EUROPEAN COMMISSION

Brussels, 30.11.2011
COM(2011) 809 final

2011/0401 (COD)

Proposal for a

REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

establishing Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020)

(Text with EEA relevance)

{SEC(2011) 1427-Volume 1}
{SEC(2011) 1428-Volume 1}

EXPLANATORY MEMORANDUM

1. CONTEXT OF THE PROPOSAL

The set of proposals for "Horizon 2020", drawn up fully in line with the Commission Communication 'A Budget for Europe 2020'[1], wholly supports the Europe 2020 strategy, which identified research and innovation as central to achieving the objectives of smart, sustainable and inclusive growth. The set consists of the proposals for:

(1) a Framework Programme for Horizon 2020 (Treaty on the Functioning of the European Union – 'TFEU'),

(2) a single set of Rules for Participation and Dissemination (TFEU),

(3) a single specific programme to implement Horizon 2020 (TFEU), as well as

(4) a single proposal for the parts of Horizon 2020 corresponding to the Euratom Treaty.

The overall political narrative and background to these legislative proposals is provided by a Commission Communication adopted together with them, which addresses a number of major cross-cutting elements such as simplification and how the approach to innovation has been strengthened.

Horizon 2020 contributes directly to tackling the major societal challenges identified in Europe 2020 and its flagship initiatives. It will contribute equally to creating industrial leadership in Europe. It will also increase excellence in the science base, essential for the sustainability and long term prosperity and wellbeing of Europe. To achieve these aims, the proposals include a full range of support that is integrated across the research and innovation cycle. Horizon 2020 therefore brings together and strengthens activities currently funded under the 7th Framework Programme for research, the innovation parts of the Competitiveness and Innovation Framework Programme, and the European Institute of Innovation and Technology. In this way, the proposals are also designed to realise a substantial simplification for participants.

2. RESULTS OF CONSULTATIONS WITH THE INTERESTED PARTIES AND IMPACT ASSESSMENTS

The preparation of the four proposals took full account of the responses to an extensive public consultation based on a Green Paper, "From challenges to opportunities: towards a common strategic framework for EU research and innovation funding", COM(2011)48. Views were expressed by the European Council, Member States and a wide range of stakeholders from industry, academia and civil society.

The proposals also rely on two in-depth impact assessments, drawing on stakeholder consultations, internal and external evaluations, and contributions from international experts. The assessments found that the Horizon 2020 option would bring more clarity of focus, best achieve the necessary critical mass of effort at programme and project level, and lead to

[1] COM(2011) 500 final

greatest impact on the policy objectives and downstream economic, competitiveness, and social benefits, while at the same time helping to simplify matters by e.g. easing the administrative burden for participants, streamlining the applicable rules and procedures, ensuring consistency between instruments and pointing to a new risk/trust balance.

3. LEGAL ELEMENTS OF THE PROPOSAL

3.1 Legal base

The proposal integrates research and innovation activities in a seamless way in order to achieve the policy objectives.

As such, Horizon 2020 will be based on the TFEU Titles "Industry" and "Research and technological development and space" (Articles 173 and 182). The related Rules for participation and dissemination will be based on the same TFEU Titles (Articles 173, 183 and 188). The "Industry" basis in both cases will relate predominantly to the European Institute of Innovation and Technology (EIT), which will be funded by a financial contribution from Horizon 2020. The EIT will not appear at the specific programme level.

It is recalled that innovation activities have been explicitly included in various Framework Programmes based on the Research Title of the Treaty on the Functioning of the European Union and that the current Framework Programmes also includes a range of innovation activities. As a consequence, the specific programme that will implement Horizon 2020 will be based on the TFEU Title "Research and technological development and space" (Article 182) as the activities foreseen in them will fall under those covered by this Title.

The proposal for the Euratom research and training programme contributing to Horizon 2020 is based on Article 7 of the Euratom Treaty.

3.2 Subsidiarity and proportionality principles

The proposals have been designed to maximise Union added value and impact, focusing on objectives and activities that cannot be efficiently realised by Member States acting alone. Union level intervention can strengthen the overall research and innovation framework and coordinate Member States' research efforts thereby avoiding duplication, retaining critical mass in key areas and ensuring public financing is used in an optimal way. Union level intervention enables continent-wide competition to select the best proposals, thereby raising levels of excellence and providing visibility for leading research and innovation. The Union level is also best placed to support trans-national mobility, thereby improving training and career development for researchers. A Union level programme is more able to take on high risk and long-term R&D, thereby sharing the risk and generating a breadth of scope and economies of scale that could not otherwise be achieved. Union level intervention can leverage additional public and private investments in research and innovation; contribute to the European Research Area whereby knowledge, researchers and technology circulate freely; and accelerate the commercialisation and diffusion of innovations across the Single Market. Union level programmes are also needed to support policy making as well as the objectives set by a range of policies. Full evidence is presented in the accompanying impact assessments.

4. BUDGETARY IMPLICATION

The budget of all proposals is presented in current prices. The legislative financial statement attached to this proposal sets out the budgetary, human and administrative resource implications. The Commission may use, on the basis of a cost-benefit analysis, existing executive agencies for the implementation of Horizon 2020, as provided for in Council Regulation (EC) No 58/2003 laying down the statute for executive agencies to be entrusted with certain tasks in the management of Union programmes.

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THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European Union (TFEU), and in particular Articles 173(3) and 182(1) thereof,

Having regard to the proposal from the European Commission,

After transmission of the draft legislative act to the national Parliaments,

Having regard to the opinion of the European Economic and Social Committee[2],

Having regard to the opinion of the Committee of the Regions[3],

Acting in accordance with the ordinary legislative procedure,

Whereas:

(1) The Union has the objective of strengthening its scientific and technological bases by achieving a European Research Area ("ERA") in which researchers, scientific knowledge and technology circulate freely, and encouraging the Union to become more competitive, including in its industry. To pursue those objectives the Union should carry out activities to implement research, technological development and demonstration, promote international cooperation, disseminate and optimise results and stimulate training and mobility.

(2) The Union also has an objective to ensure that the conditions necessary for the competitiveness of the Union's industry exist. For this purpose, action should be aimed at fostering the better exploitation of the industrial potential of policies of innovation, research and technological development.

(3) The Union is committed to achieving the Europe 2020 strategy[4], which has set the objectives of smart, sustainable and inclusive growth, highlighting the role of research

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2 OJ C , , p. .
3 OJ C , , p. .
4 COM(2010) 2020

and innovation as key drivers of social and economic prosperity and of environmental sustainability and setting itself the goal to increase spending on Research and Development to reach 3 % of gross domestic product (GDP) by 2020 while developing an innovation intensity indicator. In this context, the Innovation Union flagship initiative sets out a strategic and integrated approach to research and innovation, setting the framework and objectives to which future Union research and innovation funding should contribute. Research and innovation are also key factors for other Europe 2020 flagship initiatives, notably on resource efficient Europe, an industrial policy for the globalisation era, and a digital agenda for Europe. Moreover, for achieving the Europe 2020 objectives relating to research and innovation, Cohesion policy has a key role to play through building capacity and providing a stairway to excellence.

(4) At its meeting of 4 February 2011, the European Council supported the concept of the Common Strategic Framework for Union Research and Innovation funding to improve the efficiency of research and innovation funding at national and Union levels and called on the Union to rapidly address remaining obstacles to attracting talent and investment in order to complete the ERA by 2014 and achieve a genuine single market for knowledge, research and innovation.

(5) The European Parliament has called for a radical simplification of Union research and innovation funding in its Resolution of 11 November 2010[5], has highlighted the importance of the Innovation Union to transform Europe for post-crisis world, in its resolution of 12 May 2011[6], has drawn attention to important lessons to be learned following the interim evaluation of the Seventh Framework Programme in its resolution of 8 June 2011[7] and has supported the concept of a common strategic framework for research and innovation funding in its resolution of 27 September 2011[8].

(6) The Council of the European Union called on 26 November 2010 for future Union funding programmes to focus more on Europe 2020 priorities, address societal challenges and key technologies, facilitate collaborative and industry-driven research, streamline the instruments, radically simplify access, reduce time to market and further strengthen excellence.

(7) The importance of a coherent strategic approach was also underlined in opinions delivered by the European Research Area Committee on 3 June 2011[9], the Committee of Regions on 30 June 2011[10], and the European Economic and Social Committee on 13 July 2011[11].

(8) The Union Budget Review adopted by the Commission on 19 October 2010 put forward key principles which should underpin the future Union budget, namely focussing on instruments with proven Union added value, becoming more results-

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5 P7 TA(2011)0401
6 P7 TA(2011)0236
7 P7 TA(2011)0256
8 P7 TA(2011)0401
9 ERAC 1210/11
10 CdR 67/2011
11 CESE 1163/2011

driven and leveraging other public and private sources of funding and it proposed to bring the full range of Union instruments for research and innovation together in a Common Strategic Framework.

(9) The Commission Green Paper 'From Challenges to Opportunities: Towards a Common Strategic Framework for EU Research and Innovation funding'[12] identified key questions on how to achieve those ambitious objectives and launched a broad consultation, in the course of which stakeholders and Union institutions largely agreed with the ideas presented therein.

(10) In the Communication 'A Budget for Europe 2020'[13], the Commission proposed to address with a single Common Strategic Framework for Research and Innovation the areas covered in the period 2007-2013 under the Seventh Framework Programme for Research and the innovation part of the Competitiveness and Innovation Framework Programme, as well as the European Institute of Innovation and Technology (EIT) in order to serve the Europe 2020 Strategy target of raising spending on Research and Development to 3 % of GDP by 2020. In that Communication, the Commission also committed to mainstream climate change into Union spending programmes and to direct at least 20 % of the Union budget to climate-related objectives. Climate action and resource efficiency are mutually reinforcing objectives for achieving sustainable development. The specific objectives relating to both should be complemented through the other specific objectives of Horizon 2020. As a result it is expected that at least 60% of the overall Horizon 2020 budget should be related to sustainable development. It is also expected that climate-related expenditure should exceed 35% of the budget, including mutually compatible measures improving resource efficiency. The Commission should provide information on the scale and results of support to climate change objectives. Climate-related expenditure under Horizon 2020 should be tracked in accordance with the methodology stated in that Communicaiton.

(11) Horizon 2020 - the Framework Programme for Research and Innovation in the European Union (hereinafter 'Horizon 2020'), focuses on three priorities, namely generating excellent science in order to strengthen the Union's world-class excellence in science, fostering industrial leadership to support business, including small and medium-sized enterprises (SME) and innovation and tackling societal challenges, in order to respond directly to the challenges identified in the Europe 2020 strategy by supporting activities covering the entire spectrum from research to market. Horizon 2020 should support all stages in the innovation chain, especially activities closer to the market including innovative financial instruments, as well as non-technological and social innovation, and aims to satisfy the research needs of a broad spectrum of Union policies by placing emphasis on the widest possible use and dissemination of knowledge generated by the supported activities up to its commercial exploitation. The priorities of Horizon 2020 should also be supported through a programme under the Euratom Treaty on nuclear research and training.

(12) The Joint Research Centre (JRC) should provide customer-driven scientific and technical support to Union policies while flexibly responding to new policy demands.

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12 COM(2011) 48

13 COM(2011) 500

(13) In the context of the knowledge triangle of research, education and innovation, the Knowledge and Innovation Communities under the European Institute of Innovation and Technology should strongly contribute to addressing the objectives of Horizon 2020, including the societal challenges, notably by integrating research, education and innovation. In order to ensure complementarities across Horizon 2020 and the adequate absorption of funds, the financial contribution to the European Institute of Innovation and Technology should be made in two allocations, with the second subject to a review.

(14) Horizon 2020 should contribute to the aims of the European Innovation Partnerships in line with the flagship initiative Innovation Union, bringing together all relevant actors across the whole research and innovation chain in view of streamlining, simplifying and better coordinating instruments and initiatives.

(15) Simplification is a central aim of Horizon 2020 which should be fully reflected in its design, rules, financial management and implementation. Horizon 2020 should aim to attract the strong participation of universities, research centres, industry and specifically SMEs and be open to new participants, as it brings together the full range of research and innovation support in one common strategic framework, including a streamlined set of forms of support and uses rules for participation with principles applicable to all actions under the programme. Simpler funding rules should reduce the administrative costs for participation and will contribute to a reduction of financial errors.

(16) In accordance with Article 182(1) TFEU, the framework programme fixes the maximum overall amount and the detailed rules for Union financial participation in the framework programme and the respective shares in each of the activities provided for.

(17) This Regulation should lay down, for the entire duration of Horizon 2020, a financial envelope constituting the prime reference, within the meaning of point [] of the Interinstitutional Agreement of XX/201Z between the European Parliament, the Council and the Commission on cooperation in budgetary matters and on sound financial management, for the budgetary authority during the annual budgetary procedure.

