internal market and the ERA so as to create new business opportunities in Europe and beyond and to contribute to find solutions to key societal challenges.

Participation in Union research and innovation strengthens the R&D and technology capability of SMEs, increases their capacity to generate, absorb and use new knowledge, enhances the economic exploitation of new solutions, boosts innovation in products, services and business models, promotes business activities in larger markets and internationalises the knowledge networks of SMEs. SMEs that have a good innovation management in place, thereby often relying on external expertise and skills, outperform others.

Cross-border collaborations are an important element in the innovation strategy of SMEs to overcome some of their size-related problems, such as access to technological and scientific competences and new markets. They contribute to turn ideas into profit and company growth and in return to increase private investment in research and innovation.

Regional and national programmes for research and innovation, often backed by European cohesion policy, play an essential role in promoting SMEs. In particular, Cohesion Policy funds have a key role to play through building capacity and providing a stairway to excellence for SMEs in order to develop excellent projects that may compete for funding under Horizon 2020. Nevertheless, only a few national and regional programmes provide funding for transnational research and innovation activities carried out by SMEs, the Union-wide diffusion and uptake of innovative solutions or cross-border innovation support services. The challenge is to provide SMEs with thematically open support to realise international projects in line with companies' innovation strategies. Actions at Union level are therefore necessary to complement activities undertaken at national and regional level, to enhance their impact and to open up the research and innovation support systems.

3.3. Broad lines of the activities

(a) Mainstreaming SME support

SMEs shall be supported across Horizon 2020. For this purpose, to participate in Horizon 2020, better conditions for SMEs shall be established. In addition, a dedicated SME instrument shall provide staged and seamless support covering the whole innovation cycle. The SME instrument shall be targeted at all types of innovative SMEs showing a strong ambition to develop, grow and internationalise. It shall be provided for all types of innovation, including service, non-technological and social innovations, given each activity has a clear European added-value. The aim is to develop and capitalise on the innovation potential of SMEs by filling the gap in funding for early stage high risk research and innovation, stimulating innovations and increasing private-sector commercialisation of research results.

All of the specific objectives on societal challenges and on leadership in enabling and industrial technologies will apply the dedicated SME instrument and will allocate an amount for this.

(b) Support for research intensive SMEs

The goal is to promote transnational market-oriented innovation of R&D performing SMEs. A specific action shall target research intensive SMEs in any sectors that show the capability to commercially exploit the project results. This action will be built on the Eurostars Programme.

(c) Enhancing the innovation capacity of SMEs

Transnational activities assisting the implementation and complementing the SME specific measures across Horizon 2020 shall be supported, notably to enhance the innovation capacity of SMEs. These activities shall be coordinated with similar national measures when appropriate. Close cooperation with the National Contact Point (NCP) Network and the Enterprise Europe Network (EEN) is envisaged.

(d) Supporting market-driven innovation

Supporting transnational market-driven innovation to improve the framework conditions for innovation and tackling the specific barriers preventing, in particular, the growth of innovative SMEs.

PART III

SOCIETAL CHALLENGES

1. HEALTH, DEMOGRAPHIC CHANGE AND WELLBEING

1.1. Specific objective

The specific objective is to improve the lifelong health and wellbeing of all.

Lifelong health and wellbeing for all, high-quality, economically sustainable and innovative health and care systems, and opportunities for new jobs and growth are the aims of support to research and innovation in response to this challenge and will make a major contribution to Europe 2020.

The cost of Union health and social care systems is rising with care and prevention measures in all ages increasingly expensive, the number of Europeans aged over 65 expected to nearly double from 85 million in 2008 to 151 million by 2060, and those over 80 to rise from 22 to 61 million in the same period. Reducing or containing these costs such that they do not become unsustainable depends in part on improving the lifelong health and wellbeing of all and therefore on the effective prevention, treatment and management of disease and disability.

Chronic conditions and diseases are major causes of disability, ill-health and health related retirement, premature death, and present considerable social and economic costs.

In the Union, cardiovascular disease (CVD) annually accounts for more than 2 million deaths and costs the economy more than EUR 192 billion while cancer accounts for a quarter of all deaths and is the number one cause of death in people aged 45-64. Over 27 million people in the Union suffer from diabetes and the total cost of brain disorders (including, but not limited to those affecting mental health) has been estimated at EUR 800 billion. Environmental, occupational, life-style and socio-economic factors are relevant in several of these conditions with up to one third of the global disease burden estimated to be related to these.

Infectious diseases (*e.g.* HIV/AIDS, tuberculosis and malaria), are a global concern, accounting for 41 % of the 1.5 billion disability adjusted life years worldwide, with 8 % of these in Europe. Emerging epidemics and the threat of increasing anti-microbial resistance must also be prepared for. Increased risk for animal-borne diseases should be considered.

Meanwhile, drug and vaccine development processes are becoming more expensive and less effective. Persistent health inequalities must be addressed, and access to effective and competent health and care systems must be ensured for all Europeans.

Other factors such as nutrition, physical activity, wealth, inclusion, engagement, social capital, and work also affect health and well-being and a holistic approach must be taken.

Due to higher life expectancy the age and population structure in Europe will change. Therefore, research furthering lifelong health, active ageing and wellbeing for all will be a cornerstone of the successful adaptation of societies to demographic change.

1.2. Rationale and Union added value

Disease and disability are not stopped by national borders. An appropriate European level research, development and innovation effort with the involvement of stakeholders, patients and end-users can and should make a crucial contribution to addressing these challenges, deliver better health and wellbeing for all, and position Europe as a leader in the rapidly expanding global markets for health and wellbeing innovations.

The response depends on excellence in research to improve our fundamental understanding of the determinants of health, disease, disability, healthy employment conditions, development and ageing (including of life expectancy), and on the seamless and widespread translation of the resulting and existing knowledge into innovative, scalable and effective products, strategies, interventions and services. Furthermore, the pertinence of these challenges across Europe and in many cases, globally, demands a response characterised by long term and coordinated support for co-operation between excellent, multidisciplinary and multi-sector teams. It is also necessary to address the challenge from the perspective of the social and economic sciences and humanities.

Similarly, the complexity of the challenge and the interdependency of its components demand a European level response. Many approaches, tools and technologies have applicability across many of the research and innovation areas of this challenge and are best supported at Union level. These include the development of long term cohorts and the conduct of clinical trials, the clinical use of "-omics", systems bio-medicine or the development of ICT and their applications in healthcare practice, notably e-health. The requirements of specific populations are also best addressed in an integrated manner, for example in the development of stratified and/or personalised medicine, in the treatment of rare diseases, and in providing assisted and independent living solutions.

To maximise the impact of Union level actions, support will be provided to the full spectrum of research, development and innovation activities. From basic research through translation of knowledge to large trials, piloting and demonstration actions, mobilising private investment; to public and pre-commercial procurement for new products, services, scalable solutions, which are when necessary, interoperable and supported by defined standards and/or common guidelines. This co-ordinated, European effort will contribute to the ongoing development of the ERA. It will also interface, as and when appropriate, with activities developed in the context of the Health for Growth Programme , the Joint Programming Initiatives, including “Neurodegenerative Disease Research”, “A Healthy Diet for a Healthy Life”, “Antimicrobial resistance” and “More Years, Better Lives” and the European Innovation Partnership on Active and Healthy Ageing.

1.3. Broad lines of the activities

Effective health promotion, supported by a robust evidence base, prevents disease, contributes to wellbeing and to contain costs. Promotion of health, active ageing, wellbeing and disease prevention also depend on an understanding of the determinants of health, on effective preventive tools on effective health and disease surveillance and preparedness, and on effective screening programmes.

Successful efforts to prevent, early detect, manage, treat and cure disease, disability, frailty and reduced functionality are underpinned by the fundamental understanding of their determinants and causes, processes and impacts, as well as factors underlying good health and wellbeing. Improved understanding of health and disease will demand close linkage between fundamental, clinical, epidemiological and socio-economic research. Effective sharing of data and the linkage of these data with large scale cohort studies is also essential, as is the translation of research findings into the clinic, in particular through the conduct of clinical trials.

It is a societal challenge to adjust to the further demands on health and care sectors due to the ageing population. If effective health and care is to be maintained for all ages, efforts are required to improve decision making in prevention and treatment provision, to identify and support the dissemination of best practice in the health and care sectors, and to support integrated care. A better understanding of ageing processes and the prevention of age-related illnesses are the basis for keeping European citizens healthy and active throughout the course of their lives. Similarly important is the wide uptake of technological, organisational and social innovations empowering in particular older persons as well as disabled persons to remain active, productive and independent. Doing so will contribute to increasing, and lengthening the duration of their physical, social, and mental well-being.

All of these activities shall be undertaken in such a way as to provide support throughout the research and innovation cycle, strengthening the competitiveness of the European based industries and development of new market opportunities.

