HORIZON 2020

WORK PROGRAMME 2014 – 2015

5. *Leadership in enabling and industrial technologies*

Introduction

Important Notice on the First Horizon 2020 Work Programme

This Work Programme covers 2014 and 2015. Due to the launching phase of Horizon 2020, parts of the Work Programme that relate to 2015 (topics, dates, budget) are provided at this stage on an indicative basis only. Such Work Programme parts will be decided during 2014.

(European Commission Decision C (2013)8631 of 10 December 2013)

Policy context and objectives

Leadership in enabling and industrial technologies (LEIT) includes the parts of Horizon 2020 focusing on new opportunities for industrial leadership in Key Enabling Technologies (KETs), ICT and space. These are areas of key industrial competences determining Europe's global competitiveness. Aiming at new and breakthrough technologies, this part of the programme will contribute to boosting competitiveness, creating jobs and supporting growth. It will help to achieve the EU Industrial policy[1] goals and represents an important component of the EU Strategy for Key Enabling Technologies[2].

1. *Research and innovation to strengthen Europe's industrial capacities and business perspectives, including SMEs*

The emphasis is on areas of R&D and innovation with a strong industrial dimension and where mastering new technological opportunities will enable and drive innovation. Activities have been primarily developed with reference to relevant industrial roadmaps, including those of European Technology Platforms. The involvement of industrial participants, and of SMEs in particular, is crucial in maximising the expected impact of the actions.

The funded projects will be *outcome oriented*, developing key technology building blocks, bringing solutions closer to the market, and paving the way for industrial and commercial implementation, including in areas of societal challenges. Proposers are asked to demonstrate how the exploitation of results will generate the expected impact and contribute to the European economy. Several research and innovation activities in this part of the Work Programme may be enhanced through a combination of funding sources, from other EU, national or regional programmes (supported or not by the European Structural and Investment Funds[3]), and from financial instruments. Such combinations are encouraged, and some of the topics particularly suitable for mobilising additional funding from other available instruments have been flagged.

As proposed in the European KET Strategy, the KET parts of this work programme will use Technology Readiness Levels[4] (TRLs) where relevant. This Work Programme addresses Technology Readiness Levels from 3-4 up to 7-8.

For Space, this Work Programme focuses on low Technology Readiness Levels (1-4), with bottom-up calls, and on preparing the ground for high Technology Readiness Level activities (6-7), with Strategic Research Clusters and in-orbit demonstration.

Pilot on Open Research Data

The projects funded under the ICT part of the Work Programme 2014-15 will participate in the Pilot on Open Research Data in Horizon 2020 in line with the Commission's Open Access to research data policy for facilitating access, re-use and preservation of research data.

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[1] 'An integrated industrial policy for the globalisation era' (COM(2010)614).

[2] 'Preparing for our future: Developing a common strategy for key enabling technologies in the EU' (COM(2009)512); and 'A European strategy for Key Enabling Technologies – A bridge to growth and jobs' (COM(2012)341).

[3] For more information on R&I funding from ESIF, see http://ec.europa.eu/regional_policy/activity/research/index_en.cfm

[4] See COM(2012)341, pp. 17-18 and Annex 21 to the Work Programme, Section G.

Participants have however the possibility to opt out. Individual actions funded under the other parts of LEIT can choose to participate in the Pilot on a voluntary basis. A further new element in Horizon 2020 is the use of Data Management Plans (DMPs) detailing what data the project will generate, whether and how it will be exploited or made accessible for verification and re-use, and how it will be curated and preserved. The use of a Data Management Plan is required for projects participating in the Open Research Data Pilot. Further guidance on the Open Research Data Pilot is made available on the Participant Portal.

2. *Public-private partnerships (PPPs)*

Public-private partnerships (PPPs) are vehicles to implement technological roadmaps in particular areas and achieve leverage of private funding. They are implemented either through Joint Technology Initiatives (JTIs) using Joint Undertakings based on article 187 TFEU, or through dedicated calls for proposals and topics (contractual PPPs).

