EN

Horizon 2020

Work Programme 2016 - 2017

17. Cross-cutting activities (Focus Areas)

Important notice on the second Horizon 2020 Work Programme

This Work Programme covers 2016 and 2017. The parts of the Work Programme that relate to 2017 are provided at this stage on an indicative basis. Such Work Programme parts will be decided during 2016.

(European Commission Decision C (2015)6776 of 13 October 2015)

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Introduction

This work programme part contains the following cross-cutting calls: (i) Industry 2020 in the Circular Economy, (ii) Internet of Things, and (iii) Smart and Sustainable Cities.

Call - Industry 2020 in the Circular Economy

H2020-IND-CE-2016-17

INTRODUCTION

This focus area is at the heart of how Horizon 2020 contributes to sustainably boosting economic growth and renewing Europe's industrial capacities in a world of finite resources.

It will demonstrate the economic and environmental feasibility of the circular economy approach, and at the same time give a strong impetus to the re-industrialisation of the EU, by developing and deploying new approaches and technologies. This focus area will bring together complementary activities, which *as a whole* will address the overall objectives of enhancing European industrial competitiveness and moving towards a circular economy.

Actions will support the goals outlined in the Communications 'Towards a circular economy: A zero waste programme for Europe'[1] and 'European Industrial Renaissance'[2], and are in line with the Commission's new Roadmap for a Circular Economy Strategy. They follow up the European Council conclusions of March and June 2014, in particular the Council's call for a systemic approach to cleantech.

There are synergies to be reaped from working across different pillars of Horizon 2020 in tapping new sources of green growth and maximising the uptake of new opportunities by industry, including SMEs. These are expected to boost investment and job creation, and consolidate Europe's global green leadership.

This call supports systemic innovation, which is understood as innovation that aims at responding to a societal challenge by obtaining a systems-wide transformation through affecting the system's economic, social and environmental dimensions. This implies a trans-disciplinary perspective that integrates technology, business models and economic organisation, finance, governance and regulation as well as skills and social innovation. Systemic innovation therefore calls for the adoption of a challenge-driven, solutions-oriented research and innovation strategy that crosses disciplinary boundaries and involves co-creation of knowledge and co-delivery of outcomes with economic, industrial and research actors, public authorities and/or civil society.

The industrial side of this call is based on the contractual Public-Private Partnerships (cPPPs) on Factories of the Future (FoF) and Sustainable Process Industries (SPIRE), with a strong element on industrial pilot lines for nanotechnology and advanced materials. It will help develop and deploy the necessary key enabling technologies to support EU manufacturing across a broad range of sectors. It will help European industry to meet the increasing global

[1] COM(2014) 398 final, 2 July 2014
[2] COM(2014) 14 final, 22 January 2014

consumer demand for greener, more customised and higher quality products through the necessary transition to a demand-driven industry with less waste and a better use of resources.

To underpin the systemic approach, circular economy models play an important role as they boost innovation and involve all stakeholders in value chain(s) increasing resource efficiency. The circular economy is an economy in which production and consumption are organised in a way that the value of products, components, materials and resources is maintained or enhanced throughout the value chain and the life of the products. The circular economy decouples the creation of wealth and jobs from the consumption of resources (e.g. energy, water and primary raw materials), maximises resource productivity and minimises resource extraction and waste.

Specific objectives of the actions in this call include a reduction of costs and emissions, a more efficient use of energy and resources, and a cascade use of materials. Pioneering new production and consumption patterns and related technological and non-technological solutions will strengthen EU's position and that of its industry in new markets. Systemic solutions need to be examined, developed and demonstrated throughout value chains, while addressing all influencing factors: policy and framework conditions that affect business and finance models; industrial manufacturing and processing; eco-design of products including design for repair, disassembly and durability, energy efficiency; reduction of GHG emissions; new and efficient use of primary and secondary raw materials; green and innovative public procurement (GPP); management, governance, social innovation; and new forms of consumer behaviour. Strong multi-stakeholder involvement and the active contribution of social sciences and humanities disciplines will be essential.

This call also builds on and aligns with the European Innovation Partnerships (EIPs) on Water Efficiency and on Raw Materials, the relevant European Technology Platforms (ETPs), the Bio-Based Industries Joint Undertaking (BBI-JU) , the ERA-NET on Eco-innovation (ECO-INNOVERA), and the European Institute of Innovation and Technology's Knowledge and Innovation Communities (KICs).

This call is accompanied by a coordination and support action (NMBP-36-2016) in the NMBP call H2020-NMBP-CSA-2016, which provides policy support for Industry 2020 in the circular economy.

Full details are provided under the Horizon 2020 Work Programme Part – Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing (Part 5.ii. of this Work Programme).

PILOTS

The industrial eco-system that would deliver nanotechnologies and material technologies to the customer and citizen, requires new strategies encompassing open innovation, accelerated approaches from the idea to the product, system-level engineering and new supply chains. The overall target of this part is to strengthen the competitiveness of European industry by

leveraging existing research activities, empowering investments and product development, capable of entering the market in the 5 to 7 year time horizon; by building up industrial value chains and strengthening networks among stakeholders for further R&D+I activities for market; by reducing technical and production development risk by increasing the knowledge intensity of especially smaller companies and entrepreneurs. Actions will principally be implemented as cross-cutting KET pilot activities building on previous research that is ready to be progressed towards industrial-scale processes, combining smart, digital fabrication technologies with smart (nano)materials.

Proposals are invited against the following topic(s):

PILOTS-01-2016: Pilot lines for manufacturing of materials with customized thermal/electrical conductivity properties

Specific Challenge: Advanced functional materials with customized thermal/electrical conductivity properties provide new opportunities in manufacturing.

The improved properties of sustainable advanced functional material with customized thermal/electrical conductivity properties will benefit end user industries in many sectors, Applications areas are wide ranging, and may include new manufacturing processes such as additive and 2D/3D printing processes and roll-to-roll or other large scale manufacturing processes.

The need for such materials, affordable, industrially robust and environmental friendly, calls for the upscaling of these widely researched materials and their manufacturing processes. This should ensure the further integration of the nano-enabled multifunctional materials into practical large-scale applications, and drastically exceed the current use in niche-markets.

Scope: The proposed pilot lines should address the development, upscaling and demonstration in relevant industrial environments.

They should use existing pilot lines as a starting point for development, incorporating new materials and methods and/or instrumentation with real time characterization for measurement, analysis and monitoring at the nanoscale to characterise relevant materials, process properties and product features.

The aim is to increase the level of robustness and repeatability of such industrial processes; to optimise and evaluate the increased performance of production lines in terms of productivity and cost-effectiveness; and finally to assess the sustainability, functionality and performance of the produced new materials.

Proposals should address the complete research-development-innovation cycle and obstacles remaining for industrial application, and involve a number of relevant materials producers and users, also considering the needs of SMEs.

Technology transfer should be considered and prepared through technology services at affordable costs, facilitating the collaborating with EU SME and large industries, and the rapid deployment and commercialisation of the new technology.

Examples of possible applications include multifunctional composites and polymeric materials for applications such as sensors, integrated electronics, lighting protection, thermal layers, thermoelectric components including inks, high-voltage insulators, and providing anti-pollution, noise, thermal or anti-scratch properties and/or sensing, health assessment and self-healing functions, etc.

Non-technological aspects key for the marketing of such products (e.g. standardization, regulatory issues, user acceptance, HSE aspects, LCA) need to be considered.

Activities are expected to focus on Technology Readiness Levels 4 to 6, and target Technology Readiness Level 7. This topic addresses cross-KET activities.

The Commission considers that proposals requesting a contribution from the EU between EUR 5 and 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The improved properties of advanced functional material with customized thermal/electrical conductivity properties can benefit end user industries such as automotive, aerospace, consumer durables, electrical and electronics, safety, healthcare, and energy.

Enhanced manufacturing capacities in Europe and/or enhanced market opportunities for European enterprises. These impacts should be addressed in particular in the outline of the business case and exploitation strategy to be submitted with the proposal. The expected content of this outline is further detailed in the LEIT introduction, section 6.

Impact should be presented at three levels:

1. Impact on the consortium materials producers and users, and other involved industries, demonstrated in the form of reduced costs and full consideration of environmental and safety legislation,

2. Other existing or new materials manufacturers, describing the expected impact from further integration of the nano-enabled multifunctional materials into practical large-scale applications with producers outside the consortium,

3. Global impact in form of direct or derived benefits from competitive advantage of the new materials in products.

The impact will also be improved by a contribution to training and knowledge dissemination for building an educated workforce.

Overall the action is expected to help driving the demand in Europe as well as support the penetration of new markets worldwide. This should include clear benefits to manufacturers, including SMEs, and new entrants into the market should be expected.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

PILOTS-02-2016: Pilot Line Manufacturing of Nanostructured Antimicrobial Surfaces using Advanced Nanosurface Functionalization Technologies

Specific Challenge: Infections by pathogenic microorganisms adhering on various surfaces kill worldwide more people than any other single cause.

These diseases are of particular significance in hospitals (surfaces/furniture, medical devices/implants, surgery equipment, health care products and hygienic applications) as well as in water purification systems, textiles, food packaging and storage, domestic appliances, etc.

Alternatives to antibiotics to control infectious biofilms are required, due to the increasing prevalence of antibiotic resistant bacterial strains. The increasing demand for superior quality medical devices and improved sanitation calls for the development of nano-enabled surfaces with antimicrobial functionality.

Nanotechnologies for water treatment units in industrial environments is another example where innovation is required in addressing environmental factors, decisive for industrial competitiveness.

Also food safety issues are of increasing public health concerns. Protection and preservation of food by using active and intelligent packaging materials is a promising route to prevent foodborne illness outbreaks and reduce food waste caused due to early spoilage.

Addressing these challenges calls for the industrial upscaling of manufacturing processed for generation of nanostructured and/or functionalised antimicrobial surfaces and biomaterials having anti-biofilm activity, and eventually including smart sensing and environment dependent functionalities. Technologies that are affordable and industrially robust are required. This should ensure the further integration of the nano-enabled multifunctional materials into practical large-scale applications, and drastically exceed the current use.

Scope: The proposed pilot lines should address the development, upscaling and demonstration in relevant industrial environments of reliable materials and manufacturing processes to obtain nanostructured surfaces with antimicrobial, biocompatible, anti-adhesive properties.

They should use existing pilot lines as a starting point for development, incorporating new materials and methods and/or instrumentation with real time characterization for

measurement, analysis and monitoring at the nanoscale to characterise relevant materials, process properties and product features.

The aim is to increase the level of antimicrobial effectiveness, robustness and repeatability of such industrial processes; to optimise and evaluate the increased performance of production lines in terms of productivity and cost-effectiveness; and finally to assess the functionality and performance of the new materials/products.

Proposals should address the complete research-development-innovation cycle and obstacles remaining for industrial application, and involve a number of relevant materials producers and users, also considering the needs of SMEs.

Specific aims of the proposed actions could be

- The fabrication of new antimicrobial surfaces, or the improvement of existing ones via the application of surface coatings, or the modification of the surface architecture, in order to eliminate or substantially reduce the extent of bacterial attachment on these surfaces are foreseen. A multi-functional approach should be followed for the development/modification of the nanostructured surfaces ((i.e. prevention of adhesion combined with killing of microorganisms and evt. combined with smart sensing functionalities)

Technology transfer should be prepared through technology services at affordable costs, facilitating the collaborating with EU SME and large industries, and the rapid deployment and commercialisation of the new technology, including for example industries or municipalities located in deserted zones or islands etc.

Non-technological aspects key for the marketing of such products (e.g. standardization, regulatory issues, user acceptance, HSE aspects, LCA) need to be considered.

Activities are expected to focus on Technology Readiness Levels 4 to 6, and target Technology Readiness Level 7. This topic addresses cross-KET activities.

The Commission considers that proposals requesting a contribution from the EU between EUR 5 and 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Societal challenges in the healthcare, water and food processing fields are addressed. Medical and healthcare are obvious markets, but it is also expected to see contributions to solving other social challenges such as sustainable solutions for availability of clean water or improving on food safety.

Improved hygiene in hospital environments and prevention of cross-infections will show economic and social benefits of scale, resulting from such reduced needs for treatment of infectious diseases acquired during hospitalization.

Adding anti-microbial, anti-adhesion functionalities to water treatment equipment or food packaging is another potential area where benefits can be derived from reduced operational costs and increased water or food quality.

The aim is to facilitate the manufacturing and use of these surfaces and their production, and establish process control and characterization approaches for an industrial production. Direct benefit to the involved industries should be demonstrated in the form of reduced costs and full consideration of environmental and safety legislation.

Enhanced manufacturing capacities in Europe and/or enhanced market opportunities for European enterprises. These impacts should be addressed in particular in the outline of the business case and exploitation strategy to be submitted with the proposal. The expected content of this outline is further detailed in the LEIT introduction, section 6.

The impact should be presented at three levels:

1. Impact on the consortium materials producers and users, and other involved industries, demonstrated in the form of reduced costs and full consideration of environmental and safety legislation.

2. Other existing or new materials manufacturers, describing the expected impact from further integration of the nano-enabled multifunctional materials into practical large-scale applications with producers outside the consortium,

3. Global impact in form of direct or derived benefits from competitive advantage of the new materials in products.

The impact will also be improved by a contribution to training and knowledge dissemination for building an educated workforce.

Overall the action is expected to help driving the demand in Europe as well as support the penetration of new markets worldwide. This should include clear benefits to manufacturers, including SMEs, and new entrants into the market should be expected.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

PILOTS-03-2017: Pilot Lines for Manufacturing of Nanotextured surfaces with mechanically enhanced properties

Specific Challenge: Nanostructured coatings or nanotextured surfaces provide improved scratch and abrasion resistance, super hardness and mechanical resistance that rivals diamond in performance, improved wear resistance and corrosion inhibition, bio-compatibility, control of reflectivity, sensing ability, self-cleaning surfaces improving many products such as

technical textiles and papers, structural elements for machinery, construction elements, transportation, etc.

Nano-enhanced functional surfaces have huge potential in different sectors, including packaging, marine, water treatment, electronics, building and construction, automotive, transport, energy and other applications including textile, leather and industrial engineering.

The involved technologies to manufacture these surfaces or coatings are currently at a lower TRL level, and call for up-scaling, demonstration and validation in large scale pilot installations in operational environments, before industrial manufacturing can take place.

Scope: The proposed pilot lines should address the development, upscaling and demonstration in relevant industrial environments of reliable manufacturing processes to obtain nanostructured surfaces with mechanically enhanced properties.

They should use existing pilot lines as a starting point for development, incorporating new materials and methods and/or instrumentation with real time characterization for measurement, analysis and monitoring at the nanoscale to characterise relevant materials process properties;

The aim is to increase the level of robustness and repeatability of such industrial processes; to optimise and evaluate the increased performances of the production lines in terms of productivity and cost-effectiveness; and finally to assess the functionality and performance of the new materials/products.

Proposals should address the complete research-development-innovation cycle and obstacles remaining for industrial application, and involve a number of relevant materials producers and users, also considering the needs of SMEs.

Technology transfer should be prepared through technology services at affordable costs, facilitating the collaborating with EU SME and large industries, and the rapid deployment and commercialisation of the new technology.

Examples of possible developments include:

- Upgrade existing production methods, extending current production capabilities of mass production injection moulding, or additive technologies such as Roll-2-Roll- and sheet-2-sheet printing, into the sub-100 nm regime.
- Enhancing key properties of promising lab scale nano-enabled surfaces and upscale their production up to pilot level. Different technologies for nano-enabled surface production may be considered.
- Applying such surfaces in sectors (more than one is preferred) where they may have strong social and economic impact.

Non-technological aspects key for the marketing of such products (e.g. standardization, regulatory issues, user acceptance, HSE aspects, LCA) need to be considered.

Activities are expected to focus on Technology Readiness Levels 4 to 6, and target Technology Readiness Level 7. This topic addresses cross-KET activities.

The Commission considers that proposals requesting a contribution from the EU between EUR 5 and 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The action is expected to lead to a direct economic impact on the economy of the manufacturing industry as well as society, resulting from issues such as increased performance and durability of wear-intensive industrial components, reduction of infrastructure maintenance costs, and reduction of operational costs due to energy savings.

Functional nanotextured surfaces and nano structured coatings have a huge potential for many sectors, and embedded nanostructured functionalities in coatings and surfaces can alleviate problems from ice, pollutant, UV, fire, heat, marine life, wear, friction and corrosion. These factors cost global industry billions in maintenance, loss and downtime each year. For example, direct corrosion costs account for 3-4% of a country's GDP worldwide. The same for wear costs. Energy losses due to friction in mechanical contacts reaches more than 10% of the GDP of a developed country. More sustainable production as well as products can also be expected, including an environmental impact, from using eco-friendly nanocoatings instead of traditional lubricants for example.

Integration of state-of-the-art nanotechnology in the traditional production of coatings or surfaces will give a market advantage and enhance the competitiveness of European industry.

The new functionalities achieved will have important impact on many sectors, including packaging, marine, water treatment, electronics, building and construction, automotive, energy, textile, leather and industrial engineering.

Enhanced manufacturing capacities in Europe and/or enhanced market opportunities for European enterprises. These impacts should be addressed in particular in the outline of the business case and exploitation strategy to be submitted with the proposal. The expected content of this outline is further detailed in the LEIT introduction, section 6.

The impact should be presented at three levels:

1. Impact on the consortium materials producers and users, and other involved industries, demonstrated in the form of reduced costs and full consideration of environmental and safety legislation.

2. Other existing or new materials manufacturers, describing the expected impact from further integration of the nano-enabled multifunctional materials into practical large-scale applications with producers outside the consortium,

3. Global impact in form of direct or derived benefits from competitive advantage of the new materials and products.

The impact will also be improved by a contribution to training and knowledge dissemination for building an educated workforce.

Overall the action is expected to help driving the demand in Europe as well as support the penetration of new markets worldwide. This should include clear benefits to manufacturers, including SMEs, and new entrants into the market may be expected.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

PILOTS-04-2017: Pilot Lines for 3D printed and/or injection moulded polymeric or ceramic microfluidic MEMS

Specific Challenge: Microfluidics devices were initially based on non-polymeric materials like silicon or glass, manufactured in facilities developed for the semiconductor industry. New fabrication techniques that are completely based on polymer/plastic materials can lead to reducing fabrication costs and optimise time, including rapid prototyping methods for a new range of products.

A new generation of 3D micro and nano structured and/or injection moulded polymeric or ceramic microfluidic MEMS products are targeted. Applications may include MEMS for nozzles or filters, sensor applications, lab-on-chip systems, printed biochemical materials, soft substrates etc., and open for new applications, including disposables where production cost need to be kept to a minimum. The adoption of environment friendly material solutions may also be explored (e.g. biodegradable materials, materials from renewable resources, reusable/recyclable materials).

While typical features for the mentioned applications may be larger than leading edge semiconductor processes, the required feature sizes are nonetheless significantly smaller than what is available with current standard printing and injection moulding techniques i.e. micro- and nano-fabrication capabilities are required.

Scope: The proposed pilot lines should address the development, upscaling and demonstration in relevant industrial environments.

They should use existing pilot lines as a starting point for development, incorporating new materials and methods and/or instrumentation with real time characterization for measurement, analysis and monitoring at the nanoscale to characterise relevant materials, process properties and product features.

The aim is to increase the level of robustness and repeatability of such industrial processes; to optimise and evaluate the increased performance of production lines in terms of productivity

and cost-effectiveness; and finally to assess the functionality and performance of the new materials/products.

Proposals should address the complete research-development-innovation cycle and obstacles remaining for industrial application, and involve a number of relevant materials producers and users, also considering the needs of SMEs.

Non-technological aspects key for the marketing of such products (e.g. standardization, regulatory issues, user acceptance, HSE aspects, LCA) need to be considered.

Applications may fall within areas such as:

- 3D micro and nano printed and/or injection moulded biological applications (including instrument on a chip, bio-medical/bio-physical sensors, Lab-on-chip, organ-on-a-chip, bio-compatible or toxic scaffolds, active influence of cell growth & differentiation).
- 3D micro and nano printed and/or injection moulded polymeric or ceramic microfluidic MEMS for nozzles or filters, sensor applications, and multi-use chip (including also injection molded nanostructures in polymers).
- In-line process control technologies as well as characterization methods needs to be included in order to meet recognised quality, environmental and safety standards and legislations.

The increased performances of the production lines in terms of productivity and cost-effectiveness should be demonstrated together with the relative improved functionality and performance of the resulting products.

SME needs should be catered for, e.g. through a coordinated network of pilot line, test and validation services, in order to prepare for management decisions to progress to the next step of new technology deployment, i.e. installation of industrial pilot lines and enter the commercialization stage.

Activities are expected to focus on Technology Readiness Levels 4 to 6, and target Technology Readiness Level 7. This topic addresses cross-KET activities.

The Commission considers that proposals requesting a contribution from the EU between EUR 5 and 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The action should allow for a new generation of MEMS products.

The scaled up production lines for 3D micro and nano printing and/or injection moulding in combination with the use of polymers and new micro- and nano-fabrication capabilities is expected to increase cost-effectiveness and robustness of the process and resulting products.

Direct benefit to the involved industries should be demonstrated in the form of reduced costs and full consideration of environmental and safety legislation.

Enhanced manufacturing capacities in Europe and/or enhanced market opportunities for European enterprises. These impacts should be addressed in particular in the outline of the business case and exploitation strategy to be submitted with the proposal. The expected content of this outline is further detailed in the LEIT introduction, section 6.

Impact should be presented at three levels:

1. Impact on the consortium materials producers and users, and other involved industries, demonstrated in the form of reduced costs and full consideration of environmental and safety legislation;

2. Other existing or new materials manufacturers, describing the expected impact from further integration of the nano-enabled multifunctional materials into practical large-scale applications with producers outside the consortium;

3. Global impact in form of direct or derived benefits from competitive advantage of the new materials in products.

The impact will also be improved by a contribution to training and knowledge dissemination for building an educated workforce.

Overall the action is expected to help driving the demand in Europe as well as support the penetration of new markets worldwide, also considering the contributions to an improved quality of life from the resulting products (e.g. lab-on-chip, filters and sensors for medical or other applications), ultimately contributing to a significant growth of quality jobs.

This should include clear benefits to manufacturers, including SMEs, and new entrants into the market should be expected.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

PILOTS-05-2017: Paper-based electronics

Specific Challenge: On one hand the lifetime of electronics is becoming shorter, now approaching an average in the range of months; this evolution generates technological challenges and poses a growing ecological problem. On the other hand, paper is ubiquitous in everyday life and it is one of the cheapest materials in our society. It is renewable, portable, flexible and in addition cellulose, its main component, is the Earth's major biopolymer and has an essential economic importance in Europe, which is responsible for 30% of the world's total production. Paper Electronics represents a new concept which combines the use of paper as a functional part of electronic components or devices. Typical applications include

packaging, graphics, novel diagnostic systems and hygiene products for indicating product safety or freshness, support logistics, health-care and safety for example.

Paper-based electronics shows promising technical, economic, and environmental advantages which will allow new recyclable electronics devices like paper displays, smart labels, smart packaging, bio-and medical applications, PoC devices, RFID tags, disposable electrochemical sensors among others. Paper-based electronics represents a promising source of innovation and growth for sectors such as packaging industry which develops smart solutions able to interact with the end users or classic paper publishing industry which are facing challenges from electronic books and journals, healthcare industry which intensify the development of quantitative biosensing, microfluidic and lab-on-chip devices.

Scope: The proposal should address the physical, chemical and engineering challenges linked with the use of paper as substrate as well as active components of the electronic devices: it includes the development on new technologies for paper manufacturing (fiber enhancement, porosity, fillers, etc) and converting, new paper coatings (organic, inorganic or hybrid), paper surface characteristics and functionalization (nanocellulose functionalization, plasma or gas treatments, bio and chemical modifications for instance) but also heterogeneous integration of high-added value electronic components on paper and introduction of new materials (conductors, semiconductors, insulators, electrochromic, batteries electrodes). The proposal should develop high-precision, cost efficient, and high output printing or other manufacturing technologies on large area (inkjet, screen printing amongst others, and sheet-to-sheet or roll-to-roll processes). The proposal should also address recyclability and eco-design aspects.

The implementation of this topic is intended to start at TRL 3 and target TRL 5.

This topic addresses cross-KET activities.

The Commission considers that proposals requesting a contribution from the EU between EUR 5 and 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- To develop a new disruptive and sustainable paper-based platforms for electronics that not only integrate discrete devices but also use the cellulose as an electronic material for insulators, electrolytes, conductors, and semiconductors;
- To use the same paper substrate that supports the electronics to also drive a bioplatform or a display, process source video data, or provide the power source through an embedded chemical battery;
- Reduce the environmental impact of electronics;
- Consolidate paper making industries and wood-harvesting industries;

- In long term, the developed technologies should pave the way for active, full color, video-rate reflective displays that perform well in high-light conditions, achieving performance equivalent to classical electronics (i.e. for display devices, a contrast ratio from 10:1, reflectivity of over 80%, full color, etc.);

- Creation of new markets and new business opportunities for the European industry fulfilling or anticipating consumer needs in this area.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

FACTORIES OF THE FUTURE - FOF

Manufacturing is still the driving force of the European economy. The manufacturing industry produces approximately 80 % of the EU's exports – worth about €1.8 trillion in 2013. It involves around 2 million enterprises largely dominated **by SMEs** across the EU, employs about 30 million people directly (and another 40-60 million indirectly) contributing 15.1% of GDP. Therefore, manufacturing is of high importance to Europe, with a huge potential to generate wealth, jobs and a better quality of life. The long-term shift from a cost-based competitive advantage to one based on high added value requires that European manufacturing increases its technological base, building on the EU's excellent R&D in this domain, and develops a number of **enabling trans-sectorial production technologies**.