(18) It is appropriate to ensure a correct closure of Horizon 2020 and its predecessor programmes, in particular regarding the continuation of multi-annual arrangements for their management, such as the financing of technical and administrative assistance.

(19) The implementation of Horizon 2020 may give rise to supplementary programmes involving the participation of certain Member States only, the participation of the Union in programmes undertaken by several Member States, or the setting up of joint undertakings or other arrangements within the meaning of Articles 184, 185 and 187 TFEU.

(20) With the aim of deepening the relationship between science and society and reinforcing public confidence in science, Horizon 2020 should favour an informed engagement of citizens and civil society on research and innovation matters by promoting science education, by making scientific knowledge more accessible, by developing responsible research and innovation agendas that meet citizens' and civil

society's concerns and expectations and by facilitating their participation in Horizon 2020 activities.

(21) The implementation of Horizon 2020 should respond to the evolving opportunities and needs from science and technology, industry, policies and society. As such, the agendas should be set in close liaison with stakeholders from all sectors concerned, and sufficient flexibility should be allowed for new developments. External advice should be sought on a continuous basis during Horizon 2020, also making use of relevant structures such as European Technology Platforms, Joint Programming Initiatives and the European Innovation Partnerships.

(22) Horizon 2020 should contribute to the attractiveness of the research profession in the Union. Adequate attention should be paid to the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers[14], together with other relevant reference frameworks defined in the context of the European Research Area, while respecting their voluntary nature.

(23) The activities developed under Horizon 2020 should aim at promoting equality between men and women in research and innovation, by addressing in particular the underlying causes of gender imbalance, by exploiting the full potential of both female and male researchers, and by integrating the gender dimension into the content of projects in order to improve the quality of research and stimulate innovation. Activities should also aim at the implementation of the principles relating to the equality between women and men as laid down in Articles 2 and 3 of the Treaty on European Union and Article 8 TFEU.

(24) Research and innovation activities supported by Horizon 2020 should respect fundamental ethical principles. The opinions of the European Group on Ethics in Science and New Technologies should be taken into account. Research activities should also take into account Article 13 TFEU and reduce the use of animals in research and testing, with a view ultimately to replacing animal use. All activities should be carried out ensuring a high level of human health protection in accordance with Article 168 TFEU.

(25) The European Commission does not explicitly solicit the use of human embryonic stem cells. The use of human stem cells, be they adult or embryonic, if any, depends on the judgement of the scientists in view of the objectives they want to achieve and is subject to stringent Ethics Review. No project involving the use of human embryonic stem cells should be funded that does not obtain the necessary approvals from the Member States. No activity should be funded that is forbidden in all Member States. No activity should be funded in a Member State where such activity is forbidden.

(26) To achieve maximum impact, Horizon 2020 should develop close synergies with other Union programmes in areas such as education, space, environment, competitiveness and SMEs, the internal security, culture and media and with the Cohesion Policy funds and Rural Development Policy, which can specifically help to strengthen national and regional research and innovation capabilities in the context of smart specialisation strategies.

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[14] C(2005) 576 final, 11.3.2005

(27) SMEs constitute a significant source of innovation and growth in Europe. Therefore a strong participation of SMEs, as defined in Commission Recommendation 2003/361/EC of 6 May 2003[15], is needed in Horizon 2020. This should support the aims of the Small Business Act[16].

(28) With the aim to achieve the greatest possible impact of Union funding, Horizon 2020 is to develop closer synergies, which may also take the form of public-public partnerships, with national and regional programmes that support research and innovation.

(29) A greater impact should also be achieved by combining Horizon 2020 and private sector funds within public-private partnerships in key areas where research and innovation could contribute to Europe's wider competitiveness goals and help tackle societal challenges. The public-private partnerships in the form of Joint Technology Initiatives launched under Decision No 1982/2006/EC of the European Parliament and of the Council of 18 December 2006 concerning the Seventh Framework programme of the European Community for research, technological development and demonstration activities (2007-13)[17] may be continued using more fit-for-purpose structures.

(30) Horizon 2020 should promote cooperation with third countries based on common interest and mutual benefit. International cooperation in science, technology and innovation should be targeted to contribute to achieving the Europe 2020 objectives to strengthen competitiveness, contribute to tackling societal challenges and support Union external and development policies, including by developing synergies with external programmes and contributing to the Union's international commitments such as the achievement of Millennium Development Goals.

(31) In order to maintain a level playing field for all undertakings active in the internal market, funding provided by Horizon 2020 should be designed in accordance with state aid rules so as to ensure the effectiveness of public spending and prevent market distortions such as crowding-out of private funding, creating ineffective market structures or preserving inefficient firms.

(32) The need for a new approach to control and risk management in Union research funding was recognised by the European Council of 4 February 2011, asking for a new balance between trust and control and between risk-taking and risk avoidance. The European Parliament, in its Resolution of 11 November 2010 on simplifying the implementation of the Research Framework Programmes, called for a pragmatic shift towards administrative and financial simplification and states that the management of European research funding should be more trust-based and risk-tolerant towards participants. The interim evaluation report of the Seventh Framework Programme for Research (2007-2013) concludes that a more radical approach is needed to attain a quantum leap in simplification, and that the risk-trust balance needs to be redressed.

(33) The financial interests of the Union should be protected through proportionate measures throughout the expenditure cycle, including the prevention, detection and

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15 OJ L 124, 30.05.2003 p.36

16 COM(2008) 394

17 OJ L 412, 30.12.2006, p.1

investigation of irregularities, the recovery of funds lost, wrongly paid or incorrectly used and, where appropriate, penalties. A revised control strategy, shifting focus from minimisation of error rates towards risk-based control and fraud detection, should reduce the control burden for participants.

(34) It is important to ensure sound financial management of Horizon 2020 and its implementation in the most effective and user-friendly manner possible, while also ensuring legal certainty and the accessibility of the programme to all participants. It is necessary to ensure compliance with Regulation (EU) No XXXX/2012 [new financial regulation] and with the requirements of simplification and better regulation.

(35) Effective performance management, including evaluation and monitoring, requires development of specific performance indicators which can be measured over time; are both realistic and reflect the logic of the intervention; and relevant to the appropriate hierarchy of objectives and activities. Appropriate coordination mechanisms should be put in place between the implementation and monitoring of Horizon 2020, and the monitoring of progress, achievements and functioning of the ERA.

(36) Since the objectives of Horizon 2020 cannot be sufficiently achieved by Member States in strengthening the overall research and innovation framework and coordinating efforts across the Union, and can therefore, by reason of avoiding duplication, retaining critical mass in key areas and ensuring public financing is used in an optimal way, be better achieved at Union level, the Union may adopt measures, in accordance with the principle of subsidiarity as set out in Article 5 of the Treaty on European Union. In accordance with the principle of proportionality, as set out in that Article, Horizon 2020 does not go beyond what is necessary in order to achieve those objectives.

(37) For reasons of legal certainty and clarity, Decision No 1982/2006/EC should be repealed,

HAVE ADOPTED THIS REGULATION:

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 and fostering 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'* means 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, 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 investment, creating new job opportunities and ensuring Europe's long-term sustainable growth and competitiveness.

Article 5
General objective, priorities and specific objectives

1. Horizon 2020 shall contribute to building an economy based on knowledge and innovation across the whole Union by leveraging sufficient 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 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:

   (a) excellent science;

   (b) industrial leadership;

   (c) 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. 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 Council[18] 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 education. The relevant performance indicators for the European Institute of Innovation and Technology 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 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.

[18] 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 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 European Institute of Innovation and Technology 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 European Institute of Innovation and Technology for activities under Title XVII of the Treaty on the Functioning of the European Union. A second allocation of up to EUR 1652 million shall be provided, subject to the review set out in Article 26 (1). This additional amount shall be provided on a pro-rata basis, 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 2(c).

   This funding in two multiannual allocations shall cover:

   (a) in the first allocation, the ongoing developments of the current Knowledge and Innovation Communities (hereinafter KICs) and seed money for the launch of the second wave of three new KICs

   (b) in the second allocation, the ongoing developments of the KICs already launched and the seed money for the launch of the third wave of three new KICs

   The second allocation shall be made available following the review set out in Article 26(1) taking into account in particular:

   (a) the agreed timing of the creation of the third wave of KICs;

   (b) the programmed financial needs of the existing ones according to their specific development;

(c) the contribution of the European Institute of Innovation and Technology and its KICs to the Horizon 2020 objectives.

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, 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) of this Regulation, 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 10 % of the total initial allocation of each priority and up to 10 % 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 European Institute of Innovation and Technology 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 Instrument[19].

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.

[19] 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 and a financial contribution to the European Institute of Innovation and Technology.

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.

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 Joint Research Centre direct actions 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; and transparent and interactive processes that ensure responsible research and innovation is supported.

2. Full account shall also be taken of relevant aspects of the research and innovation agendas established by European Technology Platforms, Joint Programming Initiatives and European Innovation Partnerships.

Article 13
Cross-cutting actions

1. Linkages and interfaces shall be implemented across and within the priorities of Horizon 2020. Particular attention shall be paid in this respect to the development and application of key enabling and industrial technologies, to bridging from discovery to market application, to cross-disciplinary research and innovation, to social and economic sciences and humanities, to fostering the functioning and achievement of the ERA, to cooperation with third countries, to responsible research and innovation including gender, and to enhancing the attractiveness of the research profession and to facilitating cross-border and cross-sector mobility of researchers.

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, markets 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, markets and society, where innovation includes business, organisational and social aspects.

Article 15
Gender equality

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

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 heritable;

   (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.

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, including the Structural Funds.

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 (SME) in Horizon 2020. Quantitative and qualitative assessments of SME participation shall be undertaken as part of the evaluation and monitoring arrangements.

2. 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 6 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 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 is expected to lead to around 15% 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 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.

2. Involvement of the Union in those partnerships may take one of the following forms:

   (a) financial contributions from the Union to joint undertakings established on the basis of Article 187 TFEU under the Seventh Framework Programme, subject to the amendment of their basic acts; to new public-private partnerships set up on the basis of 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.

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, sustainable growth and socio-economic issues;

(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.

Article 20
Public-public partnerships

1. Horizon 2020 shall contribute to the strengthening of public-public partnerships 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 topping up of individual joint calls and of actions of a transnational nature;

(b) Union participation in programmes undertaken by several Member States in accordance with Article 185 TFEU.

For the purposes of point (a), top-up funding shall be conditional on a significant level of prior financial commitments of the participating entities to the joint calls and actions. The ERA-NET instrument may include 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) clear financial commitments of the participating countries, including prior commitments to pool national and/or regional investments for transnational research and innovation;

(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 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 global societal challenges;

   (c) supporting the Union's external and development policy objectives, complementing external and development programmes.

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 common interest 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.

   Cooperation priorities shall take into account developments in Union policy and opportunities for cooperation with third countries, as well as possible deficiencies in third country intellectual property systems.

3. In addition, horizontal and cross-cutting activities to promote the strategic development of international cooperation shall be implemented under Horizon 2020 under the specific objective "Inclusive, innovative and secure societies" set out in Point 6.3.2(d) of Part III of Annex I.

Article 22
Information, communication and dissemination

The European Commission shall implement information and communication actions concerning Horizon 2020, including communication measures concerning supported projects and results. 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 are underrepresented;

(b) targeted assistance to projects and consortia to provide them with access to the necessary skills to optimise the communication 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, 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 2185/96[20] 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.

[20] OJ L 292, 15.11.1996, p. 2.

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 European Institute of Innovation and Technology. This shall include information on cross-cutting topics such as sustainability and climate change, including information on the amount of climate related expenditure.

2. The Commission shall report and disseminate the results of that monitoring.

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, a review of the European Institute of Innovation and Technology. The second allocation of funds to the European Institute of Innovation and Technology as set out in Article 6(3) shall be made available following this review. The review shall assess the progress of the European Institute of Innovation and Technology against all of the following:

      (i) the level of consumption 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 European Institute of Innovation and Technology to attract funds from the partners in the Knowledge and Innovation Communities and from the private sector, as set out in Regulation XX/2012 [revised EIT Regulation];

      (ii) the agreed timing for the creation of the third wave of Knowledge and Innovation Communities and the programmed financial needs of existing ones according to their specific development; and

      (iii) the contribution of the European Institute of Innovation and Technologies and the Knowledge and Innovation Communities to the priority on societal challenges and the specific objective on "leadership in enabling and industrial technologies" of the programme Horizon 2020.

   (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 European Institute of Innovation and Technology, the Commission shall carry out, with the assistance of independent experts, an

interim evaluation of Horizon 2020, its specific programme, including the European Research Council, and the activities of the European Institute of Innovation and Technology, 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 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 and results on the long-term impact of the predecessor measures.