Specific activities shall include: understanding the determinants of health (including nutrition, physical activity, environmental, socio-economic and occupational and climate related factors), improving health promotion and disease prevention; understanding disease and improving diagnosis and prognosis; developing effective prevention and screening programmes and improving the assessment of disease susceptibility; improving surveillance and preparedness; developing better preventive and therapeutic vaccines; using in-silico medicine for improving disease management and prediction; developing regenerative medicine treating disease; transferring knowledge to clinical practice and scalable innovation actions; improving health information and better use of health data; active ageing, independent and assisted living; individual awareness and empowerment for self-management of health; promotion of integrated care; improving scientific tools and methods to support policy making and regulatory needs; and optimising the efficiency and effectiveness of healthcare provisions and reducing inequalities by evidence based decision making and dissemination of best practice, and innovative technologies and approaches.

2. EUROPEAN BIOECONOMY CHALLENGES: FOOD SECURITY, SUSTAINABLE AGRICULTURE AND FORESTRY, MARINE AND MARITIME AND INLAND WATER RESEARCH

2.1 Specific objective

The specific objective is to secure sufficient supplies of safe, healthy and high quality food and other bio-based products, by developing productive, sustainable and resource-efficient primary production systems, fostering related ecosystem services and the recovery of biological diversity, along side competitive and low carbon supply, processing and marketing chains. This will accelerate the transition to a sustainable European bio-economy, bridging the gap between new technologies and their implementation.

Over the coming decades, Europe will be challenged by increased competition for limited and finite natural resources, by the effects of climate change, in particular on primary production systems (agriculture including animal husbandry and horticulture, forestry, fisheries and aquaculture) and by the need to provide a sustainable, safe and secure food supply for the European and an increasing global population. A 70 % increase of the world food supply is estimated to be required to feed the 9 billion global population by 2050. Agriculture accounts for about 10 % of Union greenhouse gases emissions, and while declining in Europe, global emissions from agriculture are projected to increase up to 20 % by 2030. Furthermore, Europe will need to ensure sufficient and sustainably produced supplies of raw materials, energy and industrial products, under conditions of decreasing fossil carbon resources (oil and liquid gas production expected to decrease by about 60 % by 2050), while maintaining its competitiveness. Bio-waste (estimated at up to 138 million tonnes per year in the Union, of which up to 40 % is land-filled) represents a huge problem and cost, despite its high potential added value. For example, an estimated 30 % of all food produced in developed countries is discarded. Major changes are needed to reduce this amount by 50 % in the Union by 2030¹⁰.

¹⁰ COM (2011)0112

In addition, national borders are irrelevant in the entry and spread of animal and plant pests and diseases, including zoonotic diseases, and food borne pathogens. While effective national prevention measures are needed, action at Union level is essential for ultimate control and the effective running of the single market. The challenge is complex, affects a broad range of interconnected sectors and requires a holistic and systemic approach.

More and more biological resources are needed to satisfy market demand for a secure and healthy food supply, bio-materials, biofuels and bio-based products, ranging from consumer products to bulk chemicals. However the capacities of the terrestrial and aquatic ecosystems required for their production are limited, while there are competing claims for their utilisation, and often not optimally managed, as shown for example by a severe decline in soil carbon content and fertility. There is under-utilised scope for fostering ecosystem services from farmland, forests, marine and fresh waters by integrating agronomic, environmental and social goals into sustainable production and consumption.

The potential of biological resources and ecosystems could be used in a much more sustainable, efficient and integrated manner. For examples, the potential of biomass from forests and waste streams from agricultural, aquatic, industrial, and also municipal origins could be better harnessed.

In essence, a transition is needed towards an optimal and renewable use of biological resources and towards sustainable primary production and processing systems that can produce more food and other bio-based products with minimised inputs, environmental impact and greenhouse gas emissions, enhanced ecosystem services, zero-waste and adequate societal value. A critical effort of interconnected research and innovation is a key element for this to happen, in Europe and beyond as well as a continuous dialogue between political, social, economic and other stakeholder groups.

2.2 Rationale and Union added value

Agriculture, forestry, fisheries and aquaculture together with the bio-based industries are the major sectors underpinning the bio-economy. This latter represents a large and growing market estimated to be worth over EUR 2 trillion, providing 20 million jobs and accounting for 9 % of total employment in the Union in 2009. Investments in research and innovation under this societal challenge will enable Europe to take leadership in the concerned markets and will play a role in achieving the goals of the Europe 2020 strategy and its Innovation Union and Resource Efficient Europe flagship initiatives.

A fully functional European bio-economy – encompassing the sustainable production of renewable resources from land, fisheries and aquaculture environments and their conversion into food, bio-based products and bioenergy as well as the related public goods - will generate high European added value. Managed in a sustainable manner, it can reduce the environmental footprint of primary production and the supply chain as a whole. It can increase their competitiveness and provide jobs and business opportunities essential for rural and coastal development. The food security, sustainable agriculture and farming, aquatic production, forestry and overall bio-economy – related challenges are of a European and global nature. Actions at Union level are essential to bring together clusters to achieve the necessary breadth and critical mass to complement efforts made by a single or groups of Member States. A multi-actor approach will ensure the necessary cross-fertilising interactions between researchers, businesses, farmers/producers, advisors and end-users. The Union level is also necessary to ensure coherence in addressing this challenge across sectors and with strong links to relevant Union policies. Coordination of research and innovation at Union level will stimulate and help to accelerate the required changes across the Union.

Research and innovation will interface with and support elaboration of a wide spectrum of Union policies and related targets, including the Common Agriculture Policy (in particular the Rural Development Policy, the Joint Programming Initiatives, including “Agriculture, Food Security and Climate Change”, “A Healthy Diet for a Healthy Life” and “Healthy and Productive Seas and Oceans”) and the European Innovation Partnership 'Agricultural Productivity and Sustainability', the Common Fisheries Policy, the Integrated Maritime Policy, the European Climate Change Programme, the Water Framework Directive, the Marine Strategy Framework Directive, the EU Forestry Action Plan, the Soil Thematic Strategy, the Union's 2020 Biodiversity Strategy, the Strategic Energy Technology Plan, the Union's innovation and industrial policies, external and development aid policies, plant health strategies, animal health and welfare strategies and regulatory frameworks to protect the environment, health and safety, to promote resource efficiency and climate action, and to reduce waste. A better integration of research and innovation into related Union policies will significantly improve their European added value, provide leverage effects, increase societal relevance and help to further develop sustainable land, seas and oceans management and bio-economy markets.

For the purpose of supporting Union policies related to the bio-economy and to facilitate governance and monitoring of research and innovation, socio-economic research and forward looking activities will be performed in relation to the bio-economy strategy, including development of indicators, data bases, models, foresight and forecast, impact assessment of initiatives on the economy, society and the environment.

Challenge-driven actions focusing on social, economic and environmental benefits and the modernisation of the bio-economy associated sectors and markets shall be supported through multi-disciplinary research, driving innovation and leading to the development of new strategies, practices, products and processes. It shall also pursue a broad approach to innovation ranging from technological, non-technological, organisational, economic and social innovation to, for instance, ways for technology transfer, novel business models, branding and services.

2.3 Broad lines of activities

(a) Sustainable agriculture and forestry

The aim is to supply sufficient food, feed, biomass and other raw-materials, while safeguarding natural resources, such as water and soil, and enhancing ecosystems services, including coping with and mitigating climate change. The activities shall focus on delivering more sustainable and productive agriculture, including animal husbandry and forestry systems which are both resource-efficient (including low-carbon and water) and resilient and produce less waste. Furthermore, the activities shall focus on developing of services, concepts and policies for thriving rural livelihoods and encouraging sustainable consumption.

In particular for forestry, the aim is to sustainably produce bio-based products, ecosystems-, services and sufficient biomass, with due consideration to economical, ecological and social aspects of forestry. Activities will focus on the further development of production and sustainability of resource efficient forestry systems which are instrumental in the strengthening of forest resilience and biodiversity protection, and which can meet increased biomass demand.

The interaction of functional plants with health and well being, as well as the exploitation of horticulture and forestry for the development of urban greening will also be considered.

(b) Sustainable and competitive agri-food sector for a safe and healthy diet

The aim is to meet the requirements of citizens and the environment for safe, healthy and affordable food, and to make food and feed processing and distribution and consumption more sustainable and the food sector more competitive while also considering the cultural component of food quality. The activities shall focus on healthy and safe foods for all, informed consumer choices, dietary solutions and innovations for improved health and competitive food processing methods that use less resources and produce less by-products, waste and green-house gases.

(c) Unlocking the potential of aquatic living resources

The aim is to manage aquatic living resources to maximise social and economic benefits/returns from Europe's oceans, seas and inland waters. The activities shall focus on an optimal contribution to secure food supplies by developing sustainable and environmentally friendly fisheries, sustainable management of ecosystems providing goods and services, competitive as well as environmentally friendly European aquaculture in the context of the global economy and on boosting marine and maritime innovation through biotechnology to fuel smart "blue" growth. Cross-cutting marine and maritime scientific and technological knowledge will be addressed with a view to unlock the potential of the seas and inland waters across the range of marine and maritime industries, while protecting the environment and adapting to climate change.

