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COUNCIL DECISION ESTABLISHING THE SPECIFIC PROGRAMME IMPLEMENTING HORIZON 2020 - THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION (2014-2020)

WORK PROGRAMME 2014 – 2015

5. Leadership in enabling and industrial technologies

ii. Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing

INFORMAL DRAFT DISCUSSION DOCUMENT

Important notice:
The present document is meant to facilitate the discussions towards the preparation of the work programme 2014 – 2015. It does not at this stage cover all relevant aspects and it does not prejudge the outcome of the on-going interinstitutional negotiations on Horizon 2020 or internal work on cross-cutting aspects. Hence, it remains subject to change. Information, such as indicative budgets per call/area, will be provided at later stage.

Date: 11/09/2013

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Introduction to Leadership in Enabling and Industrial Technologies (LEIT)

1. Policy context and objectives

This part of Horizon 2020 focusses on new opportunities for industrial leadership in ICT, the mastering and deployment of key enabling technologies, and space. These are areas of industrial key competences which determine Europe's industrial capacities and global competitiveness, and their generic nature enables new business opportunities in a variety of sectors and for innovative SMEs. Aiming at new and breakthrough technologies, this part of the programme will contribute to boosting competitiveness, creating jobs and supporting growth. In this context it will help to achieve the EU Industrial policy goals[1] and represents an important component of the EU Strategy for Key Enabling Technologies (KET)[2].

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

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

The funded projects will be *outcome oriented*, developing key technology building blocks, bringing solutions closer to the market, and paving the way for industrial and commercial implementation, including in areas of societal challenges. Proposers are asked to demonstrate how the exploitation of results will generate the expected impact and contribute to the European economy.In general, research and innovation actions in this part of the Work Programme may be enhanced through synergies with other EU, national or regional programmes (supported or not by the European Structural and Investment Funds) through a combination of funding sources. Such combinations are encouraged, and some of the topics particularly suitable for mobilising additional funding from other available instruments have been flagged, for example to explore paths to commercial exploitation or to deploy technologies developed within Horizon 2020, and may be subject to more specific actions in this respect at a later stage.

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

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

[2] 'Preparing for our future: Developing a common strategy for key enabling technologies in the EU' (COM(2009)512);

'A European strategy for Key Enabling Technologies – A bridge to growth and jobs' (COM(2012)341)

[3] See COM(2012)341, pp. 17-18 and Annex X to the Work Programme. *NB: The box serves as reference, will be dropped in the final version*

TRL 1 – basic principles observed

TRL 2 – technology concept formulated

TRL 3 – experimental proof of concept

TRL 4 – technology validated in lab

TRL 5 – technology validated in relevant environment (industrial environment in the case of KETs)

TRL 6 – technology demonstrated in relevant environment (industrial environment in the case of KETs)

TRL 7 – system prototype demonstration in operational environment

TRL 8 – system complete and qualified

TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of KETs; or in space)

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

3. Public-private partnerships (PPPs)

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

The LEIT part of Horizon 2020 includes the following PPPs:

Contractual PPPs:

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

Joint Technology Initiatives:

- The Joint Technology Initiative on Electronic Components and Systems for European Leadership (ECSEL) will replace the two existing Joint Undertakings on embedded computing systems (ARTEMIS) and nano-electronics (ENIAC) that were set up under the Seventh Framework Programme.
- A new Joint Technology Initiative on Bio-based Industries will be established .

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

4. Cross-cutting KETs

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

The integration of different KETs represents a vital activity in Horizon 2020. Over the course of H2020, around 30% of the budget allocated to KETs will go to integrated KETs projects. Cross-cutting KETs activities will in general include activities closer to market and applications. Examples include pilot lines and demonstrator projects at high TRLs (5-8), but also activities at lower TRLs that address specific value chains with a view to subsequent innovation at higher TRLs. Manufacturability will often be a key issue on the innovation path towards the market, and pilot activities will combine at least two different KETs and integrated advanced manufacturing technologies/processes in a way that value is created beyond the mere addition of the individual technologies for a component or product.

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

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

To allow public and private stakeholders to pave the way for large-scale pilot projects in these areas, the cross-cutting KET activities are complemented by actions addressing specific cross-cutting issues (exchange of information and best practices, expression of interest, exploring possibilities for combined funding, etc.).[4]

High-performance production:

- Development of novel materials and systems for OLED lighting or displays
- Pilot line for OLEDs on flexible substrates
- Pilot line for analytical mid-infrared (MIR) micro-sensors
- Pilot line for PIC fabrication on III-V and/or dielectric based platforms
- Research and innovation actions related to Advanced Thin, Organic and Large Area Electronics (TOLAE) technologies
- All activities under the initiative "Factories of the Future"
- Additive manufacturing for tabletop nanofactories
- Open access pilot lines for cost effective nanocomposites
- Integration of novel nano materials into existing production and assembly lines

[4] ***The box with the list of topics and areas serves as reference, and will be dropped in the final version***

- Manufacturing and control of nanoporous materials
- High definition and high throughput 2D & 3D printing of multifunctional materials
- Synthesis and functionalisation of nanomaterials for printing applications
- Novel nanomatrices and nanocapsules
- Multi-KETs pilot plant for the scale-up of innovative nanomedicine production

The JTI on 'Electronic Components and Systems' ECSEL will support industrially driven R&D projects, and in particular pilot production lines and large scale demonstration activities. It will also include multi-disciplinary pilot lines that integrate, as a minimum, advanced manufacturing and typically materials research for advanced electronics-based products, e.g., those dealing with intelligent micro-nano sensors, silicon-photonics, or solid-state lighting.

Embedded energy:

- The activities related to embedded energy are under the cross-cutting *Green Vehicles* initiative [in Societal Challenge 4].

Smart Structures

- *Activities related to smart structures are under the initiative Energy-efficient buildings*

Industrial Processes using Renewable resources:

- A major goal of the Joint Technology Initiative on Bio-based Industry initiative is to overcome the innovation 'valley of death', the path from research to the marketplace. Biotechnology can deliver technological breakthroughs in the biomass to bio-product value chain, such as for the deconstruction of recalcitrant biomass as well as for the conversion of biomass into e.g. chemical building blocks, biomaterials, etc. The integration of other KETs in these joint activities, such as advanced biomaterials, may also be envisaged.
- Further contributions are under the *Sustainable Process Industry (SPIRE)* initiative; and in Societal Challenge 5 in relation to waste and raw materials.

5. Seizing the ICT opportunities

ICT underpins innovation and competitiveness across a broad range of private and public markets and sectors. ICT also enables scientific progress in all disciplines.

The potential and capabilities of modern ICT systems are still growing exponentially fuelled by the progress in electronics, microsystems, networking, the ability to master increasingly

complex cyber-physical systems and robots and progress in data processing and human machine interfaces.

These developments provide major opportunities for Europe to develop the next generation of open platforms on top of which a multiplicity of innovative devices, systems and applications can be implemented.

These new solutions will enable a wealth of new business developments in particular for SMEs and will contribute to boosting competitiveness, creating jobs and supporting growth.

Main features:

The first ICT Work Programme under H2020 provides a balanced response to the main challenges faced by Europe in the field: firstly, the need to maintain a strong expertise in key technology value chains; secondly, the necessity to move quicker from research excellence to the market.

It combines a strong support to industrial roadmaps with new mechanisms to encourage disruptive innovation. The former will reinforce medium to long term commitment to industrial strategies and provide continuity and stability. The latter will offer flexibility and openness and will help develop dynamic eco-systems in which innovators can operate. Both strands will require the involvement of new actors, on one hand to exploit and leverage new technologies and on the other to initiate and drive change.

6. Contributions to solving societal challenges and focus areas

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

ICT Calls:

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

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

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

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

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

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

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

The call on Sustainable Process Industries (SPIRE), and to a large extent the call on Factories of the Future, make key contributions to the focus areas on waste as a resource to recycle and reuse and on competitive low-carbon energy.

Biotechnology call:

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

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

Space call:

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

7. Cross-cutting aspects

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

a. International cooperation

In line with the objectives of the Union's strategy for international cooperation in research and innovation (COM(2012)497), Horizon 2020 is open to international cooperation. Certain topics have been identified as being particularly suitable for international cooperation.

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

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

b. Responsible research and innovation

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

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

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

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

ICT Part

Call for Nanotechnologies, Advanced Materials and KET support actions

H2020-NMK-2014/2015

Disclaimer to be added regarding 2015 topics which are not yet open.

This call includes topics on nanotechnologies, advanced materials, and support for the deployment of KETs. It includes contributions to cross-cutting KETs, and addresses both KETs for multiple applications, and KETs for applications in specific societal challenges or focus areas; as well as safety, outreach, structuring, business models and other innovation issues.

Bridging the gap between nanotechnology research and markets

This challenge addresses three of the key European nano-enabled industrial value chains: lightweight multifunctional materials and sustainable composites; structured surfaces; and functional fluids. The potential of multifunctional nanomaterials and composites has been demonstrated in RTD actions for several application sectors, such as packaging, transport and construction. However, a number of barriers need to be addressed, in order to leverage large scale market introduction of such innovative, safe and sustainable products. Activities addressing this challenge will therefore implement the next steps towards the deployment and market introduction of lightweight, multifunctional, economical and environmentally friendly nano-enabled products for different applications, by scaling up laboratory experience to industrial scale and by demonstrating the viability of a variety of manufacturing technologies.