(c) Not later than end 2023, the Commission shall carry out, with the assistance of independent experts, an ex-post evaluation of Horizon 2020, its specific programme and the activities of the European Institute of Innovation and Technology. 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 European Institute of Innovation and Technology, 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. 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	*For the Council*
The President	*The President*

ANNEX I
Broad lines of the specific objectives and activities

Horizon 2020 has the general objective to build 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 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).

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 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 could lead to around 15 % 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) Food security, sustainable agriculture, marine and maritime research, and the bio-economy;

(c) Secure, clean and efficient energy;

(d) Smart, green and integrated transport;

(e) Climate action, resource efficiency and raw materials;

(f) Inclusive, innovative and secure societies.

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, test-beds, support for public procurement, design, end-user driven innovation, social innovation and market take-up of innovations.

Social sciences and humanities shall be an integral part of the activities to address all the challenges. In addition, the underpinning development of these disciplines shall be supported under the specific objective ‘Inclusive, innovative and secure societies’. Support will also focus on providing a strong evidence base for policy making at international, Union, national and regional levels. Given the global nature of many of the challenges, strategic cooperation with third countries shall be an integral part of each challenge. In addition, cross-cutting support for international cooperation shall be provided under the specific objective ‘Inclusive, innovative and secure societies’.

The specific objective ‘Inclusive, innovative and secure societies’ also includes an activity to close the research and innovation divide with specific measures to unlock excellence in less developed regions of the Union.

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, 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. 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 technological paradigm shifts which will be the key drivers of productivity growth, competitiveness, wealth and social progress in the future. Such paradigm shifts have historically tended to originate from the public-sector science base 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 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 as a whole, 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 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 excellent starting researchers 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 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 directly to scientific publications of the highest quality and to the commercialisation and application of innovative technologies and ideas 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 and specific improvements in institutional practices and national policies to support top researchers.

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 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 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 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. 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 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 federation and 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 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.

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 and humanities. This requires 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 federated 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 activity need to be built up quickly to a large scale, by federating across programmes at European, national and regional levels 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 and federated 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 roadmaps. They 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 embryonic 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 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 support ambitious large-scale, science-driven research aiming to achieve a scientific breakthrough. Such activities will benefit from the alignment of European and national agendas. The scientific advance should provide a strong and broad basis for future technological innovation and economic application in a variety of areas, plus novel benefits for society.

The right mix of openness and varying degrees of structuring of topics, communities and funding shall be defined for each activity in order to address optimally the objectives pursued.

3. MARIE 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 new skills and innovation and, thus, to realise its full potential across all sectors and regions.

Well-trained, dynamic and creative researchers are the vital raw material 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. Strong 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 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 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 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 Curie actions will make a significant contribution to development of the European Research Area. With their Europe-wide competitive funding structure, Marie 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 Curie grants will also be extended to the temporary mobility of experienced researchers and engineers from public institutions to the private sector or vice versa, thereby encouraging and supporting universities, research centres and businesses to cooperate with one another on a European and international scale. With the aid of their well-established, transparent and fair evaluation system, Marie 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 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.

Extension of the co-funding mechanism of the Marie 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, international and private funding to create new programmes and to open 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 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.

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, businesses, SMEs and other socio-economic groups from different 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, businesses, SMEs and other socio-economic groups all over Europe and beyond. Opportunities to restart a research career after a break 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 short-term exchanges of research and innovation staff among a partnership of universities, research institutions, 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 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 to create new programmes and to open 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 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 ' Inclusive, innovative and secure 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 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 — energy, climate change, bio-economy and lifelong health and wellbeing for all. 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. 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 implementing the ESFRI roadmap for infrastructures[21], 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 capital base by providing world-class training for a new generation of researchers and engineers and promoting interdisciplinary collaboration.

Further development and wider use of research infrastructures at Union 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 Union level, fostering the emergence of new facilities, opening up broad access to national and European infrastructures, and making sure that regional, national, European and international policies are consistent and effective. It is not only necessary to avoid duplication of effort and to coordinate and rationalise use of the facilities, but also to pool resources so that the Union can also acquire and operate research infrastructures at world 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.

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[21] ESFRI Strategy Report on Research Infrastructure — Roadmap 2010.

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 capital and reinforcing European research infrastructure policy.

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

The aims shall be to ensure the implementation and operation of the ESFRI and other world-class research infrastructures, including the development of regional partner facilities; integration of and access to national research infrastructures; and the development, deployment and operation of e-infrastructures.

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

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 second and third activities shall be pursued by their own specific action and, whenever appropriate, as part of the first activity.

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. 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 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 and applications, 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 defined by industry and business, together with the research community 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'.

A common approach

The approach shall include both agenda-driven activities and more open areas to promote innovative projects and breakthrough solutions. Emphasis shall be on 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.

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 systems[22]. These multi-disciplinary, knowledge and capital-intensive technologies cut across many diverse sectors providing the basis for significant competitive advantage for European industry. 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, environment, health etc.). The numerous interactions of KETs and 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.

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 will 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 embraces some of the KETs and 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 fragmented in national programmes run by a subset of Union member states. Union level coordination and investment in space research are required (cf. Article 189 TFEU) to maintain the competitive edge, to safeguard Union space infrastructure such as Galileo and to sustain a future role for the Union in space. In addition, innovative downstream services and applications using space derived information represent an important source of growth and job creation.

[22] COM(2009)512

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 solutions.

The development and implementation of research and innovation agendas through public–private partnerships, 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 breed 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 Europe[23], the specific objective of ICT research and innovation (R&I) is to enable Europe to 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 can have legitimate ambitions for its businesses, governments, research and development centres and universities to lead developments in ICT, to grow new business, and to invest more in ICT innovations.

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 expenditure in ICT R&D, today at more than EUR 35 billion per year, is invested by companies created within the last two decades. This would require a considerable increase in public investments in ICT R&D in ways that leverage private spending, towards the goal of doubling investments in the next decade, and significantly more European poles 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 helps 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 allow a wide range of stakeholders to benefit from new developments and apply further innovations. Federating and partnering at Union level also enables consensus

[23] COM(2010) 245

building, establishes a visible focal point for international partners, and leads to 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. Unlimited computing, communication and data storage resources will be available to every citizen on the globe. 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 and bringing 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 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 is a significant component to prepare 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 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 and smart embedded components and systems*;*

(b) *Next generation computing:* Advanced computing systems and technologies*;*

(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. 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.

These six activity lines shall also include ICT specific research infrastructures such as living labs for large-scale 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 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, 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 both high societal and industrial returns.

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, life sciences and healthcare 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 future 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.

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 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 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.

(c) Developing the societal dimension of nanotechnology

Focusing on governance of nanotechnology for societal benefit.

(d) Efficient synthesis and manufacturing of nanomaterials, components and systems

Focusing on new operations, smart integration of new and existing processes, as well as up-scaling to achieve mass production of products and multi-purpose plants that ensures the efficient transfer of knowledge into industrial innovation.

(e) Developing capacity-enhancing techniques, measuring methods and equipment

Focusing on the underpinning technologies supporting the development and market introduction of 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 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 at the end-of-life 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 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 required for their transformation. Continuous use, recycling or secondary end-of-life utilisation of the materials shall also be covered as well as related societal innovation.

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. CO_2 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 functional materials, multifunctional materials and structural materials, for innovation in all industrial sectors.

(b) Materials development and transformation

Research and development to ensure efficient and sustainable scale up to enable industrial manufacturing of future products

(c) Management of materials components

Research and development for new and innovative techniques and systems.

(d) Materials for a sustainable and low-carbon industry

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

(e) Materials for creative industries

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 in materials science and engineering.

(g) Optimisation of the use of materials

Research and development to investigate alternatives to the use of 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, food, chemical and health.

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 bio-chemicals, of which the market share 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 CO_2 emissions, estimated to range from between 1 to 2.5 billion tons CO_2 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 also opens new avenues 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 for competitive industrial products and processes (e.g. chemical, health, mining, energy, pulp and paper, textile, starch, food processing) and its environmental dimension.

(c) Innovative and competitive platform technologies

Development of platform technologies (e.g. genomics, meta-genomics, proteomics, molecular tools) 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.

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 continue to invest 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 continue to invest in research, development and innovation to enable further progress towards a competitive low carbon economy and to comply with the agreed Union wide reductions in greenhouse gas emissions by 2050 for industrial sectors[24].

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 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 CO_2 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.

(b) Technologies enabling Energy-efficient buildings

Reducing energy consumption and CO_2 emissions by the development and deployment of sustainable construction technologies.

(c) Sustainable 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.

[24] COM(2011) 112 final

1.6. Space

1.6.1. Specific objective for space

The specific objective of space research and innovation is to foster a competitive and innovative space industry 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 of access to and operations in 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, communication, weather forecasts, and geographic information. 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 have resulted in some of the most significant scientific breakthroughs in the last decades in Earth sciences and astronomy. 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 fragmented in the national programmes of a few Member States. To maintain the technological and competitive edge Union level action is needed to coordinate space research, to promote the participation of researchers from all Member States, and to lower the barriers for collaborative space research projects across national borders. This needs to be done in coordination with the European Space Agency, which has successfully managed industrial satellite development and deep space missions on an intergovernmental basis with a subset of the Member States since 1975. 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 (e.g. International Space Station, Space Situational Awareness) 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 indispensible.

Space research and innovation under Horizon 2020 aligns with the Union space policy priorities as they continue to be defined by the Union Space Councils and the European Commission[25].

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

(b) Enabling advances in space technologies

This aims at developing advanced space technologies and operational concepts from idea to demonstration in space, including navigation and remote sensing, as well as the protection of space assets from threats such as debris and solar flares. To develop and apply advanced space technologies requires the continuous education and training of highly skilled engineers and scientists.

(c) Enabling exploitation of space data

A considerably increased exploitation of data from European satellites can be achieved if a concerted effort is made to coordinate and organise the processing, validation and standardisation of space 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, the European satellite navigation programme Galileo or IPCC for climate change issues.

(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.

[25] COM(2011) 152

2. ACCESS TO RISK FINANCE

2.1. Specific objective

The specific objective is to help remedy 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.

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 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. The use of financial instruments will also help achieve the R&I objectives of all sectors and policy areas crucial for tackling societal challenges (such as climate change, energy and resource efficiency, global food security, healthcare provision and an ageing population), 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 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. 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.

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 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 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.

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 than 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 and other innovation-relevant actors, 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 low carbon 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 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. 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 market-oriented innovation of R&D performing SMEs. A specific action shall target research intensive SMEs in high-technology sectors that show the capability to commercially exploit the project results.

(c) Enhancing the innovation capacity of SMEs

Activities assisting the implementation and complementing the SME specific measures across Horizon 2020 shall be supported, notably to enhance the innovation capacity of SMEs.

(d) Supporting market-driven innovation

Supporting 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 and economically sustainable 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 ensuring the lifelong health and wellbeing of all and therefore on the effective prevention, treatment and management of disease and disability.

Chronic conditions such as cardiovascular disease (CVD), cancer, diabetes, neurological and mental health disorders, overweight and obesity and various functional limitations are major causes of disability, ill-health and premature death, and present considerable social and economic costs.

In the Union, 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, 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.

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 systems must be ensured for all Europeans.

1.2. Rationale and Union added value

Disease and disability are not stopped by national borders. An appropriate European level research and innovation response 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 health, disease, disability, 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.

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" 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 and innovation activities. From basic research through translation of knowledge to large trials 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 and the European Innovation Partnership on Active and Health Ageing.

1.3. Broad lines of the activities

Effective health promotion, supported by a robust evidence base, prevents disease, improves wellbeing and is cost effective. Health promotion and disease prevention also depend on an understanding of the determinants of health, on effective preventive tools, such as vaccines, on effective health and disease surveillance and preparedness, and on effective screening programmes.

Successful efforts to prevent, manage, treat and cure disease, disability 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. 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.

An increasing disease and disability burden in the context of an aging population places further demands on health and care sectors. 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 and the wide uptake of technological, organisational and social innovations empowering in particular older persons as well as disabled persons to remain active 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 environmental and climate related factors), improving health promotion and disease prevention; understanding disease and improving diagnosis; developing effective screening programmes and improving the assessment of disease susceptibility; improving surveillance and preparedness; developing better preventive vaccines; using in-silico medicine for improving disease management and prediction; treating disease; transferring knowledge to clinical practice and scalable innovation actions; better use of health data; active ageing, independent and assisted living; individual 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 systems and reducing inequalities by evidence based decision making and dissemination of best practice, and innovative technologies and approaches.

2. FOOD SECURITY, SUSTAINABLE AGRICULTURE, MARINE AND MARITIME RESEARCH AND THE BIO-ECONOMY

2.1 Specific objective

The specific objective is to secure sufficient supplies of safe and high quality food and other bio-based products, by developing productive and resource-efficient primary production systems, fostering related ecosystem services, along side competitive and low carbon supply chains. This will accelerate the transition to a sustainable European bio-economy.

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, 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 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 2030[26]. In addition, national borders are irrelevant in the 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 plurality of approaches.