(d) Sustainable and competitive bio-based industries and supporting the development of a European bio-economy

The aim is the promotion of low carbon, resource efficient, sustainable and competitive European bio-based industries. The activities shall focus on fostering the knowledge-based bio-economy by transforming conventional industrial processes and products into bio-based resource and energy efficient ones, the development of integrated biorefineries, optimising the use of biomass from primary production, biowaste and bio-based industry by-products, and opening new markets through supporting standardisation and certification systems, regulatory and demonstration/field trial activities and others, while taking into account the implication of the bio-economy on land use and land use changes.

3. SECURE, CLEAN AND EFFICIENT ENERGY

3.1. Specific objective

The specific objective is to make the transition to a reliable, publicly accepted, sustainable and competitive energy system, aiming at reducing fossil fuel dependency in the face of increasingly scarce resources, increasing energy needs and climate change.

The Union intends to reduce greenhouse gas emissions by 20 % below 1990 levels by 2020, with a further reduction to 80-95 % by 2050. In addition, renewables should cover 20 % of final energy consumption in 2020 coupled with a 20 % energy efficiency target. Achieving these objectives will require an overhaul of the energy system combining low carbon profile, energy security and affordability, while at the same time reinforcing Europe's economic competitiveness. Europe is currently far from this overall goal. 80 % of the European energy system still relies on fossil fuels, and the sector produces 80 % of all the Union's greenhouse gas emissions. Every year 2.5 % of the Union's Gross Domestic Product (GDP) is spent on energy imports and this is likely to increase. This trend would lead to total dependence on oil and gas imports by 2050. Faced with volatile energy prices on the world market, coupled with concerns over security of supply, European industries and consumers are spending an increasing share of their income on energy. European cities are responsible for 70-80%¹¹ of the total energy consumption in the EU and for about the same share of green house gas emissions.

The roadmap to a competitive low-carbon economy in 2050¹² suggests that the targeted reductions in greenhouse gas emissions will have to be met largely within the territory of the Union. This would entail reducing CO₂ emissions by over 90 % by 2050 in the power sector, by over 80 % in industry, by at least 60 % in transport and by about 90 % in the residential sector and services. The roadmap also shows that inter-alia gas, in the short to medium term, can contribute to the transformation of the energy system.

¹¹ World Energy Outlook 2008, OECD- IEA, 2008

¹² COM(2011) 112

To achieve these ambitious reductions, significant investments need to be made in research, development, demonstration and market roll-out of efficient, safe and reliable low-carbon energy technologies, including gas, and services. These must go hand in hand with non-technological solutions on both the supply and demand sides by initiating participation processes and integrating consumers. All this must be part of an integrated low-carbon policy, including mastering key enabling technologies, in particular ICT solutions and advanced manufacturing, processing and materials. The goal is to develop and produce efficient energy technologies and services that can be taken up widely on European and international markets and to establish intelligent demand-side management based on an open and transparent energy trade market and intelligent energy efficiency management systems.

3.2. Rationale and Union added value

New technologies and solutions must compete on cost and reliability against highly optimised energy systems with well-established incumbents and technologies. Research and innovation are critical to make these new, cleaner, low-carbon, more efficient energy sources commercially attractive on the scale needed. Neither industry alone, nor Member States individually, are able to bear the costs and risks, for which the main drivers (transition to a low carbon economy, providing affordable and secure energy) are outside the market.

Speeding up this development will require a strategic approach at Union level, spanning energy supply, demand and use in buildings, services, domestic use, transport and industrial value chains. This will entail aligning resources across the Union, including cohesion policy funds, in particular through the national and regional strategies for smart specialisation, emission trading schemes (ETS), public procurement and other financing mechanisms. It will also require regulatory and deployment policies for renewables and energy efficiency, tailored technical assistance and capacity-building to remove non-technological barriers.

The Strategic Energy Technology Plan (SET Plan) offers such a strategic approach. It provides a long term agenda to address the key innovation bottlenecks that energy technologies are facing at the frontier research and R&D/proof-of-concept stages and at the demonstration stage when companies seek capital to finance large, first-of-a-kind projects and to open the market deployment process.

The resources required to implement the SET Plan in full have been estimated at EUR 8 billion per year over the next 10 years¹³. This is well beyond the capacity of individual Member States or research and industrial stakeholders alone. Investments in research and innovation at Union level are needed, combined with mobilisation of efforts across Europe in the form of joint implementation and risk and capacity sharing. Union funding of energy research and innovation shall therefore complement Member States' activities by focusing on cutting-edge technologies and activities with clear Union added value, in particular those with high potential to leverage national resources. Action at Union level shall also support high-risk, high-cost, long-term programmes beyond the reach of individual Member States, pool efforts to reduce investment risks in large-scale activities such as industrial demonstration and develop Europe-wide, interoperable energy solutions.

Implementation of the SET-Plan as the research and innovation pillar of European energy policy will reinforce the Union's security of supply and the transition to a low-carbon economy, help to link research and innovation programmes with trans-European and regional investments in energy infrastructure and increase the willingness of investors to release capital for projects with long lead-times and significant technology and market risks. It will create opportunities for innovation for small and large companies and help them become or remain competitive at world level, where opportunities for energy technologies are large and increasing.

On the international scene, the action taken at Union level provides a 'critical mass' to attract interest from other technology leaders and foster international partnerships to achieve the Union's objectives. It will make it easier for international partners to interact with the Union to build common action where there is mutual benefit and interest.

¹³ COM(2009) 519

The activities under this challenge will therefore form the technological backbone of European energy and climate policy. They will also contribute to achieving the Innovation Union in the field of energy and the policy goals outlined in 'Resource Efficient Europe', 'An Industrial Policy for the Globalisation Era' and 'A Digital Agenda for Europe'.

Research and innovation activities on nuclear fission and fusion energy are carried out in the EURATOM part of Horizon 2020, but coordination with the energy challenge should be sought in order to foster synergies between both programmes.

3.3. Broad lines of the activities

(a) Reducing energy consumption and carbon footprint by smart and sustainable use

Activities shall focus on research and full-scale testing of new concepts, non-technological solutions, more efficient, socially acceptable and affordable technology components and systems with in-built intelligence, to allow real-time energy management for new and existing near-zero-emission buildings, cities and districts, renewable heating and cooling, highly efficient industries and mass take-up of energy efficiency solutions by companies, individuals, communities and cities.

(b) Low-cost, low-carbon electricity supply

Activities shall focus on research, development and full scale demonstration –of innovative renewables, efficient and flexible fossile power plants (including those using natural gas) and carbon capture and storage, or CO₂ re-use technologies, offering larger scale, lower cost, environmentally safe technologies with higher conversion efficiency and higher availability for different market and operating environments.

(c) Alternative fuels and mobile energy sources

Activities shall focus on research, development and full scale demonstration of technologies and value chains to make bio-energy more competitive and sustainable, for power and heat, surface, maritime and air transport, to reduce time to market for hydrogen and fuel cells and to bring new options showing long-term potential to maturity.

(d) A single, smart European electricity grid

Activities shall focus on research, development and full scale demonstration of new smart energy grid technologies, including storage, systems and market designs to plan, monitor, control and safely operate interoperable networks, including standardisation issues, in an open, decarbonised, climate resilient and competitive market, under normal and emergency conditions.

(e) New knowledge and technologies

Activities shall focus on multi-disciplinary research for clean, safe and sustainable energy technologies (including visionary actions) and joint implementation of pan-European research programmes and world-class facilities.

(f) Robust decision making and public engagement

Activities shall focus on the development of tools, methods, models and perspective scenarios for a robust and transparent policy support, including activities on public engagement, user involvement, environmental impact, and sustainability assessment improving the understanding of energy related socio-economic trends and prospects.

(g) Market uptake of energy innovation

Activities shall focus on applied innovation and promotion of standards to facilitate the market uptake of energy technologies and services, to address non-technological barriers and to accelerate the cost effective implementation of the Union's energy policies. Attention will also be given to innovation for the smart and sustainable use of existing technologies.

4. SMART, GREEN AND INTEGRATED TRANSPORT

4.1 Specific objective

The specific objective is to achieve a European transport system that is resource-efficient, environmentally-friendly, safe and seamless for the benefit of citizens, the economy and society.

Europe must reconcile the growing mobility needs of its citizens and goods with the imperatives of economic performance and the requirements of an energy-efficient low-carbon society and climate resilient economy. Despite its growth, the transport sector must achieve a substantial reduction in greenhouse gases and other adverse environmental impacts, and must break its dependency on oil, while maintaining high levels of efficiency and mobility.

Sustainable mobility can only be achieved through a radical change in the transport system including in public transport, inspired by breakthroughs in transport research, far-reaching innovation, and a coherent, Europe-wide implementation of greener, safer and smarter transport solutions.

Research and innovation must bring about focussed and timely advances that will help achieve key Union policy objectives, while boosting economic competitiveness, supporting the transition to a climate-resilient and low-carbon economy, and maintaining global market leadership both for the service industry as well as the manufacturing industry.