The main challenge is to develop seamless integration of technologies and processing for using nanomaterials in production; to improve the control and monitoring of the conditions required for the use of nanomaterials in industrial processes; to increase the level of robustness and repeatability of such industrial processes; to optimise and evaluate the increased performance and functionality of the product as well as that of the production line in terms of productivity *in actual operational environment*. SMEs are particularly affected and are invited to participate, in order to develop and make use of the needed economic and knowledge and infrastructure capacity to carry out the required developments of process control, metrology and lifecycle analysis in-house, which represent critical steps before committing to pilot production.

NMK 1 - 2014: Open access pilot lines for cost effective nanocomposites

Specific challenge: The field of nanocomposites materials has witnessed remarkable progress in recent years with many different types of polymer nanocomposites exhibiting radically enhanced properties for a wide range of industrial applications. New manufacturing routes are also emerging, such as in-situ synthesis. The main objective is to develop cost effective industrial scale technologies for the production of nanocomposites for specific applications, aiming at the selection, testing and optimisation of materials and process parameters as well

as the verification of the nanocomposite performance for a given application in a pilot line setting, representative of operational industrial environments and ready for the start of pilot production as the next step (after the project).

In order to enable SMEs to enter this crucial stage of the research-development-innovation cycle, larger enterprises and/or research and technological organisations are asked to get together in order to provide a coordinated network of pilot line, test and validation services for SMEs 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 commercialisation stage.

Scope: The development and construction of pilot lines: Pilot line development may include new methods and/or instrumentation with real time characterization (including high-throughput) for measurement, analysis and operations at the nanoscale to characterise nanofillers dispersion with improved resolution and/or increased sensitivity, based on novel approaches or novel combinations of approaches.

The operation of the pilot lines – testing and validation include: : selection and tailoring of nano-particles/objects having the required interfacial interaction and/or compatibility with the polymer matrix to be utilised in the nanocomposite; selection of a processing technique and optimization of process parameters addressing proper dispersion and distribution of nano-particles or nano-particle aggregates within the polymer matrix.

Projects should address a range of industrial applications and involve a number of composite producers, addressing in particular the needs of SMEs active in this sector. Plans for operating the network of pilot lines as well as the individual pilot line facilities after the end of EU financial support should be prepared within the project, including business plans for the cooperation with SMEs.

The implementation of this project is intended to start at TRL 4-5, target TRL 6. Implemented as cross-KET activities.

Expected impact:

- A European eco-system for high TRL testing and validation of nano-composites, affordable and accessible for SMEs, through technical collaboration between RTOs and composite producers and through identification of all critical value chain players for the market introduction of the final product.
- Enabling of investment decisions for market introduction of novel, cost-effective and sustainable nano-enabled products that demonstrate superior performance in terms of multifunctionality and sustainability, e.g. in the packaging, transport and construction sectors.
- Demonstrated scaling-up and increased degree of automation of nanocomposites production lines/processes, leading to higher production volumes, improved reliability and repeatability of produced nanocomposites and lower production cost; availability of new or significantly improved "fit for purpose" tools for integration in those lines;
- Contribution to standardisation in the nano metrology field for fast product and process design.
- Promoting safe-by-design approaches in collaboration with the EU nano-safety cluster and contributing towards the framework of EU nanosafety and regulatory strategies[5].

[5] EU Nano-safety strategy 2015-2020 and NanoReg project

Type of action: Research & Innovation Actions (100% funding)

NMK 2 - 2015: Integration of novel nanomaterials into existing production lines

Specific challenge: Nanomaterials are intended to improve the performance of existing production technologies, and to give new functionalities to products, such as lightweight solutions for transportation and construction, enhanced solutions for packaging, decreased wear and friction of yarns, and high-performance thermal insulation and UV shielding fibrous materials (e.g. hollow fibres). However, such new nanomaterials need to be introduced into production and the correct controlled conditions need to be created and maintained in industrial processes.

Scope: The scope of the topic covers the *development and demonstration in operational environments*, *up to qualification of the production system* the integration of technologies and processing for using novel nanomaterials in production; to improve the control and monitoring of the conditions required for the use of nanomaterials in industrial processes; to increase the level of robustness and repeatability of such industrial processes; to optimize and evaluate the increased performances of the production lines in terms of productivity; to assess the functionality and performance of the produced component/product.

The implementation of this project is intended to start at TRL 5-6, target TRL 7-8, Implemented as cross-KET activities.

Expected impact:

- Accelerated market uptake of nanomaterials and products in one or more of the following sectors: fibre, yarn and textile; packaging products; energy; construction and building; and transportation;
- Improvement in existing manufacturing processes through integration of nano materials, demonstrating better resource efficiency, safety, sustainability and recyclability of a wide variety of components and final products;
- Improvement in technical knowledge on the integrated manufacturing processes for nanomaterials in terms of productivity and cost-effectiveness.
- Contribution to development of business plans that encourage private sector investment for future business growth.
- Promoting safe-by-design approaches in collaboration with the EU nano-safety cluster and contributing towards the framework of EU nanosafety and regulatory strategies[6].

Type of action: Innovation Actions (70% funding)

NMK 3 - 2015: Manufacturing and control of nanoporous materials

Specific challenge: There is a constantly growing interest in nanostructured porous materials, thanks to the many applications that can benefit from controlled porosity at the nanoscale.

[6] EU Nano-safety strategy 2015-2020 and NanoReg project

Nanoporous materials can have many kinds of pore geometries, structures and chemical compositions and possess unique surface, structural, and bulk properties that underline their important uses in various fields such as ion exchange, separation, catalysis, sensor, thermal insulation and purifications. While various methods are available for creating nanoporous materials in a laboratory environment, scaling-up and meeting the industrial demands in terms of quality and costs remain a challenge.

Scope: Projects should address the *development and demonstration in relevant environments* of reliable processes control and manufacturing routes, to obtain nanoporous materials with controlled porosity distribution aiming at improved mechanical properties, reliable permeation rate, high electrical resistance or other thermophysical and transport properties.

Projects should demonstrate the effectiveness of the developed approaches and technologies, through a pilot line aimed at the production of semi-finished products. The process and the material proposed should support and reflect developing guidance and standards relating to nanomaterials aspects.

The implementation of this project is intended to start at TRL 4-5, target TRL 6. Implemented as cross-KET activities.

Expected impact:

- Supporting European competitiveness through accelerated market uptake of nanoporous materials in one or more of the following sectors: transport; energy; construction and building; medical equipment; and filtration; Improvement in cost-effectiveness and sustainability of nanoporous materials with a verified market viability of the pilot line;
- New market opportunities through introduction of novel products enabled by nanoporous materials;
- Demonstrated scaling-up of production of nanoporous materials, leading to higher production volumes, improved reliability and repeatability of products with lower production cost;
- Improvement in technical knowledge concerning manufacturing processes of nano porous structuring of materials with innovative methods and solutions.
- Contribution to on-going and future standardisation work in the field[7]
- Promoting safe-by-design approaches in collaboration with the EU nano-safety cluster and contributing towards the framework of EU nanosafety and regulatory strategies[8].

Type of action: Innovation Actions (70% funding)

NMK 4 - 2014: High definition printing of multifunctional materials

Specific challenge: Roll-to-roll (R2R) manufacturing encompasses a wide range of processes for high volume manufacturing involving flexible substrates. The use of R2R manufacturing has widened from paper and textiles to advanced multi-layer coatings and/or stacks, and to

[7] See Mandate M/461 addressed by the European Commission to CEN/CENELEC and ETSI. http://www.cen.eu/cen/Sectors/Sectors/Nanotechnologies/Documents/M461.pdf

[8] EU Nano-safety strategy 2015-2020 and NanoReg project

new industries with applications in printed electronics. Currently there is significant interest on the part of manufacturers in adapting R2R technologies for the miniaturisation of feature sizes to the nanoscale, which would provide a new and disruptive manufacturing technology.

Scope: Projects should address industrial needs by *developing and demonstrating in relevant environments* 2D and 3D printing with higher definitions (down to nanoscale) and higher throughput utilising novel materials. Technical challenges relate to developing suitable printing technologies for high resolution and a wide range of materials; achieving overlay accuracy, especially for multi-material applications; and obtaining the right functionality after drying/sintering.

Pilot line setting should be used to verify production speed and reliability, as well as sufficient yield, quality and functionality of the intended application.

The implementation of this project is intended to start at TRL 4-5, target TRL 6. Implemented as cross-KET activities.

Expected impact:

- Significant improvements in industrial productivity in comparison with traditional processes, such as lithography, verified in a pilot line setting in terms of production speed and reliability, as well as sufficient yield, quality and functionality of the intended application;
- Contribution to improved resource efficiency, safety and sustainability of R2R printing processes and related products;
- Contribution to improved technical knowledge on R2R printing at the nanoscale, leading to new products and creating market opportunities for European industries;
- Identification of gaps in standards, paving the way for future pre-normative activities in the field.
- Promoting safe-by-design approaches in collaboration with the EU nano-safety cluster and contributing towards the framework of EU nanosafety and regulatory strategies[9].

Type of action: Innovation Actions (70% funding)

NMK 5 - 2014: Nanomaterials for printing applications

Specific challenge: The migration toward low cost liquid based high-resolution deposition and patterning processes such as ink jet, and screen printing compatible with plastic substrate and roll-to-roll systems requires that suitable nanomaterials formulations (inks) are available for end users in industrially relevant quantities.

Scope: Projects should aim at *developing and demonstrating in relevant environments* the synthesis and functionalisation of inorganic and hybrid nano-materials, for printing applications with high process throughput. Technical challenges relate to the optimisation of the synthesis process for controlling the crystallinity and morphology of functional particles, as well as obtaining the rheological properties needed for wet deposition technologies. The

[9] EU Nano-safety strategy 2015-2020 and NanoReg project

developed nanomaterials formulations should demonstrate process compatibility, non-toxicity, environmental friendliness and low-cost.