[26] COM (2011)0112

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 and environmental goals into sustainable production.

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.

2.2 Rationale and Union added value

Agriculture, forestry and fisheries 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 and aquatic 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 for rural and coastal development. The food security, sustainable agriculture, 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 researcher, 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 a wide spectrum of Union policies and related targets, including the Common Agriculture Policy (in particular the Rural Development Policy) 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 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 and economic 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 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 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 and enhancing ecosystems services, including coping with and mitigating climate change. The activities shall focus on more sustainable and productive agriculture and forestry systems which are both resource-efficient (including low-carbon) and resilient, while at the same time developing of services, concepts and policies for thriving rural livelihoods.

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

The aim is to meet the requirements of citizens for safe, healthy and affordable food, and to make food and feed processing and distribution more sustainable and the food sector more competitive. The activities shall focus on healthy and safe foods for all, informed consumer choices, 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 sustainably exploit aquatic living resources to maximise social and economic benefits/returns from Europe's oceans and seas. The activities shall focus on an optimal contribution to secure food supplies by developing sustainable and environmentally friendly fisheries and competitive European aquaculture in the context of the global economy and on boosting marine innovation through biotechnology to fuel smart "blue" growth.

(d) Sustainable and competitive bio-based industries

The aim is the promotion of low carbon, resource efficient, sustainable and competitive European bio-based industries. The activities shall focus on fostering the bio-economy by transforming conventional industrial processes and products into bio-based resource and energy efficient ones, the development of integrated biorefineries, utilising biomass from primary production, biowaste and bio-based industry by-products, and opening new markets through supporting standardisation, 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, sustainable and competitive energy system, 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.

The roadmap to a competitive low-carbon economy in 2050[27] shows 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.

To achieve these reductions, significant investments need to be made in research, development, demonstration and market roll-out of efficient, safe and reliable low-carbon energy technologies and services. These must go hand in hand with non-technological solutions on both the supply and demand sides. 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 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.

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[27] COM(2011) 112

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, 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 years[28]. 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 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.

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[28] 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.

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 near-zero-emission buildings, 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 and carbon capture and storage 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, 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 grid technologies, including storage, systems and market designs to plan, monitor, control and safely operate interoperable networks 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 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 and models for a robust and transparent policy support, including activities on public acceptance and engagement, user involvement and sustainability.

(g) Market uptake of energy innovation

Activities shall focus on applied innovation 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.

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 with the imperatives of economic performance and the requirements of a 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, 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.

Although the necessary investments in research, innovation and deployment will be significant, failing to improve the sustainability of transport will result in unacceptably high societal, ecological, and economic costs in the long term.

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. Transport is 96 % dependent on fossil fuels. Meanwhile, 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 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. CO_2 emissions would grow 35 % by 2050. 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.

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 2ºC, cutting 60 % of CO_2 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 vehicles, infrastructures and transport management will be key to achieve a cleaner and more efficient 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 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 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.

Investing in research and innovation for a greener, smarter and more 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'.

4.3. Broad lines of the activities

(a) Resource efficient transport that respects the environment

The aim is to minimise transport's impact on climate and the environment 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 and greenhouse gas emissions and improve vehicle efficiency, to accelerate the development and deployment of a new generation of electric and other low or zero emission vehicles, including through breakthroughs in engines, batteries and infrastructure; to explore and exploit the potential of alternative fuels and innovative and more efficient propulsion systems, including fuel infrastructure; to optimise the use of infrastructures, by means of intelligent transport systems 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, safe, secure and robust transport systems.

The focus of activities shall be to reduce congestion, improve accessibility 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.

The focus of activities shall be to develop the next generation of innovative transport means and to prepare the ground for the following one, by working on novel concepts and designs, smart control systems and interoperable standards, efficient production processes, shorter development times and reduced lifecycle costs.

(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 trends and prospects, 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 efficient and climate change resilient economy 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. Activities will contribute to increasing European competitiveness and improving well being, whilst assuring environmental integrity and sustainability, keeping average global warming below 2 °C and enabling ecosystems and society to adapt to climate change.

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. There needs to be an absolute decoupling of economic growth from resource use.

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)[29]. 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.

The growing impacts from climate change and environmental problems, such as ocean acidification, ice melting in the Arctic, land degradation and use, water shortages, chemical pollution 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 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 the development and deployment of cost-

[29] IPCC 4th Assessment Report , 2007, (www.ipcc.ch)

effective technologies, and mitigation and adaptation measures. 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 raw materials 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 including: the Europe 2020 strategy; the Innovation Union; Resource-Efficient Europe and the corresponding Roadmap; the Roadmap for moving to a competitive low carbon economy in 2050[30]; Adapting to climate change: Towards a European framework for action[31]; the Raw Materials Initiative[32]; the Union's Sustainable Development Strategy[33]; an Integrated Maritime Policy for the Union[34]; the Marine Strategy Framework Directive[35]; the Eco-innovation Action Plan and the Digital Agenda for Europe[36]. These actions shall reinforce the ability of society to become more resilient to environmental and climate change and ensure the availability of raw materials.

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. 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 empower actors at all levels of society to actively participate in this process.

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, policy and governance. For this reason, a European Innovation Partnership on Raw Materials is being prepared.

Eco-innovation will 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;

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30 COM (2011) 112
31 COM (2009) 147
32 COM(2011) 25
33 COM(2009) 400
34 COM(2007) 575 final
35 DIRECTIVE 2008/56/EC
36 COM(2010) 245

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 CO_2 and non-CO_2 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 measures; supporting mitigation policies.

(b) Sustainably managing natural resources and ecosystems

The aim is to provide knowledge for the management of natural resources that achieves a sustainable balance between limited resources and the needs of society and the economy. Activities shall focus on: furthering our understanding of the functioning of ecosystems, their interactions with social systems and their role in sustaining the economy and human well-being; 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, recycling and recovery of raw materials and for their substitution by economically attractive 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; finding alternatives for critical raw materials; and improving societal awareness and skills on raw materials.

(d) Enabling the transition towards a green economy 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 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.

6. INCLUSIVE, INNOVATIVE AND SECURE SOCIETIES

6.1. Specific objective

The specific objective is to foster inclusive, innovative and secure European societies in a context of unprecedented transformations and growing global interdependencies.

Europe is confronted with major socio-economic challenges which significantly affect its future - such as growing economic and cultural interdependencies, ageing, social exclusion and poverty, inequalities and migration flows, closing the digital divide, fostering a culture of innovation and creativity in society and enterprises, as well ensuring security and freedom, trust in democratic institutions and between citizens within and across borders. These challenges are enormous and they call for a common European approach.

First, significant inequalities persist in the Union both across countries and within them. In 2010 the Human Development Index, an aggregate measure of progress in health, education and income, scores the Union's Member States between 0,743 and 0,895, thus reflecting considerable divergences between countries. Significant gender inequalities also persist: for instance, the gender pay gap in the Union remains at 17.8 % in favour of men[37]. 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.

Second, 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. Whereas it is well-known that Europe needs to invest more in science and innovation, it will also have to coordinate these investments much more smartly than in the past: more than 95 % of national R&D budgets is spent without any coordination across the Union, a formidable potential waste of resources at a time of shrinking funding possibilities. Furthermore, the innovation capacities of the Member States, despite some recent convergence, remain very different, with large gaps between 'innovation leaders' and 'modest innovators'[38].

Third, many forms of insecurity, whether crime, violence, terrorism, cyber attacks, privacy abuses and other forms of social and economic disorders increasingly affect citizens. According to estimates, there is likely to be up to 75 million direct victims of crime every

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37 COM(2010) 491 final.

38 Innovation Union Scoreboard 2010.

year in Europe[39]. The direct cost of crime, terrorism, illegal activities, violence and disasters in Europe has been estimated at 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. 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 individual or associations across the continent. The development of insecurity in everyday life and because of unexpected situations is likely to affect the citizens' trust not only in institutions but also in each other.

These challenges must be tackled together and in innovative 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, social trust and security 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 and 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, innovation and security 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 understanding the underlying trends and impacts at play in these challenges and rediscovering or reinventing successful forms of solidarity, coordination and creativity that make Europe a distinctive model of inclusive, innovative and secure societies compared to other world regions. It requires a more strategic approach to cooperation with third countries. 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.

6.2. Rationale and Union added value

These challenges ignore national borders and thus call for more complex comparative analyses of mobility (of people, goods, services and capital but also of competences and knowledge) 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 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

[39] COM(2011) 274 final.

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 build inclusive, innovative and secure societies, Europe requires a response which implies to develop new knowledge, technologies and capabilities as well as the identification of policy options. 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 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. In this regard, research and innovation will be a precondition for the competitiveness of European industries and services, in particular in the areas of security, digital development and privacy protection.

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 and the Union's Internal Security Strategy, including policies on disaster prevention and response. 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 enhance solidarity as well as 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. Humanities research can play an important role here. Research shall support policymakers in designing policies that combat poverty and prevent the development of various forms of divisions, discriminations and inequalities in European societies, such as gender inequalities 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 less developed regions, thereby widening participation in Horizon 2020.

The focus of activities shall be to:

(a) promote smart, sustainable and inclusive growth;

(b) build resilient and inclusive societies in Europe;

(c) strengthen Europe's role as a global actor;

(d) close the research and innovation divide in Europe.

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. Particular support will be provided for the development of the ERA and the development of framework conditions for innovation.

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, including social innovation and creativity;

(c) ensure societal engagement in research and innovation;

(d) promote coherent and effective cooperation with third countries.

6.3.3. Secure societies

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, ICT and service industries. This will be done by developing innovative technologies and solutions that address security gaps and lead to the prevention of 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 and terrorism;

(b) strengthen security through border management;

(c) provide cyber security;

(d) increase Europe's resilience to crises and disasters;

(e) ensure privacy and freedom in the Internet and enhance the societal dimension of security.

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, further strengthening 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. 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, opening access to its facilities and through the training of researchers. 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).

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

(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 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) Food security, sustainable agriculture, marine and maritime research and the bio-economy

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) Inclusive, innovative and secure 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).

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 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. 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, 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.

Integrating education and entrepreneurship with research and innovation

The specific feature of the EIT is to integrate 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 annual business plans, 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.

Overcoming fragmentation with the aid of long-term integrated partnerships

The EIT KICs are highly integrated ventures, bringing together partners from industry, higher education, research and technology institutes, renowned for their excellence. KICs allow world-class partners 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 within the knowledge triangle.

3. BROAD LINES OF THE ACTIVITIES

The EIT shall operate mainly, but not exclusively, via the Knowledge and Innovation Communities (KICs) in areas of societal challenges that are of utmost relevance to Europe's common future. While the KICs have a large degree of autonomy in defining their own strategies and activities, there are a number of innovative features common to all KICs. The EIT will moreover enhance its impact by making the experiences from the KICs available across the Union 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 unleash 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 societal challenges that are of utmost relevance to the future, such as climate change or sustainable energy. 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 encouraging recognition of new degrees and diplomas in Member States.

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. 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. 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. 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, brining 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.

Annex II
Breakdown of the budget

The indicative breakdown for Horizon 2020 is as follows (in EUR million):

I	**Excellent science,** *of which:*	**27818**
	1. The European Research Council	15008
	2. Future and Emerging Technologies	3505
	3. Marie Curie actions on skills, training and career development	6503
	4. European research infrastructures (including eInfrastructures)	2802
II	**Industrial leadership,** *of which:*	**20280**
	1. Leadership in enabling and industrial technologies*	15580 of which 500 for EIT
	2. Access to risk finance**	4000
	3. Innovation in SMEs	700
III	**Societal challenges,** *of which*	**35888**
	1. Health, demographic change and wellbeing;	9077 of which 292 for EIT
	2. Food security, sustainable agriculture, marine and maritime research and the bio- economy;	4694 of which 150 for EIT
	3. Secure, clean and efficient energy	6537 of which 210 for EIT
	4. Smart, green and integrated transport	7690 of which 247 for EIT
	5. Climate action, resource efficiency and raw materials	3573 of which 115 for EIT
	6. Inclusive, innovative and secure societies	4317 of which 138 for EIT
European Institute of Innovation and Technology (EIT)		1542 + 1652***
Non-nuclear direct actions of the Joint Research Centre		2212
	TOTAL	87740

*****Including EUR 8975 million for Information and Communication Technologies (ICT) of which EUR 1795 million for photonics and micro-and nanoelectronics, EUR 4293 million for nanotechnologies, advanced materials and advanced manufacturing and processing, EUR 575 million for biotechnology and EUR 1737 million for space. As a result, EUR 6663 million will be available to support Key Enabling Technologies.

** Around EUR 1131 million of this amount may go towards the implementation of Strategic Energy Technology Plan (SET Plan) projects. Around one third of this may go to SMEs.