The *Factories of the Future* Public-Private Partnership (PPP) initiative aims at helping EU manufacturing enterprises, in particular SMEs, to adapt to global competitive pressures by developing the necessary key enabling technologies to support EU manufacturing across a broad range of sectors. It will help European industry to meet the increasing global consumer demand for greener, more customised and higher quality products through the necessary transition to a flexible, digitalised and demand-driven industry with lower waste generation and energy consumption.

The PPP will concentrate on increasing the technological base of EU manufacturing through the development and integration of the key enabling technologies of the future, such as innovative technologies for adaptable machines, ICT for manufacturing, and the novel industrial handling of advanced materials. ICT plays an essential role in innovating production systems in all sectors. It allows notably for a more personalized, diversified and mass-produced product portfolio and for rapid and flexible reaction to market changes. The initiative will concentrate on industry-led R&D projects and will include demonstration activities, such as production-line demonstrators for validation and market uptake. The partnership will work together to identify the R&D needs of manufacturing industry and in

particular SMEs. In order to further ensure the industrial character of the initiative, a large part of the activities in the projects is expected to be performed by industrial organisations themselves. This initiative, being by nature cross-sectorial and including efforts to address the needs of SMEs, aims at transforming Europe into a dynamic and competitive knowledge-based economy.

Proposals are invited against the following topic(s):

FOF-01-2016: Novel hybrid approaches for additive and subtractive manufacturing machines

Specific Challenge: Manufacturing has been using for the production of goods and wares many different processes that can be classified as subtractive or additive processes. Traditional machines have been normally focused on only a single type of these processes but there is a new generation of machines that combines the features of individual manufacturing processes into a single platform.

These hybrid manufacturing processes can enable a high-value and sustainable manufacturing by keeping the advantages of the single processes in a single machine whilst reducing their disadvantages. Nevertheless, the enhanced features of the hybrid machines bring as well an increasing process complexity and higher costs of production that impact the final price in the market of the produced items. High added value products with complex structures can balance out those production costs.

New hybrid machines, equipped with both subtractive and additive manufacturing technologies, can be a game changer to create new opportunities and applications for Additive Manufacturing (AM). The great potential of AM is in most of the cases limited by the subtractive post-processing steps needed to ensure optimal tolerances and surface finish. These hybrid combinations can also enable the production of larger items than in AM single machines and have a large potential for repair applications.

Scope: Proposals should address the development of advanced All-in-one machines that enable the production of a part/product directly from a CAD model in a short time and without the need of post-processing steps. A variety of Additive Manufacturing technologies and different materials can address this challenge by means of new and/or innovative processes.

- Develop new machine concepts and designs into a single set-up processing and process control.
- Full integration and automation of the subtractive and additive processes in the machine
- Increased build rate of the machine in comparison to the separate processes
- Production of parts/products that are functional and with the final desired accuracy, surface-finish and tolerances and material efficiency

- Properties of the new components after the manufacturing process

The proposal must include at least one demonstrator in real industrial settings in order to show the industrial viability of the solution.

Activities are expected to focus on Technology Readiness Levels 4 to 6.

The involvement of SMEs is encouraged.

The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The developed novel hybrid approaches should lead to a remarkable impact in the following terms:

- 20% reduction in time and cost, with respect to the current additive and subtractive processes.
- 15% increase in productivity for high-volume AM production, with respect to the current additive and subtractive processes.
- More flexibility and robustness of the machines to adapt with customisation and changing market needs
- Reduction of inventory because of the making of products on-demand
- Reduction of work floor space
- Create localised manufacturing environments and reduce supply chains length
- Contributions to standardisation and certification for new hybrid procedures.

The role of SMEs and their potential as manufacturers and end-users for the developed machines needs to be considered, in order to ensure the access to existing and new markets.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

This topic complements other call topics in this area funded under FoF-13-2016

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

FOF-02-2016: Machinery and robot systems in dynamic shop floor environments using novel embedded cognitive functions

Specific Challenge: Current production shop floors are organised in a fixed combination of sequential automated and manual tasks. Each station, in which one or more tasks are performed, is designed for optimal productivity, and the whole linear sequence of operations is as well optimised for productivity. This paradigm is efficient when production is set to the maximum capacity and the same tasks are repeated in the same way in each cycle. However, this does not scale well to other situations. The complexity and cost of shop floor organisation increases dramatically when it comes to flexible production or logistics, as for example when mixing different product models, and the cost for introducing a new product reference is also very high. Moreover, this model lacks the capacity to react to unexpected technical problems that may arise.

Future shop floors have to endorse flexibility and define networks in which a tight collaboration between humans, machines and robots is key for performance e.g. maintenance operations and changes in product set-up. Therefore the shop floors must be supported by enhanced perception capabilities including the ability to reason over the perceived environment. By using novel embedded cognitive functions, machinery and robots should be able to collaborate as network agents in a realistic semi-structured environment, being able to adapt their behaviour in order to give a response to unforeseen changes or situations. Furthermore, the cognitive capabilities will allow the machinery and robots to evolve from being programmed for a dedicated task to the handling of a multitude of different tasks.

Scope: Research activities should address at least three of the following areas:

- Perception as an integrated cognitive capability, considering collaborative perception (counting not only with on-board sensors, but also with the sensing capabilities available in the whole shop floor), scene understanding, reasoning and acting (active perception).
- Perception as a way to create intelligent, dexterous "universal" devices for handling or manipulation of products or tools (e.g. handling of soft or shape changing objects, non-task dedicated devices)
- Mobility as a key factor for flexibility: machinery and robot systems should not only be able to autonomously navigate in realistic changing scenarios, but also develop the competences to switch from environment level navigation to the accurate positioning required to complete the operations.
- Methods and technologies to eliminate physical barriers such as safety guarding or enclosures have already been developed, but lack in inherent safety of the overall system. Cognitive capabilities in order to guarantee safety at all times, including when the system is down (e.g. maintenance, failure) should be researched so that it is possible to open the way to certification.

- Adaptation through context awareness and reasoning, aiming at making machinery and robots aware of their surroundings, so that they can perceive and obtain information on the non-programmed and non-expected situations, and adapt their behaviour in order to better handle them, while taking into account safety aspects..

- Life-long learning and knowledge sharing tools, reducing to the minimum the initial programming efforts, and reusing the acquired abilities and competences over the existing machines.

Robots and machines should not be considered as individual agents, but will have to be part of an overall interactive network which should be defined and possibly standardised.

Proof of concept in terms of at least one demonstrator should be delivered before the end of the project, excluding commercially usable prototypes, but convincingly demonstrating scalability towards industrial needs taking into account age and gender aspects, and making a clear case for the safety of the worker under all circumstances.

Activities are expected to focus on Technology Readiness Levels 5 to 7 and to be centred around TRL6.

This topic addresses cross-KET activities.

The Commission considers that proposals requesting a contribution from the EU between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The developed machinery and robot systems should lead to a significant impact in the following areas:

- Automation of previously manual production in order to bring European production plants in cheap labour countries back to Europe

- Strengthen global position of European manufacturing industry through the introduction of the new technologies related to machinery and robots with enhanced capabilities

- Strengthen the innovation potential of European manufacturing industry through the creation of new products made possible with the new developed technologies

- Reduction of 20% of set-up and new product adaptation costs, increasing efficiency

- Significant improvement in the adaptability of manufacturing systems.

In order to ensure a high impact, both standardisation and certification activities have to be addressed in the proposal.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

This topic complements other call topics in this area funded under FOF-12-2017 a.ii and LEIT-ICT Robotics topics

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

FOF-03-2016: Zero-defect strategies at system level for multi-stage manufacturing in production lines

Specific Challenge: The current trend in multi-stage manufacturing is towards more complex, distributed and faster evolving manufacturing facilities. To develop a zero-defect strategy to cope with increasing competition and sustainability related issues, plants should be designed and managed using best practices from emerging key enabling technologies. Manufacturing processes have to be environmental friendly and safe and deliver high quality products adapted to customer requirements, whilst minimising costs.

Within a context of market globalisation, the quality of products has become a key factor for success in manufacturing industry. The growing unpredictability of demand necessitates continuous adjustments in production targets. The increasing interest in sustainable production places a premium on reducing material waste, re-works, rejects and stocks and has led to a demand for the development of zero-defect strategies at system level.

Scope: Proposals should develop tools and methods for multi-stage manufacturing production with the aim of preventing defect generation and propagation as part of a system-level zero-defect strategy. In this context, integrated production and quality control strategies able to achieve the desired production rate for high quality products need to be developed. They should include both tools to prevent the generation of defects at single stage level and tools to prevent the propagation of defects to downstream stages.

Quality control tools should be supported by distributed on-line data gathering systems, on-line inspection tools, on-line defect management policies (i.e. on-line re-work or workpiece repair), inter-stage information and part flow control strategies and selective inspection policies to achieve higher control of the most critical stages in the system. The final aim is to achieve production system configurations that profitably exploit the quality/productivity trade-off at system level whilst reducing complexity.

Research activities should cover several of the following fields in a multidisciplinary approach:

- Methodologies and strategies for integrating production and quality systems into the multi-stage manufacturing process.

- Knowledge management tools to facilitate problem resolution, alarm triggering, transferring knowledge from one process or product variant to another and early detection based on lessons learnt, previous alarm activations, trends, etc.
- On-line inspection Tools for understanding, monitoring, analysis and real-time fault diagnosis of industrial process operation and product quality.
- Development of system-level zero-defect strategies to prevent the generation of defects at single stage level and propagation of defects to downstream stages.
- Distributed on-line data gathering systems and on-line defect management policies.
- Inter-stage information and part flow control strategies and selective inspection policies.

Activities are expected to focus on Technology Readiness Levels 5 to 7 and to be centred around TRL6. This topic addresses cross-KET activities.

The Commission considers that proposals requesting a contribution from the EU between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The developed zero-defect strategies at system level should lead to a significant impact in the following terms:

- Achievement of zero defects in a multi-stage production line
- Reduction of production costs by 15%
- Increased production flexibility. Higher production rates by 15%
- Reduction of waste and scrap by 10%
- Wide adoption of the new strategies in the existing manufacturing systems.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

FOF-04-2016: Continuous adaptation of work environments with changing levels of automation in evolving production systems

Specific Challenge: Despite high automation levels in factories today, humans remain central to manufacturing operations.

In the past, and due to human flexibility, workers were expected to adapt to machine requirements. However, today's machines increasingly allow these roles to be reversed with automation systems becoming ever more adaptable to the capabilities of workers, and work organisation becomes more flexible in terms of time and place. Furthermore, higher levels of product customisation and variable requirements, call for new adaptive human-centred automation approaches, complementing the cognitive capabilities of humans by advanced sensing and the higher precision of machines.

Modern manufacturing system design builds on an optimal and continuous distribution of tasks between humans and machines for higher performance, adaptability and quality.

Scope: Research activities should address all of the following areas:

- Determination of adequate levels of automation for optimal flexibility, agility and competitiveness of highly customised production. Adaptive automation systems should accommodate to the worker's skills and flexibility needs, be it by compensating limitations (e.g. due to age or inexperience) or by taking full advantage of the worker's experience;

- Methods and tools for a continuous adaptation of workplaces to the physical, sensorial and cognitive capabilities of workers (especially of older and disabled people in those workplaces) and their socio-economic needs, by taking into consideration "safety and health at work" requirements. An adequate methodology to measure "worker satisfaction" should be developed and tested. The underlying theoretical framework should in particular involve knowledge from a socio-organisational and psychometrics perspective, including the engagement of workers in the design and adaptation of their workplace to ensure attractiveness;

- Exploit technologies such as virtual (and/or augmented) reality to support process and workplace simulations and industrial social networking with rich user experience for knowledge capture and decision support with a strong focus on usability, user acceptance and training.

This topic requires a a user-driven approach through a collaborative effort between social scientists and engineers to (a) come to an adequate understanding of "worker satisfaction" and the relevant quantitative indicators, and to (b) introduce the concept of "usability" of machines by the worker on the shop floor (particularly concerning elderly, disabled or other target groups with special needs) thus contributing to improving worker safety and health. Age and gender aspects should be taken into account.

Activities are expected to focus on Technology Readiness Levels 4 to 6.

This topic addresses cross-KET activities.

The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 5 million would allow this specific challenge to be addressed appropriately.

Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: : The developed new technologies should lead to a remarkable impact in the following terms:

- 20% increase in adaptability, e.g. product customisation capability;
- 10% quality increase in total system (human and automation) performance, e.g. quality or productivity;
- Increased worker satisfaction and strengthened global position of industry in Europe through higher social acceptance levels.
- Wide adoption of the new developments in advanced manufacturing systems.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

FOF-05-2016: Support for the further development of Additive Manufacturing technologies in Europe

Specific Challenge: Additive Manufacturing (AM), including 3D-Printing, is one of the potential game changers that, for some applications, has already reached a tipping point of maturity. European companies are still strong in some areas but this position requires high levels of continuous innovation, especially where competitors are fast approaching. There are also other areas that are comparatively less developed and where the technology transfer and adoption is not functional, leading to a slow uptake of the results.

Despite the EC support, in the global picture the competitiveness of the European companies is threatened by important investments at international level. Moreover, some of the more fundamental aspects in order to take advantage of this promising technology still need to be addressed.

It is necessary to identify current bottlenecks and barriers to further development of AM technologies in Europe. Furthermore the stakeholders also need to be mobilised in order to exploit the business opportunities that AM provides, facilitating the take-up of this technology in Europe, with a focussed promotion and support strategy for Additive Manufacturing technologies.

Scope: The proposals should address most of the following aspects:

- Identification of gaps and opportunities for further research and innovation, as well as non-technological gaps in order to develop policy framework recommendations (e.g. regulation, standardisation, public procurement).

- Community building activities (think-and-do-tank) and actions to foster dialogue and collaboration across levels (stakeholders and governance) and with key strategic partners, the Member States and the European Commission. This broad multi-stakeholder community (science, policy, business, society) at local, regional, national and EU level will enable the launching of innovation partnerships for developing and testing of AM.

- Assessment of the current regulatory and IPR frameworks, micro- and macro-economic assessment of opportunities and risks and its impact on social aspects and labour market benefits.

- Productivity and resource efficiency gains through AM and its impact on European competitiveness through localised manufacturing, where more goods will be manufactured on demand, individually designed and close to their point of consumption.

- Identification of current bottlenecks for the transferability of new technologies across sectors.

- Development of best practices to help stakeholders to achieve large scale deployment.

- Identification of bottlenecks that prevent the stimulation of investments in new AM technologies and promote successful innovative AM solutions.

- Support information exchange and collaboration between EU funded projects which address the same AM areas to exploit synergies, particularly through SMEs.

- Development of new integrated design and manufacturing paradigms, where the time to replan, reprogramme and evolve in the shop floor production is reduced.

- Building skills capacity for innovation and competitiveness, engaging with academia for the development of learning resources adaptable to different learning approaches and curricula at undergraduate, master, and life-long learning levels.

- Assesment of the current regulatory and IPR frameworks; anti-counterfeiting features, particularly where high value and/or safety critical components are being manufactured; micro- and macro-economic assessment of opportunities and risks; and its impact on social aspects and labour market benefits.

Proposals should include the organisation of workshops with top-ranked international experts and EC services from the various disciplines aiming at the elaboration of a future AM roadmap, as well as an International Conference on AM at the end of the project.

In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners represents an added value to the activities and this will be reflected in the evaluation, under the criteria Implementation and Impact.

The Commission considers that proposals requesting a contribution from the EU between EUR 750000 and 1000000 would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

No more than one action will be funded.

Expected Impact:

- The proposals are expected to have an impact on the European AM community in the following ways:
- Create a network of research and industry partners for further RTD and industrial innovation and contribute to the sharing of European best practices.
- Create links and foster collaboration with relevant European initiatives and activities, e.g. Additive Manufacturing Platform within the ManuFuture ETP and the Vanguard Initiative.
- Speeding up industrial exploitation and take up of results of AM and facilitate cross-sectorial technology transfer.
- Early awareness of key innovation developments and anticipation of business trends and market prospects.
- Training and educational skills capacity in the AM community, both at academic and professional level.
- Enabling regulatory authorities to address better the relevant issues based on a thorough assessment of the current legal framework, IPR management and standardisation needs.
- Rationalising the process to deliver standardisation mandates to the European Standards Organisations.
- Favour investment of financial players in additive technologies application.

Type of Action: Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

FOF-06-2017: New product functionalities through advanced surface manufacturing processes for mass production

Specific Challenge: As a response to increasing competition in global markets, many industrial sectors (e.g. automotive, aerospace, tooling or packaging) aim at improving their product performances through surface functionalisation. As the products are increasingly complex in terms of scale (from nano to macro) and shape, processes need to deliver efficiently, ensuring an uncompromised quality together with high versatility and controlled costs. One way to reach this goal is to differentiate between a product body and its surface, where specific properties can be tailored. Furthermore, the required functionalities may be achieved with little or no addition of new raw material. For example, modifications in the surface geometry or even microstructure induced by texturing processes enable to improve the performance of those products by providing them with dedicated functionalities such as tailored friction, antibacterial properties, aesthetic issues or self-cleaning capabilities, among others.

In this context, substantial research is needed for exploring innovative approaches aimed at producing high added-value functional surfaces by a superficial modification of the substrate. Special attention should be paid to the cost efficiency of the novel surface manufacturing processes and to the development of technologies that are adaptable and up-scalable to real scale conditions and to their implementation into mass production conditions. Finally, environmental aspects of the processes should also be addressed.

Scope: The proposal should address surface-modifying methods which do not alter the chemical composition of the surface or add an extra layer of a different material, for example: micro-machining, texturing, photon-based technologies, laser, mechanical treatments, etc. These methods should be used to create new manufacturing processes that can be applied on mass production lines. Due to the need for cost-effective technologies, these processes should be easy to integrate within the existing manufacturing plants and cost-effectiveness should be demonstrated. The research activities should be multi-disciplinary and address all of the following issues:

- Development of cost-efficient, up-scalable and adaptable surface processing techniques that introduce micro- or nano-scale modifications at the surface level of the part providing it with specific properties or capabilities.
- Design and implementation of specific methods and systems that enable highly efficient up-scaling of the developed processing techniques from laboratory scale to real scale, with a specific objective to apply the processes for mass production.
- Implementation of modelling tools to support selection of the processing parameters that lead to the targeted surface modifications.
- Solutions which are economically viable, environmentally friendly and easy to transfer to other fields than the demonstrated fields of application.

- In-process inspection and monitoring possibilities to ensure that the final results remain within the quality requirements.

The projects are expected to cover applied research but also demonstration activities, such as testing a prototype in a simulated operational environment. The ability of the demonstration activities to validate a technology's high level of readiness will be reflected in the evaluation.

Activities are expected to focus on Technology Readiness Levels 4 to 6.

This topic is particularly suitable for SMEs.

The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The developed innovative product functionalities should lead to a remarkable impact for both producers and users, in the following terms:

- Cost increase pertaining to those functionalities integrated into products should be below 10% with respect to the cost of conventional products .

- The improvement in the product performance should be above 20% in the targeted functionalities such as: surface friction (increase or decrease), wear resistance, surface energy, corrosion and thermal resistance, hardness, self-cleaning properties, conductivity, anti-fouling, catalytic properties, etc. Besides, the improvement can also consist in obtaining tailored optical properties including for aesthetic or functional purposes.

- Strengthened global position of European manufacturing industry through the intensive implementation of innovative and unconventional technologies along the European manufacturing value chain.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

FOF-07-2017: Integration of unconventional technologies for multi-material processing into manufacturing systems

Specific Challenge: The competitiveness of European manufacturing depends on producing differentiated and high added value products in an efficient and sustainable manner, with reduced production costs, increased product quality and minimised time to market. Multi-

material products have the advantage of putting the right material in the right place to satisfy all the expected requirements, which is particularly relevant when high cost or critical materials are involved. The aim of this topic is to integrate unconventional manufacturing technologies within a specific set (water jet, ultrasonic and micro-wave electron beam welding and/or electro discharge machining, laser and photopolymerisation) into a manufacturing system to make multi-material products composed of high cost or critical materials with a prolonged service life. These innovative manufacturing concepts and technologies can help European industry to face the challenge of improving resource efficiency and sustainability.

The integration of the above-mentioned unconventional manufacturing technologies into the process chain may be complemented with processes such as thermal treatment, in-process inspection and control, stress-relieving, micro-structural improvements, machining and joining. Successful integration will help to achieve a breakthrough in innovative manufacturing approaches for multi-material products. The major challenge lies in reinforcing the integration of these unconventional processes into manufacturing systems for multi-material products and subsequently implementing them throughout the European manufacturing sector, as well as ensuring that the disassembly of the materials is possible to enable re-use and recycling.

Scope: The proposal should use one or more of the following unconventional manufacturing technologies (water jet, ultrasonic and micro-wave electron beam welding and/or electro discharge machining, laser and photopolymerisation) to create new manufacturing systems for multi-material products. To tackle this major challenge successfully, research will need to cover all of the following areas:

- innovative process chains for high cost or critical multi-material products based on unconventional technologies, integrated if appropriate with more conventional manufacturing techniques such as machining and joining;
- manufacturing processes capable of generating the features and geometries required for multi-material products as well as integrating additional improvements such as thermal treatment, stress relieving, surface hardening, corrosion resistance or micro-structural improvements;
- new flexible machinery concepts and components to allow the integration of unconventional technologies and processes into industrial manufacturing systems able to handle a range of material combinations and products;
- in-process inspection and control to ensure quality requirements within the innovative process chains.

Activities are expected to focus on Technology Readiness Levels 4 to 6. This topic addresses cross-KET activities.

This topic is particularly suitable for SMEs.

The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The developed new technologies should lead to a remarkable impact in the following terms:

- Reduction of at least 10% in the production time through the integration of operations and the reduction of idling time between manufacturing steps.
- Reduction of at least 15% in the production cost through process integration and improved manufacturing quality.
- Resource efficiency improved by reducing the use of raw materials and energy consumption by at least 10%.
- Strengthened global position of European manufacturing industry through the intensive implementation of innovative and unconventional technologies along the European manufacturing value chain.
- Low capital investment solutions available for SME uptake.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

FOF-08-2017: In-line measurement and control for micro-/nano-enabled high-volume manufacturing for enhanced reliability

Specific Challenge: Rapid developments in micro-/nano-technologies require complex business models that respond to volatile markets in demand for faster product delivery with an unprecedented yield and quality. High-volume manufacturing is not spared from these requirements, and will in fact need to demonstrate a productivity improvement compared to lab-scale process development and low-volume manufacturing in order to remain commercially competitive.

The process scaling needs to include system-level architectures for metrology and control. This includes data acquisition and control at the levels of the process, the physical handling and the component validation. The in-line metrology and inspection for micro-/nano-production play an important role, together with a common reference system and approach across process chain. The evolution of the control system on the factory floor will also need to

show various levels of distributed control in order to cover both batch-to-batch and run-to-run variations with real-time parameter prediction and feedback.

Practical industry solutions for reference metrology at these small dimensions are not readily available. However, whilst efforts are made towards producing reference materials, reliable and fast measurements that allow for control both at the process level and at the higher level of product vehicle or line, are needed. This will enable predictive management of batches, improved quality and speed control, and machine learning enabling fully autonomous control at the level of the process tool.

Scope: Proposals should include a systems-level strategy for integrating measurement and control throughout the production line for micro-/(nano-)enabled high volume manufacturing. To address this challenge the proposal will need to cover all of the following areas:

- Measurement techniques that target highly integrated and functional products at the micro- (and nano-)scale.
- Measurement and data acquisition which are non-destructive, i.e. no waste material at the measurement steps, and allow for high throughput scenarios in their respective industrial settings.
- Traceability in the measurements back to reference samples (e.g. calibrated standard artefacts and products). Direct contributions to related standards may be a part of the proposal.
- Approaches to control at the different levels of factory integration, including process variation, product/component reliability, waste optimisation, yield/output improvements and predictive/preventive corrections to the entire line.

A**ctivities are expected to focus on Technology Readiness Levels 5 to 7 and to be centred around TRL6**.

This topic addresses cross-KET activities.

The Commission considers that proposals requesting a contribution from the EU between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The developed new technologies should lead to a significant impact in the following terms:

- Improvement in existing manufacturing processes through implementation of system-wide control systems, demonstrating better resource efficiency, yield and productivity of a wide variety of components and final products.

- Improvement in technical knowledge on the in-line metrology for micro-/(nano-)sized components in a high-volume manufacturing setting.
- Accelerated uptake by industry of in-line measurements and related control systems that allow for traceability in terms of physical dimensions, functionality and reliability of micro-/nano-sized components.
- Contribution to standardisation in the field of reference materials targeting micro-/(nano-) technology and factory integration.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

FOF-09-2017: Novel design and predictive maintenance technologies for increased operating life of production systems

Specific Challenge: The elevated complexity and costs of production assets combined with the requirements for high-quality manufactured products necessitate novel design and reliability-based maintenance approaches that are able to provide the required levels of availability, maintainability, quality, safety while considering the system as a whole and throughout the production lifecycle.