The implementation of this project is intended to start at TRL 4-5, target TRL 6. Implemented as cross-KET activities.

Expected impact:

- Supply of low cost, high performance and environmentally friendly nanomaterials tailored for R2R processing, allowing European manufacturers to exploit the great growth opportunity in this field;
- Creation of new market opportunities for nanomaterials suppliers, SMEs in particular;
- Promote closer collaboration between materials suppliers, production engineers, equipment manufacturers and end-users, addressing the full value chain and leading to a competitive advantage in the market introduction of the final products;
- Contribution to standardisation in relation to nanomaterial interaction with the R2R printing process for better product and process design.
- Promoting safe-by-design approaches in collaboration with the EU nano-safety cluster and contributing towards the framework of EU nanosafety and regulatory strategies[10].

Type of action: Innovation Actions (70% funding)

NMK 6 - 2015: Novel nanomatrices and nanocapsules

Specific challenge: Encapsulation technologies have been widely used for a long time in the pharmaceutical industry for drug delivery applications. The emergence of nanotechnology and the availability of novel tools have paved the way for a new type of nanomatrices and nanocapsules, which can be used for targeted delivery and can carry payloads for localised action. Such technologies are increasingly applied in nanomedicine but also in a wide range of consumer products, like cosmetics, household cleaning products etc.

Scope: Projects should address applications for safe, controlled and reliable novel nanomatrices and nanocapsules containing active ingredients (e.g. drugs in nanomedicine, vitamins or anti-oxidants for cosmetic products, or cleaning and antimicrobial agents for housecleaning products), as well as their manufacturing processes. Different types of inorganic nanomatrices and nanocapsules are required, depending on the nature of the material (hydrophobic or hydrophilic) to be incorporated. Technical challenges relate to the production techniques involved (such as coacervation or phase separation) for improving the stability of the nano formulation and the active ingredients (payload) involved; development of novel mechanisms for the release of the payload is a further challenge. Safety considerations and contribution to standardization should be an integral part of the projects.

Activities expected to be implemented at TRL 4-5. Implemented as cross-KET activities.

Expected impact:

[10] EU Nano-safety strategy 2015-2020 and NanoReg project

- Supply of safe, energy- and resource-efficient manufacturing systems for nanomatrices and nanocapsules, with the potential for radical improvements in therapy and/or quality of life;
- Benefit the European healthcare and/or consumer sector through novel new systems and improved collaborations between the key actors in the value chain;
- Paving the way for the future commercialisation of such products, based on an analysis of the efficacy, safety and cost-benefit of products utilising nanomatrices/nanocapsules for the end-users or patients.
- Promoting safe-by-design approaches in collaboration with the EU nano-safety cluster and contributing towards the framework of EU nanosafety and regulatory strategies[11].

Type of action: Research & Innovation Actions (100% funding)

NMK 7 - 2015: Additive manufacturing for table-top nanofactories

Specific challenge: Additive manufacturing delivers a new manufacturing paradigm: it makes the rapid, distributive manufacture of complex objects possible, and has the potential to reduce waste. What is truly transformative about additive manufacturing is the potential to manufacture individual products anywhere in the world, and to customise each of them. Rather than make manufactured goods in one place and ship them around the world, additive manufacturing technologies, such as 3D printing makes it possible to send design blueprints instantaneously via the internet, and manufacture them when and where they are needed.
3D printers are growing in sophistication, and can create increasingly complex objects, including those with different component parts. Breakthroughs in techniques such as metal sintering mean that 3D printers are no longer restricted to generic plastics. The use of nanoparticles in 3D printing is progressing rapidly, and could vastly increase the range of products that can be manufactured in this way, potentially including chemicals.

Scope: As a part of a wider initiative towards nano-manufacturing, the objective of this topic is to advance the state-of-the art of AM materials through modification of their fundamental material properties using nanotechnology and to develop novel additive manufacturing 'printing' techniques that incorporate new functionalities in the manufactured components. For example, carbon nanotube structures could be embedded and combined with the printing process to perform electronic functions such as sensing and communications, or flexible polymer materials could be used to create bio-inspired structures.

Activities expected to be implemented at TRL 4-5. Implemented as cross-KET activities.

Expected impact:

- Enables Europe to compete at the forefront of the additive manufacturing revolution, which in the long term will lead into entire new production and consumption paradigms;
- Enables manufacturing activities by SMEs to enter markets with innovations that were not possible before;
- Widening the range of available AM materials and functionalities in products will accelerate the transition of AM from mere prototyping towards production and use;

[11] EU Nano-safety strategy 2015-2020 and NanoReg project

- Enabling functionality embedded in AM parts displaces the need for multiple manufacturing operations, making AM processes even more cost effective;
- Enabling the identification of future development needs in related fields, e.g. in seamless design-to-manufacturing software and standardization for material and process quality.
- Promoting safe-by-design approaches in collaboration with the EU nano-safety cluster and contributing towards the framework of EU nanosafety and regulatory strategies[12].

Type of action: Research & Innovation Actions (100% funding)

[12] EU Nano-safety strategy 2015-2020 and NanoReg project

Nanotechnology and Advanced Materials for more effective Healthcare

This challenge taps into the potential of nanotechnologies and advanced materials to enable more effective therapies for important diseases. Despite this potential, the translation process from the pre-clinical laboratory-scale proof-of-concept to the actual clinical application is a major innovation challenge that can easily be underestimated. Following a successful proof-of-concept at the pre-clinical laboratory scale, the production technologies of the nanomedicines and nanomaterials have to be scaled-up to the pilot-scale, to provide production quantities that are sufficient for clinical testing. A preliminary design of the clinical tests has to be prepared early-on. The manufacturing of the nanomedicines and nanomaterials has to take place under Good Manufacturing Practice (GMP) conditions. Robust manufacturing and quality control processes therefore need to be developed, according to the medical regulatory requirements. At the same time a complete and efficient industrial supply chain needs to be established to provide the necessary products and services to support all this development. This innovation requires a highly interdisciplinary approach with many interactions between nanotechnologists, materials scientists, biomedical researchers, clinicians, industrialists and regulatory specialists. The aim here is to develop the technologies and therapies to the point where they can be considered fit for purpose to start clinical trials, Clinical trials are not included in the research projects, except for allowing Phase I clinical trials if this is specifically mentioned in the topic description.

The assessment of the expected impact should take into account the medical/therapeutical dimension of the proposed solutions, as well as the impact on the supply industry and the process of organising, executing and assessing clinical tests. This includes aspects of responsibilities, access to information, technology transfer for companies, with particular regard to SMEs, and new forms of cooperation between academia, research centres and industrial actors, public and private. Sustainability principles and values and the objectives of the EU 2020 Strategy need to be addressed, together with competitiveness aspects in terms of reducing time-to-market and trial costs for the different actors involved. Dissemination of results should contribute to increasing the awareness in medical communities as well as in the public about more efficient and less costly therapies – based upon innovative approaches and broader accessibility of effective therapies – supporting improved patient compliance. As relevant, further aspects of interest from a social sciences and humanities perspective could be addressed e.g. in support of dissemination and exploitation as well as in the validation of the achieved results.

Gender issues and other aspects such as age, weight or physical constitution should be taken into account in the description of activities, to ensure the research as well as the technologies/ innovations to be developed would be suited to both women and men and a further diversity of patients concerned.

NMK 8 - 2014: Scale-up of nanomedicine production

Specific challenge: The scale-up of nanomedicines production from pre-clinical laboratory scale to the quantity and GMP quality needed for clinical testing is severely hindered by a lack of pilot manufacturing capacity and supply infrastructure. The quantities required for clinical testing studies are modest (e.g. in the order of ten to hundred grams), but such pilot processes do not fit easily into existing manufacturing plants. The lack of a pilot manufacturing supply chain is especially problematic for SMEs and other organisations that do not have the necessary resources to develop the processes in-house.

Scope: Projects shall develop one or more pilot lines and processes for the scaling-up of the production of innovative nanomedicines to the quantities needed for clinical testing, taking into account the medical regulatory requirements. The pilot lines shall be developed with the appropriate characterisation and quality control processes. The medical regulatory requirements must be taken into account. The nanomedicines selected for scaling-up shall be translatable and in an advanced stage of pre-clinical development, with positives perspectives to proceed to clinical testing. The clinical testing is not part of the project.

The implementation of this project is intended to start at TRL 4-5 and target TRL 6-7. Implemented as cross-KET activities

Expected impact:

- Improve GMP nanomedicines supply for enabling clinical trials, further validating and demonstrating the effectiveness of nanomedicines for medical therapies;
- Leveraging of existing investments in successful pre-clinical nanomedicine research;
- Increase of the attractiveness of Europe as a location-of-choice to carry out advanced medical research and product development, due to improved nanomedicine supply capacity.

Type of action: Research & Innovation Actions (100% funding)

NMK 9 - 2014: Networking of SMEs in the nano-biomedical sector

Specific challenge: Many innovative nano-biomedical developments are initiated by small companies. However, they often miss the necessary knowledge of the regulatory requirements for translation of their ideas, of the market and of the financial aspects of funding the developments and the business. The development and supply chain also show shortcomings. The SMEs are usually fragmented, dispersed and rarely organised in representative associations to address these problems. This result is missed opportunities for innovation. This is especially true in nanomedicine, covering diagnostics, therapy and regenerative medicine.