Although the necessary investments in research, innovation and deployment will be significant, failing to improve the sustainability of the whole transport system will result in unacceptably high societal, ecological, and economic costs in the long term, and damaging consequences on European jobs and long term economic growth.

4.2 Rationale and Union added value

Transport is a major driver of Europe's economic competitiveness and growth. It ensures the mobility of people and goods necessary for an integrated European single market and an open and inclusive society. It represents one of Europe's greatest assets in terms of industrial capability and quality of service, playing a leading role in many world markets. Transport industry and transport equipment manufacturing together represent 6.3 % of the Union's GDP. At the same time, the European transport industry faces increasingly fierce competition from other parts of the world. Breakthrough technologies will be required to secure Europe's future competitive edge and to mitigate the drawbacks of our current transport system.

The transport sector is a major contributor to greenhouse gases and generates up to a quarter of all emissions. It is also a major contributor to other air pollution problems. Transport is still 96 % dependent on fossil fuels. It is essential to reduce this environmental impact through targeted technological improvement, bearing in mind that each mode of transport faces varying challenges and is characterised by different technology integration cycles. Moreover congestion is an increasing problem; systems are not yet sufficiently smart; alternatives for shifting between different modes of transport are not always attractive; road fatalities remain dramatically high at 34 000 per year in the Union; citizens and businesses expect a transport system that is safe and secure. The urban context poses specific challenges and opportunities to the sustainability of transport.

Within a few decades the expected growth rates of transport would drive European traffic into a gridlock and make its economic costs and societal impact unbearable. Passenger-kilometres are predicted to double over the next 40 years and grow twice as fast for air travel. CO₂ emissions would grow 35 % by 2050¹⁴. Congestion costs would increase by about 50 %, to nearly EUR 200 billion annually. The external costs of accidents would increase by about EUR 60 billion compared to 2005.

¹⁴ Commission White Paper on "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system" COM(2011) 144 final.

Business-as-usual is therefore not an option. Research and innovation, driven by policy objectives and focused on the key challenges, shall contribute substantially to achieve the Union's targets of limiting global temperature increase to 2°C, cutting ¹⁵60 % of CO₂ emissions from transport, drastically reduce congestion and accident costs, and virtually eradicating road deaths by 2050.

The problems of pollution, congestion, safety and security are common throughout the Union and call for collaborative Europe-wide responses. Accelerating the development and deployment of new technologies and innovative solutions for vehicles¹⁶, infrastructures and transport management will be key to achieve a cleaner and more efficient intermodal and multi-modal transport system in the Union; to deliver the results necessary to mitigate climate change and improve resource efficiency; to maintain European leadership on the world markets for transport related products and services. These objectives cannot be achieved through fragmented national efforts alone.

Union level funding of transport research and innovation will complement Member States' activities by focussing on activities with a clear European added-value. This means that emphasis will be placed on priority areas that match European policy objectives; where a critical mass of effort is necessary; where Europe-wide, interoperable transport solutions need to be pursued; or where pooling efforts trans-nationally and making better use of and effectively disseminating existing research evidence can reduce research investment risks, pioneer common standards and shorten time-to-market of research results.

Research and innovation activities shall include a wide range of initiatives, including relevant public-private partnerships, that cover the full innovation chain. Several activities are specifically intended to help bring results to the market: a programmatic approach to research and innovation, demonstration projects, market take-up actions and support for standardisation, regulation and innovative procurement strategies all serve this goal. In addition, using stakeholders' engagement and expertise will help bridge the gap between research results and their deployment in the transport sector.

¹⁵ Commission White Paper on "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system" COM(2011) 144 final.

¹⁶ "Vehicles" is to be understood in a broad sense, including all means of transport.

Investing in research and innovation for a greener, smarter and fully integrated transport system will make an important contribution to the Europe 2020 goals of smart, sustainable and inclusive growth and the objectives of the Innovation Union flagship initiative. The activities will support the implementation of the White Paper on Transport aiming at a Single European Transport Area. They will also contribute to the policy goals outlined in the flagship initiatives on 'Resource Efficient Europe', 'An Industrial Policy for the Globalisation Era' and 'A Digital Agenda for Europe'. They will also interface with the relevant Joint Programming Initiatives.

4.3. Broad lines of the activities

The activities will be organised in such a way as to allow for an integrated and mode-specific approach as appropriate. Multiannual visibility and continuity will be necessary in order to take into account both the specificities of each transport mode and the holistic nature of challenges, as well as the relevant Strategic Research and Innovation Agendas of the transport European Technology Platforms.

(a) Resource efficient transport that respects the environment

The aim is to minimise transport systems' impact on climate and the environment (including noise and air pollution) by improving its efficiency in the use of natural resources, and by reducing its dependence on fossil fuels.

The focus of activities shall be to reduce resource consumption, particularly fossil fuels, and greenhouse gas emissions, as well as improve transport efficiency, to accelerate the development, manufacturing and deployment of a new generation of clean (electric, hydrogen and other low or zero emission) vehicles, including through breakthroughs and optimization in engines, energy storage and infrastructure; to explore and exploit the potential of alternative fuels and innovative and more efficient propulsion and operating systems, including fuel infrastructure and charging; to optimise the planning and use of infrastructures, by means of intelligent transport systems, logistics, and smart equipment; and to increase the use of demand management and public and non-motorised transport, particularly in urban areas.

(b) Better mobility, less congestion, more safety and security

The aim is to reconcile the growing mobility needs with improved transport fluidity, through innovative solutions for seamless, inclusive, affordable, safe, secure and robust transport systems.

The focus of activities shall be to reduce congestion, improve accessibility, passenger choices and match user needs by promoting integrated door-to-door transport and logistics; to enhance inter-modality and the deployment of smart planning and management solutions; and to drastically reduce the occurrence of accidents and the impact of security threats.

(c) Global leadership for the European transport industry

The aim is to reinforce the competitiveness and performance of European transport manufacturing industries and related services including logistic processes and retain areas of European leadership (e.g. such as aeronautics).

The focus of activities shall be to develop the next generation of innovative air, waterborne and land transport means, ensure sustainable manufacturing of innovative systems and equipment and to prepare the ground for future transport means, by working on novel technologies, concepts and designs, smart control systems and interoperable standards, efficient production processes, innovative services and certification procedures, shorter development times and reduced lifecycle costs without compromising operational safety and security.

(d) Socio-economic research and forward looking activities for policy making

The aim is to support improved policy making which is necessary to promote innovation and meet the challenges raised by transport and the societal needs related to it.

The focus of activities shall be to improve the understanding of transport related socio-economic impacts, trends and prospects, including the evolution of future demand, and provide policy makers with evidence-based data and analyses.

5. CLIMATE ACTION, RESOURCE EFFICIENCY AND RAW MATERIALS

5.1. Specific objective

The specific objective is to achieve a resource - and water - efficient and climate change resilient economy and society, protection of the environment and a sustainable supply of raw materials, in order to meet the needs of a growing global population within the sustainable limits of the planet's natural resources and eco-systems. Activities will contribute to increasing European competitiveness, raw materials security and improving well being, whilst assuring environmental integrity, resilience and sustainability with the aim of keeping average global warming below 2 C and enabling ecosystems and society to adapt to climate change and other environmental changes.

During the 20th century, the world increased both its fossil fuel use and the extraction of material resources by of the order of a factor of ten. This era of seemingly plentiful and cheap resources is coming to an end. Raw materials, water, air, biodiversity and terrestrial, aquatic and marine ecosystems are all under pressure. Many of the world's major ecosystems are being degraded, with up to 60 % of the services that they provide being used unsustainably. In the Union, some 16 tonnes of materials are used per person each year, of which 6 tonnes are wasted, with half going to landfill. The global demand for resources continues to increase with the growing population and rising aspirations, in particular of middle income earners in emerging economies.

The average temperature of the Earth's surface has increased by about 0.8°C over the past 100 years and is projected to increase by between 1.8 to 4°C by the end of the 21st century (relative to the 1980-1999 average)¹⁷. The likely impacts on natural and human systems associated with these changes will challenge the planet and its ability to adapt, as well as threatening future economic development and the well being of humanity.

¹⁷ IPCC 4th Assessment Report, 2007, (www.ipcc.ch)

The growing impacts from climate change and environmental problems, such as ocean acidification, changes in ocean circulation, increase of seawater temperature, ice melting in the Arctic, land degradation and use, water scarcity, droughts and floods, seismic and volcanic hazards, chemical pollution, resources over-exploitation and biodiversity loss, indicate that the planet is approaching its sustainability boundaries. For example, without improvements in efficiency, water demand is projected to overshoot supply by 40 % in 20 years time. Forests are disappearing at an alarmingly high rate of 5 million hectares per year. Interactions between resources can cause systemic risks – with the depletion of one resource generating an irreversible tipping point for other resources and ecosystems. Based on current trends, the equivalent of more than two planet Earths will be needed by 2050 to support the growing global population.