Analysis of operational parameters and in-service behaviour, self-learning features and condition prediction mechanisms could contribute to improve smart predictive maintenance systems capable to integrate information from many different sources and of various types, in order to more accurately estimate the process performances and the remaining useful life. That will lead to a more efficient management, reconfiguration and re-use of assets and resources, avoiding false alarms and unforeseen failures which lower operators' confidence in such systems.

Scope: The aim would be to design optimal maintainability solutions into production systems to improve operating life at maximised performance and reduce costs by carrying out maintenance activities at the most optimised time before failure occurs, thus minimising the degree of intervention required and maximising the system availability.

More trustworthy predictive maintenance and cause-and-effect analysis techniques should be developed to aggregate and interpret data captured from production systems and effectively share the massive amount of information between users. Measurements of a range of parameters at the level of components, machines and production systems should be carried out to provide data for building trend reference models for prediction of equipment condition, to improve physically-based models and to synchronise maintenance with production

planning and logistics options. The dependability of the techniques would be demonstrated for a range of components and machines.

While the focus will be on demonstrating the design approaches and maintenance technologies, R&D activities supporting the integration and scale-up are expected as well.

Demonstration activities should address all of the following areas:

- Methodologies and tools for improved maintainability and increased operating life of production systems.
- Methodologies and tools to schedule maintenance activities together with production activities.
- Predictive maintenance solutions, combined with integrated quality-maintenance methods and tools, as well as failure modes, effects, and criticality analysis (FMECA) techniques, that effectively share information among different data sources in a secure way. Exploitation of networks of Smart Objects Technologies is an option.
- Versatility, in order to make solutions transferable to different industrial sectors.
- The project must include two complex demonstrators in real industrial settings to represent a clear added value.

In order to ensure the industrial relevance and impact of the demonstration effort, the active participation of industrial partners, including SMEs, represents an added value to the activities.

Activities are expected to focus on Technology Readiness Levels 5 to 7 and to be **centred around TRL6**.

This topic addresses cross-KET activities.

This topic is particularly suitable for SMEs, as well as for international cooperation.

The Commission considers that proposals requesting a contribution from the EU between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The developed new technologies should lead to a significant impact in the following terms:

- 10% increased in-service efficiency through reduced failure rates, downtime due to repair, unplanned plant/production system outages and extension of component life.

- More widespread adoption of predictive maintenance as a result of the demonstration of more accurate, secure and trustworthy techniques at component, machine and system level

- Increased accident mitigation capability.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

FOF-10-2017: New technologies and life cycle management for reconfigurable and reusable customised products

Specific Challenge: New customised products will be increasingly incorporating, in a seamless fashion, intelligence and smart functionalities through advanced materials and embedded components. The integration of highly differentiated materials and components is a key requisite for flexible manufacturing of individualised consumer/customised products. On the other hand, enhanced integration of sophisticated ICT-based components and of advanced materials implies a rapid product obsolescence rate, and can thus introduce further pollution risks if reuse of products and/or components is not improved. Therefore, reconfiguration and reuse of products, and related services, need to be developed.

Scope: To face sustainability and flexibility challenges customised products need to be conceived, designed and manufactured in a modular way, and their single components have to be developed so as to be interoperable with one another during the product/service lifetime, so as to be exchangeable and updateable whenever necessary. This influences both the hard and soft requirements and calls for new production technologies that enable the fast manufacturing, assembly and configuration of complex products, as well as the products updatability and disassembly for re-use and end of life management.

In particular, consumer goods manufacturers should be able easily and effectively to integrate products and components which can be independently designed, produced and used in order to make diverse final personalised products in different production systems.

All involved actors in the product life cycle, from manufacturers of basic products components to retailers and vendors up to the final customers, should be provided with the needed hard and soft tools to reassemble and/or reconfigure the product or its components.

Research activities should address all of the following areas:

- Methodologies, engineering and tools for the fast reconfiguration and re-use of personalised products and their components

- New production techniques allowing for a fast manufacturing, assembly and configuration of complex personalised products
- Innovative methods and technologies for personalised products updatability, disassembly for reuse and end of life management of the products as well as their different components
- Methodologies and tools for the development of assembly, configuration, disassembly and reconfiguration services along the whole consumer/customised products value chain and along its overall life cycle also including the aftersale stage.

The proposals are expected to include use-case demonstrations aiming at the rapid deployment of the new modularity, reconfiguration and re-use of personalised consumer/customised products and life cycle management. All relevant value-chain stakeholders are expected to participate, including relevant Social Sciences and Humanities (SSH) practitioners.

The resulting personalised products are expected to satisfy the final consumer needs at an individual level and consequently to facilitate daily life (particularly concerning elderly, disabled or other target groups with special needs) or improve workers and sportsmen safety and health.

Activities are expected to focus on Technology Readiness Levels 5 to 7 and to be centred around TRL6.

This topic addresses cross-KET activities.

This topic is particularly suitable for SMEs.

This topic is particularly suitable for collaboration at international level, especially regarding the involvement of multiple actors in complex value chains on a global scale for consumer/customised goods.

The Commission considers that proposals requesting a contribution from the EU between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The developed new technologies should lead to a significant impact in terms of:

- Reduction of time to market of new personalised products/services by 30% through a modular product/service design and manufacturing approach
- Cost reduction of the manufacturing of personalised products by 25% by decreasing lead times in product-services development and configuration

- Reduction of environmental impact by more than 50% due to modular reusable components and final products
- Savings of overall products/services life cycle costs by 30% as a consequence of the reusability and re-adaptability of the components of the personalised products
- Wide adoption of the technologies developed leading to increasingly flexible manufacturing of customised products

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT FOR THE FACTORIES OF THE FUTURE

Manufacturing is still the driving force of the European economy. Manufacturing activity in Europe provides about 20% of all jobs (more than 30 million persons) in 25 different industrial sectors and over 2 million companies, largely dominated by SMEs. The digital transformation of manufacturing processes and products including the related change of business models and the shift from products to product-related services is expected to provide a major contribution to the EU goal of increasing the value of industry from 15% to 20 % of GDP.

With a highly educated workforce, excellent research centres and a strong ICT industry in professional and vertical markets, Europe has many assets that enable it to benefit from advances in digital technologies in all sectors. However, businesses and mainly SMEs face a critical dilemma today. On one side, global competition is growing and reducing margins and the capacity to invest. On the other side, digital technologies are moving fast and their impact on the whole value chain from products and manufacturing processes to business models is drastic. For many companies and notably SMEs and mid-caps, it is extremely difficult to keep up with technology and assess at any time which investment to be done and by when. Likewise, knowledge and support are missing on how to migrate existing setups to novel ICT-based manufacturing environments considering human, automation and organisational factors.

To improve Europe's ability to compete on the global markets, the three topics under this theme support the integration of digital technologies in all stages of the manufacturing process from cradle to grave, enabling Europe to stay at the forefront of delivering highly innovative, high quality products and services at competitive prices.

Through research and innovation actions (RIA), topics FoF-11 supports the adoption of emerging digital technologies from cyber-physical systems, autonomous systems, the Internet of Things, big data analytics, in the manufacturing processes covering as appropriate the

complete chain including logistics and circular economy aspects. Focus is on digital automation along two dimensions: (1) collaborative manufacturing across all processes including logistics, and (2) discrete factory automation. RIAs should target highly innovative applications that exploit advanced innovative ICT in the continuous and discrete process industry at TRLs 3-5. Through innovation actions (IA), topic FoF-12 addresses the next phase of I4MS (ICT Innovation for Manufacturing SMEs) with special emphasis on supporting the organic growth of the I4MS ecosystem through linking I4MS competence and innovation hubs with industrial clusters and the smart specialisation strategies of Europe's regions including the pooling of resources from Horizon 2020 and ESIF (European Structural and Investment Funds). Through RIA and IA actions, topic FoF-13 focuses on Photonics laser-based production. In order to multiply impact on the European industry and economy, platform building is emphasised across topics FoF-11 and FoF-12.

This area is part of the Public Private Partnership Factories of the Future, which is co-managed by LEIT-ICT and LEIT-NMP. It builds on the suggestions made by EFFRA through their Strategic Research and Innovation Agenda (SRIA). The area addresses as well some aspects recommended by the SPIRE industrial associations (Sustainable Process Industry Resource and Energy Efficiency) in their SRIA. Manufacturing in the context of this area is therefore to be understood in the broad sense of manufacturing of discrete and continuous goods.

FOF-11-2016: Digital automation

Specific Challenge: Manufacturing value chains are distributed and dependent on complex information and material flow requiring new approaches inside and outside the factory both on process and product lifecycle level, from design and engineering over production to maintenance and recycling. Global competition and individualized products make it difficult for manufacturing companies to share information, to produce in collaborative networks across value chains.

Advances are needed in value- and supply-chain centric communication and collaboration schemes that merge machine, human and organizational aspects and enable manufacturing companies, especially SMEs, to respond to ever stricter requirements for being integrated into production process chains. Production architectures need to be more responsive to dynamic market demands which require radical change of production topologies to achieve dynamic production re-configurability, scaling and resource optimization. The challenge is to fully exploit the digital models of processes and products and to synchronise the digital and physical world respecting security and IPR protection requirements. This shall allow manufacturers to move from centralised production and logistics to de-centralised planning and control or hybrid combinations thereof.

Scope:

a. Research and Innovation Actions

Proposals are expected to cover at least one of the two themes identified below thereby exploiting advanced ICT like Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud-models, robotics, 3D printing, machine-to-machine (M2M) communication, advanced human-machine-interaction, modelling & simulation, artificial intelligence methodologies and data analytics, as well as security by design. RIAs shall develop reference implementations of platforms in a multi-sided market ecosystem and include user-driven proof-of-concept demonstrations and validation in several different scenarios. Proposals should contain an outline business case and industrial exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

1. **Collaborative manufacturing and logistics.** Target is to develop the "operating system" of the connected factory of the future and to integrate better manufacturing and logistics processes through platforms that enable and optimise communication and collaboration among supply networks, enterprises, machines and objects. Research issues to be addressed include: real-time architectures for interoperability; management of the data deluge from the myriad of monitoring and tracking objects and their fusion with other information sources within the factory and supply chain. Concepts are to be validated through pilots on business and system level to establish new economic collaboration models. Special emphasis will be on ICT security, knowledge protection, and trust in collaborative infrastructures.

2. **Novel architectures for factory automation**. Research should explore novel de-centralised, modular, scalable and responsive automation architectures of primarily discrete factory automation systems that support new trends in manufacturing like re-shoring and mass-customisation. Research should encompass the virtualisation of the traditional automation pyramid from sensor-control to enterprise-level and/or methods and models for the synchronization of the digital and real world, as well as integration of novel architectures into existing production systems. Special emphasis is on innovative concepts for shared situational awareness; on self-adjustment of digital models triggered by smart objects, on real-time co-simulation methods; and on handling of large amounts of sensor and process data.

The Commission considers that proposals requesting a contribution from the EU up to EUR 8 million would allow area i) to be addressed appropriately. For area ii) the Commission considers that proposals requesting a contribution from the EU up to EUR 4 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Minimum one proposal per area will be selected.

b. Coordination and Support actions

CSAs shall support industrial consensus building both with suppliers and users across Europe, addressing future factory automation systems built on CPS and the IoT; pan-European platform building, and collaboration on manufacturing issues across all relevant PPPs.

Expected Impact: Proposals should address one or more of the following impact criteria, providing metrics to measure success when appropriate

- Innovative services, models and practices optimising manufacturing and logistics processes;
- Quantified drastic reductions in the effort for integration or reconfiguration of today's hierarchical automation systems through advanced de-centralised or hybrid architectures;
- Better and faster reaction to market changes by being able to use holistic global and local optimization algorithms in a collaborative sustainable value chain.

Type of Action: Research and Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

FOF-12-2017: ICT Innovation for Manufacturing SMEs (I4MS)

Specific Challenge: For Europe's competitiveness in manufacturing, it is crucial that advances in ICT are taken up in engineering and manufacturing "at large" as soon as they have the appropriate maturity level. The topic will support fast adoption, and wide spread technology transfer of advanced ICT-based solutions for manufacturing across the business process chains – from "cradle to grave".

Scope: As Phase 3 of I4MS (www.i4ms.eu) this topic addresses the adoption of the next generation of ICT advances in the manufacturing domain. Focus is on emerging innovative technologies and processes, which need to be customised, integrated, tested and validated before being released on the market. Special emphasis is on strengthening European SMEs and mid-caps along the value chain by adopting new concepts linked to innovative business and/or service models.

a. Innovation actions must address all of the following three aspects.

1. Establishing across Europe networks of multidisciplinary competence centres offering “marketplaces” for companies that want to experiment with digital technologies in manufacturing of discrete or continuous goods. Centres should have the capacity to offer access to technology platforms and skills for developing and testing innovative technologies and applications, including access to design and manufacturing, rapid prototyping and equipment assessment initiatives. They should also act as brokers between suppliers and users of the technology products. Competence centres are encouraged to link to existing/emerging regional (smart specialisation) or national innovation hubs. If Horizon 2020 funding is complemented by ESIF or other regional or national funds: Horizon 2020 funding shall be used for carrying out highly innovative experiments that will multiply the impact of local initiatives to a European scale, and will build partnerships between businesses in Europe.

2. Carrying out a critical mass of cross-border experiments bringing together different key actors along the full value chain to customise the technologies according to the requirements of the users. Driven by the requirements of first-time users, **Application Experiments** bring together the actors of the value chain and the experts necessary to enable new users to develop novel products or services and assist them in customising and applying these in their respective environments. Experiment descriptions in proposals should include an outline of the initial exploitation plan and business scenario, which will be developed further in the proposed experiment. To remain flexible on which experiments will be carried out, the action may involve financial support to third parties, in line with the conditions set out in part K of the General Annexes. The consortium will define the selection process of additional users and suppliers running the experiments for which financial support will be granted (typically in the order of EUR 20 000 – 100 000[3] per party). Maximum 50% of the EU funding can be allocated to this purpose[4].

3. Activities to achieve long-term sustainability of the competence centres and the eco-system. This includes the development of a business plan for the competence centres and the marketplace, of which an outline business case and industrial exploitation strategy should be described in the proposal, as outlined in the Introduction to the LEIT part of this Work Programme. In addition, investors should be attracted to support business development of SMEs and mid-cap actors in successful experiments. Such activities would include also dissemination.

Proposers should cover at least one of the following four areas of technologies for adoption in manufacturing. Proposers are encouraged to support the building of pan-European ecosystems of emerging platforms and are expected to collaborate on reinforcing the European I4MS ecosystem, and to establish links to related activities, e.g. in the IoT Focus Area, the Joint Undertaking ECSEL, and the SPARC or big data PPPs.

i. **CPS and IoT:** Adoption and piloting of CPS/IoT in smart production environments, with special focus on scalable, modular and re-configurable automation systems across the process chain especially for SMEs.

ii. **Robotics**[5]**:** New robot systems that are cost effective at lower lot sizes, with the benefit of long-term improvements in productivity, the ability to work safely in close physical collaboration with human operators; and that are intuitive to use and adaptive to changes in task configuration. Key for fast adoption is the availability of flexible and easy to apply material feeding solutions. Step changes to at least two of the following abilities

[3] In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded, and if this is the case proposals should explain why this is necessary to achieve the objectives of the action.

[4] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

[5] The area of Robotics within the I4MS scheme is complementing the areas RTD-FoF2-2016 and LEIT-ICT Robotics topics

are therefore considered necessary: configurability, interaction capability, decisional autonomy in terms of context-awareness, and dependability.

iii. **Modelling, simulation and analytics**: HPC Cloud-based modelling, simulation and analytics services with special emphasis on sustained service models; on providing real-time support; and on addressing comprehensively security and privacy issues at all levels.

iv. **Digital design for additive Manufacturing**: Supporting the broad uptake of innovative additive manufacturing equipment and processes particularly focusing on the link between design tools and production, changes in business models, process chains and stakeholder relations.

The Commission considers that proposals requesting a contribution from the EU up to EUR 8 million would allow the areas to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one innovation action is supported for each area of technologies.

b. Coordination and Support actions

To advance the European I4MS innovation ecosystem the network of Innovation multipliers leveraging investment in research and innovation is to be reinforced. The aim is to achieve broad coverage in technological, application, innovation, and geographic terms. Its tasks and services shall include maintaining a single innovation portal for newcomers; sharing of best practices and experiences; dissemination; identifying new innovative ICT technologies that can benefit from this scheme, brokering between users and suppliers; leveraging further investment by mapping and matching competences in and between regions, and by linking up with regional/national initiatives and by stimulating organic growth. For these support actions, close cooperation with the European Factories of the Future Association (EFFRA [6]) is required.

Expected Impact: Proposals should address all of the following impact criteria, providing metrics to measure success when appropriate:

- Exploration of new application areas for advanced ICT in manufacturing at large: Attract a significant number of new users of advanced ICT in the manufacturing sector, in particular SMEs and the mid-caps.

- More innovative and competitive technology suppliers, in particular SMEs, both on the level of ICT and on the level of manufacturing equipment, able to supply manufacturers with new equipment, components, and tools for improved manufacturing and engineering operations.

- More competitive European service providers through provisioning of new types of services; through strengthening the presence on local markets.

[6] Web link www.effra.eu

- Creation of a self-sustainable ecosystem of competence centers, users and suppliers supported by services available through a marketplace, covering a large number of regions and their smart specialisation.

- A critical mass of pan European experiments that demonstrate innovative, sustainable business models covering the whole value chain leading to quantifiable increases in market shares and/or productivity of European companies and/or industrial capacities in Europe.

Type of Action: Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

FOF-13-2016: Photonics Laser-based production

Specific Challenge: Laser-based manufacturing has become very competitive and is one of the back-bones of modern production technologies. Highly accurate mass production is available for a wide range of products in a wide range of industries. Whilst laser processing is highly flexible, the change from one production lot to the next usually requires operator intervention, reconfigurations and costly down times to adjust current processing tools to the new task. The trend to individualisation requires a high degree of digitization as well as tools and systems which are highly autonomous and automated to reduce production time and costs.

Additive manufacturing (AM) offers a number of advantages over conventional manufacturing including the unprecedented freedom of design for example in terms of geometry, material composition and intrinsic properties of the work piece. Whilst laser-based AM is used for prototyping and has begun to penetrate some smaller markets, it is not yet competitive on a larger scale especially with respect to production speed and costs. In order to increase the productivity of laser-based AM and to bring it a significant step further towards industrial manufacturing a better mastering of all stages of the process chain and their interaction is necessary.

Scope: **a. Research and Innovation Actions**

From "design to piece" – Excellence in laser-based additive industrial manufacturing[7]: From Design to the final work piece, the topic addresses laser-based additive industrial manufacturing of metallic materials. All process chain steps may be addressed, for example CAD, modelling of the additive process, the additive process itself including the use of several materials in a single work piece, process control and quality assurance, the combination of additive and subtractive processes, surface finish and precision, etc. Materials for AM and their quality control are considered as a step. Proposals must cover at least two important steps in the process chain and the relevant links between them. The goal is to

[7] Theme a. is complementing the topic RTD-FOF1-2016

significantly improve the overall performance in terms of speed and costs whilst producing high quality work pieces. Standardisation aspects should also be addressed as appropriate. Proposals should be driven by concrete business cases and include the relevant partners of the value chain and proposals should contain an outline business case and industrial exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

The Commission considers that proposals requesting a contribution from the EU between EUR 2 and 4 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b. Innovation Actions

Rapid individualised laser-based production: Develop and set-up efficient, highly flexible high throughput pilot facilities on the basis of existing processes for laser-based production and to validate them in real settings. This will require advances in a number of aspects, including intelligent networking and machine cooperation, data handling, modelling, work piece handling, beam delivery, integration of different processes, monitoring, process control etc. Actions must be industry driven and include the key stakeholders running the pilot facility. Proposals should contain an outline business case and industrial exploitation strategy.

The Commission considers that proposals requesting a contribution from the EU between EUR 2 and 4 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Proposals should describe how the proposed work will contribute to the following impact criteria and provide metrics, the baseline and targets to measure impact.

a. Research & Innovation Actions

- Reinforced industrial leadership in laser-based Additive Manufacturing.
- Substantially improved production speed, improved productivity and substantially reduced costs of laser-based Additive Manufacturing.

b. Innovation Actions

- More efficient, more flexible and higher throughput of individualised laser-based production.
- Improved competiveness and strengthened Europe's market position of laser-based manufacturing industry (equipment and suppliers) and the end-user industry.

Type of Action: Research and Innovation action, Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SUSTAINABLE PROCESS INDUSTRIES - SPIRE

The European process industry is uniquely positioned as it represents the economic roots of the European economy (by transforming raw materials into intermediate and end-user products). It thus sits at the core of most industrial value chains by generating pre-cursors and materials used with discrete manufacturing e.g. automotive and housing sectors. The SPIRE Public-Private Partnership (PPP) brings together cement, ceramics, chemicals, engineering, minerals and ores, non-ferrous metals, steel and water sectors, several being world-leading sectors operating from Europe. These sectors all have a high dependence on resources (energy, raw materials and water) in their production and processing technologies and they all have a clear and urgent interest in improved efficiency and competitiveness which actually leads to driving the implementation of many European policies. The sectors in the SPIRE PPP represent a key part of the manufacturing base in Europe (EU27), including more than 450,000 individual enterprises. They have over 6.8 million employees, generating more than 1,600 billion € turnover. As such they represent 20% of the total European industry, both in terms of employment and turnover.

As resources are becoming increasingly scarce, resource efficiency is a key factor for the competitiveness and sustainability of EU industry. This is especially true for resource and energy intensive industries such as the process industries. The general goal is to optimise industrial processing, reducing the consumption of energy and resources, and minimising waste.

The specific goals are:

- A reduction in fossil energy intensity of up to 30% from current levels by 2030.
- A reduction of up to 20% in non-renewable, primary raw material intensity compared to current levels by 2030.
- A reduction of greenhouse gas emissions by 20% below 1999 levels by 2020, with further reductions up to 40% by 2030.

An important part of the horizontal activities in SPIRE are training and innovative business models. The integration of relevant training/learning as well as appropriate business models is key to ensure subsequent market implementation and identify and remove potential barriers for cross sectorial technology transfer is expected.

The SPIRE cPPP will address the challenges raised by the rejuvenation of the European industrial processes: more efficient use of resources (raw materials, water, etc.) and energy (including renewables), high-tech and eco-efficient production facilities and materials, and minimising and re-using waste.

Proposals are invited against the following topic(s):

SPIRE-01-2016: Systematic approaches for resource-efficient water management systems in process industries

Specific Challenge: Nowadays, 12% of water utilisation in the EU is devoted to industrial use. Since water is a scarce resource, it is crucial for the European industry to change the current paradigm and develop more sustainable and efficient water technologies, which is also an important element for increasing its competitiveness, because a significant amount of energy is consumed for industrial water treatment. In the sustainable development context, efficient water use is closely linked to the efficient use and re-use of other resources, such as energy, chemicals, raw materials and soils. As such, these aspects need to be considered holistically in order to develop sustainable solutions.

Scope: The main objective is the optimisation of the use of water in industry. Research activities should focus on several of the following areas:

- Combining existing technologies (e.g. advanced processing, nano-technology and materials) in order to achieve enhanced sustainability in water treatment processes by reducing water use, energy and raw materials consumption and at the same time minimizing waste and/or recovering valuable substances.

- Selective separation processes in order to be able to treat specific industrial fluxes, also leading to the recovery of valuable substances.

- Adaptation of current processes or equipment to use alternative water sources. e.g. rainwater, salt or brackish water, cooling water, or Waste Water Treatment Plant (WWTP) effluent.

- Alternative cooling/heating methods. Reducing the energy levels that are needed for water and steam related production processes; dry cooling technologies; water and energy recovery processes from water vapour.

- Use of renewable energy, in order to achieve low energy water treatment processes (e.g. photo-degradation of pollutants).

- Development of closed loop recycling and reuse, involving cascading of processes and industrial water symbiosis.

- Development of a sustainable strategy for selecting materials and infrastructure for water transport and use, including water storage and treatment.

The proposals should also include a Life cycle analysis, since it offers the framework to deliver meaningful information on the "water footprint" of manufactured goods, delivered services, business operations and consumer behaviour. The total footprint of the process regarding water, energy and resources should be considered.

Activities are expected to focus on Technology Readiness Levels 5 to 7 and to be centred around TRL 6. This topic addresses cross-KET activities. The proposals are expected to allocate at least 30% of the budget to demonstration activities.

This topic is particularly suitable for SMEs.