*** The total amount will be made available through allocations as foreseen in Article 6(3). The second allocation of EUR 1652 million shall be made available pro-rata from the budgets of the Societal challenges and Leadership in enabling and industrial technologies, on an indicative basis and subject to the review set out in Article 26(1)

LEGISLATIVE FINANCIAL STATEMENT

1. FRAMEWORK OF THE PROPOSAL/INITIATIVE

1.1. Title of the proposal/initiative

1.2. Policy area(s) concerned in the ABM/ABB structure

1.3. Nature of the proposal/initiative

1.4. Objective(s)

1.5. Grounds for the proposal/initiative

1.6. Duration and financial impact

1.7. Management method(s) envisaged

2. MANAGEMENT MEASURES

2.1. Monitoring and reporting rules

2.2. Management and control system

2.3. Measures to prevent fraud and irregularities

3. ESTIMATED FINANCIAL IMPACT OF THE PROPOSAL/INITIATIVE

3.1. Heading(s) of the multiannual financial framework and expenditure budget line(s) affected

3.2. Estimated impact on expenditure

3.2.1. Summary of estimated impact on expenditure

3.2.2. Estimated impact on operational appropriations

3.2.3. Estimated impact on appropriations of an administrative nature

3.2.4. Compatibility with the current multiannual financial framework

3.2.5. Third-party participation in financing

3.3. Estimated impact on revenue

LEGISLATIVE FINANCIAL STATEMENT

FRAMEWORK OF THE PROPOSAL/INITIATIVE

1.1. Title of the proposal/initiative

Horizon 2020 – The Framework Programme for Research and Innovation (2014-2020)

1.2. Policy area(s) concerned in the ABM/ABB structure[40]

- 08 - Research and Innovation
- 09 - Information Society and Media
- 02 - Enterprise and Industry
- 05 - Agriculture
- 32 - Energy
- 06 - Mobility and Transport
- 15 - Education and Culture
- 07 - Environment and climate action
- 10 - Joint Research Centre

1.3. Nature of the proposal/initiative

ý The proposal/initiative relates to **a new action**

¨ The proposal/initiative relates to **a new action following a pilot project/preparatory action**[41]

¨ The proposal/initiative relates to **the extension of an existing action**

¨ The proposal/initiative relates to **an action redirected towards a new action**

1.4. Objectives

1.4.1. The Commission's multiannual strategic objective(s) targeted by the proposal/initiative

Horizon 2020 – The Framework Programme for Research and Innovation (2014-2020) ('Horizon 2020') will contribute to the Europe 2020 strategy, including the completion of the European Research Area, by stimulating smart, sustainable and inclusive growth:

- Smart growth – develop an economy based on knowledge and innovation (implementing the Innovation Union flagship initiative).

40 ABM: Activity-Based Management – ABB: Activity-Based Budgeting.

41 As referred to in Article 49(6)(a) or (b) of the Financial Regulation.

- Sustainable growth – promote a more resource efficient, greener and more competitive economy.

- Inclusive growth – foster a high-employment economy delivering economic, social and territorial cohesion.

1.4.2. Specific objective(s) and ABM/ABB activity(ies) concerned

- Part I: Priority 'Excellent Science'

- Part II: Priority 'Industrial Leadership'

- Part III: Priority 'Societal Challenges'

- Part IV: Non-nuclear direct actions of the Joint Research Centre

- Part V: 'Integrating the knowledge triangle' (European Institute of Innovation and Technology)

ABM/ABB activity(ies) concerned

- 08 - Research and Innovation

- 09 - Information Society and Media

- 02 - Enterprise and Industry

- 05 - Agriculture

- 32 - Energy

- 06 - Mobility and Transport

- 15 - Education and Culture

- 07 - Environment and climate action

- 10 - Joint Research Centre

1.4.3. Expected result(s) and impact

Specify the effects which the proposal/initiative should have on the beneficiaries/groups targeted.

It is estimated that by 2030 Horizon 2020 is expected to generate an extra 0.92 per cent of GDP, 1.37 per cent of exports, -0.15 per cent of imports, and 0.40 per cent of employment.

For more information, please read the Commission Staff Working Paper on the impact assessment of Horizon 2020 ('IA') accompanying this legislative proposal.

1.4.4. Indicators of results and impact

Specify the indicators for monitoring implementation of the proposal/initiative.

The following table specifies for the general and specific objectives of Horizon 2020 a limited number of key indicators for assessing results and impacts.

Additional – including newly developed – indicators will be used to capture the various types of results and impacts for the different specific activities.

General objective:

Contribute to the objectives of the Europe 2020 strategy and to the completion of the European Research Area

- The Europe 2020 R&D target (3 % of GDP)

Current: 2.01 % of GDP (EU-27, 2009)

Target: 3 % of GDP (2020)

- The Europe 2020 innovation headline indicator

Current: New approach

Target: Substantial weight of fast-growing innovative enterprises in the economy

Part I: Priority 'Excellent Science'

Specific Objectives

* **European Research Council**

-Share of publications from ERC funded projects which are among the top 1 % highly cited

Current: 0.8 % (EU publications from 2004 to 2006, cited until 2008)

Target: 1.6 % (ERC publications 2014 - 2020)

-Number of institutional policy and national/regional policy measures inspired by ERC funding

Current: 20 (estimate 2007 – 2013)

Target: 100 (2014 – 2020)

* **Future and Emerging Technologies**

-Publications in peer-reviewed high impact journals

Current: New approach

Target: 25 publications per 10 Million € funding (2014 - 2020)

- Patent applications in Future and Emerging Technologies

Current: New approach

Target: 1 patent application per 10 Million € funding (2014 – 2020)

* **Marie Curie actions on skills, training and career development**

-Cross-sector and cross-country circulation of researchers, including PhD candidates

Current: 50.000, around 20 % PhD candidates (2007 - 2013)

Target: 65.000, around 40 % PhD candidates (2014 - 2020)

* **European research infrastructures (including eInfrastructures)**

-Research infrastructures which are made accessible to all researchers in Europe and beyond through Union support

Current: 650 (2012)

Target: 1000(2020)

Part II: Priority 'Industrial Leadership'

Specific Objectives

***Leadership in enabling and industrial technologies** (ICT, Nanotechnologies, Advanced Materials, Biotechnologies, Advanced manufacturing and Space)

- Patent applications obtained in the different enabling and industrial technologies

Current: New approach

Target: 3 patent applications per 10 Million € funding (2014 – 2020)

-Access to risk finance

- Total investments mobilised via debt financing and Venture Capital investments

Current: New approach

Target: EUR 100 million total investment per EUR 10 million Union contribution (2014 - 2020)

* **Innovation in SMEs**

- Share of participating SMEs introducing innovations new to the company or the market (covering the period of the project plus three years)

Current: New approach

Target: 50 %

Part III: Priority 'Societal Challenges'

Specific Objectives

For each of the challenges, progress shall be assessed against the contribution to the following specific objectives which are detailed in Annex I of Horizon 2020 together with descriptions of the substantive advancement needed for the achievement of the challenges and policy relevant indicators:

-Improve the lifelong health and wellbeing of all.

-Secure sufficient supplies of safe and high quality food and other bio-based products, by developing productive and resource-efficient primary production systems, fostering ecosystem services, alongside competitive and low carbon supply chains.

-Make the transition to a reliable, sustainable and competitive energy system, in the face of increasingly scarce resources, increasing energy needs and climate change.

-Achieve a European transport system that is resource-efficient, environmentally-friendly, safe and seamless for the benefit of citizens, the economy and society.

-Achieve a resource efficient and climate change resilient economy 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.

-Foster inclusive, innovative and secure European societies in a context of unprecedented transformations and growing global interdependencies.

Additional performance indicators are:

- Publications in peer-reviewed high impact journals in the area of the different Societal Challenges

Current: New approach (For FP7(2007-2010), 8149 publications in total - preliminary figure)

Target: On average, 20 publications per 10 Million € funding (2014 – 2020)

- Patent applications in the area of the different Societal Challenges

Current: 153 (FP7 Cooperation Programme 2007-10, preliminary figures)

Target: On average, 2 patent applications per 10 Million € funding (2014 – 2020)

- Number of Union pieces of legislation referring to activities supported in the area of the different Societal Challenges

Current: New approach

Target: On average, 1 per 10 Million € funding (2014 - 2020)

Part IV: Non-nuclear direct actions of the Joint Research Centre

Provide customer-driven scientific and technical support to Union policies

- Number of occurrences of tangible specific impacts on European policies resulting from technical and scientific policy support provided by the Joint Research Centre

Current: 175 (2010)

Target: 230 (2020)

- Number of peer reviewed publications

Current: 430 (2010)

Target: 500 (2020)

Part V: 'Integrating the knowledge triangle' (European Institute of Innovation and Technology)

- Organisations from universities, business and research integrated in Knowledge and Innovation Communities ('KICs')

Current: New approach

Target: 540 (2020)

- Collaboration inside the knowledge triangle leading to the development of innovative products and processes

Current: New approach

Target: 600 start-ups and spin-offs created by KICs students/researchers/professors; 6000 innovations in existing businesses developed by KIC students/researchers/professors

1.5. Grounds for the proposal/initiative

1.5.1. Requirement(s) to be met in the short or long term

-Improve the contribution of research and innovation to the resolution of key societal challenges.

-Boost Europe's industrial competitiveness through promoting technological leadership and getting good ideas to market.

-Strengthen Europe's science base.

-Achieve the European Research Area and increase its effectiveness (cross-cutting objectives).

For more information, please read the Commission Staff Working Paper on the impact assessment of Horizon 2020 ('IA') accompanying this legislative proposal.

1.5.2. Added value of EU involvement

There is a clear case for public intervention to tackle the problems outlined in 1.5.1 above. Markets alone will not deliver European leadership in the new techno-economic paradigm. Large-scale public intervention through both supply and demand measures will be needed to overcome the market failures associated with systemic shifts in basic technologies.

However, Member States acting alone will not be able to make the required public intervention. Their investment in research and innovation is comparatively low, is fragmented and suffers from inefficiencies - a crucial obstacle when it comes to technological paradigm shifts. It is difficult for Member States on their own to accelerate technology development over a sufficiently broad portfolio of technologies, or to tackle the lack of transnational coordination.

As highlighted in the proposal for the next Multi-annual Financial Framework, the Union is well positioned to add value by delivering the large-scale investment in "blue sky" frontier research, in targeted applied R&D, and in the associated education, training and

infrastructures which will help to strengthen our performance in thematically focused R&D and enabling technologies; by supporting companies' efforts to exploit research results and to turn them into marketable products, processes and services; and by stimulating the uptake of these innovations. A series of cross-border actions - concerning the coordination of national research funding, Union-wide competition for research funding, researcher mobility and training, coordination of research infrastructures, transnational collaborative research and innovation, and innovation support - are most efficiently and effectively organised at European level. Ex-post evaluation evidence has convincingly demonstrated that Union research and innovation programmes support research and other activities that are of great strategic importance for participants, and that in the absence of Union support would simply not take place. In other words, there are no substitutes for Union level support.

Evidence also demonstrates the European added value of policy support actions, which derives from bringing together knowledge and experience from different contexts, supporting cross-country comparisons of innovation policy tools and experiences, and providing the opportunity to identify, promote and test best practices from over the widest possible area.

The direct actions of the Joint Research Centre ('JRC') provide European added value because of their unique European dimension. These benefits range from responding to Commission's need to have in-house access to scientific evidence independent of national and private interests to direct benefits to the Union citizens through contributions to policies which lead to improved economic, environmental and social conditions.

For more information, please read the Commission Staff Working Paper on the impact assessment of Horizon 2020 ('IA') accompanying this legislative proposal.

1.5.3. Lessons learned from similar experiences in the past

The programme builds on the experience accumulated from past Framework Programmes for Research and Technological Demonstration (FP), the Competitiveness and Innovation Programme (CIP), and the European Institute of Technology and Innovation (EIT).

Over a period spanning several decades, Union programmes have:

- succeeded in involving Europe's best researchers and institutes,

- produced large-scale structuring effects, scientific, technological and innovation impacts, micro-economic benefits, and downstream macro-economic, social and environmental impacts for all Member States.

Together with the success, there are important lessons to be learned from the past:

- Research, innovation and education should be addressed in a more coordinated manner;

- Research results better disseminated and valorised into new products, processes and services;

- The intervention logic should be more focused, concrete, detailed and transparent;

- Programme access should be improved and participation increased from start-ups, SMEs, industry, less performing Member States and extra-Union countries;

- Monitoring and evaluation of the programme need to be strengthened.

The recommendations for direct actions in recent evaluation reports note i.a. that the JRC can

- promote stronger integration in the production of knowledge in the Union;

- introduce impact analyses and cost-benefit studies of specific work;

- enhance cooperation with industry in order to strengthen effects for the benefit of the competitiveness of the European economy.