The LEIT part of Horizon 2020 includes the following PPPs:

Joint Technology Initiatives:[5]

- The Joint Technology Initiative on Electronic Components and Systems for European Leadership (ECSEL) will replace the two existing Joint Undertakings on embedded computing systems (ARTEMIS) and nano-electronics (ENIAC), which were set up under the Seventh Framework Programme, and it will also cover activities from the technology platform EPoSS (European technology Platform on Smart Systems integration).

- A new Joint Technology Initiative on Bio-based Industries will be established.

These two JTIs will develop their own work plans, which will be decided and implemented through their specific governance mechanisms and rules.

Contractual PPPs:[6]

- Robotics, Photonics, Advanced 5G Network Infrastructures, Factories of the Future, Energy-efficient Buildings and Sustainable Process Industries (SPIRE).

These six contractual PPPs are implemented in this work programme through different topics and calls. Robotics, Photonics and Advanced 5G Network Infrastructures are exclusively covered under the ICT part, while Factories of the Future, Energy Efficient Buildings and SPIRE are cross-thematic, in that some of their topics are placed elsewhere in the work programme. For completeness, the list of all the topics for each of these contractual PPPs is provided below:

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[5] the JTIs are subject to the adoption of the corresponding Council regulations

[6] the contractual PPPs are subject to the signature of the corresponding contractual arrangements

Factories of the Future

FoF 1 – 2014: Process optimisation of manufacturing assets
FoF 2 – 2014: Manufacturing processes for complex structures and geometries with efficient use of material
FoF 3 – 2014: Global energy and other resources efficiency in manufacturing enterprises
FoF 4 – 2014: Developing smart factories that are attractive to workers
FoF 5 – 2014: Innovative product-service design using manufacturing intelligence
FoF 6 – 2014: Symbiotic human-robot collaborations for safe and dynamic multimodal manufacturing systems
FoF 7 – 2014: Support for the enhancement of the impact of FoF PPP projects
FoF 8 – 2015: ICT-enabled modelling, simulation, analytics and forecasting technologies
FoF 9 – 2015: ICT Innovation for Manufacturing SMEs (I4MS)
FoF 10 – 2015: Manufacturing of custom made parts for personalised products
FoF 11 – 2015: Flexible production systems based on integrated tools for rapid reconfiguration of machinery and robots
FoF 12 – 2015: Industrial technologies for advanced joining and assembly processes of multi-materials
FoF 13 – 2015: Re-use and re-manufacturing technologies and equipment for sustainable product life cycle management
FoF 14 – 2015: Integrated design and management of production machinery and processes

Energy-efficient Buildings

EeB 1 – 2014: Materials for building envelope
EeB 2 – 2014: Adaptable envelopes integrated in building refurbishment projects
EeB 3 – 2014: Development of new self-inspection techniques and quality check measures for efficient construction processes
EeB 4 – 2014: Support for the enhancement of the impact of EeB PPP projects
EeB 5 – 2015: Innovative design tools for refurbishment at building and district level
EeB 6 – 2015: Integrated solutions of thermal energy storage for building applications
EeB 7 – 2015: New tools and methodologies to reduce the gap between predicted and actual energy performances at the level of buildings and blocks of buildings
EeB 8 – 2015: Integrated approach to retrofitting of residential buildings
EE 1 – 2014: Manufacturing of prefabricated modules for renovation of building (see section 10)
EE 2 – 2015: Buildings design for new highly energy performing buildings (see section 10)
EE 3 – 2014: Energy strategies and solutions for deep renovation of historic buildings (see section 10)

Sustainable Process Industries (SPIRE)