The Commission considers that proposals requesting a contribution from the EU between EUR 5 and 7 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Reduction of at least 20% in water use compared to the current practice in the sector.
- Reduction of at least 30% in wastewater production compared to the current practice in the sector.
- Reduction of at least 15% in energy use compared to the current practice in the sector.
- Minimising the Water Footprint, employing less water intensive or waterless technologies and increasing recycling.
- New technology developments in water treatment and wide adoption of these technologies to enhance sustainability in the process industries.
- Decouple the industrial production from the utilisation of fresh water reserves

In order to properly monitor the Resource Efficiency Impact, Key Performance Indicators should be implemented.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SPIRE-02-2016: Plant-wide monitoring and control of data-intensive processes

Specific Challenge: All current plants in process industries have control systems managing their production processes. Distributed Control Systems (DCS) and Programmable Logic Controls (PLC) are present all across production sites with continuous semi-continuous or batch processes. However, there is still a lack of integration of local control systems dedicated to unit processes into an overarching real-time optimisation and scheduling system controlling and monitoring the operations of the whole plant. This plant or even site-wide integration is

especially challenging for production processes where monitoring involves the collection and evaluation of large amounts of data.

Future plant monitoring and control systems will have to integrate lower scale model based control frameworks into plant scale scheduling, or even geographic and logistic optimisation tools. The generalisation of model based predictive control techniques to plant-wide and possibly site-wide monitoring and control should be developed using overall plant models, and optimised solutions should be demonstrated.

Scope: Research activities should address all of the following areas:

- Extension of the model based control techniques to the level of plant or site-wide control and scheduling by the use of dynamic overall plant models, ensuring a robust real-time optimisation of the plant's operations.
- Integration of local control systems into an overarching real-time plant and/or site optimisation and scheduling system, taking into account geographic and logistic constraints, potential malfunctions and providing the necessary interfaces for real-time communication between systems.
- Cross-sectorial transfer of the technologies developed.
- Model Based Predictive Control frameworks taking into account the Operators Training Systems in their design.
- Plant level LC management tools (integrated or possibly as a plug-in to the control system) and robustness of the real-time optimisation tools.

Solutions should consider the “data-intensive” nature of the process chains (data reliability, handling of huge amounts of data in real-time, extraction of decisions from large data-sets. Proof of concept in terms of at least one demonstrator should be delivered before the end of the project, excluding commercially usable prototypes, but convincingly demonstrating scalability towards industrial needs and making a clear case for the safety of the worker under all circumstances.

The project can make use of pre-existing commercially available plant optimisation and scheduling solutions, making all the required adaptations. In order to ensure the impact of the project, standardisation is to be addressed.

Activities are expected to focus on Technology Readiness Levels 4 to 6.

This topic is particularly suitable for SMEs.

The Commission considers that proposals requesting a contribution from the EU between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Compared to the current practice in the sector:

- Decrease of on-site material handling time by 10%
- Decrease of resource consumption by 10%
- Decrease the global use of energy on-site by 10%.
- Decrease of the Green House Gases emissions by 10%.
- Strengthen the global position of European process industry through the adoption of the new technologies related to plant-wide and/or, if possible, site-wide process control.
- Contribution to standardisation activities.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SPIRE-03-2016: Industrial technologies for the valorisation of European bio-resources into high added value process streams

Specific Challenge: Bio-based resources constitute a valuable source of sustainable raw materials for Europe, but currently they are not utilised in an optimal way. For example, residues from agriculture and forestry (e.g. lignocellulose), as well as waste streams from aquaculture, farms, and food and feed industry (including skins, feathers, fats, shells, by-products from slaughter-houses and fish mills, etc.) and biodegradable industrial waste are often not fully exploited. Considering that such bio-resources contain valuable substances for the production of high added value chemicals and bio-materials (e.g. sugars, fatty acids, amino acids, alcohols, resins, fibres, aromatic substances, proteins), which could provide sustainable alternatives to analogues currently manufactured from fossil feedstock, their efficient utilisation is needed in order to support the establishment of a more sustainable and efficient industry in Europe. Furthermore, these bio-based streams could provide access to new building blocks and products with added functionalities, which are currently not commercially available, thus opening new market opportunities for industry.

For a wider utilisation of such bio-resources, the development of technologies for the efficient processing, isolation, fractionation and purification of these waste and side streams, will be essential to efficiently recover valuable bio-components, while maintaining key chemical functionalities present in bio-based molecules. The industrial deployment of such technologies will allow improving the competitiveness of the European chemical and process industry and will ensure a better utilisation of available European bio-resources. These technologies will also support a decrease in waste generation and contribute to making Europe

self-sufficient in terms of raw materials, leading to increased long term sustainability for the European process industry.

Scope: Proposals should address the efficient utilisation of biomass waste streams of organic nature from industrial processes (e.g. food and feed industry, aquaculture)and/or side streams from harvesting activities (e.g. agricultural and forestry harvesting residues) ensuring non-competition with higher value chains (e.g. food production). The proposals should aim to provide novel concepts to fully valorise these bio-resources, providing high added-value products, chemical building blocks and bio-based streams (bio-chemicals, monomers, fibres, polymers, proteins etc.) for further utilisation in industry. The concepts taken into account should yield novel products and process streams with a quality that is equal or better than the one of the available fossil analogues already on the market and where possible, provide opportunities to open new markets (e.g. development of novel products).

Proposals should target technologies (e.g. chemo/thermo/bio-catalytic technologies and fermentation), which can include recovery, and primary (e.g. sugars, lignin, tannins, resins, proteins) and/or secondary (e.g. furans, sugar acids, carboxylic acids, fatty acids and aromatics) processing of bio-resources, leading to bio- products and streams with high added value. The concepts are expected to provide significant added value creation in the process. Proposals are expected to address R&I activities covering the following areas:

- Chemo/thermo/bio-catalytic technologies and fermentation route development for conversion processes as well as purification processes where needed, including mastering of the technology in order to yield (new) bio-based building blocks, polymers and chemicals and derived product portfolios in a relevant industrial environment.

- Market analysis and techno-economical evaluation of the concepts proposed to assess the economic viability of the approaches and a business plan for the deployment of the technology.

The concepts should demonstrate improved resource efficiency based on Life Cycle Assessment, including a significant reduction of fossil resources and energy utilisation, as well as water and other utilities. The concepts should also bring a reduction in CO2 emissions compared to the commercially utilised process (or similar for new processes that do not have commercial analogues).

Proposals should envisage the demonstration of the concepts in an industrially relevant environment and show the potential for their integration into the relevant industrial sectors. An integrated waste management strategy, considering also industrial waste, will add value to the proposal. Demonstration of the integration in existing industrial scenarios would be a major added-value. The demonstration activities are expected to address the scalability and replicability of the proposed concepts.

Activities are expected to focus on Technology Readiness Levels 5 to 7 and to be centred around TRL 6.

A significant participation of SMEs with R&D capacities is encouraged.

The Commission considers that proposals requesting a contribution from the EU between EUR 5 and 7 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- The concepts proposed should provide a decreased utilisation of fossil resources in the process industry of at least 30 % compared to similar commercially available processes.
- The concepts proposed should provide an improvement in energy utilisation in the process industry of at least 30 % compared to similar commercially available processes.
- The concepts proposed should provide a decrease in CO_2 emissions of at least 30% compared to similar commercially available processes.
- The economic viability of the concepts should be demonstrated, as well as the contribution to the long term sustainability of the industrial sectors targeted.
- The proposal should provide a clear business case for the deployment of the solutions in industry.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SPIRE-04-2016: Industrial furnace design addressing energy efficiency in new and existing furnaces

Specific Challenge: Industrial furnaces with higher performances, optimised resource and energy efficiencies and less pollutant emissions are a major goal for combustion researchers, furnace producers and the process industries. Relatively few new furnaces are installed in Europe these days due to the capital intensive nature of the industrial furnaces, which makes this challenge more urgent to overcome.

In addition, most of the industrial furnaces in Europe are currently fed with natural gas. Another challenge in the coming years will be the use of alternative energy sources or hybrid heating systems for such applications. Novel designs based on new technical concepts, materials and different combustion routes and processes are key for new advanced furnaces and the retrofitting of existing ones.

The development of a clear understanding of the process function, the reliability of the process information and how the furnace interacts with the rest of the manufacturing process will be paramount for the new generation of technologies for new and retrofitted industrial furnaces. To develop and to scale up new systems and equipment based on new high temperature materials and advance protective coatings is a real challenge and could contribute to great savings in energy.

Scope: Proposals need to consider all aspects for the construction of new furnaces or the retrofitting of existing furnaces with more efficient and effective technologies. They need to also consider the effects on upstream and downstream processes linked to those heating systems.

The design methods and criteria need to take into account technical aspects, constraints found in legislation, compliance with codes and standards and all the related economic aspects, including how the cost of design changes can escalate.

Research activities for new industrial furnace design or the retrofitting of existing furnaces should address all of the following areas:

- Use of at least two different energy sources, e.g. electricity, gas, oil, biogas, biomass, coal. Hybrid heating systems can also be considered. Design has to take into consideration the type of feed and an optimised fuel consumption.
- Prediction tools and computer simulation development applied to the design process and performance prediction.
- Interaction of the furnace with the rest of the manufacturing process, including the effect on upstream and downstream processes. Optimisation has to be considered at system level. Heat transfer and recovery need to be also considered.
- Improved equipment efficiency by using new and improved high temperature/corrosion/wear resistance materials e.g. new steels, super alloys, high resistance composite metallic alloys, innovative refractories, high temperature insulation materials systems, hybrid metallic/ceramic solutions for high temperature applications.
- Monitoring and control systems for the SOx, NOx and CO emission of industrial furnaces

The proposals must include at least one demonstrator in an industry-relevant environment, for either new or existing furnaces.

Activities are expected to focus on Technology Readiness Levels 4 to 6. This topic addresses cross-KET activities.

This topic is particularly suitable for SMEs.

The Commission considers that proposals requesting a contribution from the EU between EUR 5 and 7 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Compared to the current practice in the sector:

- Reduce the energy consumption by at least 15%.
- Reduce the operating costs by at least 15%.
- Reduce NOx, SOx and CO emission by at least 25%.
- Reduce Capex and Opex costs of the furnaces by at least 15%.
- Clear business cases for the deployment of the solutions in industry.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SPIRE-05-2016: Potential use of carbon dioxide / carbon monoxide and non-conventional fossil natural resources in Europe as feedstock for the process industry

Specific Challenge: Europe is facing a large emission of CO_2-containing gases and at the same time a need for additional carbon-based resources. Whereas today the carbon flow of the process industries is organised in a linear way from feedstock input to output of product plus emission (among other residues), the objective is to facilitate a cyclic flow in which CO_2-containing gases from one industry becomes the feedstock of another.

Due to greenhouse gas emissions (GHG), the process industry is increasingly looking into the potential use of non-conventional fossil natural resources (e.g. shale gas, gas hydrates, tar sands, coal bed methane, gas to liquid and coal to liquid technologies) as alternative feedstock. Moreover, some organic solid wastes (both from domestic and from industrial applications) can be used to obtain carbon based gas (e.g. biogas, syngas).

The challenge is to understand how to turn these different carbon sources into chemicals that can be used as sustainable building blocks or fuels, while at the same time the process is economically feasible depending on the different energy price scenarios. The aim is to perform a forecast study for the use of CO_2 containing process gases as feedstock for process industries, by means of the conversion of CO_2 and CO to carbon-derived products. Converting these gases into chemicals and products could lead to a major reduction of emissions and dependency on fossil fuels.

Presently the prices for the emission of CO_2 are dropping significantly compared to the initial prediction (e.g. in the ETS scheme) and at the same time both fossil based and renewable feedstock are highly volatile on the world market. Therefore, there is an urgent need to forecast different possible scenarios for a sustainable use of carbon resources and how this can be organised in a cyclic flow in the process industry.

Scope: There is a strong need to evaluate the novel technologies and solutions for the use of CO_2/CO containing process gas as well as non-conventional fossil natural resources at production site level together with the economic feasibility. Furthermore, it is required to compile information on and create awareness on the relative maturity and adaptability of technologies to the local situations, with the aim to accelerate market adoption and replication of these solutions.

Some of the targeted chemicals offer dual use as an intermediate in chemical production as well as an energy carrier such as chemical energy storage. Therefore, the proposed technology not only links CO2-producing and intensive carbon sectors but addresses various high-volume applications and significant markets.

The focus of the forecast study should be on the use of CO_2/CO containing process gases to produce high value added products (e.g. fine chemicals and polymers).

The study should address an integrated approach including the following aspects:

- To lay the foundation of the design of future facilities to demonstrate conversion of CO_2-containg gas into chemicals on site.
- The design of scenarios for the proper and most valuable uses of different gas resources.
- To analyse the need for pre and post-conversion separation and conditioning processes
- To evaluate the potential impacts of the use of non-conventional fossil natural resources on the CO_2/CO use and identify best solutions
- The scenarios should be linked to Life Cycle Assessment to provide a basis for sustainability, leading to acceptance and recognition of new “clean” products, business models, and skill sets.

All aspects above should take into consideration the following issues: i) the most carbon efficient process; ii) the technical challenges that hamper the deployment of technical solutions at demonstration scale; and iii) the challenge of building a new model for integrating different industrial sectors.

The Commission considers that proposals requesting a contribution from the EU between EUR 250000 and 500000 would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

No more than one project will be funded.

Expected Impact:

- New scenarios for increased use of CO_2/CO containing process gases and non-conventional fossil natural resources as new feedstock depending on future fossil fuel and energy prices.
- Strategies to facilitate the use of primary fossil feedstock displacement (downstream consuming industry).
- Future scenarios that enable new business models improving competitiveness of participating industries based on the use of CO_2/CO containing process gases and non-conventional natural resources as feedstock for the process industry.
- Synergies by linking production sites of emitting and downstream consuming industries.
- New areas for SME development and growth

Type of Action: Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SPIRE-06-2016: Business models for flexible and delocalised approaches for intensified processing

Specific Challenge: The competitiveness of European manufacturing depends on producing differentiated and high added value products in an efficient and sustainable manner, with reduced production costs, increased product quality and minimised time to market. To create a long-lasting competitive advantage for the European process industry it is also needed to properly inter-relate the production with modern and innovative ways of doing business.

Therefore, technological innovation in sustainable manufacturing in the process industry needs to be matched with new business models, which may support industry and cross-sector clusters as well as industrial parks, while also allowing more flexible and delocalised operations. These new business models should be designed to address the barriers which have so far prevented regionally or locally adapted solutions, with an emphasis on technical but also non-technological barriers, such as legal, regulatory or cultural ones.

On the other hand, these new business models should allow the positive interactions between the different actors (firms, neighbouring municipalities, infrastructure administrations), which can allow positive outcomes in terms of accrued economic value associated with perceived level of attractiveness to inward investors, leading to jobs creation, and sustainable development promotion by local authorities, industries and policy makers. In addition, these business models should consider the influence of industrial consumer trends on future energy

and resource systems to achieve ambitious sustainability paths, which will be very relevant for the whole market.

Scope: New business solutions should enable higher throughput operations and allowing industry to produce in a distributed and small scale manner; these new business models are expected to be more flexible and demand-driven. Site re-optimization studies will help identifying barriers towards good practice solutions and integrating several industries or processes.

Activities should focus on all of the following areas:

- To determine the spatial flexibility parameters which allow to optimise activities interdependence and to define the resource flexibility parameters which allow optimising yearly fluxes between companies
- Integrated business model solutions for customer-driven supply chain management based on intensified processing.
- To deliver design constraints for new decentralised locations, which would position them, if applied, in the industrial symbiosis category,
- To pinpoint the routes which allow the reduction of carbon footprint at affordable interdependence investments
- Scenarios for novel distributed and intensified processing, sourcing and design solutions linking individual "home-based" designers and manufacturers to the supply-chain, promoting social inclusion and deploying skills locally available.
- Scenarios for local sourcing and supply, thus reducing the environmental footprint, taking into account both raw material and energy sources

The proposals are expected to include an evaluation of best use and practical cases for intensified processing, while also providing an understanding on the research needs to achieve rapid deployment of the novel business solutions in particular consumer-targeted domains and a roadmap for their implementation. All relevant supply-chain stakeholders should be considered (including representatives from socio-economic sciences) and it is expected that SMEs will play an important role in the deployment and application of future business models.

The needs of SMEs as part of the supply-chain should be addressed.

The Commission considers that proposals requesting a contribution from the EU between EUR 250000 and 500000 would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

No more than one action will be funded.

Expected Impact: A study on the research needs to develop new business model solutions that can support the return of delocalised manufacturing to Europe, in the order of at least 5% of the total manufacturing capacity, in the process industry sectors, within 5 years after the end of the study.

The overall aim is to obtain an understanding of how to achieve in the medium term new business model solutions which should provide:

- Reduction in the environmental footprint compared to products produced in the traditional value chains by 10% through less stock, less waste, and less transportation;
- Reduction of raw material by 15% through the creation of strong networks with related sources of raw material coming from different sources (primary and secondary) locally
- Development of scenarios in order to identify the proper locations and opportunities associated to delocalised facilitates taking into account legal and social hampering factors
- Increased business opportunities on a local scale.
- More involvement of customers/users in the integrated innovative business model solutions.

Type of Action: Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SPIRE-07-2017: Integrated approach to process optimisation for raw material resources efficiency, excluding recovery technologies of waste streams

Specific Challenge: Process industries are currently facing the challenge of an increase in the energy and raw materials cost, a few of them facing a relative scarcity. Raw materials resources are blended, mixed and transformed into finished products by means of different manufacturing processes. Material losses and variable yields in the different processes can mean a considerable increase in the total cost breakdown.

Input from end-of-life recycling is an important goal covered in previous Horizon 2020 Calls including the SPIRE-7-2015 topic. However, yield losses in the different production steps in process industries are still important and this leaves room for improvement (e.g. real losses in pipelines, the storage containers extraction operations, raw materials residues left in ovens, mixing bowls and mixer blades, altogether with inefficient or ineffective chemical reactions).

Improving the utilisation of raw materials resources (fluids, solids or gases) is essential to increase yields throughout the supply chain. The reduction in losses will also ensure a decrease of the environmental footprint and therefore contribute to a more sustainable industry.

The challenge of a more efficient use of raw materials resources in order to deliver high performance and sustainable production must be accompanied by optimising material efficiency all along the process route and throughout the value chain.

Scope: Proposals should address the technological improvements for both continuous and batch processes to improve material and energy efficiency in the entire production route. They should also identify key bottlenecks and resource efficiency improvement opportunities that will increase yields while optimising the energy consumption of the original processes. The process review and the implementation of improvements should also significantly increase the current production rates.

Research and Innovation activities should address all of the following areas:

- Reduction of material losses during the upstream beneficiation, the intermediate processing, the final process stages. Improvement of both the yield and the energy efficiency of the production process routes.
- Quality and process control that ensures process stability and robustness while allowing some flexibility at the inlet conditions and the development of tools to assess the optimal combination of material input and yield control.
- Identification and use of KPIs based on energy, water and raw material resources consumption, carbon dioxide emissions that can ensure the sustainability of the processes.
- Mapping of the material and energy flows across the entire production system to allow for a cross-sectorial integration and optimisation.
- Evaluation and quantification of the emissions reduction by improving yield.

The proposals must include at least one demonstrator per process in a real industrial setting.

Activities are expected to focus on Technology Readiness Levels 5 to 7 and to be centred around TRL 6.

This topic is particularly suitable for SMEs.

The Commission considers that proposals requesting a contribution from the EU between EUR 6 and 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- At least 25% reduction in yield losses when compared to the current practice in the sector, by optimising/minimising production losses and an increased material consumption on interconnected cycles

- At least 10% improvement in energy efficiency when compared to the current practice in the sector.
- Identify bottlenecks and resource efficiency improvement opportunities
- Identify knowledge gaps in the supply chain
- Adoption of the new technological improvements for enhanced resource efficiency in industrial processes.
- Contribution to achieving the objectives of the European Innovation Partnership on Raw Materials, in particular to the relevant impacts shown in Action I.4: Processing and refining of raw materials of the Strategic Implementation Plan[8].

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SPIRE-08-2017: Carbon dioxide utilisation to produce added value chemicals

Specific Challenge: CO_2 represents an alternative, abundant and valuable source of carbon which could be a suitable raw material, and its utilization has the potential to contribute significantly to reducing greenhouse gas emissions and thereby unwanted climate change effects. In addition, the utilisation of CO_2 (and CO) as a feedstock by the European process industry to produce materials, chemicals and fuels could be a key solution to reduce the dependence on imports of fossil resources while providing a secure of supply of carbon feedstock.

The chemical industry is still largely based on the use of fossil fuels and feedstock as source of carbon, but a decrease is necessary in order to reduce carbon dioxide emissions. The utilisation of CO_2 (and CO) to produce added value chemicals may represent a viable opportunity. While there are still significant scientific technological challenges to be solved in order to exploit the CO_2 (and CO) as a carbon source in a more systematic manner, there have already been concepts demonstrated at lab scale, which could provide possible solutions if properly scaled up. Therefore, it is necessary to demonstrate the feasibility of such CO_2 (and CO) utilisation technologies to produce added value products at larger scale, in an operational environment, to be able to assess the industrial potential of such technologies.

Scope: Proposals should address innovative chemical (e.g. catalytic) processes to produce added value chemicals from CO_2 (and CO) and demonstrate the technical and economic

[8] https://ec.europa.eu/eip/raw-materials/en/content/strategic-implementation-plan-part-ii#I.4%20Processing

feasibility in an industrially relevant environment through demonstration of a system prototype. Technologies targeting conversion of CO_2 (and CO) to short chain alcohols, dimethyl ether and fuels are considered outside the scope of this topic.

The topic focuses on the conversion of CO_2 (and CO) to chemicals, possibly including chemicals with other components beyond C, H and O (such as N), in an integrated approach and therefore, the proposals need to consider the following elements:

- CO_2 (and CO) should come preferably from industrial flue and process gases from the process industries e.g., cement, steel and other energy intensive industries
- CO_2 (and CO) purification and conditioning methods to bring the gas to a sufficient quality for efficient conversion into chemicals.
- The testing of a system prototype should be integrated with process modelling and life cycle assessment in order to quantify the processes in terms of resource intensity reduction as well as reduction of emissions.
- The quality of the products obtained should relate to the specifications requested by the market.
- The project should contain an analysis of the economic feasibility and impact, and the evaluation of the market potential, and benefit on the European competiveness deriving from the introduction of the new process.
- An analysis of the environmental and social benefits.

Proposals should involve industries in a clear leadership role.

Activities are expected to focus on Technology Readiness Levels 4 to 6. This topic addresses cross-KET activities.

The Commission considers that proposals requesting a contribution from the EU between EUR 6 and 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Demonstrate technical and economic feasibility in the relevant environment of novel processes for CO_2 and CO conversion to added-value chemicals.
- Reduction of at least 20%, on Life-Cycle-Assessment basis, of the emissions of greenhouse gases and energy/resource intensity with respect to commercial manufacturing of the same product. The impact on greenhouse emissions will be an important element of the evaluation.

- Significant increase of the industrial competiveness deriving from the adoption of the novel processes of conversion of CO_2 and CO to added-value chemicals.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SPIRE-09-2017: Pilot lines based on more flexible and down-scaled high performance processing

Specific Challenge: Although the European process industry holds a globally strong position, it is losing competitiveness in the face of world regions which are richer in raw materials and/or have lower energy, labour and environmental costs. Consequently, in order to maintain its competitiveness on the global stage, it will be important to substantially improve its performance, as well as the energy and resource efficiency of its operations. In addition, the existing industrial processes often do not provide sufficient flexibility (e.g. ability to easily change production rates) making them unable to meet the demand for fluctuating production volumes and seasonal production campaigns requiring in situ processing (e.g. bio-mass, limited batches), which would benefit from flexible and/or mobile production systems that do not require extensive infrastructure (e.g. containerised approach).

During the last decade, several concepts have been developed and reported to enable more flexible, compact and cost effective processes proposing a variety of process intensification methodologies, which have the potential to achieve the very significant improvements in performances, energy usage and material efficiency sought by the industry. However, these concepts have mostly been demonstrated/validated at laboratory/small scale and further work is needed to fully assess their industrial potential in terms of performances, techno-economic feasibility and scalability, in order to contribute to a circular economy in the European market.

Scope: Proposals are expected to identify and demonstrate innovative, compact, high performance production lines for existing and novel products with significantly lower operational and investment costs (compared to their existing analogues). This may be achieved by adaptation, redesign of existing process units or by completely new concepts, possibly using process optimised materials, provided that a significant improvement in cost, flexibility and performance can be achieved, compared to the commercially available processes. The approach proposed should allow short time-to-market and integration in currently existing plants, while ensuring a high flexibility (e.g. production lines with a broad turn-down ratio or by using parallel modular units for adapting capacity).

Proposals should address all of the following activities:

- The proposed solutions should encompass the elimination, combination or replacement of one or more process steps/units aiming to achieve significant efficiency improvement and higher productivity and flexibility, while ensuring lower capital and operation costs.

- Significant demonstration activities in a relevant industrial environment are expected, which will allow validating the productivity and flexibility improvements and provide clear indications on the scalability, replicability and potential for its integration in existing industrial plants.

- Techno-economic analysis (including LCA) providing a basis for economic and industrial feasibility for the innovative, high performance, flexile/scalable production lines that will be demonstrated, as well as a business plan for the deployment of the technology.

Demonstration of the integration in existing industrial scenarios would be a major added-value.

The proposal should include clear steps for the deployment of the concepts in industry (e.g. including clear business cases and a work package on business plans).

The proposal should provide evidence on the concept potential for job creation.

For this topic, proposals should include an outline of the initial exploitation and business scenarios, which will be developed further in the proposed project.