For more information, please read the Commission Staff Working Paper on the impact assessment of Horizon 2020 ('IA') accompanying this legislative proposal.

1.5.4. Coherence and possible synergy with other relevant instruments

In the context of the achievement of the Europe 2020 objectives, synergies will be established and developed with the other Union programmes like the Common Strategic Framework for Economic, Social and Territorial Cohesion and with the Competitiveness and SMEs Programme.

1.6. Duration and financial impact

ý Proposal/initiative of **limited duration**

– ý Proposal/initiative in effect from 01/01/2014 to 31/12/2020

– ý Financial impact from 2014 to 2026

¨ Proposal/initiative of **unlimited duration**

– Implementation with a start-up period from YYYY to YYYY,

– followed by full-scale operation.

1.7. Management mode(s) envisaged[42]

ý **Centralised direct management** by the Commission

ý **Centralised indirect management** with the delegation of implementation tasks to:

– ý executive agencies

– ý bodies set up by the Communities[43]

– ý national public-sector bodies/bodies with public-service mission

– ¨ persons entrusted with the implementation of specific actions pursuant to Title V of the Treaty on European Union and identified in the relevant basic act within the meaning of Article 49 of the Financial Regulation

¨ **Shared management** with the Member States

¨ **Decentralised management** with third countries

ý **Joint management** with international organisations, including the European Space Agency

If more than one management mode is indicated, please provide details in the "Comments" section.

Comments:
The Commission intends to use a variety of management modes to implement this activity building on the management modes used under the current financial perspectives. These management modes include centralised management and joint management.
Management will be through the services of the Commission, through the existing Executive Agencies of the Commission renewing and extending their mandates in a balanced manner and through other externalised bodies such as entities created under Articles 187 (e.g. Joint Undertakings with renewed mandates after assessment and new ones to be set up in the context of implementing e.g. the 'Societal Challenges' part), 185

42 Details of management modes and references to the Financial Regulation may be found on the BudgWeb site: http://www.cc.cec/budg/man/budgmanag/budgmanag_en.html

43 As referred to in Article 185 of the Financial Regulation.

(programmes undertaken jointly by several member states, where national public-sector bodies/bodies with public-service mission will play a role) of the Lisbon Treaty as well as through the European Institute of Innovation and Technology and financial instruments.

Activities already externalised under the current financial perspective (e.g. Frontier Research, Marie Curie Actions, SME actions, Knowledge and Innovation Communities), which will be continued under Horizon 2020, will be implemented keeping the current form of externalisation. This may entail deepening the specialisation and simplifying management of the respective externalised bodies and brining them to a comparable operational size.

Externalisation of further activities of Horizon 2020, in particular through recourse to existing Executive Agencies of the Commission, is foreseen as long as it is compatible with keeping core policy competences within Commission services. The externalisation means retained to implement these activities will be selected on the basis of their proven effectiveness and efficiency. At the same time, the staff assigned to the Executive Agencies of the Commission will have to increase in proportion to the part of the budget corresponding to the externalised activities and taking into account the commitment on staffing made by the Commission (A Budget for Europe 2020, COM(2011)500).

Where higher leverages can be achieved, the European Space Agency may be involved in the implementation of space-related activities of Horizon 2020.

2. MANAGEMENT MEASURES

Simplification

Horizon 2020 must attract the most excellent researchers and the most innovative European enterprises. This can only be reached by a programme with the least possible administrative burden for participants and by appropriate funding conditions. **Simplification** in Horizon 2020 will therefore target **three overarching goals**: to reduce the administrative costs of the participants; to accelerate all processes of proposal and grant management and to decrease the financial error rate. Moreover, simplification of research and innovation funding will also result from the revision of the Financial Regulation (e.g. no interest bearing accounts for pre-financing, eligible VAT, limitation of extrapolation of systematic errors).

Simplification in Horizon 2020 will be achieved along several dimensions.

Structural simplification is provided through

-Integration of all research and innovation related funding instruments (EIT, CIP, FP) into the Horizon 2020 Framework Programme and its Specific Programme;

-One single Specific Programme implementing Horizon 2020;

-One single set of participation rules covering all components of Horizon 2020.

Major **simplification of funding rules** will make the preparation of proposals and the management of projects easier. At the same time, they will reduce the number of financial errors. The following approach is proposed:

Main funding model for grants:

-Simplified reimbursement of real direct costs, with a broader acceptance of beneficiaries' usual accounting, including the eligibility of certain taxes and charges;

-The possibility of using unit personnel costs (average personnel costs) for beneficiaries for which this is their usual accounting method, and for SME owners without a salary;

-Simplification of time-recording by providing a clear and simple set of minimum conditions, in particular abolition of time-recording obligations for staff working exclusively on a Union project;

-One single reimbursement rate for all participants instead of 3 different rates by type of participant;

-One single flat rate covering indirect costs, instead of 4 methods to calculate indirect costs, as a general rule;

-Continuation of the system of unit costs and flat rates for mobility and training actions (Marie Curie);

Output-based funding with lump sums for whole projects in specific areas.

A revised control strategy, as described in section 2.2.2, achieving a new balance between trust and control will further reduce the administrative burden for participants.

Beyond the simpler rules and controls, all **procedures and processes** for project implementation will be rationalised. This includes the detailed provisions on the content and shape of proposals, the processes for turning proposals into projects, the requirements for reporting and monitoring, as well as the related guidance documents and support services. A major contribution to reduced administrative costs for participation will come from a single user-friendly IT platform, based on the Union's Seventh Framework Programme for R&D (2007-2013) ('FP7') Participant Portal.

2.1. Monitoring and reporting rules

A new system will be developed for the evaluation and monitoring of the indirect actions of Horizon 2020. It will be based on a comprehensive, well-timed and harmonised strategy, with a strong focus on throughput, output, results and impacts. It will be supported by an appropriate data archive, experts, a dedicated research activity, and increased cooperation with Member States and Associated States, and it will be valorised through appropriate dissemination and reporting. For direct actions, the JRC will continue to improve its monitoring by further adjusting its indicators measuring output and impact.

The system will include information concerning cross-cutting topics such as sustainability and climate change. Climate related expenditure will be calculated in accordance with the tracking system based on Rio markers.

2.2. Management and control system

A 2 % error limit was adopted as chief indicator in the area of legality and regularity concerning the area of research grants. However, this has caused a number of unexpected or undesirable side-effects. There has been a strong feeling, amongst the beneficiaries as well as amongst the legislative authority, that the control burden has become too great. This runs the risk of lowering the attractiveness of the Union's Research programme, and so negatively affecting Union research and innovation.

The European Council of February 4th 2011 concluded that 'it is crucial that EU instruments aimed at fostering R&D&I be simplified in order to facilitate their take-up by the best scientists and the most innovative companies, in particular by agreeing between the relevant institutions a new balance between trust and control and between risk taking and risk avoidance' (see EUCO 2/1/11 REV1, Brussels 8 March 2011).

The European Parliament, in its Resolution of 11 November 2010 (P7_TA(2010)0401) on simplifying the implementation of the Research Framework Programmes explicitly supports a higher risk of errors for research funding and "expresses its concern that the current system and the practice of FP7 management are excessively control-oriented, thus leading to waste of resources, lower participation and less attractive research landscapes; notes with concern that the

current management system of ‘zero risk tolerance’ seems to avoid, rather than to manage, risks".

The sharp increase in the number of audits and the subsequent extrapolation of results has also provoked a wave of complaints from the world of research (e.g. the Trust Researchers initiative[44], with over 13,800 signatures so far).

There is therefore an acceptance among stakeholders and Institutions that the current approach needs to be reviewed. There are other objectives and interests, especially the success of the Research policy, international competitiveness and scientific excellence, which should also be considered. At the same time, there is a clear need to manage the budget in an efficient and effective manner, and to prevent fraud and waste. These are the challenges for the Horizon 2020 programme.

It remains the ultimate objective of the Commission to achieve a residual error rate of less than 2% of total expenditure over the lifetime of the programme, and to that end, it has introduced a number of simplification measures. However, other objectives such as the attractiveness and the success of the EU research policy, international competitiveness, scientific excellent and in particular the costs of controls (see point 2.2.2) need to be considered.

Taking these elements in balance, it is proposed that the Directorates General charged with the implementation of the research and innovation budget will establish a cost-effective internal control system that will give reasonable assurance that the risk of error over the course of the multiannual expenditure period is, on an annual basis, within a range of 2-5 %, with the ultimate aim to achieve a residual level of error as close as possible to 2 % at the closure of the multi-annual programmes, once the financial impact of all audits, correction and recovery measures have been taken into account.

2.2.1. Internal control framework

The internal control framework for grants is built on:

-the implementation of the Commission's Internal Control Standards;

-procedures for selecting the best projects and translating them into legal instruments;

- project and contract management throughout the lifetime of every project;

-ex-ante checks on 100% of claims, including receipt of audit certificates and ex-ante certification of cost methodologies;

- ex post audits on a sample of claims;

- and scientific evaluation of project results.

[44] http://www.trust-researchers.eu/

For direct actions, financial circuits include ex-ante checks for procurement and ex-post controls. Risks are assessed annually and progress in the execution of work and the consumption of resources is monitored regularly, based on defined objectives and indicators.

2.2.2. Costs and benefits of the controls

The cost of the internal control system for the Directorates General charged with the implementation of the research and innovation budget is estimated at €267m per year (based on the 2009 Tolerable Risk of Error exercise). It has also led to a considerable burden on beneficiaries and Commission services.

43 % of the total costs of control of the Commission services (not including the costs of the beneficiary) are borne at the stage of project management, 18 % on selection of proposals, and 16 % on negotiation of contracts (16 %). Ex post audits and their resulting implementation amounted to 23 % (€61m) of the total.

However, this considerable control effort has not managed to fully achieve its objective. The estimated "residual" error rate for FP6, after taking account of all recoveries and corrections that have been or will be implemented, remains over 2 %. The current rate of error from audits of FP7 carried out by the Directorate General Research and Innovation is around 5 %, and although this will be reduced due to the effects of the audits, and is somewhat biased because it is concentrated on beneficiaries not previously audited, it is unlikely whether the 2 % residual error will be attained. The rate of error identified by the European Court of Auditors is in a similar range.

2.2.3. Expected level of risk of non-compliance

The starting point is the status quo, based on audits carried out in FP7 so far. This preliminary representative error rate is close to 5 % (for the Directorate General Research and Innovation). The majority of errors detected arise because the present system of research funding is based on the reimbursement of the actual costs of the research project declared by the participant. This leads to considerable complexity regarding the assessment of eligible costs.

An analysis of error rates has been carried out for the FP7 audits so far performed in the Directorate General Research and Innovation shows that:

-Around 27% by number, and 35% by amount, relate to errors in the charging of personnel costs. Regular problems identified are charging average or budgeted costs (rather than actual costs), failure to keep adequate records of time spent on the programme, charging of ineligible items.

-Around 40% by number, and 37% by value, relate to other direct costs (not personnel). Regular errors identified are the inclusion of VAT, lack of a clear link to the project, failure to provide invoices or proof of payment and incorrect calculation of depreciation charging the full cost of equipment rather than the depreciated amount, subcontracting without prior authorization, or without respecting the rules of value for money, etc.

-Around 33% by number, and 28% by amount, relate to errors in indirect costs. The same risks apply as for personnel costs, with the additional risk of an inaccurate or unfair allocation of overheads to Union projects.

In a number of cases the indirect costs are a flat rate percentage of direct costs, and so the error in indirect costs is proportional to the error in direct costs.

Horizon 2020 introduces a significant number of important simplification measures (see point 2 above) that will lower the error rate in all the categories of error. However, the consultation of stakeholders and the institutions on further simplification, and the Horizon 2020 impact assessment, clearly indicate that the continuation of a funding model based on the reimbursement of actual costs is the favoured option. A systematic resort to output based funding, flat rates or lump sums appears premature at this stage as such a system has not been tested in previous programmes. Retaining a system based on the reimbursement of actual costs does however mean that errors will continue to occur.

An analysis of errors identified during audits of FP7 suggests that around 25-35 % of them would be avoided by the simplification measures proposed. The error rate can then be expected to fall by 1.5 %, i.e. from close to 5 % to around 3.5 %, a figure that is referred to in the Commission Communication striking the right balance between the administrative costs of control and the risk of error.

The Commission considers therefore that, for research spending under Horizon 2020, a risk of error, on an annual basis, within a range between 2-5 % is a realistic objective taking into account the costs of controls, the simplification measures proposed to reduce the complexity of rules and the related inherent risk associated to the reimbursement of costs of the research project. The ultimate aim for the residual level of error at the closure of the programmes after the financial impact of all audits, correction and recovery measures will have been taken into account is to achieve a level as close as possible to 2 %.

The ex-post audit strategy for expenditure under Horizon 2020 takes account of this target. It will be based on the financial audit of a single representative sample of expenditure across the whole programme, complemented by a sample compiled on the basis of risk considerations.