The sustainable supply and resource-efficient management of raw materials, including their exploration, extraction, processing, re-use, recycling and substitution, is essential for the functioning of modern societies and their economies. European sectors, such as construction, chemicals, automotive, aerospace, machinery and equipment, which provide a total added value of some EUR 1.3 trillion and employment for approximately 30 million people, heavily depend on access to raw materials. However, the supply of raw materials to the Union is coming under increasing pressure. Furthermore, the Union is highly dependent on imports of strategically important raw materials, which are being affected at an alarming rate by market distortions. Moreover, the Union still has valuable mineral deposits, whose exploration and extraction is limited by a lack of adequate technologies and hampered by increased global competition. Given the importance of raw materials for European competitiveness, the economy and for their application in innovative products, the sustainable supply and resource efficient management of raw materials is a vital priority for the Union.

The ability of the economy to adapt and become more climate change resilient, resource efficient and at the same time remain competitive depends on high levels of eco-innovation, of both a societal, economic and technological nature. With the global market for eco-innovation worth around EUR 1 trillion per annum and expected to triple by 2030, eco-innovation represents a major opportunity to boost competitiveness and job creation in European economies.

5.2. Rationale and Union added value

Meeting Union and international targets for greenhouse gas emissions and concentrations and coping with climate change impacts requires a transition towards a low-carbon society and the development and deployment of cost-effective technologies, and mitigation and adaptation measures, and a stronger understanding of societal responses to these challenges. Union and global policy frameworks must ensure that ecosystems and biodiversity are protected, valued and appropriately restored in order to preserve their ability to provide resources and services in the future. Research and innovation can help secure reliable and sustainable access to and exploitation of raw materials on land and sea bed and ensure a significant reduction in resource use and wastage.

The focus of Union actions shall therefore be on supporting key Union objectives and policies covering the whole innovation cycle and the elements of the knowledge triangle including: the Europe 2020 strategy; the Innovation Union; the Industrial Policy for a globalised era, Resource-Efficient Europe and the corresponding Roadmap; the Roadmap for moving to a competitive low carbon economy in 2050¹⁸; Adapting to climate change: Towards a European framework for action¹⁹; the Raw Materials Initiative²⁰; the Union's Sustainable Development Strategy²¹; an Integrated Maritime Policy for the Union²²; the Marine Strategy Framework Directive²³; the Water Framework Directive and daughter Directives; the Flood Directive; the Eco-innovation Action Plan and the Digital Agenda for Europe²⁴. These actions shall, when appropriate, interface with relevant European Innovation Partnerships and Joint Programming Initiatives. These actions shall reinforce the ability of society to become more resilient to environmental and climate change and ensure the availability of raw materials.

¹⁸ COM (2011) 112

¹⁹ COM (2009) 147

²⁰ COM(2011) 25

²¹ COM(2009) 400

²² COM(2007) 575 final

²³ DIRECTIVE 2008/56/EC

²⁴ COM(2010) 245

Given the transnational and global nature of the climate and the environment, their scale and complexity, and the international dimension of the raw materials supply chain, activities have to be carried out at the Union level and beyond. The multi-disciplinary character of the necessary research requires pooling complementary knowledge and resources in order to effectively tackle this challenge in a sustainable way. Reducing resource use and environmental impacts, whilst increasing competitiveness, will require a decisive societal and technological transition to an economy based on a sustainable relationship between nature and human well-being. Coordinated research and innovation activities will improve the understanding and forecasting of climate and environmental change in a systemic and cross-sectoral perspective, reduce uncertainties, identify and assess vulnerabilities, risks, costs and opportunities, as well as expand the range and improve the effectiveness of societal and policy responses and solutions. Actions will also seek to improve research and innovation delivery and dissemination to support policy-making and to empower actors at all levels of society to actively participate in this process. In this context, water challenges include water use in rural, urban and industrial environments and the protection of aquatic ecosystems.

Addressing the availability of raw materials calls for co-ordinated research and innovation efforts across many disciplines and sectors to help provide safe, economically feasible, environmentally sound and socially acceptable solutions along the entire value chain (exploration, extraction, processing, re-use, recycling and substitution). Innovation in these fields will provide opportunities for growth and jobs, as well as innovative options involving science, technology, the economy, society, policy and governance. For this reason, a European Innovation Partnership on Raw Materials is being prepared.

Responsible eco-innovation may provide valuable new opportunities for growth and jobs. Solutions developed through Union level action will counter key threats to industrial competitiveness and enable rapid uptake and replication across the Single Market and beyond. This will enable the transition towards a green economy that takes into account the sustainable use of resources. Partners for this approach will include: International, European and national policy makers; international and Member State research and innovation programmes; European business and industry; the European Environment Agency and national environment agencies; and other relevant stakeholders.

In addition to bilateral and regional cooperation, Union level actions will also support relevant international efforts and initiatives, including the Intergovernmental Panel on Climate Change (IPCC), the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) and the Group on Earth Observations (GEO).

5.3. Broad lines of the activities

(a) Fighting and adapting to climate change

The aim is to develop and assess innovative, cost-effective and sustainable adaptation and mitigation measures, targeting both CO₂ and non-CO₂ greenhouse gases, and underlining both technological and non-technological green solutions, through the generation of evidence for informed, early and effective action and the networking of the required competences. Activities shall focus on: improving the understanding of climate change and the provision of reliable climate projections; assessing impacts, vulnerabilities and developing innovative cost-effective adaptation and risk prevention and management measures; supporting mitigation policies including studies that focus on impact from other sectoral policies.

(b) Protection of the environment, sustainable management of natural resources, water, biodiversity and ecosystems

The aim is to provide knowledge and tools for the management and protection of natural resources that achieves a sustainable balance between limited resources and the present and future needs of society and the economy. Activities shall focus on: furthering our understanding of biodiversity and the functioning of ecosystems, their interactions with social systems and their role in sustaining the economy and human well-being; developing integrated approaches for the sustainable management of water-related challenges; and providing knowledge and tools for effective decision making and public engagement.

(c) Ensuring the sustainable supply of non-energy and non-agricultural raw materials

The aim is to improve the knowledge base on raw materials and develop innovative solutions for the cost-effective and environmentally friendly exploration, extraction, processing, re-use, recycling and recovery of raw materials and for their substitution by economically attractive and environmentally sustainable alternatives with a lower environmental impact. Activities shall focus on: improving the knowledge base on the availability of raw materials; promoting the sustainable supply and use of raw materials, including mineral resources, from land and sea; finding alternatives for critical raw materials; and improving societal awareness and skills on raw materials.

(d) Enabling the transition towards a green economy and society through eco-innovation

The aim is to foster all forms of eco-innovation that enable the transition to a green economy. Activities shall focus on: strengthening eco-innovative technologies, processes, services and products, including exploring ways to reduce the quantities of raw materials in production and consumption, and overcoming barriers in this context, and boosting their market uptake and replication, with special attention for SMEs; supporting innovative policies and societal changes; measuring and assessing progress towards a green economy; and fostering resource efficiency through digital systems.

(e) Developing comprehensive and sustained global environmental observation and information systems

The aim is to ensure the delivery of the long-term data and information required to address this challenge. Activities shall focus on the capabilities, technologies and data infrastructures for Earth observation and monitoring that can continuously provide timely and accurate information, forecasts and projections. Free, open and unrestricted access to interoperable data and information will be encouraged. Activities shall help define future operational activities of the European Earth Monitoring programme (GMES) and enhance the use of GMES data for research activities.

(f) Cultural heritage

The aim is to research into the strategies, methodologies and tools needed to enable a dynamic and sustainable cultural heritage in Europe in response to climate change. Cultural heritage in its diverse physical forms provides the living context for resilient communities responding to multivariate changes. Research in cultural heritage requires a multidisciplinary approach to improve the understanding of historical material. Activities shall focus on identifying resilience levels via observations, monitoring and modelling as well as provide for a better understanding on how communities perceive and respond to climate change and seismic and volcanic hazards.

6. EUROPE IN A CHANGING WORLD – INCLUSIVE, INNOVATIVE AND REFLECTIVE SOCIETIES

6.1. Specific objective

The specific objective is to foster a greater understanding of Europe, provide solutions and support inclusive, innovative and reflective European societies in a context of unprecedented transformations and growing global interdependencies.

Europe is confronted with major socio-economic challenges which significantly affect its common future. These include: growing economic and cultural interdependencies, ageing and demographic change, social exclusion and poverty, integration and disintegration, inequalities and migration flows, a growing digital divide, fostering a culture of innovation and creativity in society and enterprises, a decreasing sense of trust in democratic institutions and between citizens within and across borders. These challenges are enormous and they call for a common European approach.