Activities are expected to focus on Technology Readiness Levels 5 to 7 and to be centred around TRL 6. This topic addresses cross-KET activities.

A significant participation of SMEs with R&D capacities is encouraged.

The Commission considers that proposals requesting a contribution from the EU between EUR 6 and 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- The equipment size/production-capacity ratio, energy and resource consumption, or waste production will be significantly improved by more than 30% compared to existing approaches. The targets should be quantified in the proposal and validated during the execution of the demonstration.

- Project outcomes should demonstrate a positive environmental impact, by reducing by-products and/or waste generation, as well as reducing CO2 emissions and energy consumption compared to the state of the art and in the scale relevant for the different applications

- The novel processes/production lines should contribute to lowering the investment and/or operating costs by at least 20% compared to existing approaches. The targets should be quantified in the proposal and validated during the execution of the demonstration.

- Wide adoption of the technologies developed for increasingly compact and flexible production lines.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SPIRE-10-2017: New electrochemical solutions for industrial processing, which contribute to a reduction of carbon dioxide emissions

Specific Challenge: Electrochemical processes have the potential to be highly efficient and thereby create less by-product waste compared to conventional chemical processes. Important reasons for the industrial interest include the use of less expensive starting materials, less aggressive process conditions (e.g. lower temperatures with less degradation of feed and/or product), fewer processing steps (for example electrochemical synthesis and product separation may be combined in one reactor), precise control of oxidation or reduction level by control of electrode potential and discovery of unique processing routes to establish new markets for products. In addition, electrochemical processes have the potential to replace polluting chemical reactions with more environmentally friendly electrochemical reactions.

Despite the large number of chemicals available in the market, electrochemical synthesis of chemicals has until now been limited to a narrow spectrum. However, advances in electrochemical synthesis and methods are now possible and facilitated by recent developments in materials science, nanotechnology, and by the development of new in-situ analytical techniques or the progress in multi-scale modelling. This provides opportunities for new approaches for the electrochemical manufacturing of products.

Intensive research into organic and inorganic electrochemical processing promises major developments in different applications, specifically with the prospect of greatly reduced electricity consumption and the use of electrical power generated from environmentally friendly production processes like wind and solar energy, thereby contributing to the reduction of greenhouse gas emissions.

Scope: Proposals should develop new electrochemical methodologies for industrial processing and provide a proof of the economic and industrial feasibility of the new technologies. The proposed solutions should also have the potential for integration into existing industrial

operations. A prospect for a wider impact of the proposed solutions on the process industry is also needed.

Important aspects that should be taken into account are:

- Easy integration with renewable energy (electricity from renewable production sources).
- Electrochemical synthesis and/or electrolysis which allows the direct creation of products (e.g. fuels, chemicals, metals, nanomaterials and new functional surface layers).
- Ease of operation at low temperature and pressure conditions.
- Integration of product produced into existing storage and supply infrastructures.
- Significant improvements in energy and resource efficiency compared to the commercially available analogue (or similar process) with reduction of direct and/or indirect greenhouse gas emissions.
- Improvement in safety and the work environment.
- Life Cycle Assessment to provide a basis for environmental sustainability.

Projects will carry out demonstration activities in industrial environments aimed at confirming the industrial relevance and feasibility of the proposed technologies, showing the potential for integration in existing operations.

Activities are expected to focus on Technology Readiness Levels 4 to 6.This topic addresses cross-KET activities.

This topic is particularly suitable for SMEs.

The Commission considers that proposals requesting a contribution from the EU between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Decrease by 25% of energy use compared to related non-electrochemical processes
- Decrease by 30% of Green House Gases emissions compared to related non-electrochemical processes
- Strengthen the global position of European process industry through the wide adoption of new technologies related to electrochemical processing of materials in the different application actions.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SPIRE-11-2017: Support for the enhancement of the impact of SPIRE PPP projects

Specific Challenge: Dissemination, exploitation and transfer of projects results are important activities during project life-time and beyond in order to make sure that projects fully achieve the expected impacts. Clustering of project activities, according to specific objectives and addressed themes, and their inter-linking with existing technology transfer activities, are effective ways to stimulate the take-up of project results and to exploit synergies. Further, there is a need to focus on knowledge transfer and training issues regarding present and future industrial workers in the whole value chain, for which a strong link between industry and academia is needed.

An adequate exploitation of such activities together with a joint analysis of the results obtained and the training needs during the project lifetime and beyond is also needed, to ensure an effective implementation at the PPP level.

Scope: Proposals should aim in particular to actively cluster existing activities under the SPIRE PPP that go beyond the exploitation and dissemination activities of each project. The initiative, which is expected to last 2 years, will require close collaboration with relevant industrial associations, technology and knowledge transfer programmes as well as the training community.

The project should aim at looking for new ways of engaging with the broader process community, and encouraging engagement with other networks in the process industry (e.g. regional networks).

Activities may include:

- Moving beyond traditional dissemination activities and favour the development of tailored innovative dissemination actions and initiatives inspired by project outcomes and targeted at specific stakeholders (incl. SMEs, learning community).

- Sharing insights on innovative business model concepts for implementing resource and energy efficient solutions, including cradle to cradle and industrial symbiosis approaches.

- Identification of gaps and opportunities for further research and innovation, as well as non-technological gaps in order to develop policy framework recommendations (e.g. regulation, standardization, public procurement).

- Workshops with top-ranked international experts from the various disciplines aiming at the elaboration of future SPIRE priorities and training needs within the technological area of the cluster.

- Building skills capacity for innovation and competitiveness in the process industry (e.g. engaging with the academia for the development of learning resources adaptable to different learning approaches and curricula at undergraduate, master, and life-long learning levels, based in particular on the innovation outcome of projects).

- Reviews of recent technological developments, publications, international RTD and innovation programmes within the technological area of the cluster.

The Commission considers that proposals requesting a contribution from the EU between EUR 250000 and 500000 would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The impact on the areas of application of the projects is expected to be:

- Speeding up industrial exploitation and take up of results of SPIRE PPP projects and facilitate cross-sectorial technology transfer.

- Stimulation of networks and alliances for further RTD and industrial innovation in the addressed technology and application areas.

- Added value beyond the original scope of the SPIRE PPP projects by exploiting synergies and sharing best practice, including on innovative business models. Increased public presence and awareness of SPIRE PPP activities.

- More effective execution of activities of common interest, such as training & education, IPR management and standardisation.

- Anticipation of business trends and market prospects.

- Early awareness of key innovation developments.

- Dissemination of project results beyond traditional dissemination models and timeframe of the projects.

- Development of training and innovation skills capacity in the process industry.

Type of Action: Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SPIRE-12-2017: Assessment of standardisation needs and ways to overcome regulatory bottlenecks in the process industry

Specific Challenge: It is essential to take advantage of the potential important benefits from new technologies and materials while ensuring that there are mechanisms in place to prevent, identify and manage any potential risks that come about associated with certain use of such

technologies. The European regulatory process should also instil consumer confidence in the approved marketed products and encourage the reduction of production costs and the increase of efficiency, improving of the quality of products and services, ensuring worker health and safety, and protecting the environment in order to keep jobs and a competitive economy.

The EU Regulation 1025/2012 defines the procedures to be applied when harmonised standards are used to provide a presumption of conformity with legal requirements.

Scope: Regulation should be simple and stable but, above all, should be reliable. Before any changes are considered, a very careful and well-thought analysis should be undertaken in order to minimise the risk of potential negative impact on innovation and on the uptake of technology. Furthermore, standards should be non-restrictive, reflecting a balance between a need for harmonisation and innovation.

A clear, consistent and predictable regulatory framework which avoids unnecessary administrative and financial burden is needed. Proposed support actions should cover the needs of the different industrial sectors representing big and small companies within the process industry. Their objective should be to identify and to propose solutions along the value chain, required to reach long term sustainability for Europe in terms of global competitiveness, ecology and employment.

Evaluation of standardisation and/or regulation needs could include recommendations within the following issues:

- Re-use of different grades of wastewater for industrial purposes.
- Re-use of different types of waste (e.g. through re-classification) as feed for industrial production and/or energy sources.
- Recovery of valuable materials, metals and minerals from waste.
- Lifecycle Assessment methodologies to allow a harmonised comparison between industries and sectors.
- Production of advanced renewable fuels from the use of CO_2 as feedstock.
- General harmonisation of the European Waste, Water and Energy policies.
- Eliminating bottlenecks for the transferability of new technologies across European borders.
- Eliminating bottlenecks that prevent the stimulation of investments in new technologies, e.g. within clean and low carbon technologies.
- New standardisation methodologies that facilitate continuous production.

While in some cases it is necessary to recommend harmonisation on a European scale through regulation and European Standards, in other cases it may only be necessary to enable transferability of technology across sectorial boundaries.

Examples for this could be (but are not restricted to) the following:

- IT control systems and plant monitoring systems facilitating industrial symbiosis.
- Equipment for Process Intensification.
- Equipment for small scale localised production.

The Commission considers that proposals requesting a contribution from the EU between EUR 500000 and 1000000 would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

No more than one action will be funded.

Expected Impact:

- Enabling regulatory authorities to better address the different relevant issues based on a better assessment and taking into consideration the different stakeholders in SPIRE.
- Rationalising the process to deliver standardisation mandates to the European Standards Organisations.
- Successful implementation of different policies, regulations and standards within the SPIRE sectors.
- Enabling of industrial symbiosis and better use of industrial resources.
- Reducing cost of operation for the process industry.
- International cooperation.

Type of Action: Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

CIRCULAR ECONOMY

The objective of this part of the call is to foster economic, social and environmental prosperity – 'living well, within the limits of our planet' as set out in the EU's 7th Environmental Action Programme – by positioning Europe as a front runner in moving to a circular economy and society. A systemic approach to eco-innovation is intended to promote new modes of production and consumption, triggering a disruptive transformation for a resource efficient

society. Systemic innovation is understood as innovation that aims at responding to a societal challenge by obtaining a systems-wide transformation through affecting the system's economic, social and environmental dimensions as well as their interconnections. This implies a trans-disciplinary perspective that integrates technology, business models and economic organisation, finance, governance and regulation as well as skills and social innovation. Systemic innovation therefore calls for the adoption of a challenge-driven, solutions-oriented research and innovation strategy that crosses disciplinary boundaries and involves co-creation of knowledge and co-delivery of outcomes with economic, industrial and research actors, public authorities and/or civil society.

This systemic approach to innovation is in line with Horizon 2020's Responsible Research and Innovation[9] (RRI) cross-cutting objective, engaging society, integrating the gender and ethical dimensions and ensuring access to research outcomes. The ethical dimension of the activities, including relevant socioeconomic implications, should be taken into account, such as personal data protection and privacy, protection of participants and researchers, ensuring informed consent, dual use and potential misuse of the research results, fair benefit sharing when developing countries are involved, animal welfare, etc.

The innovation actions in this part of the call are expected to offer particular opportunities to SMEs to participate and to deliver on innovative solutions.

This call introduces in topics CIRC-01-2016-2017 and CIRC-02-2016-2017 the possibility for beneficiaries of funded projects to apply for 'Innovation Deals'. Innovation Deals are meant as voluntary agreements, initiated by funded projects which expect or already have knowledge about EU regulatory provisions that may pose barriers to the development, replication or scaling up of their innovative solutions. After assessment of the application, the European Commission may launch an Innovation Deal with the project and relevant local/regional/central authorities to analyse the EU regulatory barrier and develop practical lines of action to address the barrier. These actions may not jeopardize any environmental or societal protection and will have to be fully in line with existing EU provisions regarding competition law and internal market principles. After the Innovation Deal, which would not be linked to the signed grant agreement and to the funding of the project, the European Commission will investigate and may take action to address the EU regulatory barrier at EU level as part of its better regulation agenda.

Interest to participate in an Innovation Deal is not taken into account during the evaluation procedure. Proposals will not be evaluated favourably because they express an interest in an Innovation Deals and will not be penalised for not expressing an interest.

Within the projects funded, where relevant, additional or follow-up funding should be sought, be it private or public, including from relevant regional/national schemes under the European Structural and Investment Funds (ESIF), in particular under the European Regional Development Fund (ERDF), or other relevant funds such as the Instrument for Pre-accession

[9] http://ec.europa.eu/research/swafs/pdf/rome_declaration_RRI_final_21_November.pdf

Assistance (IPA II). To achieve this, projects could seek contact with ERDF/IPA managing authorities and with the authorities who developed the Research and Innovation Smart Specialisation Strategies (RIS3). The responsible regional/national authorities could then take an interest in the projects and their expected results. They could engage in the use and deployment of the novel solutions resulting from projects e.g. through pre-commercial public procurement or public procurement for innovative solutions. The project proposals could already indicate which interested regions/countries or other partners have been pre-identified for contact during the project. Please note, however, that reference to such additional or follow-up funding will not lead automatically to a higher score in the evaluation of the proposal.

The performance of innovative technologies ready for the market (TRLs 7-8) developed under the topics in this part of the call may be verified through technology verification schemes such as the EU Environmental Technology Verification (ETV)[10] pilot programme.

A novelty in Horizon 2020 is the Pilot on Open Research Data which aims to improve and maximise access to and re-use of research data generated by projects. Projects under the Societal Challenge 5 'Climate action, environment, resource efficiency and raw materials' Work Programme 2016-17 will by default participate in the Pilot on Open Research Data in Horizon 2020, i.e. topics CIRC-01-2016-2017, CIRC-02-2016-2017, CIRC-03-2016 and CIRC-04-2016 in the call 'Industry 2020 in the Circular Economy'. Projects funded under the other calls of this Work Programme may participate in the Open Research Data Pilot in Horizon 2020 on a voluntary basis.

Projects have the possibility to opt out of the Pilot. Participation in the Pilot is not taken into account during the evaluation procedure. Proposals will not be evaluated favourably because they are part of the Pilot and will not be penalised for opting out of the Pilot.

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 DMP is required for projects participating in the Open Research Data Pilot. Other projects are invited to submit a DMP if relevant for their planned research. Only funded projects are required to submit a DMP.

Proposals are invited against the following topic(s):

CIRC-01-2016-2017: Systemic, eco-innovative approaches for the circular economy: large-scale demonstration projects

Specific Challenge: The increasing resources' constraints that EU is facing strongly condition its competitiveness and the quality of life of individuals. Important gains in resource efficiency can be made by replacing current linear economic models with circular models of production and consumption,, which result, at the same time, in a substantial reduction of

[10] http://iet.jrc.ec.europa.eu/etv/

GHG emissions. While relying on industrial leadership, the success of circular economy models will depend on adopting a systemic approach to eco-innovation that encompasses value and supply chains in their entirety and engages all actors involved in such chains. A systemic approach entails foresight of the diverse impacts that transformative innovative solutions can have on the economy, environment and society at large. Side-effects of innovative practices can thus be addressed, e.g. change in energy policy due to a reduction of waste available for energy recovery. Bringing end-users closer to the design and production phases, and customising the production and delivery of goods and associated services can boost new consumption patterns that add greater value and reduce over-production, waste and other negative environmental impacts. The involvement of end-users in designing circular economic models that better respond to their needs can enable the development of value-added solutions and act as a driver for Europe's re-industrialisation.

Scope: Proposals shall address **one** of the following issues:

a) Design for circular value and supply chains (2016): Through large scale demonstration projects, organisations, including from process and manufacturing industries and SMEs, whether dealing with biotic and/or abiotic resources, are expected to test and showcase circular economy solutions based on re-design of value and supply chains, taking into account products, production processes, and/or systems, as well as involving final users. Such solutions should entail the environmentally sustainable recovery, recycling and/or re-use of resources and energy flows, including by cross-sectorial symbiosis, within the overall chain from resources to marketed products.

The proposals should enable entrepreneurs, industries and researchers to collectively implement the innovative solutions at an appropriate scale, which goes beyond a single production plant. They should develop new forms of organisation and governance within and across value and supply chain(s), considering where appropriate collaboration between public and private sectors. The proposals should include an outline business plan which can be developed further in the course of the project.

Where relevant, projects are expected to contribute to the implementation of the SPIRE PPP Roadmap.

For the technological innovation components, TRL 5-7 are to be aimed for (as defined in the General Annexes of this Work Programme). The EU Environmental Technology Verification (ETV) pilot programme[11] could be used to verify the performance of innovative technologies at higher TRLs.

The Commission considers that proposals requesting a contribution from the EU of between EUR 7 million and EUR 10 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

[11] http://iet.jrc.ec.europa.eu/etv/

b) Systemic services for the circular economy (2017): To demonstrate through large scale projects the economic and environmental feasibility of circular economic business models that underpin new services based on performance/functionality rather than ownership, and/or on mass customisation, including through supporting demand side measures. Proposals should adopt a systemic eco-innovative approach addressing all forms of innovation, combining technological, organisational, societal, cultural and behavioural innovation, and strengthening the participation of civil society. Such an approach can foster new forms of collaboration between end-users, producers and researchers. In particular proposals should consider ways of supporting co-creation by developing, experimenting and demonstrating new business models together with end-users, taking into consideration their needs, including gender dimension, thus enabling the development of value adding solutions. Business models that foster new services and consumption and production patterns will require support to end-users in the transition to the circular economy by raising awareness and knowledge sharing activities on circular economy models. The proposals should include an outline business plan which can be developed further in the course of the project.

The Commission considers that proposals requesting a contribution from the EU of between EUR 4 million and EUR 7 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

For both: Within the projects funded, additional or follow-up funding should be sought, be it private or public, so as to achieve a more effective implementation and deployment at larger scale and scope of the innovative solutions addressed. Additional funding sources could include relevant regional/national schemes under the European Structural and Investment Funds (ESIF), such as under the European Regional Development Fund (ERDF), or other relevant funds such as the Instrument for Pre-accession Assistance (IPA II). In the latter case, contacts could be established with the funds managing body during the duration of the projects. In case of relevance for the Research and Innovation Smart Specialisation Strategies, the project proposals could already indicate which interested regions/countries have been pre-identified. Please note, however, that reference to such additional or follow-up funding will not lead automatically to a higher score in the evaluation of the proposal.

Within the projects funded, possible regulatory barriers should also be addressed, as appropriate. In particular 'Innovation Deals' may be proposed. By 'Innovation Deal' a bottom-up approach to address regulatory bottlenecks to innovation is understood, that would take the form of voluntary agreements, with the European Commission and external stakeholders, with the aim of identifying and overcoming regulatory barriers and thus facilitating the market up-take of innovative solutions.

A life cycle thinking and assessment, in line with the recommendations and reference data from the European Platform on Life Cycle Assessment[12] when applicable, should be applied.

Expected Impact: **a)** The testing and demonstration of circular value and supply chains, within cross sectorial, collaborative systemic approaches is expected to make measurable contributions in the medium term to:

- substantially improving the efficient use of resources in Europe, leading to significant reduction of adverse environmental impacts, including on climate change, and to optimisation of production;
- substantially reducing the generation of residual waste, by applying the principles of the waste hierarchy (as set in the Waste Framework Directive[13]), compared to current best practice;
- creating new business opportunities for industry and SMEs in the EU, including in manufacturing, contributing to the exploitation of EU innovative solutions, and improving the competitiveness of European enterprises in the global market for eco-innovative solutions;
- demonstrating the economic, social, and environmental sustainability of the proposed approaches and main elements that a business plan should include in order to realise them, including the assessment of possible positive and negative side-effects and risks, such as those associated with harmful substances potentially present in recycled materials;
- providing evidence-based knowledge for enabling framework conditions (such as the regulatory or policy framework) that facilitate a broader transition to the circular economy in the EU.

b) The testing and demonstrating of circular economic business models and services, including logistics and ICT capabilities, based on performance/functionality enhancement, is expected to measurably contribute in the medium term to:

- creating markets for new products/services (e.g. leasing or 'sharing' practices) which empower end-users in their choice for more sustainable consumption patterns, and require the implementation of innovative producer responsibility or other sectorial or cross-sectorial governance schemes;
- enabling the development of new approaches for designing products/services that collectively consider end-users, brand owners, as well as entrepreneurs, and researchers, and deliver the needs of end-users;

[12] Data should be disseminated through nodes in the Life Cycle Data Network and studies through the Resource Directory (for further information refer to http://eplca.jrc.ec.europa.eu)

[13] Directive 2008/98/EC

- reducing supply chain length, thus increasing resource efficiency and reducing adverse impacts on the environment, including on climate change;
- facilitating the inclusion of resource or materials criteria in designing products/services (e.g. durability, reparability and recyclability), thus contributing to an increase in resource and energy efficiency, and reduced environmental impacts, in the whole life cycle of products;
- creating new business opportunities for industry and SMEs in the EU, contributing to the exploitation of EU innovative solutions, and improving the competitiveness of European enterprises in the global market for eco-innovative solutions;
- demonstrating the economic, social, cultural and environmental sustainability of the proposed approaches and main elements that a business plan should include in order to realise them, including the assessment of possible positive and negative side-effects and risks, such as those associated with harmful substances potentially present in recycled materials;
- providing evidence-based knowledge regarding the enabling framework conditions (such as the regulatory or policy framework or cultural factors) that facilitate a broader transition to a circular economy in the EU.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

CIRC-02-2016-2017: Water in the context of the circular economy

Specific Challenge: The European water sector has a prominent position in economy and society, but it is very diverse and fragmented. It needs to revolutionise the way public and private actors work together so as to address water-related challenges and seize on opportunities strengthening a demand-driven approach. A systemic approach, incorporating both the physical structure of the system and the rules governing the operation, performance and interactions of its components, could address those issues in an integrated manner. Such an approach should go beyond the pursuit of wastewater treatment and reduction of water use to inspire technological, organisational and social innovation through the whole value chain of water (i.e. water as a resource, as a productive input and as a waste stream), moving towards a circular economy approach.

More specifically, with an increasing global demand for food, feed and fibre, the demand for nutrients is growing. Although increasing food and biomass production necessitates a higher application of nutrients, current fertilisation practices use resources inefficiently. At the same time accumulation of nutrients is causing major environmental problems. The EU legislation is already aiming at regulating nutrient emissions to the environment but more can be done to encourage a transition to an efficient nutrient recovery and recycling. Water is the most used

carrier of nutrients and, at the same time, an important resource itself. Water treatment management models and technologies have the potential to create new business opportunities for an extensive nutrient recovery and contribute to the circular economy. However, an extensive implementation of integrated nutrient recovery technologies and the use of the recovered nutrients at European level is still lacking and this is proposed to be addressed in the 2016 call for proposals**.**

In addition, today's water services aim mainly to save water and to improve its quality. However, water becomes more and more a scarce resource as a result of urbanisation, increased competition between various uses, economic sectors and extreme weather events. To deal effectively with these pressures, there is a need for improving water systems by considering the whole water-use production chain and by identifying solutions that enhance both the economic and environmental performance of the system. These innovative solutions should be in line with the objectives of the circular economy, contributing to the challenges of a depletion of raw materials (e.g. through the recovery of resources from waste water) and climate change (reducing energy needs or producing energy) and should be demonstrated at large scale. This is proposed to be addressed in the 2017 call for proposals.

Scope: Proposals shall address **one** of the following issues:

a) Demonstrating the potential of efficient nutrient recovery from water (2016): The objective of this topic is to implement large scale demonstration projects to tap the potential of nutrient recovery and to encourage the use of these nutrients throughout Europe. Projects should cover the whole value chain from recovery of nutrients to their recycling. The demonstration may involve recovery technologies implemented in any water sector (i.e. industrial, agriculture, or municipal). Treatment schemes should be optimised to allow better recovery rates and material qualities adapted to users' needs and capacities. A life-cycle assessment approach should be used together with environmental and health risk assessment methodologies. New business models exploiting the benefits associated with nutrient recovery and recycling should also be implemented and tested. The proposals should include an outline business plan which can be developed further in the course of the project. Relevant legal, societal and market challenges affecting the recycling of recovered nutrients and their market uptake should be addressed. Involvement of social sciences and humanities disciplines is deemed necessary, for instance to address issues such as attitudes to and acceptance of recycled products. Prospective end-users need to be involved in the projects, informing them about the quality and safety requirements to be met by the products derived from nutrient recovery, thus ensuring the involvement of the demand side to increase market success. Proposals should include participation of industry partners from relevant sectors, and active participation of SMEs where relevant.

This topic supports the implementation of the EIP Water, addressing several priority areas such as water and wastewater treatment, including recovery of resources, and water reuse and recyling.

Where technological innovation is concerned, TRL 5-7 should be achieved.

The Commission considers that proposals requesting a contribution from the EU of between EUR 6 million and EUR 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) Towards the next generation of water systems and services– large scale demonstration projects (2017): The objective of this topic is to demonstrate innovative solutions at a large scale (i.e regions, cities and/or river basins), in line with EIP Water priorities and the objectives of the Water Framework Directive. Proposals should focus on developing the water services of the future, going beyond water supply sustainability addressing the different water value chains. They should integrate, for instance, the management of water resources and the provision of water services, expanding the re-use of treated waste water and the use of desalinated water (where appropriate), ensuring carbon neutral water services, and closing the water cycle by increasing the efficiency of wastewater treatment plants, including the recovery of energy and the re-use of chemicals and nutrients.