Scope: In order to alleviate this problem, the ETP Nanomedicine developed the concept of a 'Translation Hub'. This Coordination and Support Action shall provide advice and follow-up at all stages of the research and development and provide examples of best practice to European R&D teams in nano-bio-medicine. It shall provide SMEs and other organisations with a technological and business oriented assessment of their technologies and provide business advice before engaging further resources and efforts for preclinical and clinical tests.

The Coordination and Support Action shall network SMEs, aiming to improve their knowledge of translation in a sustainable way; to build bridges with academia and hospitals; and to link them with large companies and investors. It shall provide education and training in translation and entrepreneurship to academia and SMEs and help showcasing of preclinical or early clinical proofs of concepts to large companies and investors. It will assist nanomedicine research projects in better anticipating the requirements of the translation process, in order to improve the probability of the developments to reach the market. It will also engage in communicating about nanomedicine to the public.

Expected impact:

- Reinforce support to European SMEs and academia as drivers of innovations in nanomedicine, by assisting them in the development of their bottom-up ideas, going from pre-clinical proof of concept to late clinical trials.
- Improve the innovation capacity of the European nano-bio-medical sector – especially at the level of SMEs - through catalysing a more effective translation process from research into industrial marketable products.
- Improve the knowledge in the research community of the translation, regulatory and business aspects of new nano-biomedical developments, leading to more efficient use of resources and research.

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Type of action: Coordination and Support Action; no more than one action will be funded

NMK 10 - 2014: Biomaterials for the treatment of diabetes mellitus

Specific challenge: Diabetes mellitus and its complications have become a major public health problem. It causes significant physical and psychological morbidity, disability and premature mortality among those affected and imposes a heavy financial burden on health services.[13] The ultimate goal for all research into its cure is effective long-lasting blood glucose normalisation and stabilisation for both type I and type II diabetic patients, at levels comparable to those achieved by intensive insulin therapy in the Diabetes Control and Complications Trial (DCCT). Despite improvements in the insulin pharmaceutical efficacy and delivery methods, this approach still has major limitations, significantly impacting on patients' quality of life.

Scope: Projects should develop one or more functional biomaterials for long-term clinical efficacy of transplanted pancreatic islets, and the safe and reliable harvesting of cells from identified source(s), which facilitate highly sensitive identification/screening and sorting of isolated cells; allow for easy handling and safe storage of isolated cells and/or tissue engineering constructs; provide immunoprotection and facilitate construct grafting in target anatomical areas; as well as clinically-reflective in vitro models useful as indicators of long-term in vivo behaviour. A realistic endpoint of the project should be described and justified. Proposals should generate comprehensive pre-clinical data. After completion of the project, the material should be in an optimal position for entering clinical trials. Preclinical regulatory matters, including the investigational medicinal product dossier (IMPD), should be completed or taken to an advanced stage. Experimental protocols should be planned in accordance with the provisions of the Advanced Therapy Medicinal Products (ATMP) Regulation. Also, the standardisation and manufacturing process can be addressed including up-scaling and good manufacturing practice (GMP).

Activities expected to be implemented at TRL 5.

Expected impact:

- Improvement of the quality of life of both Type I and Type II patients with diabetes mellitus;

[13] A recent study found that the total cost of diabetes (direct and indirect) is estimated to exceed €188 billion in 5 study countries (UK, Spain, Italy, France, Germany) of the EU alone. The absolute number of diabetics in the EU27 is expected to rise from approximately 33 million in 2010 to 38 million in 2030.

- Reduced direct and indirect costs linked to the disease and its treatment, and wide availability of treatments;
- Implementation of relevant objectives of the European Innovation Partnership on Active and Healthy Ageing (COM (2012)83).

Type of action: Research & Innovation Actions (100% funding)

NMK 11 - 2015: Nanomedicine therapy for cancer

Specific challenge: Promising pre-clinical nano-medicine proof-of-concepts have been developed for therapy of cancer, but their translation into clinical therapies remains a major challenge. An important bottleneck is the up-scaling under Good Manufacturing Practice (GMP) conditions of the production of the nanomedicines from the pre-clinical labscale to the quantity needed for clinical testing.

Scope: The aim is to translate promising novel nano-technology enabled therapies for cancer with pre-clinical proof-of-concept, from a pre-clinical lab stage up to clinical testing Phase I. The project shall start from an established pre-clinical proof-of-concept, with relevant efficacy and toxicity data. The project shall be focused on the translation process, so that ultimately new effective therapies can be introduced to the European healthcare market. An important aspect is the development of a pilot line for scaling-up the production of the nanomedicines and the quality control, taking into account Good Manufacturing Practice (GMP) and the medical regulatory requirements. Projects may include the later stages of pre-clinical testing and the clinical testing Phase 1, but the clinical testing is not required. Nanopharmaceuticals may be manufactured with either a top-down or a bottom-up approach, using for example self-assembling technology. Applicants must describe, according to industrial criteria, how they will address and de-risk the various barriers for getting their new therapy into clinical application, including technical, IPR, competitive, commercial and regulatory criteria, with efficacy and toxicity. They must pay attention to the clinical trial design. The foreseen research and commercial path to market introduction has to be well outlined.

The research is to be implemented from TRL 4/5 and target to reach TRL 6/7.
Implemented as cross-KET activities.

Expected impact:

- Potential major improvement in clinical cancer therapy, thereby providing enhanced quality of life for patients.
- Potential reduced direct and indirect healthcare costs linked to the disease and its treatment.
- Accelerated introduction of new nanotechnology enabled cancer therapy, through robust manufacturing and quality control procedures for new nanotechnology enabled drugs.

Type of action: Innovation Actions (70% funding)

NMK 12 - 2015: Biomaterials for treatment and prevention of Alzheimer's disease

Specific challenge: An estimated 7.3 million Europeans in the EU27 between 30 and 99 years of age suffered from different types of dementias in 2006 (14.6 per 1 000 inhabitants), most of these being of the Alzheimer's variety. Innovative approaches based on biomaterials can improve the treatment and prevention of Alzheimer's disease.

Scope: Projects should develop new multifunctional biomaterials, as part of eventual Medical Devices and Advanced Therapies, which aim to create, optimise, enhance, substitute or support therapeutic interventions in Alzheimer's disease. They should include: materials and devices for early detection and advanced diagnostics, biocompatible and biodegradable biomaterials as part of minimally invasive treatments, theragnostic materials, smart bioactive and biocompatible materials with improved longevity. The development of new drug candidates for Alzheimer's and clinical trial are excluded.

The development of new integrated experimental and computational approaches aimed to describe interface processes and their determinants should be considered as key step for the design of safe and performing materials. Experimental protocols should be planned taking due account of current good laboratory practice (GLP) and ISO guidelines. Standardisation and manufacturing processes can be addressed, including upscaling, good manufacturing practice (GMP), process analytical technology (PAT), and regulatory work in respect of relevant regulations as appropriate.

Activities expected to be implemented at TRL 5.

Expected impact:

- Improved quality of life due to minimally invasive action;
- Reduced direct and indirect costs linked to the disease and its treatment;
- Implementation of relevant objectives of the European Innovation Partnership on Active and Healthy Ageing (COM (2012) 83).

Type of action: Research & Innovation Actions (100% funding)

Nanotechnology and Advanced Materials for low-carbon energy technologies and Energy Efficiency

The EU has made the commitment to reduce greenhouse gas emissions by 20% below 1999 levels by 2020, with a further reduction to at least 80% by 2050. In addition, there are legal targets that renewables should cover 20% of final energy by 2020, coupled with a 20% energy efficiency objective.

This challenge taps into nanotechnologies and advanced materials as foundations of low-carbon energy technologies which in turn support the EU objectives to increase the use of renewable energy sources and to significantly improve energy efficiency. The objective is to develop to a technology readiness demonstrating their potential for take-up in practical applications, which would be further pursued in technology or product development under the relevant societal challenge. The activities will make important contributions to implement the Materials Roadmap Enabling Low Carbon Energy Technologies, which is endorsed by the industrial initiative EMIRI (European Materials Industrial Research Initiative). Time to market for the new technologies should be assessed with a view to providing a contribution to the EU 2020 targets.

NMK 13 - 2014: Storage of energy produced by decentralised sources

Specific challenge: Electricity will increasingly be produced by sources which are geographically decentralised and/or intermittent by their nature. There is an urgent need to increase the storage of energy, in order to improve on the stability of weak grids, to be able to intentionally island the electricity distribution, and to ensure the continuity of energy supply.

Scope: Research proposals should develop innovative materials solutions that will make storage technologies more available, better performing and more cost effective. The solutions should exploit as much as possible synergies between technologies, contributing to the development of hybrid systems. Activities addressing enhanced performance of chemical storage in hydrogen will be covered by the Fuel Cell & Hydrogen Joint Undertaking, and hence outside the scope of this topic.

Taking into account the requirements for Regional Policy in this Programming Period, notably to establish Smart Specialisation Strategies, regions are invited to express their interest in addressing this topic area in their respective programmes , as well as their interest in potentially exploiting and deploying the technologies to be developed under this call. For this purpose the tools provided by the Smart Specialization Platform, Eye@RIS3, http://s3platform.jrc.ec.europa.eu should be used.

This topic is particularly suitable for matching EU funding with national and/or regional funding programmes, notably related to smart specialisation strategies, for the exploitation and deployment of project results.

Activities expected to be implemented at TRL 5.

Expected impact:

- Alleviation of geographical constraints for low carbon energy production, with increased efficiencies at a reduced cost;
- Reduction of the barriers to increase the penetration rate of distributed and /or intermittent renewable energy sources;

- Realisation of a new generation of energy technologies that will support the competitiveness of European industries through the realisation of a new generation of storage technologies based on advanced materials;
- Implementation of relevant parts of the Materials Roadmap Enabling Low Carbon Energy Technologies (SEC (2011) 1609), and relevant objectives of the SET-Plan.