SPIRE 1-2014: Integrated Process Control
SPIRE 2-2014: Adaptable industrial processes allowing the use of renewables as flexible feedstock for chemical and energy applications
SPIRE 3-2014: Improved downstream processing of mixtures in process industries
SPIRE 4-2014: Methodologies, tools and indicators for cross-sectorial sustainability assessment of energy and resource efficient solutions in the process industry
SPIRE 5-2015: New adaptable catalytic reactor methodologies for Process Intensification
SPIRE 6-2015: Energy and resource management systems for improved efficiency in the process industries
SPIRE 7-2015: Recovery technologies for metals and other minerals
SPIRE 8-2015: Solids handling for intensified process technology

LCE 2-2014/2015: Developing the next generation technologies of renewable electricity and heating/cooling (see section 10)
LCE 3-2014/2015: Demonstration of renewable electricity and heating/cooling technologies (see section 10)
EE 18-2014/2015: New technologies for utilisation of heat recovery in large industrial systems, considering the whole energy cycle from the heat production to transformation, delivery and end use (see section 10)
Waste 1-2014: Moving towards a circular economy through industrial symbiosis (see section 12)

Future Internet
ICT 14 - 2014: Advanced 5G Network Infrastructure for the Future Internet

Robotics
ICT 23 - 2014: Robotics
ICT 24 - 2015: Robotics

Photonics
ICT 26 - 2014: Photonics KET
ICT 27 - 2015: Photonics KET
ICT 28 - 2015: Cross-cutting ICT KETs
ICT 29 - 2014: Development of novel materials and systems for OLED lighting[7]

High Performance Computing, implemented under the excellent science part (section 2)

Green Vehicles, a cross-thematic contractual PPP, largely in the transport societal challenge (section 11); one topic is covered under the NMP part in this section:
NMP 17 - 2014: Post lithium ion batteries for electric automotive applications

3. *Cross-cutting KETs*

"Cross-cutting KETs" activities bring together and integrate different KETs and reflect the interdisciplinary nature of technological development. They have the potential to lead to unforeseen advances and new markets, and are important contributions to new technological components or products.

The integration of different KETs represents a vital activity in Horizon 2020. Over the course of Horizon 2020, around 30% of the budget allocated to KETs will go to integrated KETs projects. Cross-cutting KETs activities will in general include activities closer to market and applications. Examples include pilot lines and demonstrator projects at high Technology Readiness Levels (5-8), but also activities at lower Technology Readiness Levels, which address specific value chains (with a view to subsequent innovation at higher TRLs). Manufacturability will often be a key issue on the innovation path towards the market, and pilot activities will normally combine at least two different KETs and integrated advanced manufacturing technologies/processes, in a way that value is created beyond the mere addition of the individual technologies for a component or product.

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[7] Topic jointly funded by LEIT-ICT and NMP parts

This work programme includes cross-cutting KETs in several parts. The relevant topics, flagged as such, have been developed on the basis of industrial roadmaps and with input from a specific study identifying promising areas of industrial and societal interest for cross-cutting KETs.

More specifically, the topics calling for pilot production lines, can be grouped in four areas of high industrial interest and innovation potential, as proposed by the High-level Group on KETs: high-performance production, embedded energy, smart structures, and industrial processes using renewable resources. They are considered as potential test cases for ambitious projects of industrial scale. They are therefore particularly suitable for a combination of funding instruments, including relevant national or regional research and innovation programmes, and in particular European Structural and Investment Funds (ESIF) under smart specialisation strategies.

The cross-cutting KET activities are complemented by actions addressing specific cross-cutting issues (exchange of information and best practices, expression of interest, exploring possibilities for combined funding, etc.).