Projects should build on experience already gained in areas where integration of various aspects of water management and other economic and social activities is already taking place at different levels, with replication potential in other areas of Europe or at wider scale, thus demonstrating a real added-value at EU level. Successful projects should engage all relevant stakeholders, especially user communities, at an early stage in the co-creation process, bringing together technology push and application pull. This is also necessary to show the potential of using systemic eco-innovative approaches in water, to overcome related barriers and bottlenecks and to create new opportunities for jobs and growth in various regions and river basins. Participation of industry partners from relevant sectors is considered essential and the active participation of SMEs is encouraged. The application of new business models and new value chains is encouraged. The proposals should include an outline business plan which can be developed further in the course of the project. Where relevant, integrated environmental impact assessments and risk assessment of potential harmful substances should be considered. Relevant socio-economic issues, in particular, regulatory/governance issues, social behaviour and acceptability should also be addressed, requiring the participation of social sciences and humanities disciplines such as political sciences, economics, governance and business studies. To enhance the systemic approach and the transformation of water services toward a more circular economy approach, digital technologies and ICT tools should be also considered. Activities aiming at facilitating the market uptake of innovative solutions, including standardisation, should also be addressed.

Within the projects funded, additional or follow-up funding should be sought, be it private or public, so as to achieve a more effective implementation and deployment at larger scale and scope of the innovative solutions addressed. Additional funding sources could include relevant regional/national schemes under the European Structural and Investment Funds (ESIF), such as under the European Regional Development Fund (ERDF), or other relevant funds such as the Instrument for Pre-accession Assistance (IPA II). In these cases, contacts could be established with the funds' managing body during the duration of the projects. In

case of relevance for the Research and Innovation Smart Specialisation Strategies, the project proposals could already indicate which interested regions/countries have been pre-identified. Please note, however, that reference to such additional or follow-up funding will not lead automatically to a higher score in the evaluation of the proposal.

Where technological innovation is concerned, TRL 5-7 should be achieved.

The Commission considers that proposals requesting a contribution from the EU of a range of EUR 10 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

For both (2016 and 2017): Within the projects funded, possible regulatory barriers should also be addressed, as appropriate. In particular 'Innovation Deals' may be proposed. By 'Innovation Deal' an innovative better regulation instrument is understood, in the form of voluntary agreements with external stakeholders to identify and overcome regulatory barriers to innovative solutions that would enable policy or legislative objectives to be better achieved.

Expected Impact: Projects are expected to contribute to:

a)

- decreasing the dependency on primary nutrient resources and increasing the supply security at European level;
- reducing the adverse effects of nutrient emissions on the environment;
- closing the water and nutrients cycles in the whole production and consumption value chain;
- improving the quality of data on nutrient flows, thus providing important information for investments into the recycling of recovered nutrients;
- creating new green jobs and industries around nutrient recovery and recycling, including exports;
- creating new business opportunities for industry and SMEs in the EU, contributing to the exploitation of EU innovative solutions, and improving the competitiveness of European enterprises in the global market for eco-innovative solutions;
- improving the policy and market conditions in Europe and globally for large scale deployment of innovative solutions;
- providing evidence-based knowledge regarding the enabling framework conditions (such as the regulatory or policy framework) that facilitate a broader transition to a circular economy in the EU.

b)

- significant reduction of the current water and energy consumption at regional and/or river basin scale by closing the cycles of material, water and energy, using alternative water sources and supporting the transition towards smart water services;
- interconnectivity between the water system and other economic and social sectors;
- increased public involvement in water management;
- increased citizen satisfaction with water services;
- replication of new business models in other areas and replication of models for synergies between appropriate funding instruments at regional, national or European level;
- closing of the infrastructure and investment gap in the water service sector;
- creation of new markets in the short and medium term;
- providing evidence-based knowledge regarding the enabling framework conditions (such as the regulatory or policy framework) that facilitate a broader transition to a circular economy in the EU.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

CIRC-03-2016: Smart Specialisation for systemic eco-innovation/circular economy

Specific Challenge: Regions are key players in the transition to a circular economy and can together create new circular economy value chains with critical mass. However, knowledge of each other's strengths and the available resources and services is often limited. Developing joint strategies, built on complementarities and respective strengths, can therefore be valuable for better realising their individual and combined potential.

Scope: The purpose is to support a transition towards the circular economy in European regions in synergy with Smart Specialisation strategies. A systemic approach should be adopted that seeks connections between sectors, value chains, markets, natural resources and relevant societal actors. The project should develop a coherent EU reference framework enabling and encouraging regions and Member States to establish operational synergies between R&I investments from Horizon 2020 and the European Structural and Investment Funds leading to market uptake and replication of innovative solutions. The developed reference framework should include recommendations for policy makers, in particular in EU Cohesion countries, providing guidance on how to invest European Structural and Investment Funds to support the transition to a circular economy within the context of existing smart specialisation strategies.

Participants must be regional authorities and/or national/regional/local structures responsible for the implementation of Smart Specialisation strategies.

The Commission considers that proposals requesting a contribution from the EU of between EUR 1 million and EUR 1.5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Realisation of complementarities between existing smart specialisation strategies of a sufficient number of regions, addressing all of the following elements:

- identification of concrete sectors or areas with high potential to support a transition to a circular economy, within a European reference framework;
- investment needs per region and sector/area to enhance existing smart specialisation strategies of involved regions;
- operational actions to connect the activities of the identified sectors/areas of involved regions in view of trans-national cooperation along relevant value chains;
- development of policy support advisory services that enable regions to invest EU funds to leapfrog to circular economy solutions in achieving compliance with EU objectives and targets.

Such cooperation in the implementation of smart specialisation strategies should lead to a measurable transition towards a circular economy within the identified sectors/areas, in the regions and Member States involved. The transition can be measured in, for example: application of new business models; application of adjusted value or production chains; application of new product and/or service design; or 30% increase in resource efficiency.

Type of Action: Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

CIRC-04-2016: New models and economic incentives for circular economy business

Specific Challenge: The circular economy holds high potential to contribute to sustainable economic growth and resource efficiency. To capitalise on this potential, appropriate business models are required that can respond to the specific characteristics of the circular economy, in particular in terms of altering value chains, consumption patterns, producer-consumer relationships and financing needs. Furthermore, these business models need to address the issues of trust and traceability. This includes ensuring environmentally, economically and ethically secure sources of materials as well as ensuring that incentives are appropriately distributed throughout the entire supply chain.

Circular economy business models and improved knowledge thereof need to be developed and disseminated to enable entrepreneurs, industries, and business sectors to work together effectively and to make the transition towards the circular economy. In order to make this transition permanent and sustainable, it is of great importance to integrate public policy-making and business decision-making into the development and analysis of best practices, and their subsequent uptake and scaling-up of circular economy business models.

Scope: Proposals should establish the baseline and facilitate better understanding of the relevant factors which stimulate or hinder successful implementation of circular economy business models. In addition, the underpinning economics leading to further development and future implementation of business models that facilitate the transition towards a circular economy, should be investigated together with the potential of these business models to achieve wider social sustainability benefits, including job creation potential, especially in SMEs. These activities should be based on the identification of drivers and barriers through existing initiatives, programmes, or concrete cases of already successfully applied circular economy business models or selected sectors which have high potential for a transition to the circular economy. All relevant actors and entire chains of production and use should be taken into account. The selected concrete cases or sectors should be sufficient in number to derive generic recommendations at EU level and relevant to support Europe's re-industrialisation, and the Commission’s initiatives in the field of Industry 2020, Internet of Things, the Digital Single Market and Resource Efficiency. Recommendations should be provided in support of policy making, and for future implementation or replication of developed circular economy business models.

Smart, data-driven ICT environments that can contribute to enabling a new generation of business models that maximise performance and added value to the customer, could be also considered, for example sharing, leasing, remanufacturing and new forms of cooperative or social enterprises.

The project activities should aim to attract interest from public and private organisations; the engagement of policy and decision makers should be envisaged; the involvement of scientific actors and business- and higher economic education schools is encouraged in the selection and analysis of cases. Projects should provide an effective mechanism to promote and pave the way for enabling education about and in support of and implementation of business models for the circular economy in a consistent and sustainable manner.

Proposals should consider a systemic approach in business models, applying economic, technological, social, financial, governance, Corporate Social Responsibility and regulatory innovation and embed a strong focus on design, interaction and distribution of value across all actors in a value chain and/or value network.

The activities should take into account and liaise with, where appropriate, other EU past and present projects and initiatives in the field such as the research and education programs of the relevant Knowledge and Innovation Communities (KICs) of the European Institute for

Innovation & Technology (EIT) – namely the Climate-KIC, the EIT Raw Materials and the upcoming KIC on Added-value manufacturing (to be launched in 2016).

The Commission considers that proposals requesting a contribution from the EU in the range EUR 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The project results are expected to contribute to:

- recognition by industry and policy makers of the role that business models can play in the circular economy;
- establishing a practice of co-design and replication of new circular economy business models, linking business development and policy making, based on the trans-disciplinary research outcomes on drivers and barriers also in sectors not yet engaged in the circular economy;
- better application and replication of applied research and innovation outcomes through enhanced exchange of information, experience, and best practice on circular economy business models and policy making in support thereof between policy makers, businesses, academics, business and higher economic education schools, practitioners, and regional development organisations;
- enabling circular businesses to overcome barriers originating from dominant market structures of the linear economy, and reinforcing the shift in consumption, production and value chain operation with effective cooperation mechanisms;
- Europe's sustainable transition towards a circular economy;
- increased dissemination among relevant communities of circular economy-related best practices in business development, financial instruments, scaling up activities and policy making.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

CIRC-05-2016: Unlocking the potential of urban organic waste

Specific Challenge: Waste production, processing and disposal are increasing challenges for urban areas. In this context, local biorefineries can use waste from surrounding industries and municipalities in a symbiotic manner. Today, there are very few examples of facilities that can convert the biodegradable fraction of municipal solid waste and sewage sludge into anything other than compost and energy. Further innovations in urban waste management

schemes could contribute to better collection and processing of waste for the production of higher value bio-based products, including for example bio-based chemicals and bio-plastics.

Scope: Catalogue proven and emerging innovations in the collection, processing and use of organic urban waste and sewage sludge, and on that basis identify potential new value chains. Create and support a platform of regional, municipal and local stakeholders, including public authorities, civil society, and industry (the waste management industry, as well as industries that produce organic waste and those that may have an interest using such waste as a resource). Identify technological and regulatory barriers that hinder the use of more biodegradable waste as raw material for higher value bio-based products, and carry out targeted research that would help to address specific barriers. Such research could contribute to the generation of information required for the development of end-of-waste criteria for urban organic waste.

The Commission considers that proposals requesting a contribution from the EU in the range of EUR 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: To enable the creation of new value chains for higher value purposes other than just for compost or energy, proposals will have to show how to:

- Contribute to new developments in strategy and policy at regional and local level for the innovative use of urban organic waste.
- Boost investments in the local and regional economy supporting sustainable growth, development and employment;
- Facilitate the exchange of information and sharing of experiences among local and regional bioeconomy stakeholders on the production of bio-based products from urban organic waste. In particular, provide inputs to tackle related regulatory gaps and obstacles.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

Conditions for the Call - Industry 2020 in the Circular Economy

Opening date(s), deadline(s), indicative budget(s):[14]

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2016	2017	
Opening: 15 Oct 2015			
PILOTS-01-2016 (IA) PILOTS-02-2016 (IA)	32.00 [15]		08 Dec 2015 (First stage) 24 May 2016 (Second stage)
FOF-01-2016 (RIA) FOF-02-2016 (IA) FOF-03-2016 (IA) FOF-04-2016 (RIA) FOF-05-2016 (CSA)	77.00 [16]		21 Jan 2016
FOF-11-2016 (RIA)	51.00 [17]		
FOF-11-2016 (CSA)	2.00 [18]		
FOF-13-2016 (RIA)	15.00 [19]		

[14] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.
All deadlines are at 17.00.00 Brussels local time.
The Director-General responsible may delay the deadline(s) by up to two months.
The deadline(s) in 2017 are indicative and subject to a separate financing decision for 2017.
The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.
The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

[15] of which EUR 32.00 million from the 'Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing' WP part.

[16] of which EUR 77.00 million from the 'Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing' WP part.

[17] of which EUR 51.00 million from the 'Information and Communication Technologies ' WP part.

[18] of which EUR 2.00 million from the 'Information and Communication Technologies ' WP part.

[19] of which EUR 15.00 million from the 'Information and Communication Technologies ' WP part.

FOF-13-2016 (IA)	15.00 [20]		
SPIRE-01-2016 (IA) SPIRE-02-2016 (RIA) SPIRE-03-2016 (IA) SPIRE-04-2016 (RIA) SPIRE-05-2016 (CSA) SPIRE-06-2016 (CSA)	74.00 [21]		21 Jan 2016
Opening: 10 Nov 2015			
CIRC-03-2016 (CSA)	1.50 [22]		08 Mar 2016
CIRC-04-2016 (RIA)	3.00 [23]		
CIRC-05-2016 (RIA)	3.00 [24]		
CIRC-01-2016-2017 (IA)	60.00 [25]		08 Mar 2016 (First stage) 06 Sep 2016 (Second stage)
CIRC-02-2016-2017 (IA)	20.00 [26]		
Opening: 11 May 2016			
PILOTS-03-2017 (IA)		48.00 [27]	27 Oct 2016 (First stage)

[20] of which EUR 15.00 million from the 'Information and Communication Technologies ' WP part.

[21] of which EUR 74.00 million from the 'Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing' WP part.

[22] of which EUR 1.50 million from the 'Climate action, environment, resource efficiency and raw materials' WP part.

[23] of which EUR 3.00 million from the 'Climate action, environment, resource efficiency and raw materials' WP part.

[24] of which EUR 3.00 million from the 'Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy' WP part.

[25] of which EUR 60.00 million from the 'Climate action, environment, resource efficiency and raw materials' WP part.

[26] of which EUR 20.00 million from the 'Climate action, environment, resource efficiency and raw materials' WP part.

[27] of which EUR 48.00 million from the 'Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing' WP part.

PILOTS-04-2017 (IA) PILOTS-05-2017 (RIA)			04 May 2017 (Second stage)
Opening: 20 Sep 2016			
FOF-06-2017 (RIA) FOF-07-2017 (RIA) FOF-08-2017 (IA) FOF-09-2017 (IA) FOF-10-2017 (IA)		85.00 [28]	19 Jan 2017
FOF-12-2017 (IA)		32.00 [29]	
FOF-12-2017 (CSA)		1.00 [30]	
SPIRE-07-2017 (IA) SPIRE-08-2017 (RIA) SPIRE-09-2017 (IA) SPIRE-10-2017 (RIA) SPIRE-11-2017 (CSA) SPIRE-12-2017 (CSA)		80.00 [31]	19 Jan 2017
Opening: 08 Nov 2016			
CIRC-01-2016-2017 (IA)		40.00 [32]	07 Mar 2017 (First stage) 05 Sep 2017 (Second stage)
CIRC-02-2016-2017 (IA)		30.00 [33]	

[28] of which EUR 85.00 million from the 'Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing' WP part.

[29] of which EUR 32.00 million from the 'Information and Communication Technologies ' WP part.

[30] of which EUR 1.00 million from the 'Information and Communication Technologies ' WP part.

[31] of which EUR 80.00 million from the 'Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing' WP part.

[32] of which EUR 40.00 million from the 'Climate action, environment, resource efficiency and raw materials' WP part.

Overall indicative budget	353.50	316.00	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

For two stage procedure:

- Information on the outcome of the evaluation: Maximum 3 months from the final date for submission for the first stage and maximum 5 months from the final date for submission for the second stage; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission of the second stage.

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes to the work programme. The following exceptions apply:

CIRC-03-2016	Due to the nature and objectives of this action, participants must be regional authorities and/or national/regional/local structures responsible for the implementation of Smart Specialisation strategies.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part H of the General Annexes to the work programme. The following exceptions apply:

	For single-stage and second-stage evaluations, the threshold for the criteria Excellence and Impact will be 4. The overall threshold, applying to the sum of the three individual scores, will be 12. In case of equal overall scores in the ranked list, the priority order of proposals will be established in accordance with part H of the General Annexes, except that proposals will be ranked on the basis of individual scores for the Impact criterion before the

[33] of which EUR 30.00 million from the 'Climate action, environment, resource efficiency and raw materials' WP part.

	Excellence criterion. In case of equal overall scores in the ranked list, the priority order of proposals will be established in accordance with part H of the General Annexes, except, when comparing *ex aequo* proposals of different topics, the proposals will be ranked first according to the position in the topic ranked lists

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in part H of the General Annexes.

The full evaluation procedure is described in the relevant guide published on the Participant Portal.

Consortium agreement: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

Call - Internet of Things

H2020-IOT-2016-2017

Internet of Things - Focus Area (IoT- FA) ambition is to foster the take up of IoT in Europe and to enable the emergence of IoT ecosystems supported by open technologies and platforms. It will be addressed through a complementary set of activities structured around Large Scale Pilots.

IoT Pilots will make use of the rich portfolio of technologies and tools so far developed and demonstrated in reduced and controlled environments and extend them to real-life use case scenarios with the goal of validating advanced IoT solutions across complete value chains with actual users and proving its enormous socio-economic potential.

Support actions provide consistency and linkages between the pilots and complement them by addressing horizontal challenges critically important for the take-up of IoT at the anticipated scale. These include ethics and privacy[34], trust and security, respect for the scarcity and vulnerability of human attention, validation and certification, standards and interoperability, user acceptability and control, liability and sustainability. A coordination body will ensure an efficient interplay of the various elements of the IoT-FA and liaise with relevant initiatives at EU, Member States and international levels.

Research and innovation effort in specific IoT topics will ensure the longer-term evolution of Internet of Things.

A novelty in Horizon 2020 is the Pilot on Open Research Data which aims to improve and maximise access to and re-use of research data generated by projects. Projects funded under the IoT call of the Work Programme 2016-17 will by default participate in the Pilot on Open Research Data in Horizon 2020.

Projects have the possibility to opt out of the Pilot. Participation in the Pilot is not taken into account during the evaluation procedure. In other words, proposals will not be evaluated favourably because they are part of the Pilot and will not be penalised for opting out of the Pilot.

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 DMP is required for projects participating in the Open Research Data Pilot. Other projects are invited to submit a DMP if relevant for their planned research. Only funded projects are required to submit a DMP.

[34] In the context of this call, the concept of privacy refers to the EU legal provisions applicable at the moment of pilot implementation in relation to both the "right to privacy" (right to respect for private and family life) but as well to the "right to protection of personal data".

Further guidance on the Pilot on Open Research Data and Data Management is available on the Participant Portal.

Proposals are invited against the following topic(s):

IoT-01-2016: Large Scale Pilots

Specific Challenge: The challenge is to foster the deployment of IoT solutions in Europe through integration of advanced IoT technologies across the value chain, demonstration of multiple IoT applications at scale and in a usage context, and as close as possible to operational conditions. Compared to existing solutions, the roadblocks to overcome include i) the integration and further research and development where needed of the most advanced technologies across the value chain (components, devices, networks, middleware, service platforms, application functions) and their operation at large scale to respond to real needs of end-users (public authorities, citizens and business), based on underlying open technologies and architectures that may be reused across multiple use cases and enable interoperability across those; ii) the validation of user acceptability by addressing, in particular, issues of trust, attention, security and privacy through pre-defined privacy and security impact assessments, liability, coverage of user needs in the specific real-life scenarios of the pilot, iii) the validation of the related business models to guarantee the sustainability of the approach beyond the project.

Scope: Pilots are targeted, goal driven initiatives that will propose IoT approaches to specific real-life industrial/societal challenges. Pilots are autonomous entities that involve stakeholders from supply side to demand side, and contain all the technological and innovation elements, the tasks related to the use, application and deployment as well as the development, testing and integration activities. Large scale validation is characterised by the fact that it will be possible to operate the functional entities implemented in the pilot under load and constraints conditions close to operational load one's, either with real traffic/request/processing loads, or with emulated loads where full implementation is not possible. Demonstration to operate the system across multiple sites, scalability to large amount of heterogeneous devices and systems, as well as with large amount of real users are expected. Pilot work plans should include feedback mechanisms to allow adaptation and optimisation of the technological and business approach to the particular use case.

Use of experimental testbeds, such as FIRE[35], and real-world demonstrations may support IoT technologies validation before they are deployed in field trials. Given the considerable amount of work carried out on M2M/IoT and Cyber Physical Systems architectures (e.g. IoT-A) open platforms (e.g. FIWARE, CRYSTAL, UniversAAL) and standards (e.g. oneM2M) over the last few years, pilots are encouraged to exploit this previous work where applicable with the objective of further demonstrating the generic applicability and interoperability of these and/or other architectures, platforms and standards, and to identify where standards are missing or should evolve, as well as needed pre-normative activities.

[35] Future Internet Research and Experimentation

IoT finds applicability in a broad range of industry, business and public services scenarios. On the basis of European relevance, technology readiness and socio-economic interest the following areas have been identified to be addressed with Large Scale IoT Pilots.

Pilot 1: Smart living environments for ageing well

The objective is to deploy innovative and user-led pilot projects capable of supporting and extending independent living at home for older adults based on Internet of Things (IoT) technologies. The smart living environments should be based upon an integrated system of a range of IoT-based technologies and services with user-friendly configuration and management of connected technologies for homes and outside.

They should provide seamless services and handle flexible connectivity while users are switching contexts and moving in their living environments. The proposed pilots should also demonstrate feasibility of integration with other relevant application domains such as energy, transport, or smart cities. The solutions shall build upon advanced IoT technologies, using and extending available open service platforms, standardised ontologies and open standardised APIs. Proposals shall address integration, standardisation and interoperability work on required ICT platforms, services and data sources, as well as on innovation in organisational and business models for service delivery.

Proposed solutions should take into account the specific requirements for accessibility, usability, cost efficiency, personalisation and adaptation arising from this application sector. They should be based on active user engagement from the outset and should involve a multi-disciplinary approach in order to ensure the understanding of user needs and their evolution, safeguarding ethics and privacy and the assessment of impact. This should include quality of life for older adults and their carers, care system efficiency gains, business and financing models and organisational changes required for service delivery.

A clear methodology for socio-economic impact assessment should be included. Large scale pilots should demonstrate the benefits of smart living environments based on IoT in terms of prolonged independent and safe living of older adults at home with good quality of life. The number of users involved and duration of pilot services should be sufficient to ensure statistical significance in impact analysis, with a minimum of 4 pilot sites in 4 countries.

Pilot 2: Smart Farming and Food Security

The implementation of Precision Agriculture has become possible thanks to the development of sophisticated sensors, robots and sensor networks combined with procedures to link mapped variables to appropriate farming management actions. Those sensors, either wired or wireless, integrated into an IoT system gather all the individual data needed for monitoring, control and treatment on farms located in a particular region. Such future Internet of Things scenario would bring data management to a new level by establishing interactions between the concerned objects, help them exchange information in efficient ways and enable them to execute autonomously appropriate interventions in different agricultural sub-sectors (e. g. arable crops, livestock , vegetable and fruit production) and their associated post-production

value chain through to the consumer. The introduction of the IoT scenario would allow monitoring and control of plant and animal products during the whole life cycle from farm to fork. It should thereby also help farmers' decision making with regard to the use of inputs and management processes. The challenge is to design architectures to "program" or track each object for optimal behaviour, according to its role in the Smart Farming system and in the overall food chain, decreasing use of water as well as other natural resources and inputs, lowering ecological footprints and economic costs as well as increasing food security. It also enables consumers to access trustworthy traceability information throughout the whole food chain.

Proposals shall include an adequate combination of different farms to ensure that the deployment of the technology is adapted to the needs of different types and sizes of farms across Europe. Activities should allow for a wide geographic coverage within Europe and benefit both conventional and organic agro-food chains. In addition, proposals shall cover at least three sub-sectors (e.g.arable crops, livestock, vegetable and fruit production).

Proposals should fall under the concept of multi-actor approach[36] and allow for adequate involvement of the farming sector in the proposed activities.

Pilot 3: Wearables for smart ecosystems

Demonstration of innovative wearable solutions and services integrated in interoperable IoT ecosystems. Wearables are integrating key technologies (e.g. nano-electronics, organic electronics, sensing, actuating, localization, communication, energy harvesting, low power computing, visualisation and embedded software) into intelligent systems to bring new functionalities into clothes, fabrics, patches, watches and other body-mounted devices. They assist humans in monitoring, situational awareness and decision making. Particular attention should be devoted to actuating functions providing whenever feasible fully automated closed-loop solutions. Prototype development and demonstration are expected for healthcare, well-being, safety, security and infotainment applications. Actions should be driven by concrete business cases, open design approaches and user requirements, taking into account data protection and liability concerns. They should involve the actors of the entire innovation value chain, potentially including creative and artistic actors, and aim at demonstrations in real world settings. The number of users involved should be sufficient to ensure statistical significance in impact analysis.

Pilot 4: Reference zones in EU cities

[36] The multi-actor approach aims at more demand-driven innovation through the genuine and sufficient involvement of various actors (end-users such as farmers/farmers' groups, fishers/fisher's groups, advisors, enterprises, etc. As a minimum, this material should feed into the European Innovation Partnership (EIP) 'Agricultural Productivity and Sustainability' for broad dissemination as 'practice abstracts' in the common EIP format for practitioners. Facilitation/mediation between the different types of actors and involvement of relevant interactive innovation groups operating in the EIP context, such as EIP Operational Groups funded under Rural Development Programmes, are strongly recommended. For further information on the multi-actor approach concept please refer to the Introduction to SC2 Work Programme.