Type of action: Research & Innovation Actions (100% funding).

NMK 14 - 2015: ERA-NET on Materials for Energy

Specific challenge: Rolling out the low-carbon technology mix that would make the EU energy system clean, secure, efficient and competitive will critically depend on the availability of new materials and processing routes. The Materials Roadmap Enabling Low Carbon Energy Technologies (SEC (2011)1609) was recently published in the context of the Strategic Energy Technology (SET) Plan. A strategic and industrial relevant approach to implement this roadmap needs to cover the entire research and innovation chain by pooling together the national research and innovation capacities, thereby mobilising European infrastructure networks as well as promoting education and training in low-carbon energy technologies.

Scope: The proposed ERA-NET aims at coordinating the research efforts of the participating Member States, Associated States and Regions in the field of materials for enabling low carbon energy technologies and to implement a joint transnational call for proposals with EU co-funding to fund multinational innovative research initiatives in this domain. Only COFUND eligible partners can participate.

The Commission considers that projects requesting a contribution from the EU of around EUR X would allow this topic to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected impact:

- Synergies and coherence in key fields of industrial materials research at national and regional level, in particular contributing to the medium and long term needs of identified energy applications;
- Implementation of relevant parts of the Materials Roadmap Enabling Low Carbon Energy Technologies (SEC(2011)1609), and relevant objectives of the SET-Plan (COM (2009)519).

Type of action: ERA-NET (COFUND).

NMK 15 - 2015: Materials innovations for the optimisation of cooling in power plants

Specific challenge: Currently, power generation requires enormous amounts of cooling water, ranking second to the volume of water used for agriculture. As an example, a typical 500 MW thermal electricity plant equipped with a cooling tower evaporates 26 million litres of water per day (the equivalent of the daily water consumption of more than 43 000 EU families). Once-through cooling systems consume less water but withdraw significantly more: the same plant equipped with a once-through system would withdraw typically 1.4 billion litres of water per day, returning it to the water source about 10-15°C warmer. Such systems not only impose serious burdens on the local water management and the environment, but also limit the development of distributed power generation (foreseen by the SET plan) by their stringent

requirements concerning cooling. The lack of adequate cooling water may even lead to power plant shutdowns.

Scope: Research proposals should develop robust materials solutions for optimising cooling in thermal power plants by

- Allowing their functioning at higher temperatures, thus increasing their efficiency and reducing the amount of water withdrawn or consumed;
- Allowing the use of alternative cooling fluids (including air-based or hybrid coolants); and
- Increasing the available effective water supply, either by permitting to upgrade the quality of the water (e.g. using membranes) or by improving the robustness of the cooling equipment. Proposals should include activities to test the proposed solutions in relevant existing pilot plants.

Note: Thermal power plants include, inter alia, plants fired by coal, natural gas, liquid fossil fuels, as well as geothermal and solar thermal plants. Non-thermal power plants, such as wind turbines or PV plants/installations consume considerably less water during their operational life; projects should not deal mainly with materials solutions to reduce the water consumption in such non-thermal plants.

Activities expected to be implemented at TRL 6.

Expected impact:

- Significant reduction of the amount of water, in particular cleaner water, used in thermal power plants within one or more application areas;
- Implementation of relevant parts of the Materials Roadmap Enabling Low Carbon Energy Technologies (SEC(2011)1609); and relevant objectives of the SET-Plan (COM (2009)519).
- Type of action: Innovation Actions (70% funding).

NMK 16 - 2015: Extended in-service life of advanced functional materials in energy technologies (capture, conversion, storage and/or transmission of energy)

Specific challenge: Functional materials are enabling the large scale market penetration of secure, sustainable and affordable energy based on low-carbon, decentralised power generation. The benefits of using advanced functional materials can often be demonstrated in terms of, e.g., more efficient energy generation, storage or transmission, under controlled conditions. The high up-front investment costs of new power plants requires lifetimes of the order of 20 to 25 years, with minimal down and service time. However, not enough is known about the degradation of such materials during long-term service. This can seriously hamper the industrial uptake of such materials; increase the initial investments due to over-specification of the material requirements; or increase the exploitation costs, either by downtime due to materials related failure or due to more intensive maintenance schedules.

Scope: Projects should investigate the long-term in-service degradation of functional materials that have already demonstrated enhanced performance in terms of energy capture, conversion, storage and/or transmission of energy, and the capability of a production at a scale that could warrant an industrial uptake. Projects should include relevant modelling and testing under realistic conditions at pilot level. They should focus on improving the practical understanding of long-term in-service degradation on the performance of the functional

material and its impact on the overall performance of the technology components and systems. The development of improved materials solutions as well as relevant roadmaps and a catalogue of good practices should be included.

Activities expected to be implemented at TRL 6.

Expected impact:

- Reduction of the capital (CAPEX) and/or operating (OPEX) expenditures in specific low carbon energy technologies;
- Implementation of relevant parts of the Materials Roadmap Enabling Low Carbon Energy Technologies (SEC(2011)1609); and relevant objectives of the SET-Plan (COM(2009)519).
- Type of action: Innovation Actions (70% funding).

Exploiting the cross-sector potential of Nanotechnologies and Advanced materials to drive competitiveness and sustainability

This challenge addresses the development of nanotechnologies and advanced materials with a view to their use in several different applications and economic sectors, with the dual aim of boosting the competitiveness of European industry and making contributions to a sustainable economy. This includes contributions to European culture and creativity through novel materials. The emphasis is on enabling multi-sectorial potential, by developing and advancing technological readiness of solutions with break-through potential. International cooperation in this general area is particularly appropriate.

NMK 17 - 2014: Development of novel materials and systems for OLED lighting or displays

[Topic jointly implemented with the ICT part of LEIT, and appearing under the FoF call in this version as FoF 0 - 2014]

NMK 18 - 2014: Materials solutions for use in the creative industry sector

Specific challenge: The recent communication 'Promoting cultural and creative sectors for growth and jobs in the EU' highlighted the competitive advantage that creative and cultural inputs bring to the European industries. The most obvious example is the wider use of design in manufacturing industries, adding value to products, services, processes and market structures. Firms spending twice the average amount on creative inputs are 25% more likely to introduce product innovations (COM (2012) 537).

An innovative, sustainable approach in conceiving, developing, producing, using and recycling materials can be effective in strengthening the competiveness and success of the European creative industries linked to manufacturing (e.g. architecture, art, crafts, supports for cultural items, decoration, fashion, furniture, lighting, interior design materials and products, jewels, luxury, media supports, publishing, sport and toys), adding value to products and processes also by "intangible" factors (e.g. enhanced sensations, values) .

Scope: Research proposals should address the development of innovative material solutions for use in the creative industry sectors based on waste or process by-products to produce new materials or adopting bio-mimetic approaches. A sustainable and socially responsible approach to reduce energy consumption and environmental impact should be clearly demonstrated. Proof of concept in terms of product and/or process must be delivered within the project, excluding commercially usable prototypes (in compliance with European Commission Communication 2006/C323/01), but convincingly demonstrating scalability towards industrial needs.

In order to ensure the industrial relevance and impact of the research efforts, the cost effectiveness and commercial potential of the innovative technologies compared to state-of-the-art solutions currently available on the market should be convincingly assessed in the proposal. The active participation of designers, societal stakeholders, materials suppliers, manufacturers and end users of the resulting products represents an added value and this will be reflected in the second stage of the evaluation.

Taking into account the requirements for Regional Policy in this Programming Period, notably to establish Smart Specialisation Strategies, regions are invited to express their interest in addressing this topic area in their respective programmes , as well as their interest in potentially exploiting and deploying the technologies to be developed under this call. For this purpose the tools provided by the Smart Specialization Platform, Eye@RIS3, http://s3platform.jrc.ec.europa.eu should be used.

This topic is particularly suitable for matching EU funding with national and/or regional funding programmes, notably related to smart specialisation strategies, for the exploitation and deployment of project results.

Activities expected to be implemented at TRL 6*; particularly suitable for SME participation.*

Expected impact:

- Innovative sustainable material solutions for products with lower environmental footprint for use in the creative industry sector;
- Strong interaction of all actors along the value chain;
- New business opportunities for the European industry via novel material solutions, with suitable-for-use properties and controlled environmental impact;
- Contribute to achieving the relevant EU policy objectives in COM(2012)537: Promoting cultural and creative sectors for growth and jobs in the EU.

Type of action: Innovation Actions (70% funding)

NMK 19 - 2015: Materials for severe operating conditions, including added-value functionalities

Specific challenge: The need to develop materials which can perform well in severe operating environments is increasing with advances in technology and requirements for higher efficiency in all areas such as manufacturing, energy generation, transport and communications etc. This poses a major challenge for materials science, and requires a fundamental understanding of how the processing, microstructures and properties of such material interact in order to enhance their response under more severe conditions.

The general aim is to develop new products with a step change in efficiency (e.g. photovoltaic systems, solar collectors, lasers, nano-scale electronics for computers and communication, fuel cells, batteries, fire resistant materials and high temperature operating materials for turbines and heat exchangers for more efficient jet engines and power plants, new insulating, conducting, and magnetic materials).

Scope: Projects should develop bulk materials that can function within an aggressive environment without property degradation, synthesise new structures with useful properties, and force chemical reactions that normally result in damage to proceed along selected pathways that are either benign or initiate the self-repair of damage.