The overall number of ex-post audits will be limited to that strictly necessary to the achievement of this target and the strategy. The governance of the ex-post audit activities will ensure that the audit burden on participants is minimized. As a guide, the Commission considers that a maximum of 7 % of participants in Horizon 2020 would be subject to audit over the whole programming period. Past experience shows that the expenditure subject to audit would be considerably higher.

The ex-post audit strategy regarding legality and regularity will be complemented by reinforced scientific evaluation and the anti-fraud strategy (see point 2.3 below).

This scenario is based on the assumption that the measures of simplification are not subject to substantial modifications in the decision making process.

Note: this section only concerns the process of grant management, for administrative and operational expenditure implemented through public procurement processes the 2% ceiling will apply as tolerable risk of error.

2.3. Measures to prevent fraud and irregularities

The Directorates General charged with the implementation of the research and innovation budget are determined to fight against fraud at all stages of the grant management process. They have developed, and are implementing, anti-fraud strategies, including an enhanced use of intelligence, especially using advanced IT tools, and training and information for staff. Sanctions have been developed to provide deterrents to fraud, as well as appropriate penalties if they are identified. These efforts will continue. The proposals for Horizon 2020 have been subject to fraud proofing and an assessment of their impact. Overall the measures proposed should have a positive impact on the fight against fraud, especially the greater emphasis on risk based audit and reinforced scientific evaluation and control.

It should be underlined that detected fraud has been very low in proportion to total expenditure, nevertheless the Directorates General charged with the implementation of the research budget remain committed to combat it.

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.

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, over all grant beneficiaries, contractors and subcontractors who have received Union funds under the Programme.

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 Regulation (Euratom, EC) No 2185/96 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.

Without prejudice to the paragraphs above, 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 OLAF to conduct such audits, on-the-spot checks and inspections.

3. ESTIMATED FINANCIAL IMPACT OF THE PROPOSAL/INITIATIVE

3.1. Heading(s) of the multiannual financial framework and expenditure budget line(s) affected

- Existing expenditure budget lines (Not applicable)

In order of multiannual financial framework headings and budget lines.

Heading of multiannual financial framework	Budget line	Type of expenditure	Contribution			
	Number [Description……...…….]	Diff./non-diff ([45])	from EFTA[46] countries	from candidate countries[47]	from third countries	within the meaning of Article 18(1)(aa) of the Financial Regulation
	[XX.YY.YY.YY]	Diff./non-diff.	YES/NO	YES/NO	YES/NO	YES/NO

- New budget lines requested

In order of multiannual financial framework headings and budget lines.

Heading of multiannual financial framework	Budget line	Type of expenditure	Contribution			
	Number [Heading 1 - Smart and Inclusive Growth]	Diff./non-diff.	from EFTA countries	from candidate countries	from third countries	within the meaning of Article 18(1)(aa) of the Financial Regulation
	Administrative Expenditures *Indirect Research:* XX 01 05 01 Expenditure related to Research Staff XX 01 05 02 External staff for Research XX 01 05 03 Other management expenditure for Research *Direct Research:* 10 01 05 01 Expenditure related to Research Staff 10 01 05 02 External staff for Research 10 01 05 03 Other management expenditure for Research 10 01 05 04 Other expenditure for major research infrastructures[48]	NDA	YES	YES	YES	YES

[45] Diff. = Differentiated appropriations / Non-Diff. = Non-differentiated appropriations

[46] EFTA: European Free Trade Association.

[47] Candidate countries and, where applicable, potential candidate countries from the Western Balkans.

	Operational Expenditures XX 02 01 01 Horizontal Actions *Excellent science* 08 02 02 01 European Research Council 15 02 02 00 Marie Curie actions on skills, training and career development 08 02 02 02 European Research Infrastructures (including eInfrastructures) 09 02 02 01 European Research Infrastructures (including eInfrastructures) 08 02 02 03 Future and Emerging Technologies 09 02 02 02 Future and Emerging Technologies *Industrial leadership* 08 02 03 01 Leadership in enabling and industrial technologies 09 02 03 00 Leadership in enabling and industrial technologies 02 02 02 01 Leadership in enabling and industrial technologies 08 02 03 02 Access to risk finance 02 02 02 02 Access to risk finance 08 02 03 03 Innovation in SMEs 02 02 02 03 Innovation in SMEs *Societal challenges* 08 02 04 01 Health, demographic change and wellbeing 08 02 04 02 Food security, sustainable agriculture, marine and maritime research and the bio-economy 05 02 01 00 Food security, sustainable agriculture, marine and maritime research and the bio-economy 08 02 04 03 Secure, clean and efficient energy 32 02 02 00 Secure, clean and efficient energy 08 02 04 04 Smart, green and integrated	DA	YES	YES	YES	YES

[48] The JRC requests a new budget line for infrastructure investments. Most of the JRC facilities date from the 60's and 70's and are not state of the art anymore. As a consequence, new facilities and the upgrading of the existing infrastructure are necessary to carry out the JRC multi-annual work-programme in compliance with EU safety and security standards as well as with the EU/20/20/20 environmental objectives. The JRC has established its "Infrastructure Development plan 2014 – 2020"; identifying the investment needs till 2020 for all JRC sites that are reflected in the new budget line proposed.

	transport 06 02 02 00 Smart, green and integrated transport 08 02 04 05 Climate action, resource efficiency and raw materials 07 02 02 00 Climate action, resource efficiency and raw materials 02 02 03 01 Climate action, resource efficiency and raw materials 08 02 04 06 Inclusive, innovative and secure societies 02 02 03 02 Inclusive, innovative and secure societies 09 02 04 00 Inclusive, innovative and secure societies 15 02 03 00 European Institute for innovation and Technology 10 02 01 00 Non-nuclear direct actions of the Joint Research Centre					

3.2. Estimated impact on expenditure

3.2.1. Summary of estimated impact on expenditure

EUR million (to 3 decimal places)

Heading of multiannual financial framework:	Number	[Heading 1 - Smart and Inclusive Growth]]

DGs: Research and Innovation / Information Society and Media/ Education and Culture/ Enterprise and Industry/ Energy/ Mobility and Transport/ Agriculture and Rural Development/ JRC direct research/ Environment			2014	2015	2016	2017	2018	2019	2020	=2021	**TOTAL**
Ÿ Operational appropriations											
Horizontal actions											
XX 02 01 01	Commitments	(1a)	pm	pm	pm	pm	pm	pm	pm	pm	
	Payments	(2a)	pm	pm	pm	pm	pm	pm	pm	pm	
08 02 02 01 European Research Council	Commitments	(1b)	1640,417	1753,575	1879,819	2009,349	2144,525	2284,826	2427,130		**14139,641**
	Payments	(2b)	204,154	1055,485	1335,717	1661,563	1868,955	2063,161	2199,449	3751,158	**14139,641**
08 02 02 02 European Research Infrastructures (including eInfrastructures)	Commitments	(1c)	199,794	211,723	225,177	238,964	253,364	268,311	283,451		**1680,784**
	Payments	(2c)	24,865	128,015	161,107	199,448	223,066	244,699	259,212	440,372	**1680,784**
08 02 02 03Future and	Commitments	(1d)	283,318	300,310	320,217	469,448	606,917	642,722	678,989		**3301,921**

Emerging Technologies** 09 02 02 02 Future and Emerging Technologies**	Payments	(2d)	48,847	251,487	316,496	391,819	438,217	480,715	509,225	865,115	**3301,921**
08 02 03 01 Leadership in enabling and industrial technologies	Commitments	(1e)	545,193	577,744	614,457	652,078	691,372	732,159	773,472		**4586,474**
	Payments	(2e)	67,851	349,323	439,624	544,249	608,697	667,728	707,329	1201,673	**4586,474**
08 02 03 02 Access to risk finance** 02 02 02 02 Access to risk finance**	Commitments	(1f)	447,955	474,700	504,865	535,776	568,062	601,574	635,520		**3768,450**
	Payments	(2f)	447,955	474,700	504,865	535,776	568,062	601,574	635,520	0	**3768,450**
08 02 03 03 Innovation in SMEs** 02 02 02 03 Innovation in SMEs**	Commitments	(1g)	78,373	83,053	88,330	93,738	99,387	105,250	111,189		**659,320**
	Payments	(2g)	9,754	50,216	63,197	78,238	87,502	95,988	101,681	172,744	**659,320**
08 02 04 01 Health, demographic change and wellbeing	Commitments	(1h)	1030,952	1051,848	1073,128	950,146	1398,959	1481,491	1565,088		**8551,612**
	Payments	(2h)	126,578	651,675	820,134	1015,317	1135,546	1245,671	1319,549	2237,142	**8551,612**
08 02 04 02 Food security,	Commitments	(1i)	525,695	557,082	592,481	628,757	666,645	705,974	745,810		**4422,444**

sustainable agriculture, marine and maritime research and the bio-economy** 05 02 01 00 Food security, sustainable agriculture, marine and maritime research and the bio-economy**	Payments	(2i)	65,424	336,830	423,901	524,785	586,927	643,848	682,032	1158,697	**4422,444**
08 02 04 03 Secure, clean and efficient energy** 32 02 02 00 Secure, clean and efficient energy**	Commitments	(1j)	732,073	775,781	825,079	875,596	928,359	983,126	1038,601		**6158,614**
	Payments	(2j)	91,108	469,063	590,317	730,805	817,344	896,610	949,786	1613,580	**6158,614**
08 02 04 04 Smart, green and integrated transport** 06 02 02 00 Smart, green and integrated transport**	Commitments	(1k)	861,218	912,637	970,631	1030,059	1092,129	1156,559	1221,820		**7245,052**
	Payments	(2k)	107,180	551,811	694,454	859,727	961,532	1054,781	1117,337	1898,231	**7245,052**

08 02 04 05 Climate action, resource efficiency and raw materials** 02 02 03 01 Climate action, resource efficiency and raw materials ** 07 02 02 00 Climate action, resource efficiency and raw materials **	Commitments	(1l)	400,096	423,983	450,925	478,534	507,370	537,302	567,620		**3365,830**
	Payments	(2l)	49,793	256,354	322,622	399,403	446,698	490,019	519,081	881,860	**3365,830**
08 02 04 06 Inclusive, innovative and secure societies** 09 02 04 00 Inclusive, innovative and secure societies** 02 02 03 02 Inclusive, innovative and secure societies**	Commitments	(1m)	483,533	512,402	544,963	578,329	613,179	649,353	685,994		**4067,754**
	Payments	(2m)	60,177	309,815	389,903	482,696	539,855	592,210	627,332	1065,767	**4067,754**
09 02 02 01	Commitments	(1n)	113,951	120,755	128,428	136,291	144,504	153,029	161,664		**958,622**

European Research Infrastructures (including eInfrastructures)	Payments	(2n)	14,181	73,012	91,886	113,754	127,224	139,562	147,839	251,163	**958,622**
09 02 03 00 Leadership in enabling and industrial technologies	Commitments	(1o)	1005,176	1065,189	1132,878	1202,241	1274,686	1349,886	1426,056		**8456,112**
	Payments	(2o)	125,096	644,049	810,537	1003,436	1122,258	1231,095	1304,108	2215,533	**8456,112**
02 02 02 01 Leadership in enabling and industrial technologies	Commitments	(1p)	194,477	206,088	219,184	232,604	246,620	261,169	275,907		**1636,048**
	Payments	(2p)	24,203	124,608	156,819	194,140	217,129	238,186	252,313	428,651	**1636,048**
15 02 02 00 Marie Curie actions on skills, training and career development	Commitments	(1q)	728,274	771,756	820,798	871,052	923,542	978,025	1033,212		**6126,659**
	Payments	(2q)	90,635	466,629	587,254	727,013	813,103	891,958	944,858	1605,208	**6126,659**
15 02 03 00 European Institute for innovation and Technology *	Commitments	(1r)	267,498	324,047	389,375	472,279	[497,465]*	[554,83]*	[599,78]*		**1453,199**
	Payments	(2r)	232,723	281,921	338,756	410,883	188,916 + [243,863]*	[482,704]*	[521,806]*	[403,684]*	**1453,199**
10 02 01 00 Non-nuclear direct actions of the Joint Research Center	Commitments	(1s)	32,459	33,108	33,771	34,445	35,134	35,838	36,554		**241,311**
	Payments	(2s)	12,325	27,672	31,582	33,891	34,568	35,261	35,965	30,048	**241,311**

* An additional amount of EUR 1652,057 million shall be made available for the years 2018-2020 pro-rata from the budgets of the Societal challenges and Leadership in enabling and industrial technologies, on an indicative basis and subject to the review set out in Article 26(1).