Building on the past results and achievements[37] in some cities in Europe, a large scale pilot will cover a series of cities to operate as reference zones for showcasing and experimenting new citizen-centred IoT services. Starting from users' expressed preferences and needs, these cities will experiment and test similar new services and solutions, also through involvement of creativity hubs such as fablabs, co-working spaces, and gather experience at scale and evaluate citizens' acceptability and endorsement. It will enable SMEs to use open demonstrators to test innovative new services. This includes advanced solutions for traditional services' provisioning e.g. water management but also solutions that are at the edge of authorised business practices or regulation (ex: sharing of electricity, autonomous vehicles) and thus require dedicated testing zones. Whenever applicable, pilots will provide evidence of access to city areas where legal contexts are adapted to the demonstration requirements (i.e. 'reference zones'). Federation and interoperability between platforms may be considered as appropriate, as well as the ability to integrate data from different service providers. The number of users involved and duration of pilot services should be sufficient to ensure statistical significance in impact analysis, with a minimum of 4 pilot sites in 4 countries.

Pilot 5: Autonomous vehicles in a connected environment

The pilot addresses the added value and the potential of applying IoT for autonomous vehicles in a connected environment.

It should test scenarios of deployment of safe and highly and fully autonomous vehicles (up to SAE[38] international level 5, full automation) in various representative use case scenarios, exploiting local and distributed information and intelligence. Core technologies include reliable and real-time platforms managing mixed criticality car services, advanced sensors and Internet information sources around which value-added apps may be constructed, efficient navigation and improved decision-making technology, interconnectivity between vehicles, vehicle to infrastructure communication. Using advanced technologies for connectivity is seen as an asset. The selected scenarios will provide proofs of concept showing how such technology provides benefits affecting users on a daily basis, for instance on the highways or in urban congested environment, either on dedicated lanes or mixing autonomous connected vehicles and legacy vehicles. To make a real step towards future large scale deployment and to demonstrate dependability, robustness and resilience of the technology over longer period of time and under a large variety of conditions, priority will be given to permanent installations and sustainable pilots rather than to temporary prototypes or demonstrators.

These evolutions are expected to be supported by an open service platform which may have access to all in vehicle embedded information sources and to car surrounding information, in view of providing value-added apps e.g. intelligent maintenance. Key barriers to the deployment of such vehicles and ecosystems such as robustness of the perception, how to keep users of highly and fully automated vehicles sufficiently engaged and overall user acceptance are in scope, as well as economic, ethical, legal and regulatory issues.

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37 E.g. FIRE and FIWARE

38 Society of Automotive Engineers, J3016 standard

Specific Pilot considerations:

- Mapping of pilot architecture approaches with validated IoT reference architectures such as IoT-A enabling interoperability across use cases;
- Common or interoperable object connectivity/functionality/intelligence approaches on various levels – protocols, data formats
- Common or interoperable set of IoT related enablers and services. Pilots are requested to address the elements that provide the basis for interoperability with related fields outside the pilot especially for key aspects such as object identification/naming, service publication characteristics, search, semantic properties.
- For the incorporation of users of the pilots, developers of additional applications, replication of the pilot through new sites or new connected devices, and complementary assessment of the acceptability of the use case where appropriate, the actions may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. Each consortium will define the selection process of the third parties for which financial support will be granted (typically in the order of EUR 100 000 to 300 000[39] per party). Up to 20% of the EU funding requested by the proposal may be allocated to the purpose of financial support to third parties[40].
- Exchange on requirements for legal accompanying measures.
- Involvement of social scientists and representative user groups, in order to design systems that are useful and acceptable for people/citizens and optimise testing and experimentation.
- Integration of objects, devices and systems in an IoT environment adapted to the expressed needs of the users.

Pilots Implementation:

Pilots in the selected areas will clearly identify the supply and demand sides. The effort devoted to supply and demand should be balanced for each pilot.

The supply side represents the technological part of the pilot and addresses all the ICT elements that constitute the proposed approach. This includes:

- definition of the IoT architecture;

[39] In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded, and if this is the case proposals should explain why this is necessary to achieve the objectives of the action.

[40] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

- IoT platform choice, technologies , necessary adaptations, trade offs required for the application requirements, and their management,
- Retained platform deployment conditions, of non technological nature
- development and operation of the distributed IoT nodes;
- management and adaptation of involved sensing, actuating, processing, energy supply, storage technologies at node level (setting, programming, conditioning);
- integration of devices, objects and systems in an IoT environment;
- approaches to interoperability and openness;
- security and privacy approaches;
- contribution and compliance to relevant IoT standards;

The demand/user side of the pilot covers all the application and usage related elements. This includes:

- definition, design, implementation and testing of multiple use-case scenarios;
- setting up application(s) requirements in terms of performance, scale, reliability, cost, usability, maintenance;
- interoperability needs and testing;
- security and privacy needs;
- feed-back to IoT supplier for technology optimisation;
- users/citizen awareness, involvement and acceptance;
- pro-active uptake of societal (RRI-SSH) issues;
- impact, added value and affordability assessment;
- mechanisms for replication;
- business and sustainability models;
- pilot conclusions and validation from the user side;
- dissemination of results in relevant communities;
- contribution and compliance to relevant IoT standards.

Pilot projects are expected to contribute to the consolidation and coherence work that will be implemented by the CSA supporting the activities defined under "Horizontal Activities"

below. This requires that they contribute to clustering their results of horizontal nature (interoperability approach, standards, security and privacy approaches, business validation and sustainability, methodologies, metrics, etc.).

The Commission considers that proposals requesting a contribution from the EU up to EUR 30 million (pilot 2), up to EUR 20 million (pilot 1), up to EUR 15 million (pilots 3, 4) and up to EUR 20 million (pilot 5) would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one large pilot is supported for each area.

Expected Impact: Pilots are expected to have a high impact on citizens, both in the public and private spheres, industry, businesses and public services. Key performance indicators should be identified to measure progress on citizen benefits, economic growth, jobs creation, environment protection, productivity gains, etc.

Pilots' impact should go beyond involved partners and will aim at influencing external communities by putting in place appropriate mechanisms.

- Validation of technological choices, sustainability and replicability, of architectures, standards, interoperability properties, of key characteristics such as security and privacy;
- Exploration and validation of new industry and business processes and innovative business models validated in the context of the pilots.
- User acceptance validation addressing privacy, security, vulnerability, liability, identification of user needs, concerns and expectations of the IoT solutions
- Significant and measureable contribution to standards or pre-normative activities in the pilots' areas of action via the implementation of open platforms
- Improvement of citizens' quality of life, in the public and private spheres, in terms of autonomy, convenience and comfort, participatory approaches, health and lifestyle, and access to services.
- Creation of opportunities for entrepreneurs by promoting new market openings, providing access to valuable datasets and direct interactions with users, expanding local businesses to European scale, etc.
- Development of secure and sustainable European IoT ecosystems and contribution to IoT infrastructures viable beyond the duration of the Pilot.

For Pilot 1:

- Proposals should show clear evidence of the benefits of the proposed solutions for active and independent living and quality of life of older persons compared to current state of the art based on appropriate methodologies and metrics.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

IoT-02-2016: IoT Horizontal activities

Specific Challenge: The challenge is to ensure a sound coherence and exchanges between the various activities of the Focus Area, and notably cross fertilisation of the various pilots for technological and validation issues of common interest across the various use cases. Issues of horizontal nature and topics of common interest, such as privacy, security, user acceptance, standardisation, creativity, societal and ethical aspects, legal issues and international cooperation, need to be coordinated and consolidated across the pilots to maximise the output and to prepare the ground for the next stages of deployment including pre-commercial or joint public procurement. A related challenge is to foster links between communities of IoT users and providers, as well as with Member States' initiatives, and to connect with other initiatives including contractual Public-Private-Partnerships (e.g. in the area of Big Data, Factories of the Future, 5G-infrastructure), Joint Technology Initiatives (e.g. ECSEL), European Innovation Partnerships (e.g. on Smart Cities), other Focus Areas (e.g. on Autonomous transport), and RRI-SSH issues.

A related challenge addresses inter-operability and integration, through open IoT platforms across application areas such as FIWARE, CRYSTAL or SOFIA. It addresses the reference implementation of promising IoT standards serving the interoperability and openness objectives, by consolidating results obtained through standard implementation and pre-normative activities at the platform and/or pilot levels.

Scope: Proposals should cover one of the following set of activities (a or b):

a. Co-ordination of and support to the IoT Focus Area

- Focused Action level coordination ensuring consistent exploitation of the outcomes of the various projects forming the FA***:*** coordination of the projects and related pilot areas through mapping of pilot architecture approaches; interoperability and standards approaches at technical and semantic levels for object connectivity, protocols, data formats, privacy & security, open API***s;*** exchange on requirements for legal accompanying measures; development of common methodologies and KPI for design, testing and validation and for success and impact measurement; federation of pilot activities and transfer to other pilot areas, facilitating the access for IoT entrepreneurs/API developers/Makers and SME in general. The corresponding activities will be developed and consolidated together with the pilots at FA level, and include where appropriate results from other relevant activities in the Factory, smart city, and vehicle domains.

- Horizontal support: further development and exploitation of security and privacy mechanisms towards best practices and a potential label (“Trusted IoT”); legal support in

relation to data ownership and protection, security, liability, sector-specific legislations; contribution to pre-normative activities and to standardization both horizontally and in various application areas, also linked with IoT Governance. The corresponding activities will be developed and addressed in the pilots and consolidated at programme level under this horizontal support activity line. Promotion for sharing of conclusions and road-mapping with similar activities in countries and regions outside Europe, including convergence and interoperability of European and non-European IoT reference architectures/platforms. Exploitation of the combination of ICT & Art for stimulating innovation and acceptance; preparation for the next stages of IoT deployment including through pre-commercial or joint public procurement.

The Commission considers that proposals requesting a contribution from the EU up to EUR 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A minimum of one proposal will be funded.

b. RRI-SSH support to IoT

- Pilots shall be citizen-driven, involving existing and local communities at an early stage and addressing a combination of sustainability areas. The corresponding activities should accompany the pilots, analyse societal, ethical and ecological issues related to the pilots, and develop recommendations for tackling IoT adoption barriers including educational needs and skill-building. Consortium participation requires at least two entities from domains different than ICT technologies (e.g. social sciences, psychology, gerontology, economy, art, etc.).

The Commission considers that proposals requesting a contribution from the EU up to EUR 1 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Ensure efficient and innovative IoT take-up in Europe, building on the various parts of the initiative (pilots, research, horizontal actions)
- Efficient information sharing across the programme stakeholders for horizontal issues of common interests
- Extension and consolidation of the EU IoT community, including start-ups and SMEs
- Validation of technologies deployment, replicability towards operational deployment
- Validation in usage context of most promising standards and gap identification
- Strengthening of the role of EU on the global IoT scene, in particular in terms of access to foreign markets.

Type of Action: Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

IoT-03-2017: R&I on IoT integration and platforms

Specific Challenge: The future design of the Internet of Things applications will depend crucially on the development of sophisticated platform architectures for smart objects, embedded intelligence, and smart networks. Most of the today's IoT systems are however mainly focused on sensors, whereas in the future actuation and smart behaviour will be the key points.

Research driven by ambitious use cases and benefiting from innovation areas in components, systems, networking and web technologies needs to be carried out to respond to the ever increasing needs of future IoT systems in terms of scalability, heterogeneity, complexity and dynamicity. IoT platforms should be open and easy-to-use to support third party innovation

Scope:

- Architectures, concepts, methods and tools for open IoT platforms integrating evolving sensing, actuating, energy harvesting, networking and interface technologies. Platforms should provide connectivity and intelligence, actuation and control features, linkage to modular and ad-hoc cloud services, Data analytics and open APIs as well as semantic interoperability across use cases and conflict resolution. The work may also address the emergence of an open Web of Things like environment with search capabilities, so that "thing events" can be published, consumed, aggregated, filtered, re-published and searched for. Platforms should be compatible with existing international developments addressing object identity management, discovery services, virtualisation of objects, devices and infrastructures and trusted IoT approaches. Proposed research and innovation should take advantage of previous work and build on existing platforms, such as FIWARE, CRYSTAL or SOFIA, if appropriate.

- IoT security and privacy. Advanced concepts for end-to-end security in highly distributed, heterogeneous and dynamic IoT environments. Approaches must be holistic and include identification and authentication, data protection and prevention against cyber-attacks at the device and system levels. They should address relevant security and privacy elements such as confidentiality, user data awareness and control, integrity, resilience and authorisation.

Proposals should address above mentioned topics, verification and testing, and identify the added value of the proposed approach specific to IoT in comparison to generic solutions. They are expected to include two or more usage scenarios to demonstrate the practicality of the approach.

The Commission considers that proposals requesting a contribution from the EU of between EUR 3 and 5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Two or more of the following criteria should be addressed, with success metrics where appropriate.

- Evolution of platform technologies and contribution to scientific progress enabling novel, advanced semi-autonomous IoT applications.
- Strengthen the industrial EU technological offer of innovative IoT solutions
- Contribution to emerging or future standards and pre-normative activities
- Increase of IoT usability and user acceptance, notably through strengthened security and user control
- Support emergence of an open market of services and innovative businesses
- Promote the adoption of EU platforms in European and international context

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

Conditions for the Call - Internet of Things

Opening date(s), deadline(s), indicative budget(s):[41]

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2016	2017	
Opening: 20 Oct 2015			
IoT-01-2016 (IA)	100.00 [42]		12 Apr 2016
IoT-02-2016 (CSA)	4.00 [43]		
Opening: 08 Dec 2016			
IoT-03-2017 (RIA)		35.00 [44]	25 Apr 2017
Overall indicative budget	104.00	35.00	

Pilot 1 in IoT-01-2016 will be jointly funded by ICT-LEIT "Leadership in enabling and industrial technologies Information and Communication Technologies" and SC1 "Health, Demographic Change and Wellbeing". A budget of max. 10 M EUR will be equally contributed by SC1 and ICT-LEIT. Thus, the max. total budget for Pilot 1 is 20 M EUR.

Pilot 2 in IoT-01-2016 will be jointly funded by ICT-LEIT "Leadership in enabling and industrial technologies Information and Communication Technologies" and SC2 "Food security, sustainable agriculture and forestry, marine and maritime and inland water research

[41] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.
All deadlines are at 17.00.00 Brussels local time.
The Director-General responsible may delay the deadline(s) by up to two months.
The deadline(s) in 2017 are indicative and subject to a separate financing decision for 2017.
The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.
The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

[42] of which EUR 15.00 million from the 'Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy' WP part, EUR 10.00 million from the 'Health, demographic change and well-being' WP part, EUR 75.00 million from the 'Information and Communication Technologies ' WP part.

[43] of which EUR 4.00 million from the 'Information and Communication Technologies ' WP part.

[44] of which EUR 35.00 million from the 'Information and Communication Technologies ' WP part.

and the bioeconomy". A budget of max. 15 M EUR will be equally contributed by SC2 and ICT-LEIT. Thus, the max. total budget for Pilot 2 is 30 M EUR.

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes to the work programme.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part H of the General Annexes to the work programme.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in part H of the General Annexes.

The full evaluation procedure is described in the relevant guide published on the Participant Portal.

Consortium agreement: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

Call - SMART AND SUSTAINABLE CITIES

H2020-SCC-2016-2017

INTRODUCTION

European cities are forerunners in the transition towards a low carbon and resource efficient economy. A fast growing percentage (currently 72%) of the EU population lives in urban areas, using 70% of our energy. Quality of city life and the attractiveness of cities as environments for learning, innovation, doing business and job creation are now key parameters for success in the global competition for talent, growth and investments.

Key challenges for Smart and Sustainable Cities are to provide solutions to significantly increase cities' overall energy and resource efficiency through actions addressing the building stock, energy systems, mobility, climate change, water and air quality. Such actions should bring profound economic, social and environmental impacts, resulting in a better quality of life (including health and social cohesion), competitiveness, jobs and growth.

This new “Smart and Sustainable Cities” cross-cutting focus area aims at bringing together cities, industry and citizens to demonstrate solutions and business models that can be scaled up and replicated, and that lead to measurable benefits in energy and resource efficiency, new markets and new jobs. The scope will include the creation of urban spaces powered by secure, affordable and clean energy, smart electro-mobility, smart tools and services, innovative nature-based solutions and showcasing economic viability.

Particular focus will be on creating the right enabling frameworks for large-scale innovation at urban scale, including the development and testing of new business, financing and governance models that allow for quick replication at scale.

This cross-cutting call on Smart and Sustainable Cities comprises two distinct but mutually reinforcing parts.

Smart Cities and Communities (SSC1) focusses on demonstrating sustainable, cost-effective and replicable district-scale solutions at the intersection of energy, transport enabled by ICT. They should integrate smart homes, energy efficiency measures, very high shares of renewables, smart grids, energy storage, electric vehicles and smart charging infrastructures, using latest generation ICT platforms (and infrastructure) based on open specifications. This should in turn help to manage a successful transformation towards intelligent, user-driven and demand-oriented city infrastructure and services.

It continues with the 'lighthouse project' approach of the Smart Cities calls since 2014. The 2020 goal is to have a significant number of new lighthouse cities of all sizes all over Europe, in a very large number of Member States with various, climatic and economical positions.

Sustainable cities though Nature-based solutions (SSC2-4) focusses on providing evidence that re-naturing of cities through the deployment of innovative, locally adapted, systemic solutions - that are inspired and supported by nature - can be a cost-effective and economically viable way to make cities more sustainable, resilient, greener, and healthier. This will also help to increase their attractiveness for citizens, new economic activities and investments.

The replication of successfully demonstrated solutions can be further spread by the European Innovation Partnership on Smart Cities and Communities.

A novelty in Horizon 2020 is the Pilot on Open Research Data which aims to improve and maximise access to and re-use of research data generated by projects. Projects funded under 'Smart and Sustainable Cities' will by default participate in the Pilot on Open Research Data in Horizon 2020[45]

SMART CITIES AND COMMUNITIES

SCC-1-2016-2017: Smart Cities and Communities lighthouse projects

Specific Challenge: To demonstrate solutions at district scale integrating smart buildings, smart grids (electricity, district heating, telecom, water, etc.), energy storage, electric vehicles and smart charging infrastructures, using the latest generation ICT platforms (and infrastructure) based on open specifications. This should in turn help to manage a successful transformation towards intelligent, user-driven and demand-oriented city infrastructures and services.

This should be accompanied by energy efficiency measures and the use of very high shares of renewables at the level of districts.

Scope: Lighthouse cities develop and test integrated innovative solutions at large scale (at least district size). These lighthouse cities should become the most advanced cities in Europe and act as exemplars for their region by paving the way for replication of these solutions, adapted to different sizes and local conditions. They are fully committed to implement their Sustainable Energy Actions Plans approved by the Covenant of Mayors initiative. Links with

[45] Projects funded under the other parts of this Work Programme may participate in the Open Research Data Pilot in Horizon 2020 on a voluntary basis. Projects have the possibility to opt out of the Pilot. Participation in the Pilot is not taken into account during the evaluation procedure. Proposals will not be evaluated favourably because they are part of the Pilot and will not be penalised for opting out of the Pilot. 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 DMP is required for projects participating in the Open Research Data Pilot. Other projects are invited to submit a DMP if relevant for their planned research. Only funded projects are required to submit a DMP.

the broader Sustainable and Integrated Urban Development Strategies in the framework of the European Structural and Investment Funds should be sought as well as the funds available for the upscaling and replication of the projects (in particular ESIF). A city can be funded as a lighthouse city only once under Horizon2020.

Technologies should exist already or be very near-to-market (technological readiness levels TRL 7 and more, see part G of the General Annexes). The innovation is in the advanced combination of these technologies and the accompanying business models that enable deployment at large scale.

An important focus of this call is on replication of solutions: Follower cities are defined as cities that have not yet acquired the full technical competence to become a lighthouse city; however they shall be fully involved in the project from the beginning and have within the project enough committed resources to deliver a replication plan of most (if not all) the solutions developed within the project. Proof of long term commitment of follower cities to replicate validated solutions will be part of the evaluation. They shall replicate relevant measures within a few years after the end of the project (to do so they could use ESIF).

Follower cities shall study the lighthouse cities' solutions and – as part of the project and in a clearly structured and budgeted work plan – plan how best to implement the successfully demonstrated solutions in their city. Replication can also benefit from active knowledge transfer through e.g. active mentoring or staff exchange between cities.

The proposals should address a well-balanced combination of smart homes, smart energy and ICT systems and electric vehicles. The projects should cover:

1. A larger district of buildings (old or new or mixed and ideally nearly zero or low energy). These districts shall be adapted to the different sizes of the cities and the local conditions. Each building shall become smart, i.e. featuring the latest generation ICT, smart meters, smart appliances, smart energy management, smart use of the thermal mass; smart management of cooling (where applicable) etc. and capitalizing also on synergies between these single components). A larger number of smart buildings shall create a smarter district through intensive interaction between the buildings for increased synergies and decreased costs.

2. Smart interaction of different energy systems at districts level going far beyond classical electricity grids management only: smart management of electricity, heat, cold, gas or other grid systems (including water) with smart solutions for storage including the intelligent use of the thermal mass of buildings that exploit synergies between these urban grids in order to increase efficiency and reduce energy costs.

3. Integration with and/or consolidation of low carbon ICT systems at district level (communication networks, computing facilities, data centres).

4. Electromobility (in line with Directive 2014/94): smart EV charging (grid to vehicle and vehicle to grid) while ensuring a positive impact on the whole energy system from a

technical and economic point of view. Attention should be given to locally weak or old grids.

Each lighthouse city should:

- Significantly improve energy efficiency: Innovative integration of existing buildings with new buildings (especially in areas of mixed use such as university campuses, innovation districts, etc.).
- Incorporate RES based to a large degree on a high level of local resources (including waste heat, electricity and/or heat storage), high shares of self-consumption. The active participation of consumers (e.g. use of aggregators) must be demonstrated.
- Integrate electricity fuelling infrastructure for electric vehicle fleets for public transport or private transport or logistics or freight distribution. The positive/negative impact of the deployment of high numbers of vehicles on the electricity grid must be assessed (costs of the recharging infrastructure and the vehicles are not eligible).
- ICT solutions for improved planning management, control and maintenance of physical urban infrastructures and operational technologies in buildings, energy and transport, and that enable better services for individuals and businesses.
- Prove interoperability between software modules to allow an effective management of components and information flows. To this end, and to ensure adaptability as new user requirements and technologies evolve, urban ICT platforms must be non-proprietary and based on open specifications, including the data structures and APIs. Concerns about security, privacy and confidentiality need to be tackled.
- Develop innovative Business Models to demonstrate that both technical and financial risks are low enough for large scale investments in all cities: large or small, rich or poor, and irrespective of location. Deployment plans for the lighthouse cities and quick replication in the follower cities and potentially other cities shall be submitted (and will be part of the evaluation).

Each project should:

- Address concrete urban challenges identified by the respective urban authorities.
- Include partners from industry, public authorities, research communities and small and medium-sized enterprises.
- Have a performance monitoring which lasts for a period of at least 2 years.
- Have a convincing replication and investment plan for each lighthouse city and each follower city that describes (a)what the partners in each city will do in order to ensure a large scale replication in their city after the successful end of the project and (b) where the funding will come from (in particular whether ESIF would be used). The replication

plans are compulsory and are part of the evaluation. The investment plans shall show that after successful demonstration private capital can take over further investments at low technical and financial risks so that the economically weakest regions and cities of all sizes become attractive for investors.

- Have a consortium with clearly defined structure roles and responsibilities for all involved entities. The different actions in each city and between all cities (6 or more) must show excellent synergies. The added value of this cooperation versus each city alone must be clearly described.

- Have a well-balanced geographical coverage between lighthouse and follower cities.

- Commit to scientific and technical requirements to support reliability and sustainability: Open data and interoperability are necessary conditions to allow for ease of innovation for improved replicability and economies of scale, and so that solutions can be extended and lock-in of customers to specific solutions and/or vendors can be avoided.

- Contribute to common long term data collection systems, measurement and disclosure methodology, in order to facilitate a common footprint calculation methodology and other metrics (especially for energy saving; CO2 reductions, financial savings, number of jobs created, environmental impact etc.). All projects will foresee a work package for cooperation with other selected projects on business models and legal, regulatory and other market barriers (foresee about 2 % to 3% of the requested funds for inter-project cooperation).

- Incorporate all performance data into the Smart Cities Information System database (SCIS)[46] and cooperate with CITYKEYS, the support action selected in the 2014 call for performance measurement across sectors.

- Use a robust and viable monitoring protocol, also valid after the end of the project so that future data can easily be introduced into the SCIS.

Each project must:

- Be realised in 3 new lighthouse cities that are situated in different EU Member states or associated countries.

- Involve at least 3 follower cities from at least 3 different EU Member states or associated countries (that are different also from the countries of the lighthouse cities of the project).

Each lighthouse city must:

- Have Sustainable Energy Action Plan (SEAP), positively evaluated by the Covenant of Mayors (please attach proof in Annex).

[46] http://www.smartcities-infosystem.eu/

Non-eligible costs:

The costs of construction (including scale of unit costs), the costs of retrofitting (including scale of unit costs), the full cost of purchasing of electric vehicles, the costs of acquisition of standard ICT tools, conventional RES and their mounting are not eligible. Insulation of the building envelope, good windows; heat pumps, and other appliances are not eligible costs.