Significant inequalities persist in the Union both across countries and within them. In 2011 the Human Development Index, an aggregate measure of progress in health, education and income, scores the Union's Member States between 0,771 and 0,910, thus reflecting considerable divergences between countries. Significant gender inequalities also persist: for instance, the gender pay gap in the Union remains at an average of 17.8 % in favour of men²⁵. One in every six Union citizens today (around 80 million people) is at risk of poverty. Over the past two decades the poverty of young adults and families with children has risen. The youth unemployment rate is above 20 %. 150 million Europeans (some 25 %) have never used the internet and may never get sufficient digital literacy. Political apathy and polarisation in elections has also risen, reflecting citizen's faltering trust in current political systems. These figures suggest that some social groups and communities are persistently left out of social and economic development and/or democratic politics. These inequalities do not only stifle societal development but hamper the economies in the European Union and reduce the research and innovation capacities within and across countries.

²⁵ COM(2010) 491 final.

A central challenge in addressing these inequalities will be the fostering of settings in which European, national and ethnic identities can coexist and be mutually enriching.

Moreover, the number of Europeans aged over 65 is expected to rise significantly by 42% from 87 million in 2010 to 124 million in 2030. This presents a major challenge for the economy, society and the sustainability of public finances.

Europe's productivity and economic growth rates have been relatively decreasing for four decades. Furthermore, its share of the global knowledge production and its innovation performance lead compared to key emerging economies such as Brazil and China are declining fast. Although Europe has a strong research base, it needs to make this base a powerful asset for innovative goods and services. Since the financial crisis many economic and social inequalities in Europe have been aggravated even further and the return of pre-crisis rates of economic growth seems a long way off for most of the European Union. The current crisis also suggests that it is challenging to find solutions to crises that reflect the heterogeneity of Member States and their interests.

These challenges must be tackled together and in innovative and multi-disciplinary ways because they interact in complex and often unexpected ways. Innovation may lead to weakening inclusiveness, as can be seen, for instance, in the phenomena of digital divide or labour market segmentation. Social innovation and, social trust are sometimes difficult to reconcile in policies, for instance in socially depressed areas in large cities in Europe. Besides, the conjunction of innovation and citizens' evolving demands also lead policymakers, economic and social actors to find new answers that ignore established boundaries between sectors, activities, goods or services. Phenomena such as the growth of Internet, of the financial systems, of the ageing economy and of the ecological society abundantly show how it is necessary to think and respond to these issues across their dimensions of inclusiveness and, innovation at the same time.

The in-built complexity of these challenges and the evolutions of demands thus make it essential to develop innovative research and new smart technologies, processes and methods, social innovation mechanisms, coordinated actions and policies that will anticipate or influence major evolutions for Europe. It calls for a renewed understanding of determinants of innovation, interactions between science and society as well as principles and practices with respect to responsible research and innovation. In addition, it calls for understanding the underlying trends and impacts within these challenges and rediscovering or reinventing successful forms of solidarity, behaviour, coordination and creativity that make Europe distinctive in terms of inclusive, innovative and reflective societies compared to other world regions. It also requires a more strategic approach to cooperation with third countries that is based on a deeper understanding of the Union's past and its current and future role as a global player.

6.2. Rationale and Union added value

These challenges go beyond national borders and thus call for more complex comparative analyses of mobility (of people, goods, services and capital but also of competences, knowledge and ideas) and forms of institutional cooperation, intercultural interactions and international cooperation. If they are not better understood and anticipated, forces of globalisation also push European countries to compete with each other rather than cooperate, thus accentuating differences in Europe rather than commonalities and a right balance between cooperation and competition. Addressing such critical issues, including socio-economic challenges, only at national level carries the danger of inefficient use of resources, externalisation of problems to other European and non-European countries and the accentuation of social, economic and political tensions that may directly affect the aims of the European Treaty regarding its values, in particular Title I of the Treaty on European Union.

In order to understand, analyse and build inclusive, innovative and reflective societies, Europe requires a response which unfolds the potential of shared ideas for the European future to create new knowledge, technologies and capabilities. The concept of inclusive societies acknowledges the diversity in culture, regions and socio-economic settings as a European strength. Turning European diversity into a source of innovation and development is needed. Such endeavour will help Europe tackle its challenges not only internally but also as a global player on the international scene. This, in turn, will also help Member States benefit from experiences elsewhere and allow them to better define their own specific actions corresponding to their respective contexts.

Fostering new modes of cooperation between countries within the Union and worldwide, as well as across relevant research and innovation communities, will therefore be a central task under this challenge. Engaging citizens and industry, supporting social and technological innovation processes, encouraging smart and participatory public administration, as well as informing and promoting evidence based policymaking will be systematically pursued in order to enhance the relevance of all these activities for policymakers, social and economic actors and citizens. Research and innovation will be a precondition for the competitiveness of European businesses and services with particular attention to sustainability, advancing education, increasing employment, and reducing poverty.

Union funding under this challenge will thus support the development, implementation and adaptation of key Union policies, notably Europe 2020 priorities for smart, sustainable and inclusive growth. It will interface, as and when appropriate, with Joint Programming Initiatives, including “Cultural Heritage”, “More Years, Better Lives” and “Urban Europe” and coordination with the Joint Research Centre direct actions will be pursued.

6.3. Broad lines of activities

6.3.1. Inclusive societies

The aim is to understand, analyse and develop social, economic and political inclusion and positive inter-cultural dynamics in Europe and with international partners, through cutting-edge science and interdisciplinarity, technological advances and organisational innovations. The main challenges to be tackled concerning a European models for social cohesion are migration, integration, demographic change, the ageing society and disability, as well as the reduction of poverty taking into account the different regional and cultural characteristics.

Social Sciences and Humanities research play a leading role here as they explore changes over time and space and enable exploration of imagined futures. Europe has a huge shared history of both co-operation and conflict. Its dynamic cultural interactions provide inspiration and opportunities. Research is needed to understand identity and belonging across communities, regions and nations. Research will support policymakers in designing policies that foster employment, combat poverty and prevent the development of various forms of divisions, discriminations and inequalities in European societies, such as gender and intergenerational inequalities, discrimination due to disability or ethnic origin or digital or innovation divides, and with other world regions. It shall in particular feed into the implementation and the adaptation of the Europe 2020 strategy and the broad external action of the Union. Specific measures shall be taken to unlock excellence in low performing RDI regions, and thereby widening participation in Horizon 2020.

The focus of activities shall be to understand and foster or implement:

- (a) the mechanisms to promote smart, sustainable and inclusive growth;
- (b) trusted organisations, practices, services and policies that are necessary to build resilient, inclusive, participatory, open and creative societies in Europe, in particular taking into account migration, integration and demographic change;

- (c) Europe's role as a global actor notably regarding human rights and global justice;
- (d) the processes and practices to close the research and innovation divide in Europe;
- (e) the promotion of sustainable and inclusive environments through innovative spatial and urban planning and design.

6.3.2. Innovative societies

The aim is to foster the development of innovative societies and policies in Europe through the engagement of citizens, enterprises and users in research and innovation and the promotion of coordinated research and innovation policies in the context of globalisation and the need to promote the highest ethical standards. Particular support will be provided for the development of the ERA and the development of framework conditions for innovation. Cultural and societal knowledge is a major source of creativity and innovation, including business, public sector and social innovation. In many cases social and user-led innovations also precede the development of innovative technologies, services and economic processes. The creative industries are a major resource to tackle societal challenges and for competitiveness. As interrelations between social and technological innovation are complex, and rarely linear, further research, including cross-sectoral and multidisciplinary research, is needed into the development of all types of innovation and activities funded to encourage its effective development into the future. -

The focus of activities shall be to:

- (a) strengthen the evidence base and support for the Innovation Union and ERA;
- (b) explore new forms of innovation, with special emphasis on social innovation and creativity and understand how all forms of innovation are developed, succeed or fail;
- (c) make use of the innovative, creative and productive potential of all generations;
- (d) ensure societal engagement in research and innovation;
- (e) promote coherent and effective cooperation with third countries.

6.3.3. Reflective Societies – cultural heritage and European identity

The aim is to contribute to an understanding of Europe's intellectual basis: its history and the many European and non-European influences; as an inspiration for our lives today. Europe is characterized by a variety of different peoples (including minorities and indigenous people), traditions and regional and national identities as well as by different levels of economic and societal development. Migration and mobility, the media, industry and transport contribute to the diversity of views and lifestyles. This diversity and its opportunities should be recognized and considered.

European collections in libraries, including digital ones, archives, museums, galleries and other public institutions have a wealth of rich, untapped documentation and objects for study. These archival resources, together with intangible heritage, represent the history of individual Member States but also the collective heritage of a European Union that has emerged through time. Such materials should be made accessible, also through new technologies, to researchers and citizens to enable a look to the future through the archive of the past. Accessibility and preservation of cultural heritage in these forms is needed for the vitality of the living engagements within and across European cultures now and contributes to sustainable economic growth.

The focus of activities shall be to:

- (a) study European heritage, memory, identity, integration and cultural interaction and translation, including its representations in cultural and scientific collections, archives and museums, to better inform and understand the present by richer interpretations of the past;
- (b) research into European countries' and regions' history, literature, art, philosophy and religions and how these have informed contemporary European diversity;
- (c) research on Europe's role in the world, on the mutual influence and ties between the world regions, and a view from outside on European cultures.