High-performance production:

Pilot activities on high-performance production technologies:

- Pilot line for OLEDs on flexible substrates (ICT 28.b-2015)
- Pilot line for analytical mid-infrared (MIR) micro-sensors (ICT 28.b-2015)
- Pilot line for PIC fabrication on III-V and/or dielectric based platforms (ICT 28.b-2015)
- Pilot activities under the initiative "Factories of the Future"
  - Pilot lines for symbiotic human-robot collaborations (FoF 6-2014)
  - Flexible production systems based on integrated tools for rapid reconfiguration of machinery and robots (FoF 11-2015)
  - Industrial technologies for advanced joining and assembly processes of multi-materials (FoF 12-2015)
- Integration of novel nano materials into existing production and assembly lines (NMP 2-2015)
- High definition printing of multifunctional materials (NMP 4-2014)
- Industrial-scale production of nanomaterials for printing applications (NMP 5-2014)
- Scale-up of nanopharmaceuticals production (NMP 8-2014)

The JTI on 'Electronic Components and Systems' ECSEL will support industrially driven R&D projects, pilot production lines and large-scale demonstration activities. The pilot lines may integrate advanced manufacturing and materials research for advanced electronics-based products, e.g. those dealing with intelligent micro-nano sensors, silicon-photonics, or solid-state lighting.

Embedded energy:

Pilot activities related to embedded energy : integration of different technologies enabling electric, thermal and chemical (incl. renewable) energy storage for the mobility, construction and manufacturing industries:

- The activities related to embedded energy are under the cross-cutting *Green Vehicles* initiative (in Societal Challenge 4):
  Pilot line for next generation of batteries for e-mobility applications (GV 1-2014)
- Other activities related to embedded energy are in the Energy Challenge (Societal Challenge 3):
  - Pilot lines for power electronics for charging systems (LCE 6-2014)
  - Technology for district heating and cooling (EE 13-2014/2015, SCC 1-2014/2015)
  - New technologies for utilization of heat recovery in large industrial systems (EE 19-2014/2015)

The JTI Fuel Cells and Hydrogen will support industrially driven R&D projects, and in particular pilot production lines (e.g. for hydrogen storage systems and fuel cells).

Smart Structures:

Pilot activities related to smart structures: lightweight, high strength and functional materials and manufacturing processes addressed to the transport, building and other sectors:

- Pilot activities related to smart structures under the initiative Energy-efficient buildings:

  - Pilot lines for mechanical and electromagnetic resilient envelope (structures, buildings) (EeB 1-2014: Materials for building envelope)

  - Manufacturing of prefabricated modules for buildings renovation (EE 1 – 2014)

- Open access pilot lines for cost effective nanocomposites (NMP 1-2014)

- Manufacturing and control of nanoporous materials (NMP 3-2015)

- Innovation actions related to Advanced Thin, Organic and Large Area Electronics (TOLAE) technologies (ICT 3b – 2014)

Industrial Processes using Renewable resources:

Pilot activities related to innovative industrial processes using renewable resources, enabling innovative products and product applications:

- A major goal of the Joint Technology Initiative on the Bio-based Industries is to overcome the so-called 'valley of death' on the path from research to the marketplace. This JTI will support industrially driven R&D projects, and in particular pilot lines and large-scale demonstration activities (e.g. pilot lines for bio-based products and biorefinery demonstrators). Biotechnology can deliver technological breakthroughs in the biomass to bio-product value chain. The integration of other

KETs in these joint activities, such as advanced biomaterials, may also be envisaged.

- Further contributions are under the *Sustainable Process Industry (SPIRE)* initiative:
    - Pilot lines/demonstrator for the use of renewables as flexible feedstock for chemical and energy applications (SPIRE 2-2014);
    - Pilot lines for recovery technologies for metals and other minerals (SPIRE 7-2015)
    - Demonstrators for solids handling for intensified process technology (SPIRE 8-2015)
- Other pilot lines are in Societal Challenge 5 in relation to waste and raw materials.:
    - Demonstrator on industrial symbiosis (WASTE 1-2014: Moving towards a circular economy through industrial symbiosis);
    - Demonstrator on waste-based biorefineries (e.g. WASTE 2-2014: Valorization of municipal waste and food industry waste)