** The repartition between DGs is not determined at this stage.

			2014	2015	2016	2017	2018	2019	2020	=2021	**TOTAL**
Ÿ TOTAL operational appropriations	Commitments	(4)	9570,455	10155,782	10814,513	11489,691	12194,753	12926,590	13668,077		**80819,860**
	Payments	(5)	1802,849	6502,665	8079,171	9906,943	10785,6	11613,07	12312,62	19816,94	**80819,860**
Ÿ TOTAL appropriations of an administrative nature financed from the envelope for specific programmes		(6)									
XX 01 05 01 Expenditure related to Research Staff*		(6a)	226,187	230,711	235,325	240,031	244,832	249,729	254,723		**1681,538**
XX 01 05 02 External staff for Research*		(6b)	169,252	232,572	258,456	289,571	316,454	341,909	376,531		**1984,745**
XX 01 05 03 Other management expenditure for Research*		(6c)	138,404	162,149	172,823	185,361	196,450	207,073	220,939		**1283,199**
10 01 05 01 Expenditure related to Research Staff		(6d)	151,686	156,996	162,490	168,178	174,064	180,156	186,461		**1180,031**
10 01 0,5 02 External staff for Research		(6e)	34,280	35,052	35,840	36,647	37,471	38,314	39,176		**256,781**
10 01 05 03 Other management expenditure for Research		(6f)	65,312	66,618	67,950	69,309	70,695	72,109	73,551		**485,545**
10 01 05 04 Other expenditure for major research infrastructures		(6g)	6,551	6,682	6,816	6,952	7,091	7,233	7,378		**48,703**
Ÿ TOTAL administrative appropriations		6	791,672	890,780	939,700	996,049	1047,057	1096,523	1158,759		**6920,542**
TOTAL appropriations under HEADING 1 of the multiannual financial framework	Commitments	=4+6	10362,127	11046,561	11754,214	12485,739	13241,811	14023,113	14826,837		**87740,402**
	Payments	=5+6	2383,229	7221,855	8818,966	10664,002	11835,992	12920,485	13694,775	20201,100	**87740,402**

*** These figures are based on an almost full use of the authorised maximum administrative expenditures foreseen in the legal base. They are presented for illustrative purposes in terms of the numbers of personnel that could be employed with these amounts.**

If more than one heading is affected by the proposal / initiative:

Ÿ TOTAL operational appropriations	Commitments	(4)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Payments	(5)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ÿ TOTAL appropriations of an administrative nature financed from the envelope for specific programmes		(6)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
TOTAL appropriations under HEADINGS 1 to 4 of the multiannual financial framework (Reference amount)	Commitments	=4+ 6	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Payments	=5+ 6	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Heading of multiannual financial framework:	**5**	" Administrative expenditure "

EUR million (to 3 decimal places)

		Year **N**	Year **N+1**	Year **N+2**	Year **N+3**	… enter as many years as necessary to show the duration of the impact (see point 1.6)			**TOTAL**
DG: <…….>									
Ÿ Human resources		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ÿ Other administrative expenditure		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
TOTAL DG <…….>	Appropriations	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

TOTAL appropriations under HEADING 5 of the multiannual financial framework	(Total commitments = Total payments)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

EUR million (to 3 decimal places)

		Year 2014	Year 2015	Year 2016	Year 2017	Year 2018	Year 2019	Year 2020	Year =2021	**TOTAL**
TOTAL appropriations under HEADINGS 1 to 5 of the multiannual financial framework	Commitments	10362,127	11046,561	11754,214	12485,739	13241,811	14023,113	14826,837		**87740,402**
	Payments	2383,229	7221,855	8818,966	10664,002	11835,992	12920,485	13694,775	20201,100	**87740,402**

3.2.2. Estimated impact on operational appropriations

– ¨ The proposal/initiative does not require the use of operational appropriations

– þ The proposal/initiative requires the use of operational appropriations, as explained below:

Commitment appropriations in EUR million (to 3 decimal places)/ current prices

Indicate objectives and outputs			Year 2014		Year 2015		Year 2016		Year 2017		Year 2018		Year 2019		Year 2020		**TOTAL**	
	OUTPUTS																	
ò	Type of output[49]	Average cost of the output	Number of outputs	Cost	Number of outputs	Cost	Number of outputs	Cost	Number of outputs	Cost	Number of outputs	Cost	Number of outputs	Cost	Number of outputs	Cost	Total number of outputs	Total cost
SPECIFIC OBJECTIVE No 1[50] Excellent science																		
- Output																		
- Output																		
- Output																		
Sub-total for specific objective N°1 Excellent science				2965,755		3158,119		3374,440		3725,105		4072,852		4326,913		4584,446		26207,628
SPECIFIC OBJECTIVE No 2 Industrial leadership																		
- Output																		

[49] Outputs are products and services to be supplied (e.g.: number of student exchanges financed, number of km of roads built, etc.).

[50] As described in Section 1.4.2. "Specific objective(s)…"

Sub-total for specific objective N°2 Industrial leadership		2271,175		2406,774		2559,714		2716,437		2880,127		3050,036		3222,143		19106,407
SPECIFIC OBJECTIVE No 3 Societal challenges																	
- Output																	
Sub-total for specific objective N°3 Societal challenges		4033,565		4233,731		4457,207		4541,423		5206,640		5513,803		5824,934		33811,304
SPECIFIC OBJECTIVE No 4 Non-nuclear direct actions of the Joint Research Centre																	
- Output																	
Sub-total for specific objective N°4 Non-nuclear direct actions of the Joint Research Centre		32,459		33,108		33,771		34,445		35,134		35,838		36,554		241,311
SPECIFIC OBJECTIVE No 5 "Integrating the knowledge triangle" (European Institute of Innovation and Technology)																	
- Output																	
Sub-total for specific objective N°5 "Integrating the knowledge triangle" (European Institute of Innovation and Technology)		267,5		324,050		389,380		472,280		[497,46]		[554,832]		[599,777]		1453,199
TOTAL COST		9570,455		10155,782		10814,513		11489,691		12194,753		12926,590		13668,077		**80819,860**

3.2.3. Estimated impact on appropriations of an administrative nature

3.2.3.1. Summary

– ¨ The proposal/initiative does not require the use of administrative appropriations

– þ The proposal/initiative requires the use of administrative appropriations, as explained below:

EUR million (to 3 decimal places)

	Year **2014** [51]	Year **2015**	Year **2016**	Year **2017**	Year **2018**	Year **2019**	Year **2020**	**TOTAL**
HEADING 5 of the multiannual financial framework	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Human resources	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other administrative expenditure	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Subtotal HEADING 5 of the multiannual financial framework	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Outside HEADING 5[52] **of the multiannual financial framework**								
Human resources*	581,406	655,330	692,112	734,426	772,821	810,108	856,892	**5103,095**
Other expenditure of an administrative nature*	210,266	235,449	247,589	261,622	274,237	286,415	301,868	**1817,447**
Subtotal outside HEADING 5 of the multiannual financial framework	791,672	890,779	939,701	996,048	1047,058	1096,523	1158,760	**6920,545**
TOTAL**	**791,672**	**890,779**	**939,701**	**996,048**	**1047,058**	**1096,523**	**1158,760**	**6920,545**

*** These figures are based on an almost full use of the authorised maximum administrative expenditures foreseen in the legal base. They are presented for illustrative purposes in terms of the numbers of personnel that could be employed with these amounts.**

**** These figures might be adjusted as a result of the envisaged externalisation procedure.**

[51] Year N is the year in which implementation of the proposal/initiative starts.

[52] Technical and/or administrative assistance and expenditure in support of the implementation of EU programmes and/or actions (former "BA" lines), indirect research, direct research.

3.2.3.2. Estimated requirements of human resources

– ¨ The proposal/initiative does not require the use of human resources

– þ The proposal/initiative requires the use of Commission human resources, as explained below:

Estimate expressed in full amounts (or at most to one decimal place)

		Year **2014**	Year **2015**	Year **2016**	Year **2017**	Year **2018**	Year **2019**	Year **2020**
Ÿ **Establishment plan posts (officials and temporary agents)**								
XX 01 01 01 (Headquarters and Commission's Representation Offices)		100	100	100	100	100	100	100
XX 01 01 02 (Delegations)								
XX 01 05 01 (Indirect research)**		1681	1681	1681	1681	1681	1681	1681
10 01 05 01 (Direct research)		1390	1390	1390	1390	1390	1390	1390
Ÿ **External personnel (in Full Time Equivalent unit: FTE)**[53]								
XX 01 02 01 (CA, INT, SNE from the "global envelope")								
XX 01 02 02 (CA, INT, JED, LA and SNE in the delegations)								
XX 01 04 ***yy*** [54]	- at Headquarters[55]							
	- in delegations							
XX 01 05 02 (CA, INT, SNE - Indirect research)*		867	867	867	867	867	867	867
10 01 05 02 (CA, INT, SNE - Direct research)		593	593	593	593	593	593	593
Other budget lines (specify)								
TOTAL		**4631**	**4631**	**4631**	**4631**	**4631**	**4631**	**4631**

* The above figures will be adjusted in accordance with the results of the envisaged externalisation process.

****** The workload corresponding to the implementation of EIT and Innovation is estimated at some 100 establishment plan posts for the Commission.

XX is the policy area or budget title concerned.

The human resources required will be met by staff from the DG who are already assigned to management of the action and/or have been redeployed within the DG, together if necessary with any additional allocation which may be granted to the managing DG under the annual allocation procedure and in the light of budgetary constraints.

53 CA= Contract Agent; INT= agency staff ("*Intérimaire"*); JED= "*Jeune Expert en Délégation"* (Young Experts in Delegations); LA= Local Agent; SNE= Seconded National Expert;

54 Under the ceiling for external personnel from operational appropriations (former "BA" lines).

55 Essentially for Structural Funds, European Agricultural Fund for Rural Development (EAFRD) and European Fisheries Fund (EFF).

Description of tasks to be carried out:

Officials and temporary agents	The total number of officials and temporary agents will be used to contribute to the objectives of Horizon 2020 during all the process, from the preparation of the Work Programme to the final dissemination of results during 2014-2020. These human resources include all the needs in the various management modes as indicated in point 1.7 of the LFS
External personnel	The total number of external personnel will assist officials and temporary agents to contribute to the objectives of Horizon 2020 during all the process, from the preparation of the Work Programme to the final dissemination of results during 2014-2020. These human resources include all the needs in the various management modes as indicated in point 1.7 of the LFS

3.2.4. Compatibility with the current multiannual financial framework

– þ Proposal/initiative is compatible the current multiannual financial framework.

– ¨ Proposal/initiative will entail reprogramming of the relevant heading in the multiannual financial framework.

Not applicable

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– ¨ Proposal/initiative requires application of the flexibility instrument or revision of the multiannual financial framework[56].

Not applicable

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3.2.5. Third-party contributions

– The proposal/initiative provides for the co-financing estimated below:

Appropriations in EUR million (to 3 decimal places)

	Year **2014**	Year **2015**	Year **2016**	Year **2017**	Year **2018**	Year **2019**	Year **2020**	Total
Specify the co-financing body	Third countries associated to the programme							
TOTAL appropriations co-financed *	pm							

* Bilateral Association Agreements are not fixed yet and that is why they will be added at a later stage.

[56] See points 19 and 24 of the Interinstitutional Agreement.

3.3. Estimated impact on revenue

– ¨ Proposal/initiative has no financial impact on revenue.

– þ Proposal/initiative has the following financial impact:

– ¨ on own resources

– þ on miscellaneous revenue

EUR million (to 3 decimal places)

Budget revenue line:	Appropriations available for the ongoing budget year	Impact of the proposal/initiative[57]*						
		Year **2014**	Year **2015**	Year **2016**	Year **2017**	**Year 2018**	**Year 2019**	**Year 2020**
Item 6011 Item 6012 Item 6013 Item 6031		pm	pm	pm	pm	pm	pm	pm

* Bilateral Association Agreements are not fixed yet and that is why they will be added at a later stage.

For miscellaneous assigned revenue, specify the budget expenditure line(s) affected.

02 03 01 Appropriations accruing from contributions form third parties
05 03 01 Appropriations accruing from contributions from third parties
06 03 01 Appropriations accruing from contributions form third parties
07 03 01 Appropriations accruing from contributions form third parties
08 04 01 Appropriations accruing from contributions form third parties
09 03 01 Appropriations accruing from contributions form third parties
10 02 02 Appropriations accruing from contributions form third parties
15 03 01 Appropriations accruing from contributions form third parties
32 03 01 Appropriations accruing form contributions from third parties

Specify the method for calculating the impact on revenue.

Certain associated states may contribute to a supplementary funding of the framework programme through association agreements. The method of calculation will be agreed in these Association Agreements and is not necessarily the same in all agreements. Mostly the calculations are based on the GDP of the Associated State compared to the GDP of the Member States whilst applying this percentage to the overall budget voted.

[57] As regards traditional own resources (customs duties, sugar levies), the amounts indicated must be net amounts, i.e. gross amounts after deduction of 25% for collection costs.