Projects should include appropriate numerical tools (e.g. density functional theory, molecular dynamics) to capture the multi-scale evolution of damage; and predictive modelling tools for materials operating in extreme environments. Standardisation and/or the production of (certified) reference materials may also be addressed as an integrated part of the research

proposal. Proof of concept in terms of product and/or process must be delivered within the project, excluding commercially usable prototypes, but convincingly demonstrating scalability towards industrial needs. The cost effectiveness and commercial potential of the innovative technologies compared to state-of-the-art solutions currently available on the market should be quantified during the project, with the involvement of end users. The environmental sustainability of each proposed solution should also be assessed with special emphasis on efficient materials usage.

Activities expected to be implemented at TRL 5.

Expected impact:

- Increase in competitiveness and sustainability of European industry through high value products and manufacturing processes in various sectors, e.g. transport, energy, electronics etc;

- Employment and training through engagement in cutting-edge technologies.

Type of action: Research & Innovation Actions (100% funding)

NMK 20 - 2014: Widening materials models

Specific challenge: The future of the European industry relies *inter alia* on a strong modelling capacity. An efficient approach is needed to shorten the development process of materials-enabled products, being a key to the global competitiveness of industry. Existing models describe processes limited in length- and time-scales, and thus several models need to be linked to cover all scales and arrive at industrial relevant results.

Scope: Research proposals should elaborate the physics and chemistry involved in existing codes to extend the scales to which the model can be applied. The models to be expanded can be electronic, atomistic, mesoscale and continuum scale models; there is a special need for the expansion of mesoscale models.

The proposals should also include interface design to facilitate the future implementation in larger and extendable framework architecture. Proposals should contain a series of model validation in which the model is validated against a chain of experimental data of increasing complexity relevant to materials design leading up to and including realistic test cases. These data should either be collected during the project or exist already. The extended model should be implemented in a code integrated in a multi-scale approach available to end-users. As part of each project, industrial end-users should assess this code on predefined industrial test cases, to guarantee industrial relevance.

Activities expected to be implemented at TRL 5; In line with the objectives of the Union's strategy for international cooperation in research and innovation (COM(2012) 497), as well as with the conclusions of the Materials Summit 2013, international cooperation is encouraged, in particular with the USA.

Expected impact:

- Rapid deployment of lower-cost advanced materials solutions through predictive design of novel materials and production routes optimised for specified applications (e.g.

properties and functionality minimise the environmental impact, reduced risk of product failure and increased life);

- Improved control of materials production and an improved control of concerned industrial products and processes.

Type of action: Research & Innovation Actions (100% funding).

NMK 21 - 2014: Materials-based solutions for the protection or preservation of European cultural heritage

Specific challenge: Europe has significant cultural diversity together with exceptional ancient architecture, built environment and artefact collections. However time, exposure and environmental changes present significant threats to this cultural heritage (which is one of the assets on which the tourism-related industry relies).

Scope: Projects should develop one or more functional materials for highly innovative techniques in the restoration and preventive conservation of works of art. These new techniques will ensure long term protection and security of cultural heritage, taking into account environmental and human risk factors. An environmental impact assessment of the new materials is to be included, to ensure development of sustainable and compatible materials and methods. A multidisciplinary approach should allow the development of practicable methodologies. Activities should focus on innovative and long lasting solutions in the conservation of cultural assets with historical and/or artistic value.

Proof of concept in terms of product and/or process must be delivered within the project, excluding commercially usable prototypes but demonstrating scalability towards industrial needs. Dedicated multiscale modelling, tailored (e.g. interface) characterisation, standardisation and/or the production of (certified) reference materials may also be covered in projects.

Taking into account the requirements for Regional Policy in this Programming Period, notably to establish Smart Specialisation Strategies, regions are invited to express their interest in addressing this topic area in their respective programmes , as well as their interest in potentially exploiting and deploying the technologies to be developed under this call. For this purpose the tools provided by the Smart Specialization Platform, Eye@RIS3, http://s3platform.jrc.ec.europa.eu should be used.

This topic is particularly suitable for matching EU funding with national and/or regional funding programmes, notably related to smart specialisation strategies, for the exploitation and deployment of project results.

Activities expected to be implemented at TRL 6*; particularly suitable for SME participation*

Expected impact:

- Practical and affordable solutions in terms of cost and/or complexity of operation by those who will use the materials and techniques developed;

- Contribution to achieving EU policies, in line with the Lisbon Treaty recommendation to take actions on a global scale to ensure that Europe's cultural heritage is conserved, safeguarded and enhanced (Article 3);

- Implementation of the objectives of the Joint Programming Initiative COM(2010/238/EU) – 'Cultural heritage and Global Change: a new Challenge for Europe'; and COM(2010)352 – 'Europe, the world's No 1 tourist destination – a new political framework for tourism in Europe'.

Type of action: Innovation Actions (70% funding)

NMK 22 - 2015: Fibre-based materials for non-clothing applications

Specific challenge: New approaches to improve the functionality of materials are important for the sustainable development of Europe's competitiveness. Fibre-based materials for technical, high -value, high -performance products at reasonable prices, with improved safety and functionality, represent a challenge for materials science and engineering.

Scope: Research proposals should aim to develop engineered fibre materials for novel, smart, high-value and high-performance non-clothing parts and products for technical and industrial use. New approaches and production technologies will enable a broader spectrum of industrial applications and lighter advanced structures and (pre)forms, taking into account issues such as sustainability, recycling, safety and the energy aspect. Of particular interest, is the functionalisation of technical textiles (e.g. actively responding to cooling and heating, self-cleaning or self-repairing).

The environmental sustainability of each proposed solution should be assessed with special emphasis on the efficient use of resources. In order to ensure the industrial relevance of the research, the cost effectiveness and commercial potential of the innovative technologies compared to state-of-the-art solutions currently available on the market should be quantitatively monitored during the project. A market estimate should be outlined in proposals and developed in projects, with recommendations for future industrial uptake.

Proof of concept in terms of product and/or process must be delivered within the project, excluding commercially usable prototypes, but convincingly demonstrating scalability towards industrial needs. Dedicated multiscale modelling and characterisation, and standardisation or the production of (certified) reference materials may also be addressed.

Activities expected to be implemented at TRL 6.

Expected impact:

- Increase in competitiveness and sustainability of European multiple sectors industry through innovative high value products and manufacturing processes;

- Employment and training through engagement in cutting edge technologies in various sectors, e.g. transport, construction, sport and leisure etc.

Type of action: Innovation Actions (70% funding)

NMK 23 - 2015: Novel materials by design for substituting critical elements

Specific challenge: Many technologies with significant socio-economic benefits face material requirements that are, or may be, problematic with today's technologies. Research is needed in particular to improve our fundamental understanding of the development of new materials, with a reduced or completely eliminated critical element content, but maintaing or enhancing

the performance of materials, components and products. Examples may be the critical raw materials (see COM(2011) 25 and related documents), due to possible supply disruptions, or those elements which may turn out to be dangerous (e.g. for cadmium see Regulation 494/2011).

Scope: Proposals are called for to investigate the development of such materials by rational design, with focus on the interplay between theory and/or large-scale computational screening. Validation by experimental methods should be included.

In line with the objectives of the Union's strategy for international cooperation in research and innovation (COM(2012) 497), international cooperation is encouraged, in particular with Japan and the USA.

Activities expected to be implemented at TRL 2-4.

Expected impact:

- Reduced use or substitution of critical elements for well-defined technologies;
- Improved performance of industrial products in the longer term;
- Safer and/or more sustainable materials, components and products;
- Contribute to achieving the EU policy COM(2011)25: Tackling the challenges in commodity markets and on raw materials.

Type of action: Research & Innovation Actions (100% funding)

NMK 24 - 2015: Low-energy solutions for drinking water production – pilot plants

Specific challenge: Low-energy solutions are badly needed for water softening and especially for water desalination. The present technologies for large scale desalination of seawater are stuck at energy consumption rates around 3 kWh/m^3 whilst the target has been set at 1 kWh/m^3 years ago.

Scope: Approaches that may bring better performance and lower energy use may be based on (but are not limited to) a combination of membrane filtration (reverse osmosis) and applying electric potential, electrochemical membrane processes, membrane destillation, or selective ion conducting materials. Projects should develop integrated solutions or combinations of technologies that come closer to the mentioned target.

Projects should aim at developing pilot plants demonstrating the low energy consumption as well as the overall competitiveness of the technology.

The implementation of this project is intended to start at TRL 4-5, target TRL 6-7; In line with the objectives of the Union's strategy for international cooperation in research and innovation (COM(2012) 497), international cooperation is encouraged, in particular with developing countries.

Taking into account the requirements for Regional Policy in this Programming Period, notably to establish Smart Specialisation Strategies, regions are invited to express their interest in addressing this topic area in their respective programmes , as well as their interest in potentially exploiting and deploying the technologies to be developed under this call. For

this purpose the tools provided by the Smart Specialization Platform, Eye@RIS3, http://s3platform.jrc.ec.europa.eu should be used.

This topic is particularly suitable for matching EU funding with national and/or regional funding programmes, notably related to smart specialisation strategies, for the exploitation and deployment of project results.

Expected impact:

- Contribution to one of the main global societal issues – access to safe and pure water;
- Improved performance, energy efficiency and usability of high-performance water purification systems;
- Benefit the European water purification industry through new product developments in this important growth market.