7. SECURE SOCIETIES – PROTECTING FREEDOM AND SECURITY OF EUROPE AND ITS CITIZENS

7.1. Specific objective

The specific objective is to foster secure European societies in a context of unprecedented transformations and growing global interdependencies and threats, while strengthening the European culture of freedom and justice.

There is a widespread perception of insecurity, whether from crime, violence, terrorism, natural/man-made disasters, cyber attacks, privacy abuses and other forms of social and economic disorders. This affects citizens directly and has a wider impact on notions of trust, care and communication and links to the level of preparation and organisation of society.

According to estimates, there are likely to be up to 75 million direct victims of crime every year in Europe²⁶. The direct cost of crime, terrorism, illegal activities, violence and disasters in Europe has been estimated at least EUR 650 billion (about 5 % of the Union's GDP) in 2010. A vivid example of the consequences of terrorism is the attack against the Twin Towers in Manhattan on 11 September 2001. Thousands of lives were lost and it is estimated that this event caused losses in US productivity amounting to US\$ 35 billion, US\$ 47 billion in total output and a rise in unemployment by almost 1 % in the following quarter. It also had a significant cultural and global impact. Citizens, firms and institutions are increasingly involved in digital interactions and transactions in social, financial and commercial areas of life but the development of Internet has also led to cyber crime worth billion of Euros each year and breaches of privacy affecting individuals or associations across the continent. Changes in the nature and perception of insecurity in everyday life are likely to affect citizens' trust not only in institutions but also in each other.

²⁶ COM(2011) 274 final

In order to anticipate, prevent and manage these threats, it is necessary to develop and apply innovative technologies, solutions, foresight tools and knowledge, stimulate cooperation between providers and users, find civil security solutions, improve the competitiveness of the European security industry and services, including ICT, and prevent and combat the abuse of privacy and breaches of human rights in the Internet, and elsewhere, while ensuring European citizens individual rights and freedom.

To enhance better cross-border collaboration between different kinds of emergency services, attention should be given to interoperability and standardisation.

Finally, as security policies should interact with different social policies, enhancing the societal dimension of security research will be an important aspect of this challenge.

7.2. Rationale and Union added value

Security is a legitimate concern for Europe and its citizens and in this respect represents a major challenge for society. The European Union, its citizens, its industry and its international partners are confronted with a range of security threats like crime, terrorism, illegal trafficking and mass emergencies due to man-made or natural disasters. These threats can span across borders and aim at physical targets or the cyberspace with attacks arising from different sources. Attacks against information or communication systems of public authorities and private entities, for instance, not only undermine the citizen's trust in information and communication systems and lead to direct financial losses and a loss of business opportunities, but may also seriously affect critical infrastructure and services such as energy, aviation and other transport, water and food supply, health, finance or telecommunications.

These threats could possibly endanger the inner foundations of our society. Technology and creative design can bring an important contribution to any response to be made. Yet, new solutions should be developed while bearing in mind the appropriateness of the means and their adequacy to the societal demand, in particular in terms of guarantees for citizens' fundamental rights and freedoms.

Finally, security also represents a major economic challenge. The security market is worth around 100 billion euro per year worldwide, of which Europe's share is between 25 and 35%. Moreover, it is a fast growing market despite the present economic crisis. Given the potential impact of some threats on services, networks or businesses, the deployment of adequate security solutions has become critical for the economy and European manufacturing competitiveness.

Union funding under this challenge will thus support the development, implementation and adaptation of key Union policies, notably Europe 2020 priorities for smart sustainable and inclusive growth, the Common Foreign and Security Policy, the Union's Internal Security Strategy and the Digital Agenda for Europe. Coordination with the Joint Research Centre direct actions will be pursued.

7.3. Broad lines of activities

The aim is to support Union policies for internal and external security and to ensure cyber security, trust and privacy in the Digital Single Market, whilst at the same time improving the competitiveness of the Union's security industry and services, including ICT. The activities will include a focus on the research and development of the next generation of innovative solutions, by working on novel concepts and designs, and interoperable standards. This will be done by developing innovative technologies and solutions that address security gaps and lead to a reduction in the risk from security threats. These mission-oriented actions will integrate the demands of different end-users (citizens, businesses, and administrations, including national and international authorities, civil protections, law enforcement, border guards, etc.) in order to take into account the evolution of security threats and privacy protection and the necessary societal aspects.

The focus of activities shall be to:

- a) fight crime, illegal trafficking and terrorism, including understanding and tackling terrorist ideas and beliefs;
- b) protect and improve the resilience of critical infrastructures, supply chains and transport modes;
- c) strengthen security through border management;
- d) improve cyber security;
- e) increase Europe's resilience to crises and disasters;
- f) ensure privacy and freedom, including in the Internet and enhance the societal legal and ethical understanding of all areas of security, risk and management;
- g) Enhance standardisation and interoperability of systems, including for emergency purposes.

PART IV
NON-NUCLEAR DIRECT ACTIONS OF THE JOINT RESEARCH CENTRE (JRC)

1. SPECIFIC OBJECTIVE

The specific objective is to provide customer-driven scientific and technical support to Union policies, while flexibly responding to new policy demands.

2. RATIONALE AND UNION ADDED VALUE

The Union has defined an ambitious policy agenda to 2020 which addresses a set of complex and interlinked challenges, such as sustainable management of resources and competitiveness. In order to successfully tackle these challenges, robust scientific evidence is needed which cuts across different scientific disciplines and allows the sound assessment of policy options. The JRC, playing its role as the science service for Union policy making will provide the required scientific and technical support throughout all stages of the policy-making cycle, from conception to implementation and assessment. To this aim it will focus its research clearly on Union policy priorities while enhancing cross-cutting competences and cooperation with the Member States. The JRC's independence of special interests, whether private or national, combined with its scientific-technical reference role enable it to facilitate the necessary consensus building between stakeholders and policy makers. Member States and Union citizens' benefit from the research of the JRC, most visibly in areas such as health and consumer protection, environment, safety and security, and management of crises and disasters.

The JRC is an integral part of the ERA and will continue to actively support its functioning through close collaboration with peers and stakeholders, maximizing access to its facilities and through the training of researchers and by close cooperation with MS and international institutions that pursue similar objectives. This will also promote the integration of new Member States and Associated Countries; for these, the JRC will continue to provide dedicated training courses on the scientific-technical basis of the body of Union law. The JRC will establish coordination links with relevant other Horizon 2020 specific objectives. As a complement to its direct actions and for the purpose of further integration and networking in the ERA, the JRC may also participate in Horizon 2020 indirect actions and co-ordination instruments in areas where it has the relevant expertise to produce added value.

3. BROAD LINES OF ACTIVITIES

The JRC activities in Horizon 2020 will focus on the Union policy priorities and the societal challenges addressed by them; they are aligned with Europe 2020 and its main objectives of smart, sustainable and inclusive growth, Security and Citizenship, and Global Europe.

The JRC's key competence areas will be energy, transport, environment and climate change, agriculture and food security, health and consumer protection, information and communication technologies, reference materials, and safety and security (including nuclear in the Euratom programme). The JRC activities in these areas will be conducted taking into account relevant initiatives at the level of regions, Members States or the EU, within the perspective of shaping the European Research Area.

These competence areas will be significantly enhanced with capacities to address the full policy cycle and to assess policy options. This includes

- (a) anticipation and foresight - pro-active strategic intelligence on trends and events in science, technology and society and their possible implications for public policy.
- (b) economics - for an integrated service covering both the scientific-technical and the macro-economic aspects.

- (c) modelling - focussing on sustainability and economics and making the Commission less dependent on outside suppliers for vital scenario analysis.
- (d) policy analysis - to allow cross-sectoral investigation of policy options.
- (e) impact assessment - providing scientific evidence to support policy options.

The JRC shall continue to pursue excellence in research and extensive interaction with research institutions as the basis for credible and robust scientific-technical policy support. To that aim, it will strengthen collaboration with European and international partners, i.a. by participation in indirect actions. It will also carry out exploratory research and build up competences in emerging, policy-relevant areas on a selective basis.

The JRC shall focus on:

3.1 Excellent science

Carry out research to enhance the scientific evidence base for policy making and examine emerging fields of science and technology, including through an exploratory research programme.

3.2 Industrial leadership

Contribute to European competitiveness through support to the standardisation process and standards with pre-normative research, development of reference materials and measurements, and harmonization of methodologies in five focal areas (energy; transport; Digital Agenda; security and safety; consumer protection). Carry out safety assessments of new technologies in areas such as energy and transport and health and consumer protection. Contribute to facilitating the use, standardisation and validation of space technologies and data, in particular to tackle the societal challenges.

3.3 Societal challenges

(a) Health, demographic change and wellbeing

Contribute to health and consumer protection through scientific and technical support in areas such as food, feed, consumer products; environment and health; health-related diagnostic and screening practices; and nutrition and diets.