Eligible costs:

Eligible costs cover all those innovative aspects that transform the city into a smart city, such as for example:

- Integration of storage with all grids (across electricity, telecom, heating, cooling, gas, water, etc.).
- Smart building management incorporating smart appliances, smart meters, domotics, of which only the smart/innovative part that is leading to a deep integration with the local energy system (electricity, telecom, heating and cooling, gas) is eligible.
- Smart integration of the electricity grid with RES, with electricity storage and heat storage (or cold storage for air conditioning or cooling or freezing, etc.) at the district level; the smart use of the existing thermal mass for better building management and the integration with good HVAC is recommended and eligible.
- Only the innovative parts of RES, suited for smart integration of PV modules, wind turbines, innovative integration of heat pumps or CHP combined with smart management of heat and electricity are eligible.
- Proposals should focus on the development of integrated approaches and testing of "business" models for the local production and distribution of electricity together with electric vehicle fleets, to create the conditions for market take up in urban and sub-urban areas.
- Smart electricity, heat or cold storage and its management for maximising self-consumption is eligible.
- ICT: only platforms based on open specifications with open APIs, and that cater for data security and cyber-security are eligible.
- Economic research and development of new business models that avoid lock-in situations and that lead to reduction of the energy bills for citizens is eligible as well as the development of new templates for easy understanding and transparency of the energy bills.
- Replication plans have to be submitted with the initial proposal; further refinements and creating more ambitious targets during the project are eligible.

- Training and education within and between cities is compulsory and thus eligible.
- Including additional cities in the training and education (if the benefit is clearly stated) is eligible.

The Commission considers that proposals requesting a contribution from the EU of between EUR 12 to 18 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Each project shall significantly contribute to the impacts described below:

- Put in practice a solution for a challenge identified by the city;
- Increase the energy efficiency on district scale at least;
- Increase significantly the share of renewable energies, their integration into the energy system, stimulate self-consumption, reduce curtailment to the minimum;
- Increase local air quality;
- Reduce the technical and financial risks in order to give confidence to investors for investing in large scale replication
- Make the local energy system more secure, more stable and cheaper for the citizens and public authorities;
- Ensure the roll-out of electric vehicles in cities while containing the need for excessive upgrading of the electricity grid);
- Reduce transport based CO2 emissions , on the basis of CO2 intensity of the European electricity grid of 540 CO2/kWh (coherent with TEST format);
- Create stronger links and active cooperation between cities in a large number of Member States with a large coverage of cities with different size, geography, climatic zones and economical situations.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SUSTAINABLE CITIES THROUGH NATURE-BASED SOLUTIONS

The objective of this part of the call is to position Europe as world leader in innovating with nature to address urban societal challenges and thus support transition pathways towards sustainable urbanisation. Nature-based solutions, such as well-connected green and blue

infrastructure and green and unsealed surfaces in cities, green roofs, natural water retention measures, and salt marshes and dunes for coastal protection, are inspired and supported by nature and simultaneously provide environmental, social, cultural and economic benefits. They use the properties and functions of ecosystems to provide water regulation, flood risk protection, climate change adaptation, etc. They are designed to bring more nature and natural features and processes into cities, landscapes and seascapes, through locally adapted and systemic interventions. They are locally attuned, resource efficient, multi-purpose, multi-functional and multi-beneficial[47]. These key features of nature-based solutions make them different from 'grey' infrastructure, such as artificial river banks, dikes, etc. The analysis of the proposals submitted to the call for ideas launched by the European Commission in December 2014 showed a strong support for greening/renaturing cities as solutions for urban regeneration and change of lifestyles in Europe. Stakeholders supported green development initiatives, enhancement of urban social, cultural and economic resilience and climate change adaptation particularly with respect to flooding and heat stress. The outcomes of the Horizon 2020 Expert Group on nature-based solutions[48] have largely been taken into account in prioritising the challenges identified in this call to be addressed through the deployment of nature-based solutions and the knowledge gaps for which further evidence is necessary. EU-wide evidence and a European reference framework about the cost-effectiveness and longer-term social, economic, cultural and ecological benefits of these solutions to address societal challenges would contribute to create a global market, supporting both supply and demand, mobilise new investment strategies and promote their large-scale deployment.

SCC-02-2016-2017: Demonstrating innovative nature-based solutions in cities

Specific Challenge: Mass urbanisation presents one of the most urgent challenges of the 21st century. Rapidly developing and changing industrial activities, uncontrolled urban sprawl, large, concentrated and often culturally diverse populations have created numerous complex social and health problems. Cities and urban communities have to cope with challenges related poor air quality, heat island effects, increased flood risks, increased frequency/severity of extreme events (floods, droughts, storms, heat waves, etc.), derelict industrial sites, dis-functioning urban areas, increased criminality, social exclusion, inequalities, marginalisation, poverty and degraded urban environments. These challenges have serious impacts on human health, quality of life, well-being and security of citizens, particularly among the less privileged social classes.

Cities accounting for 72% of the European population are major contributors to climate change consuming 75% of global energy and emitting 80% of greenhouse gas generated by human activity. Growing urban populations, pollution and economic activities also place water resources under severe stress, exacerbating demand whilst affecting the quality and

[47] For instance, green roofs retain rainwater and thus reduce run off from storm water and thus decrease stress on sewer systems during peak periods. At the same time they increase the aesthetic value of the buildings and contribute to their natural cooling and heating and thus enhance the energy efficiency of the building and the city.

[48] http://ec.europa.eu/research/environment/index_en.cfm?pg=nature-based-solutions

quantity of supply. Climate change mitigation and adaptation and the sustainable management of water resources are therefore key challenges for the cities in Europe and beyond.

There is convincing but fragmented evidence that nature-based solutions can significantly enhance the climate and water resilience of cities. Furthermore nature-based solutions, by reshaping the built environment, can enhance the inclusivity, equitability and liveability of the cities, regenerate deprived districts, improve mental and physical health and quality of life for the citizens, reduce urban violence, and decrease social tensions through better social cohesion particularly for the most vulnerable groups e.g. children, elderly and people of low socioeconomic status.

The challenge is therefore to provide a robust, EU-wide evidence base and develop a European reference framework on nature-based solutions for regional and local city authorities, communities, enterprises and other stakeholders about the benefits, co-benefits, cost-effectiveness and economic viability of these solutions to enhance on the one hand climate and water resilience in cities and on the other hand to address inclusive urban regeneration in cities and thus promote their large scale deployment and the creation of a global market.

Scope: Projects should adopt a 'front-runner' and 'follower' cities approach, as described in more detail below, to facilitate the rapid exploitation, replication and up-scaling of the solutions and via large-scale demonstrations should aim to:

- develop, deploy at an appropriate scale of intervention[49] and demonstrate in 'front-runner' cities as 'living laboratories' innovative, replicable and locally attuned nature-based solutions, with a systemic impact at the scale of intervention, to address the challenges specified below. Solutions should be co-designed, co-developed and co-implemented in a trans-disciplinary, multi-stakeholder and participatory context and systemically embedded in an integrated urban and land use planning;

- assist 'follower' cities that commit to proactively seek advice, expertise, assistance, capacity building (e.g. through staff exchanges) and mentoring from the 'front-runners' and develop, within the duration of the project, a sustainable urban planning that systemically replicates, embeds and integrates the demonstrated nature-based solutions 'customised' to their particular context to successfully address the challenges specified below. This urban plan is a contractual obligation and should be delivered by the end of the project. 'Followers' should have privileged contacts with the project partners and access to the know-how and outcomes of the project and should participate in the definition of user requirements and the design of the methodology for replicating and transferring solutions, data, etc.;

[49] The scale of intervention proposed should be chosen in order to maximize both the size of the impact that it will make with respect to the overall urban context and the potential for up scaling/replicating at larger scales the tested nature-based solutions and the associated context allowing for their systemic, participatory, trans-disciplinary and multi-stakeholder design, development and deployment.

- engage the 'front-runner' cities (as 'coaching cities') in further networking and knowledge-sharing efforts with cities beyond those directly involved in the project to maximise the benefits of the project for a broader community beyond the limits of the project;

- set up a robust monitoring scheme to monitor, for a period of at least 2 years within the life of the project, the performance and assess the impact of the deployed solutions in an as quantifiable way as possible against a well-defined baseline regarding the challenges in the participating cities at the time of the proposal. Longer term commitment to monitoring and systematic documentation beyond the end of the project will give an added value to the proposal; develop methodologies to assess the efficacy, performance and cost-effectiveness of the solutions compared to alternative options, considering benefits, co-benefits (such as carbon sequestration, mitigation of heat island effects, natural cooling and heating, recreation due to dual use spaces, mitigation of soil sealing effects, enhanced soil, reduction of noise and air pollution, flood prevention/protection, enhancement of biodiversity and natural capital, human well-being and health, reduction of noise and air pollution, improvement of water quality etc., where these are not the primary objectives) and negative impacts that their deployment could entail when addressing the challenges specified below;

- develop methodologies for replication and up-scaling in different contexts of the solutions deployed in the 'front-runner' cities, including investment strategies, governance and business models and approaches for their systemic integration in the urban and land use planning;

- identify and assess potential regulatory, economic, social (such as gender, age, disability and culture) and technical barriers of relevance to these solutions and propose ways to overcome them;

- establish long-term sustainable data platforms to systematically document information and provide evidence on practices and lessons learnt regarding the deployment, cost-effectiveness (including benefits and co-benefits) and performance of nature-based solutions. deploy appropriate state-of-the-art digital technologies, ICT and innovative communication strategies and tools securing open access and interoperability along data infrastructures and a continuous building up of the 'knowledge portfolio' through future activities under Horizon 2020 and beyond.

Proposals shall address **all** of the above points. The involvement of social sciences and humanities in the project will be required to properly address these complex challenges.

Consortia should involve competent local, city and regional authorities, community groups, enterprises, academics and local communities in a clear structure with well-defined roles and responsibilities for all involved parties.

To maximise benefits at European level, each project shall involve at least 2 'front-runner' cities and 3 'follower' cities from different Member States and/or Associated Countries.

In addition to the coverage of the points mentioned above, the success potential of the proposal will be assessed according to the innovative character, the replicability and market potential of the nature-based solutions and of the systemic processes envisaged for their co-designing, co-developing and co-implementation, the long-term commitment, both political and financial, of the competent authorities that would guarantee the project implementation independently of possible changes in the urban political context during the project and the sustainability of financing, through mobilisation and leveraging of investments.

In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation is encouraged. To this end, participation of 'follower' cities from non-EU countries would enhance the potential for international replication, including in the context of, but not limited to, the EU-China Sustainable Urbanisation Partnership and the EU-China Innovation Dialogue. This would contribute to the creation of a global market for nature-based solutions.

Resources should be envisaged for clustering with other projects financed under the “Nature-based solutions for territorial resilience” part of the call for Societal Challenge 5 ' Climate action, environment, resource efficiency and raw materials', namely topics SC5-08-2017, SC5-09-2016 and SC5-10-2016, to optimise collaboration, synergies, interactions and mutual support to the achievement their corresponding objectives and, if possible, under other relevant parts of Horizon 2020.

Because of the substantial investments that might be necessary for implementing the nature-based solutions, additional and/or follow-up funding (private or public) should be sought, be it private or public, relevant regional/national schemes under the European Structural and Investment Funds (ESIF) and/or the European Regional Development Fund (ERDF), or other relevant funds such as the Instrument for Pre-accession Assistance (IPA II). In these cases, contacts could be established with the funds managing body during the duration of the projects. In case of relevance for the Research and Innovation Smart Specialisation Strategies (RIS3) the project proposals could already indicate which interested regions/countries or other partners have been pre-identified. Please note, however, that reference to such additional or follow-up funding will not lead automatically to a higher score in the evaluation of the proposal.

As illustrated by proposals responding to the call for ideas, the Commission considers that proposals requesting a contribution from the EU of at least EUR 10 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Proposals shall address **one** of the following issues:

a) Demonstrating innovative nature-based solutions for climate and water resilience in cities (2016)

Actions should aim to improve urban resilience to climate change (mitigation and adaptation) and enhance water resources management sustainability through deployment of nature-based solutions, or an optimal combination of nature-based solutions and other technologies. Trans-disciplinary and community-based approaches including social sciences and humanities in the co-designing, co-development and co-implementation of the solutions is considered necessary.

b) Nature-based solutions for inclusive urban regeneration (2017)

Actions should address nature-based solutions for inclusive urban regeneration – including regeneration of deprived districts, or neglected or abandoned areas[50]. They should also test to what extent nature-based solutions can reduce crime and security costs, and enhance human health, wellbeing and social cohesion.

The role of social innovation, and hence the participation of social sciences and humanities disciplines such as law, economics, political science, architecture or design studies, is particularly important to properly address these complex challenges.

Expected Impact: Projects are expected to contribute to:

- in the mid-term, the creation of an European reference framework and the establishment of EU leadership in a new global market (offer and demand) for nature-based solutions, new economic opportunities, new products, services, protocols and standards, leverage of investments, reduced regulative and administrative barriers, and new local green jobs;
- increased awareness of the benefits of re-naturing cities, creation of 'communities of practice', more effective policy making and better informed decision making across Europe based on an EU-wide evidence base regarding efficacy, efficiency and comparative advantages of a range of tested, well documented, up-scalable and marketable nature-based solutions;
- enhanced stakeholder and citizen ownership of the solutions through their effective and systematic involvement in participatory, trans-disciplinary and multi-stakeholder consultation processes for co-design, co-development and co-implementation of visionary urban planning;
- increased international cooperation and global market opportunities through replication of approaches and solutions in non-EU countries, including in the context of the EU-China platform;
- enhanced implementation of EU environmental policies, such as the EU Water Framework Directive, the 7th Environment Action Programme, the EU Biodiversity

[50] The scale of intervention proposed should be chosen in order to maximize both the size of the impact that it will make with respect to the overall urban context and the potential for up scaling/replicating at larger scales the tested nature-based solutions and the associated context allowing for their systemic, participatory, trans-disciplinary and multi-stakeholder design, development and deployment

Strategy to 2020, the EU Climate Change Adaptation Strategy, the 'Blueprint to safeguard Europe's waters' and the 'Communication on Green Infrastructures', and of the Sustainable Development Goals and UN conventions in the fields of biodiversity, soil and land management, disaster risk reduction.

In addition, **projects addressing part a)** are expected to contribute to:

- creating by 2020 healthier and greener European cities, with increased resilience to climate change (e.g. reduced flood risks, mitigated heat stress) and water-related challenges thanks to the implementation of nature-based solutions, with better living conditions for all, increased green infrastructure and biodiversity, improved air and water quality, reduced noise and health costs, improved mobility conditions, opportunities for urban farming[51] and increased social cohesion.

In addition, **projects addressing part b)** are expected to contribute to:

- creating by 2020, through the implementation of nature-based solutions, healthier, culturally diverse and greener regenerated (including deprived districts and neglected or abandoned areas) European cities, with better living conditions for all, reduced crime and security costs, increased green infrastructure and biodiversity, improved air and water quality, enhanced human health and wellbeing, reduced health costs, improved mobility conditions, opportunities for urban farming and increased social cohesion.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SCC-03-2016: New governance, business, financing models and economic impact assessment tools for sustainable cities with nature-based solutions (urban re-naturing)

Specific Challenge: Re-naturing cities can provide solutions to the multitude of challenges that cities are facing because nature-based solutions have proven to be multi-purpose and multi-beneficial. To enable the systemic integration of these solutions into a sustainable urban planning, new governance, business, financing models and partnerships are needed allowing for their co-designing, co-development and co-implementation by all stakeholders and societal actors, and leveraging of investments and synergies between private and public action.

Scope: Actions should:

- map and analyse existing experiences and practices and recommend innovative business models, financing mechanisms (e.g. crowd funding) and governance arrangements to develop socially acceptable urban 're-naturing' planning through participatory, multi-

[51] Urban farming is dealt with under the topic "SFS-48-2017: Resource-efficient urban agriculture for multiple benefits – Contribution to the EU-China Urbanisation Partnership"

stakeholder and trans-disciplinary way, involving also local communities, empowering citizens and allowing for an equitable distribution of costs and benefits (including co-benefits) at different scales and trade-offs resolution models, new forms of partnerships (e.g. public-private) and strategies for mobilising new investments and creating new business opportunities;

- develop and validate analytical frameworks and methodologies, tools, protocols, standards, indicators and matrixes to: characterize nature-based solutions; assess their cost-effectiveness (accounting for both benefits, co-benefits and possible negative impacts) as compared to alternative combinations of green/grey/hybrid solutions; identify their limits under different conditions and assess confidence intervals, performance thresholds and corresponding uncertainties;

- develop and validate decision-support tools, models, management strategies, guidelines and recommendations to assist the urban re-naturing design process and enable the systemic integration of these solutions into a sustainable urban planning, replicability and scalability;

- identify cultural, social, economic, institutional, legal, regulatory and administrative barriers, incentives/disincentives fostering/discouraging the implementation of nature-based solutions and bottlenecks at city, regional, national and EU level, including aspects such as citizens' perceptions, consumer behaviour and willingness to pay to conserve/enhance urban green space, for re-naturing cities to enhance their economic, social, cultural and environmental resilience, and recommend ways to overcome them.

Proposals shall address **all** of the above points.

The role of social innovation, and the participation of social sciences and humanities, is particularly important to properly address the complex challenges of this topic. Resources should be envisaged for clustering the projects financed under the Nature-based solutions for territorial resilience" part of the call for Societal Challenge 5 ' Climate action, environment, resource efficiency and raw materials', namely topics SC5-08-2016-2017, SC5-09-2016, and SC5-10-2016, to optimise collaboration, synergies, interactions and mutual support to the achievement of their corresponding objectives and – if possible – under other parts of Horizon 2020.

The Commission considers that proposals requesting a contribution from the EU of around EUR 7.5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Projects are expected to contribute to:

- develop enhanced strategies, new institutional and governance arrangements and new finance and business models, fostering multi-stakeholder involvement, citizens'

engagement and empowerment, leveraging both public and private funding of nature-based solutions in cities;

- kick-start of a collective learning process to foster creative and visionary urban design in re-naturing cities, securing an equitable distribution of the multiple benefits that city re-naturing entails to various stakeholders and citizens at different scales;
- develop an integrated evidence base and a European reference framework on nature-based solutions, in order to create a global market; new business opportunities, growth and jobs, and a green economy;
- optimise the policy and regulatory and administrative frameworks;
- shift in public and private investments from conventional to nature-based or effective combinations of nature/grey/hybrid solutions to urban challenges.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SCC-04-2016: Sustainable urbanisation

Specific Challenge: In a globalised world, cities all over the world are facing broadly similar challenges. Finding solutions and defining optimal pathways towards sustainable urbanisation receives high priority in the Research and Innovation (R&I) policy of the majority of the countries worldwide. In this context, aligning R&I agendas to underpin sustainable urbanisation and implementing them through international collaboration will promote synergies, and thus an optimal use of the available expertise, capacity and resources, avoid duplication and ensure robust outcomes of global relevance. The opening of JPI Urban Europe to third country partners is increasingly finding interest among its members and among third countries. The Belmont Forum provides an excellent platform for international collaboration in the area of sustainable urbanisation.

Scope: Proposals should pool the necessary financial resources from the participating national (or regional) research programmes with a view to implementing a joint call for proposals resulting in grants to third parties with EU co-funding in this area. Proposers are encouraged to include other joint activities including additional joint calls without EU co-funding. Actions should build on the international strategy of the JPI Urban Europe and launch in collaboration with the Belmont Forum at least one international call on sustainable urbanisation.

Participation of legal entities from international partner countries and/or regions, in particular with countries participating in the Belmont Forum, is encouraged in the joint call as well as in other joint activities including additional joint calls without EU co-funding. Participants from

countries which are not automatically eligible for funding[52] may nonetheless request a Union contribution (on the basis of the ERA-NET unit cost) for the co-ordination costs of additional activities.

The Commission considers that proposals requesting a contribution from the EU in the range of EUR 5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Actions are expected to lead to:

- the alignment of research and innovation agendas in the area of sustainable urbanisation and co-ordinated streamlining of the implementation of the respective calls;
- enhanced excellence and global relevance of research and innovation activities on sustainable urbanisation and increased visibility at international level;
- strong and lasting alliance with the funding agencies of key international partners for research and innovation actions on sustainable urbanisation (e.g China, Japan, Brazil, Mexico, USA etc.);
- linking of possible European and international demonstration actions on re-naturing cities to induce a wider, worldwide application of nature-based solutions.

Type of Action: ERA-NET Cofund

The conditions related to this topic are provided at the end of this call and in the General Annexes.

[52] http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/international-cooperation_en.htm

Conditions for the Call - SMART AND SUSTAINABLE CITIES

Opening date(s), deadline(s), indicative budget(s):[53]

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2016	2017	
Opening: 10 Nov 2015			
SCC-02-2016-2017 (IA)	40.00 [54]		08 Mar 2016 (First stage) 06 Sep 2016 (Second stage)
SCC-03-2016 (RIA)	15.00 [55]		08 Mar 2016
SCC-04-2016 (ERA-NET-Cofund)	5.00 [56]		
Opening: 08 Dec 2015			
SCC-1-2016-2017 (IA)	60.00 [57]		05 Apr 2016
Opening: 04 Oct 2016			
SCC-1-2016-2017 (IA)		71.50 [58]	14 Feb 2017

[53] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.
All deadlines are at 17.00.00 Brussels local time.
The Director-General responsible may delay the deadline(s) by up to two months.
The deadline(s) in 2017 are indicative and subject to a separate financing decision for 2017.
The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.
The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

[54] of which EUR 40.00 million from the 'Climate action, environment, resource efficiency and raw materials' WP part.

[55] of which EUR 15.00 million from the 'Climate action, environment, resource efficiency and raw materials' WP part.

[56] of which EUR 5.00 million from the 'Climate action, environment, resource efficiency and raw materials' WP part.

[57] of which EUR 60.00 million from the "Secure, Clean and Efficient Energy" WP part.

[58] of which EUR 71.50 million from the "Secure, Clean and Efficient Energy" WP part.

Opening: 08 Nov 2016			
SCC-02-2016-2017 (IA)		40.00 [59]	07 Mar 2017 (First stage) 05 Sep 2017 (Second stage)
Overall indicative budget	120.00	111.50	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

For two stage procedure:

- Information on the outcome of the evaluation: Maximum 3 months from the final date for submission for the first stage and maximum 5 months from the final date for submission for the second stage; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission of the second stage.

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes to the work programme. The following exceptions apply:

SCC-02-2016-2017	Each project shall involve at least 2 'front-runner' cities and 3 'follower' cities, as defined in the topic text, from different Member States and/or Associated Countries, due to the nature and objectives of the action and in order to maximise benefits at EU level.
SCC-1-2016-2017	Each project must: • Be realised in 3 new lighthouse cities that are situated in different EU Member states or associated countries. • Involve at least 3 follower cities from different EU Member

[59] of which EUR 40.00 million from the 'Climate action, environment, resource efficiency and raw materials' WP part.

	states or associated countries (that are different also from the countries of the lighthouse cities of the project). Each lighthouse city must: • Have Sustainable Energy Action Plan (SEAP), positively evaluated by the Covenant of Mayors (please attach proof in Annex)

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part H of the General Annexes to the work programme.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in part H of the General Annexes. The following exceptions apply:

SCC-1-2016-2017	The page limit for a full proposal is 150 pages.

The full evaluation procedure is described in the relevant guide published on the Participant Portal.

Consortium agreement: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

Budget[60]

	Budget line(s)	2016 Budget (EUR million)	2017 Budget (EUR million)
Calls			
H2020-IND-CE-2016-17		See footnote[61]	See footnote[62]
H2020-IOT-2016-2017		See footnote[63]	See footnote[64]
H2020-SCC-2016-2017		See footnote[65]	See footnote[66]
Estimated total budget		**577.50**	**462.50**

[60] The budget figures given in this table are rounded to two decimal places.
The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.
The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

[61] To which EUR 183.00 million from part 5.ii (budget line 08.020201) and EUR 3.00 million from part 9 (budget line 08.020302) and EUR 84.50 million from part 12 (budget line 08.020305) and EUR 83.00 million from part 5.i (budget line 09.040201) will be added making a total of EUR 353.50 million for this call

[62] To which EUR 213.00 million from part 5.ii (budget line 08.020201) and EUR 70.00 million from part 12 (budget line 08.020305) and EUR 33.00 million from part 5.i (budget line 09.040201) will be added making a total of EUR 316.00 million for this call

[63] To which EUR 15.00 million from part 9 (budget line 05.090301) and EUR 79.00 million from part 5.i (budget line 09.040201) and EUR 10.00 million from part 8 (budget line 09.040301) will be added making a total of EUR 104.00 million for this call

[64] To which EUR 35.00 million from part 5.i (budget line 09.040201) and will be added making a total of EUR 35.00 million for this call

[65] To which EUR 60.00 million from part 12 (budget line 08.020305) and EUR 60.00 million from part 10 (budget line 32.040301) will be added making a total of EUR 120.00 million for this call

[66] To which EUR 40.00 million from part 12 (budget line 08.020305) and EUR 71.50 million from part 10 (budget line 32.040301) will be added making a total of EUR 111.50 million for this call