Type of action: Innovation Actions (70% funding)

NMK 25 - 2015: Inducement prize for the development of new materials and materials-based creative solutions by upstream collaboration between material scientists and designers

[pending completion of required preparatory work]

Specific challenge: New and innovative solutions are needed to address the existing and emerging societal challenges. Inducement prizes represent a major opportunity to mobilise private investment in research and innovation, as well as public support, to attract non-traditional players and reduce entry barriers, to create new partnerships, and to provide incentives to researchers and innovators to take risks and develop new, sustainable, safe and better performing products and services. The recent communication 'Promoting cultural and creative sectors for growth and jobs in the EU' (COM(2012)537) highlighted the economic contribution that creative and cultural inputs bring to the European industries. The most obvious example is the wider use of design in manufacturing industries, adding value to products, services, processes and market structures. Firms spending twice the average amount on creative inputs are 25% more likely to introduce product innovations (see e.g. COM (2012)537).

In the context of strengthening the EU's global position in innovation and technology and respond to the economic crisis, it is necessary to add value to products and processes via new functionalities (also "intangible", e.g. enhanced sensations, values), embedded service and sustainability, as well as to allow the development of completely new (and often unforeseen) products with strong competitive advantages. There is a strong need to reinforce stronger collaborations between the creative and the technological (e.g. material) communities as well as foster cross-disciplinary education and creative skills development.

Scope: The contest will reward the development of new materials and materials-based creative solutions by upstream collaboration between material scientists and designers.

Expected impact:

- Contribute to achieving the EU policy COM(2012)537: Promoting cultural and creative sectors for growth and jobs in the EU.

Type of action: Prize

NMK 26 – 2014: Accelerating the industrial uptake of nanotechnologies or advanced materials by SMEs

Specific challenge: Research results should be transferred to industry harvesting the hitherto untapped potential of nanotechnologies and advanced materials. The goal is to create added value by creatively combining research results, to transfer results across sectors where applicable, to accelerate innovation and eventually create profit or other benefits.

Scope: The research and innovation activities should combine and develop existing critical but separate S&T elements of a product or manufacturing technology related to nanotechnologies or advanced materials. The combination is to be developed in the project. Proof should be given that the ideas/critical parts to be combined have already been developed to an appropriate technology readiness level and proposals should include a proof of concept of the analytical and experimental critical function. The activities should bring the technology and manufacturing readiness of the combination to a level appropriate for commercialisation right after the project.

Proof of concept in terms of product and/or process in a relevant environment must be delivered within the project, excluding commercially usable prototypes, but convincingly demonstrating scalability towards industrial needs.

The SME instrument consists of three separate phases and a coaching and mentoring service for beneficiaries. Participants can apply to phase 1 with a view to applying to phase 2 at a later date, or directly to phase 2.

In phase 1, a feasibility study shall be developed verifying the technological/practical as well as economic viability of an innovation idea with considerable novelty to the industry sector in which it is presented (new products, processes, services and technologies or new market applications of existing technologies). The activities could, for example, comprise risk assessment, market study, user involvement, Intellectual Property management, innovation strategy development, partner search, feasibility of concept and the like to establish a solid high-potential innovation project aligned to the enterprise strategy and with a European dimension. Bottlenecks in the ability to increase profitability of the enterprise through innovation shall be detected and analysed during phase 1 and addressed during phase 2 to increase the return in investment in innovation activities.

In phase 2, innovation projects will be supported that address the combination and development of existing critical but separate S&T elements of a product or manufacturing technology related to nanotechnologies or advanced materials, and that demonstrate high potential in terms of company competitiveness and growth underpinned by a strategic business plan. Activities should focus on innovation activities such as demonstration, testing, prototyping, piloting, scaling-up, miniaturisation, design, market replication and the like aiming to bring an innovation idea (product, process, service etc) close to deployment and market introduction, but may also include some research. For technological innovation a

Technology Readiness Levels of 6 or above (or similar for non-technological innovations) are envisaged.

In addition, **in phase 3**, SMEs can benefit from indirect support measures and services as well as access to the financial facilities supported under Access to Risk Finance of this work programme. *[Link to the Access to Risk Finance Part]*

Successful beneficiaries will be offered coaching and mentoring support during phase 1 and phase 2. This service will be accessible via the Enterprise Europe Network and delivered by a dedicated coach through consultation and signposting to the beneficiaries. The coaches will be recruited from a central database managed by the European Commission and have all fulfilled stringent criteria with regards to business experience and competencies. Throughout the three phases of the instrument, the Network will complement the coaching support by providing access to its innovation and internationalisation service offering. This could include, for example, depending on the need of the SME, support in identifying growth potential, developing a growth plan and maximising it through internationalisation; strengthening the leadership and management skills of individuals in the senior management team and developing in-house coaching capacity; developing a marketing strategy or raising external finance.

Expected impact:

- Enhancing profitability and growth performance of SMEs by combining and transferring new and existing knowledge into innovative, disruptive and competitive solutions seizing European and global business opportunities.
- Market uptake and distribution of innovations tackling the uptake of nanotechnologies and advanced materials in a sustainable way.
- Increase of private investment in innovation, notably leverage of private co-investor and/or follow-up investments.
- The expected impact should be clearly described in qualitative and quantitative terms (e.g. on turnover, employment, market perspectives, IP management).

Type of action: SME Instrument (70%*; funding for phase 1 will be provided in the form of a lump sum of 50 000 EUR*)

The conditions related to this topic are provided along with the general conditions for this call. *[Link to end of the description of the call]*

NMK 26 bis – 2015: Accelerating the industrial uptake of research in the fields of advanced manufacturing and processing

Specific challenge: Many SMEs are active in the areas of advanced manufacturing, construction and processing industrial activities as addressed under the calls on Factories of the future, energy-efficient buildings, and sustainable process industries. Research results in these areas should be transferred to SMEs, but often additional RTD and innovation activities are required before uptake by SMEs is possible. The goal is to create added value by

enhancing specific research results to a level enabling industrial take-up by SMEs in these areas, transferring results to SME actors across sectors where applicable, accelerating innovation and eventually creating profit or other benefits.

Scope:

The SME instrument consists of three separate phases and a coaching and mentoring service for beneficiaries. Participants can apply to phase 1 with a view to applying to phase 2 at a later date, or directly to phase 2.

In phase 1, a feasibility study shall be developed verifying the technological/practical as well as economic viability of an innovation idea with considerable novelty to the industry sector in which it is presented (new products, processes, services and technologies or new market applications of existing technologies). The activities could, for example, comprise risk assessment, market study, user involvement, Intellectual Property management, innovation strategy development, partner search, feasibility of concept and the like to establish a solid high-potential innovation project aligned to the enterprise strategy and with a European dimension. Bottlenecks in the ability to increase profitability of the enterprise through innovation shall be detected and analysed during phase 1 and addressed during phase 2 to increase the return in investment in innovation activities.

In phase 2, innovation projects will be supported in the fields of advanced manufacturing and processing, which demonstrate high potential in terms of company competitiveness and growth underpinned by a strategic business plan. Activities should focus on innovation activities such as demonstration, testing, prototyping, piloting, scaling-up, miniaturisation, design, market replication and the like aiming to bring an innovation idea (product, process, service etc) close to deployment and market introduction, but may also include some research. For technological innovation a Technology Readiness Levels of 6 or above (or similar for non-technological innovations) are envisaged.

In addition, **in phase 3**, SMEs can benefit from indirect support measures and services as well as access to the financial facilities supported under Access to Risk Finance of this work programme. *[Link to the Access to Risk Finance Part]*

Successful beneficiaries will be offered coaching and mentoring support during phase 1 and phase 2. This service will be accessible via the Enterprise Europe Network and delivered by a dedicated coach through consultation and signposting to the beneficiaries. The coaches will be recruited from a central database managed by the European Commission and have all fulfilled stringent criteria with regards to business experience and competencies. Throughout the three phases of the instrument, the Network will complement the coaching support by providing access to its innovation and internationalisation service offering. This could include, for example, depending on the need of the SME, support in identifying growth potential, developing a growth plan and maximising it through internationalisation; strengthening the leadership and management skills of individuals in the senior management team and developing in-house coaching capacity; developing a marketing strategy or raising external finance.

Expected impact:

- Enhancing profitability and growth performance of SMEs by combining and transferring new and existing knowledge into innovative, disruptive and competitive solutions seizing European and global business opportunities.

- Market uptake and distribution of innovations tackling the uptake of nanotechnologies and advanced materials in a sustainable way.

- Increase of private investment in innovation, notably leverage of private co-investor and/or follow-up investments.

- The expected impact should be clearly described in qualitative and quantitative terms (e.g. on turnover, employment, market seize, IP management).

- Demonstration of the results in relevant operational and industrial environment, excluding commercially usable prototypes, but convincingly demonstrating scalability towards industrial needs.

Type of action: SME Instrument (70%*; funding for phase 1 will be provided in the form of a lump sum of 50 000 EUR*)

The conditions related to this topic are provided along with the general conditions for this call. *[Link to end of the description of the call]*

Safety of nanotechnology-based applications and support for the development of regulation

Nanotechnology-based applications will substantially improve the performance of many products through the unique properties of engineered nanoparticles. The same properties, however, give rise to questions and concerns with regard to potential health and safety risks.

To support the safe development of nanotechnologies, these risks should be managed by identifying the hazards, understanding the potential adverse effects; and by measuring and controlling exposure. Risk management should become an integral part of the culture of the organisations involved in the supply chain, including regulatory support and risk governance. The objective is to support methods, techniques and equipment for material characterisation, hazard identification, occupational exposure assessment and risk reduction and mitigation and their demonstration. The environmental fate and end-of-life treatment of products and waste containing nanomaterials are also of prime importance.