(b) European bioeconomy challenges: Food security, sustainable agriculture and forestry, marine and maritime and inland water research

Support the development, implementation and monitoring of European agriculture and fisheries policies, including food safety and security and the development of a bio-economy through e.g. crop production forecasts, technical and socio-economic analyses and modelling.

(c) Secure, clean and efficient energy

Support the 20/20/20 climate and energy targets with research on technological and economic aspects of energy supply, efficiency, low-carbon technologies, energy/electricity transmission networks.

(d) Smart, green and integrated transport

Support the Union's policy for the sustainable, safe and secure mobility of persons and goods with laboratory studies, modelling and monitoring approaches, including low carbon technologies for transport, such as electrification, clean and efficient vehicles and alternative fuels, and smart mobility systems.

(e) Climate action, resource efficiency and raw materials

Investigate the cross-sectoral challenges of the sustainable management of natural resources through monitoring of key environmental variables and the development of an integrated modelling framework for sustainability assessment.

Support resource efficiency, emission reductions and sustainable supply of raw materials through the integrated social, environmental and economic assessments of clean production processes, technologies, and products and services.

Support Union development policy goals with research to help ensure adequate supplies of essential resources focussing on monitoring environmental and resource parameters, food safety and security related analyses, and knowledge transfer.

(f) Europe in a changing world - Inclusive, innovative and reflective societies

Contribute to and monitor the implementation of the Innovation Union with macro-economic analyses of the drivers and barriers of research and innovation, and development of methodologies, scoreboards and of indicators.

Support the European Research Area (ERA) by monitoring the functioning of the ERA and analysing drivers of and barriers to some of its key elements; and by research networking, training, opening JRC facilities and databases to users in Member States and Candidate and Associated Countries.

Contribute to the key goals of the Digital Agenda by qualitative and quantitative analyses of economic and social aspects (Digital Economy, Digital Society, Digital Living).

(g) Secure societies - Protecting freedom and security of Europe and its citizens.

Support internal safety and security through the identification and assessment of the vulnerability of critical infrastructures as vital components of societal functions; and through the operational performance assessment of technologies related to the digital identity; Address global security challenges including emerging or hybrid threats through the development of advanced tools for information mining and analysis as well as for crisis management

Enhance the Union capacity for managing natural and man-made disasters by strengthening the monitoring of infrastructures and the development of global multi-hazard early warning and risk management information systems, making use of satellite-based earth observation frameworks.

PART V
THE EUROPEAN INSTITUTE OF INNOVATION AND TECHNOLOGY (EIT)

1. SPECIFIC OBJECTIVE

The specific objective is to integrate the knowledge triangle of research, innovation and higher education and thus to reinforce the Union's innovation capacity and address societal challenges.

Europe is facing a number of structural weaknesses when it comes to innovation capacity and the ability to deliver new services, products and processes thereby hampering sustainable economic growth and job creation. Among the main issues at hand are Europe's relatively poor record in talent attraction and retention; the underutilisation of existing research strengths in terms of creating economic or social value; low levels of entrepreneurial activity; a scale of resources in poles of excellence which is insufficient to compete globally; and an excessive number of barriers to collaboration within the knowledge triangle of higher education, research and business on a European level.

2. RATIONALE AND UNION ADDED VALUE

If Europe is to compete on an international scale, these structural weaknesses need to be overcome. The elements identified above are common across Member States and affect the Union's innovation capacity as a whole.

The EIT will address these issues by promoting structural changes in the European innovation landscape. It will do so by fostering the integration of higher education, research and innovation of the highest standards, notably via its Knowledge and Innovation Communities (KICs), thereby creating new environments conducive to innovation, and by promoting and supporting a new generation of entrepreneurial people. In doing so, the EIT will contribute fully to the objectives of Europe 2020 and notably the Innovation Union and Youth on the Move flagship initiatives. In addition, the EIT and its KICs should seek synergies and interaction across pillars in Horizon 2020 and with other relevant initiatives.

Integrating education and entrepreneurship with research and innovation

The specific feature of the EIT is to integrate higher education and entrepreneurship with research and innovation as links in a single innovation chain across the Union and beyond.

Business logic and a results-oriented approach

The EIT, via its KICs, operates in line with business logic. Strong leadership is a pre-requisite: each KIC is driven by a CEO. KIC partners are represented by single legal entities to allow more streamlined decision-making. KICs must produce clearly defined annual business plans, setting out a multiannual strategy and including an ambitious portfolio of activities from education to business creation, with clear targets and deliverables, looking for both market and societal impact. The current rules concerning participation, evaluation and monitoring of KICs allow fast-track, business-like decisions. Business and entrepreneurs should have a strong role in driving activities in KICs and the KICs should be able to mobilize investment and long-term commitment from the business sector.

Overcoming fragmentation with the aid of long-term integrated partnerships

The EIT KICs are highly integrated ventures, bringing together partners from industry including SMEs, higher education, research and technology institutes, renowned for their excellence, in an open and transparent manner. KICs allow partners from across the EU and beyond to unite in new, cross-border configurations, optimise existing resources and open up access to new business opportunities via new value chains, addressing higher-risk, larger-scale challenges.

Nurturing Europe's main innovation asset: its highly talented people

Talent is a key ingredient of innovation. The EIT nurtures people and interactions between them, by putting students, researchers and entrepreneurs at the centre of its innovation model. The EIT will provide an entrepreneurial and creative culture and cross-disciplinary education to talented people, via EIT-labelled Masters and PhD degrees, intended to emerge as an internationally recognised brand of excellence. In doing so, the EIT strongly promotes mobility and training within the knowledge triangle.

3. BROAD LINES OF THE ACTIVITIES

The EIT shall operate mainly, via the Knowledge and Innovation Communities (KICs) particularly in areas which offer a true innovation potential. While the KICs have overall substantial autonomy in defining their own strategies and activities, there are a number of innovative features common to all KICs where coordination and synergies shall be sought. The EIT will moreover enhance its impact by disseminating good practices on how to integrate the knowledge triangle and the development of entrepreneurship, integrating relevant new partners where they can provide added value, and by actively fostering a new culture of knowledge sharing.

- (a) Transferring and applying higher education, research and innovation activities for new business creation

The EIT shall aim to create an environment to develop the innovative potential of people and capitalise on their ideas, irrespective of their place in the innovation chain. Thereby, the EIT will also help to address the ‘European paradox’ that excellent existing research is far from being harnessed to the full. In doing so, the EIT shall help to bring ideas to the market. Chiefly via its KICs and its focus on fostering entrepreneurial mindsets, it will create new business opportunities in the form of both start-ups and spin-offs but also within existing industry.

- (b) Cutting-edge and innovation-driven research in areas of key economic and societal interest

The EIT’s strategy and activities shall be driven by a focus on areas which offer a true innovation potential and has a clear relevance to the societal challenges addressed in Horizon 2020. By addressing key societal challenges in a comprehensive way, the EIT will promote inter- and multi-disciplinary approaches and help focus the research efforts of the partners in the KICs.

- (c) Development of talented, skilled and entrepreneurial people with the aid of education and training

The EIT shall fully integrate education and training at all stages of careers and develop new and innovative curricula to reflect the need for new profiles engendered by complex societal and economic challenges. To this end, the EIT will play a key role in promoting new joint or multiple degrees and diplomas in Member States respecting the principle of subsidiarity.

The EIT will also play a substantial role in fine-tuning the concept of ‘entrepreneurship’ via its educational programmes, which promote entrepreneurship in a knowledge-intensive context, building on innovative research and contributing to solutions of high societal relevance.

(d) Dissemination of best practice and systemic knowledge-sharing

The EIT shall aim to pioneer new approaches in innovation and to develop a common innovation and knowledge-transfer culture, among other things by sharing the diverse experience of its KICs via various dissemination mechanisms, such as a stakeholder platform and a fellowship scheme.

(e) International dimension

The EIT acts conscientious of the global context it operates in and shall help to forge links with key international partners in accordance with article 21(2). By scaling up centres of excellence via the KICs and by fostering new educational opportunities, it will aim to make Europe more attractive for talent from abroad.

(f) Enhancing European wide impact via an innovative funding model

The EIT will make a strong contribution to the objectives set in Horizon 2020, in particular by addressing societal challenges in a way complementing other initiatives in these areas. Within the framework of Horizon 2020 it will test out new and simplified approaches to funding and governance and thereby play a pioneering role within the European innovation landscape. Its approach to funding will be firmly based on a strong leverage effect, mobilising both public and private funds at national and EU level and will be communicated, in a transparent manner, to the Member States and relevant stakeholders. Moreover, it will employ entirely new vehicles for targeted support to individual activities through the EIT Foundation.

(g) Linking regional development to European opportunities

Via the KICs and their co-location centres – nodes of excellence, bringing together higher education, research and business partners in a given geographical location – the EIT will also be linked to regional policy. In particular, it shall ensure a better connection between higher education institutions and regional innovation and growth, in the context of regional and national smart specialisation strategies. In doing so, it will contribute to the objectives of the Union’s Cohesion Policy.