Other cross-cutting KETs activities:

- Research actions related to Advanced Thin, Organic and Large Area Electronics (TOLAE) technologies (ICT 3 – 2014)
- Development of novel materials and systems for OLED lighting (ICT 29 – 2014)
- Additive manufacturing for tabletop nanofactories (NMP 7-2015)
- Novel nanomatrices and nanocapsules (NMP 6-2015)

4. *Seizing the ICT opportunities*

ICT underpins innovation and competitiveness across a broad range of market sectors. The topics addressed in this Work Programme cover the ICT technology value chain in a comprehensive way, from key enabling technologies up to content and information management technologies, robotics and networking technologies.

With regard to ICT, the first Work Programme under H2020 provides a balanced response to the main challenges faced by Europe in the field: firstly, the need to maintain a strong expertise in key technology value chains; secondly, the necessity to move quicker from research excellence to the market. It combines a strong support to industrial roadmaps with new mechanisms to encourage disruptive innovation.

On the one hand, actions will reinforce medium to long term commitment to industrial strategies and provide continuity and stability. Support to public-private-partnerships implementing roadmaps defined by industry in the areas of electronic components and systems, photonics, robotics, Factory of the Future and 5G will help decrease fragmentation and safeguard a competitive edge at world scale in these sectors. All of these areas are of special strategic interest to Europe due to their enabling characteristics across many economic sectors.

On the other hand, new bottom up actions will offer flexibility and openness and will help develop dynamic eco-systems in which innovators can operate.

Both strands will require the involvement of new actors to exploit and leverage new technologies and to initiate and drive change.

5. *Contributions to solving Societal Challenges and to Focus Areas*

Future solutions to the major Societal Challenges will require the deployment of key enabling technologies, ICT components and systems, and communication infrastructure (including space). The activities under this part of the Work Programme will further develop the technologies that are needed to enable promising solutions for important (focus) areas and applications addressing societal challenges, ensuring that EU industry remains strong in the core technologies that are at the roots of future value chains, and aiming at advances which will be taken up and further developed in the respective value chains.

ICT Calls

The ICT field includes smart components, micro-systems and cyber-physical systems; advanced computing systems; networking; cloud and internet technologies; sensors and actuators; Internet of Things; intelligent interfaces and robotics systems; as well as software, simulation and visualisation tools and big data analytics technologies. These will build the foundations for the next generation of solutions to all Focus Areas, including health and care, food security, smart cities, energy efficiency, mobility, resource efficiency and digital security.

In addition, some ICT KETs and tools will contribute directly to societal challenges. For example, ICT-KET integrated platforms include: low-cost, micro-nano-bio and bio-photonics systems developed for the healthcare and food sectors; mobile, low-cost, point-of-care bio-photonics devices for the screening of cardiovascular cancer and neurodegenerative diseases; a Big Data integrator platform to help coordinate technology and user communities in any actions supported in Horizon 2020 addressing or making use of Big Data, including all societal challenges.

Calls in the areas of nanotechnology, advanced materials and advanced manufacturing and processing

Nanotechnology and advanced materials are key drivers for breakthrough innovations in many fields. This work programme identifies a number of activities to foster their potential to enable new medical therapies contributing to personalised health care, to create and improve the technological basis for a wider use of renewable energy sources and to realising energy efficiency goals, to provide clean water, and to increase the resource efficiency and reduce waste in the context of industrial and manufacturing processes.

For example, in order to combat cancer and diabetes, the technological basis for nano-medicine treatment and bio-materials will be brought towards pilot production as a precondition for subsequent clinical trials.

New forms of energy storage and maintenance questions are key for the development and attractiveness of decentralised energy production from renewable sources. The activities on energy-efficient buildings will deliver a key contribution to the focus area on energy efficiency and the related policy objectives.

One topic is dedicated to drinking water production and thus represents a contribution to the focus area on water.

The call on Sustainable Process Industries (SPIRE), and to a large extent the call on Factories of the Future, make key contributions to the focus areas on waste as a resource to recycle and reuse and on competitive low-carbon energy. Finally, the NMP call includes a support action on the eco-design of products, eco-innovation, and product life cycle management.

Biotechnology call

Biotechnology projects are expected to develop generic technology building blocks enabling true stepping stones towards solutions to a number of societal challenges: Better health (SC1); Low-carbon energy generation (SC3); Resource- and energy- efficiency and industrial pollution reduction (SC5).

Moreover, for the bio-based industries JTI, together with Societal Challenge 2 (Food security, sustainable agriculture, marine and maritime research and the bio-economy) contribution, activities will include biotechnology-based solutions for the cost-competitive and sustainable conversion of biomass into industrial products.. In addition, biotechnology is relevant for a number of focus areas (blue growth, sustainable food security, competitive low-carbon energy, energy efficiency, waste, water, personalised medicine). In some instances biotechnology is specifically stated in the context of some topics (e.g. blue growth). In other cases it is one of the technologies that the participants can use to address the specific challenges.

Space call

Space systems produce information which often cannot be acquired in any other way and hence space based data is an important tool for effectively addressing many of the societal challenges and focus areas. The application of space technologies is thus expected to be supported through the respective Societal Challenges, where appropriate. Additionally to this mainstreaming of space data exploitation, research on new ideas which ensure Europe's leadership in space-enabled applications outside the remit of the societal challenge areas, or addresses directly space industry competitiveness, or enables the future use of Space data in societal challenges, is supported in calls in the Space domains of EGNSS and Earth Observation.

6. Cross-cutting aspects

The following elements of a cross-cutting nature should be considered in the preparation of proposals.

International cooperation

In line with the objectives of the Union's strategy for international cooperation in research and innovation (COM(2012)497), Horizon 2020 is open to international cooperation. Certain topics have been identified as being particularly suitable for international cooperation, notably in relation to "Safety of nanotechnology-based applications and support for the development of regulation".

In addition to the general opening, this is implemented through combinations of targeted openings and dedicated coordinated calls in ICT and Space.

Beyond the identified opportunities, participants are strongly encouraged to identify and propose international collaborations that would lead to "win-win" scenarios, for example those helping to create export opportunities for European industry.

Responsible research and innovation

Wherever relevant, key principles to encourage a responsible approach to research and innovation are included in the work programme. Particular attention will be given to the engagement of a broad set of relevant stakeholders, and to the respect of ethical and safety principles and relevant legislation during the implementation.

Some cutting-edge areas of nano- and biotechnology may raise ethical concerns. This may be the case for synthetic biology, as this aims at designing new biological organisms. Ethical and safety issues are embedded in this topic but should be addressed more generally where particular potential safety or ethical issues may be identified.

Similarly, an extensive section is dedicated to the safety of nanotechnology-based applications and support for the development of regulation; and there are activities to promote societal engagement.

Given the transformative impact of ICT on society at large, this Work Programme pays particular attention to the ethical and societal acceptability of the targeted research and innovation, including citizens' concerns for their right to privacy and to protection of personal data. It calls for a stronger involvement of users and citizens, as well as of social scientists wherever they are needed. It also includes a specific challenge exploring a 'Human-centric Digital Age' to help understand better the way technologies, networks and digital media change the way people behave, think, interact and socialize in the networked society.

In addition, attention is given to the importance of security, through a dedicated set of activities as well as a pervasive consideration for security issues throughout the other research and innovation areas. In particular, the cross-cutting activities topic on "Cybersecurity, Trustworthy ICT" is complementary to the call on "Digital Security: Cybersecurity, Privacy and Trust" supported under the "Secure societies – Protecting freedom and security of Europe and its citizens" societal challenge, where the validation of state-of-the-art security solutions and their large scale demonstration is envisaged.