All projects under this heading should align with the EU Nanosafety Cluster and other international activities (eg, EU-US communities of research or the OECD-WPMN) in order to facilitate research cohesion and integration, and the advancement of the EU Nanosafety Cluster goals and agenda. In line with the objectives of the Union's strategy for international cooperation in research and innovation (COM(2012) 497), international cooperation is encouraged, in all topics under this technology challenge, in particular with the leading nanotechnology developing nations, such as the US, Canada, Australia, Korea, Japan, China and Brazil.

In addition to the need for risk assessment and management, dealt with under this challenge, responsible governance is emerging as a determining factor of future impact of nanotechnologies on society and the economy. This need is dealt with under the following challenge on KET support.

NMK 27 - 2014: Joint EU & MS activity on the next phase of research in support of regulation “NANOREG II"

Specific challenge: Regulation of the nanomaterials market evolves parallel to technology development and societal requirements. The commercial viability of nanomaterial development in the EU is conditional on new nanomaterials meeting current and future regulatory requirements and should be based on cutting-edge technology with regard to risk management and risk mitigation. Demonstration of integration of such technology into the design of new nanomaterials and products and their applications is a major challenge and the main objective of this joint action.

Scope:

(1) To develop and demonstrate Safe-by-Design regulatory approaches for nanomaterial development.

(2) To validate the tools and methodology, as well as their background data-sets, that will lead to the manufacture of novel, inherently safe nanomaterials.

(3) To address barriers for the application of Safe-by-Design as standard industry practice.

The project should seek to establish principles for grouping strategies for nanomaterials according to their assumed modes of toxicological action for regulatory purposes. Out of each group, a few representative materials should be selected and a toxicological profile shall be assessed. The scope may include novel materials, coated materials and self-assembled materials, nanomaterials with different surface functionalisation, and third generation particles. The project should take into account future dossier requirements under REACH, or other related EU legislation, to limit the required additional information, especially animal testing, to the essential minimum. Active participation of industrial partners is strongly encouraged to establish strong industry-authorities collaboration and the partners should conclude a results communication policy before the start of the project. This collaboration should be complemented by solid mechanisms networking state and private laboratories in nanotechnology toxicity testing and exposure control.

Activities expected to be implemented at TRL 6. Jointly funded with Member States; a maximum of one project will be funded.

Expected impact: The project is expected to:

- Strengthen seamless collaboration among authorities of the MS governments with regard to the knowledge required for appropriate risk assessment and management in this field given the fast development of the market;

- Bring together the activities of national authorities responsible for consumer and worker protection, public health, and the environment including chemical safety and all other relevant authorities covering the whole value;

- Coordinate regulatory oriented activities of, or cooperate with, other on-going projects on toxicity testing, on decision making for material characterisation and testing protocols, and for data management; and

- Integrate its work with OECD-WPMN, CEN[14] and ISO, and other European funded projects in the nanosafety cluster.

Type of action: Research and Innovation Action (100% funding); no more than one project will be funded

NMK 28 - 2014: Coordination of EU and international efforts in safety of nanotechnology

Specific challenge: The development of a novel safety culture for the nanomaterial research and engineering community, and the industry producing engineered nanomaterials and nano-enabled products is a significant challenge in the coming years. Incorporating the safety-by-design as a part of the core research activities of nano material sciences and the production of these materials and products would be a major step forward in assuring nanosafety. Such activities are currently on going in the EU and several other industrialised countries in a rather fragmented manner. The efforts of emerging economies and emerging science countries should also be integrated with the leading actors in the area of nanosafety.

[14] See Mandate M/461 addressed by the European Commission to CEN/CENELEC and ETSI. http://www.cen.eu/cen/Sectors/Sectors/Nanotechnologies/Documents/M461.pdf

Scope:

The main aim is to bring together EU member states and international efforts for risk assessment, management and governance by streamlining data collection and data management on regulatory oriented toxicology testing of nanomaterial, exposure monitoring, LCA, and disposal and treatment of waste nanomaterials. The coordination may focus on one or more of the following tracks:

- Coordination of EU and international efforts in support of regulation, in particular within the context of Nanoreg, which is a major undertaking jointly funded by FP7, EU Member States, FP7 Associated States and industry, and of the work carried on by OECD-WPMN;

- Expanding the international dimension of EU nano-safety research e.g. through networking of researchers, twinning of projects or creation of Communities of Research with the objective of sharing of best practises and harmonising test methods.

- Widening the coordination of MS, AS and regional R&D efforts aimed at management of nano-related risks with the objective of pooling resources for a transnational programme of nano-safety research along the lines of the nanosafety cluster Strategic Research Agenda 2015-2020.

Expected impact:

• By exploiting synergies with, mainly national European but also world-wide, activities aiming at support to regulation, the project should lead to joint projects, twinned projects and global networks facilitating the goal of risk management and incorporating risk assessment in the early stages of product or process design

• The project should combine efforts with those of the Nanoreg project so that the expected datasets from the latter be complemented and cross validated with similar datasets from other projects running globally in order to reach OECD - MAD (Mutually Accepted Data) status identifying and brushing-out any inconsistencies.

• The impact of the NANOREG initiative, in establishing a seamless cooperation between industry, including risk engineering, and authorities, should be enhanced and expanded to include global market leaders.

• The project is expected to promote standardisation at international level.

Type of action: Coordination and Support Action; no more than one project will be funded

NMK 29 - 2014: Assessment of environmental impact of nanomaterials

Specific challenge: A potential nanomaterial risk for humans and the environment is present only when both exposure and a hazard potential of the nanomaterial exist. The challenge is to address the prediction of environmental distribution, concentration and form (speciation) of nanomaterials. It includes release and exposure studies using laboratory, field and model simulations of possible release and transformation of nanomaterials transport and fate, availability and bioaccumulation potential, to allow early assessment of potential exposure and facilitate safe product design.

Scope: The testing and modelling framework to be developed must allow prediction of the release and fate of nanomaterials over relevant whole product chains from manufacturing, downstream application and use, including waste and accidents, consumer use, to end-of-life recycling or disposal and final environmental fate. The predictive framework to be developed should include basic geographical and demographic considerations for uses, and address the physico-chemical characterisation at the release sources as well as the identification of the main mechanisms and nanomaterial properties driving their transformation and fate. The framework should enable predictive mapping of zones of accumulations and exposure potential (including the final aging transformations, forms and uptake availabilities) of nanomaterials in these "environmental sinks" and hot spots.

A close collaboration with stakeholders and different industries should be envisaged, to enhance realistic modelling and testing.

Activities expected to be implemented at TRL 4.

Expected impact:

- understanding and quantifying nanomaterial release from manufacturing, use and end-of-life stages in relevant product value chains

- an overall framework that ensures the completeness and quality of information and data needed for understanding and predictive modelling of environmental transport and transformation

- understanding of the interplay of the different transformation, transport, and aging mechanisms determining environmental exposure

- enabling safer product design guidance, comprehensive laboratory and field test procedures all along the product chain, and address international harmonisation and regulation.

Type of action: Research & Innovation Actions (100% funding)

NMK 30 - 2015: Increasing the capacity to perform nano-safety assessment

Specific challenge: Systems biology, high throughput screening and toxicogenomics approaches have the potential to revolutionise how chemical substances, including nanomaterials, are assessed for regulatory and risk management purposes. A paradigm shift in toxicology using innovative techniques such as High Thoughput Screening (HTS) approaches, Toxicogenomics and High Content Analysis (HCA) is being established. With such approaches it is possible to identify underlying affected pathways (so called "toxicity pathways"). The challenge is to develop and demonstrate a mechanism-based understanding of toxicity, that will enable improved toxicity testing by identifying novel endpoints essential to tailor-made first tier hazard and risk assessment of novel and emerging materials.

Scope: Projects should enhance the understanding of the mechanisms underlying any observed adverse effects from engineered nanomaterials, and ultimately link the potential for such adverse effects to specific physical or chemical nano scale properties.

They should establish and demonstrate the basis for the development of appropriate tools to maximise read across (taxa and nano properties) and assess which tools or endpoints may not necessarily be applicable across the board. These approaches should aim to support the grouping of nanomaterials, to help in developing intelligent testing strategies and identifying

"nanomaterials or properties of concern" that need to be tested more thoroughly.

Activities expected to be implemented at TRL 4.

Expected impact:

- New screening tools to enhance the efficiency of end-rate at which nanomaterial hazard profiling can be performed
- Facilitate faster definition of nanomaterials toxicity mechanisms
- Enable “safer by design” approaches, tailored to stakeholders’ needs (modellers, industry and regulators)
- Data in a recognised and accessible database for use beyond the lifetime of the project
- Provision of solutions to the long-term challenges of nanosafety and nanoregulation

Type of action: Research and Innovation Actions (100% funding)

NMK 31 - 2015: Next generation tools for risk governance of Nanomaterials

Specific challenge: The conventional risk assessment approach, i.e. deriving no-effect levels or limit values from dose-effect relationships is inadequate for enabling safe use for newly developed materials in the fast moving market of nanomaterials. The challenge is to build a state-of-the art and flexible risk banding tool to keep pace with developments in innovation and risk research by harvesting and implementing results from concluded, ongoing and planned research in next generation risk governance frameworks. For nanotechnology, as with any new and rapidly evolving technology, analysis of risk is technically and methodologically limited, and thus associated with a high degree of uncertainty which should be understood and quantified. Stakeholders' concerns and risk perception should be understood and communicated. Risk acceptance is strongly affected by a clear understanding of the risks, the benefits and the uncertainties perceived on equity and trust.

Scope: Research should focus on the testing, the calibration and the further development of risk prioritisation (or banding) tools for both human and environmental risks, with emphasis on:

a) the use of inputs from computational toxicology and/ or ‘high concern grouping approaches’ in risk banding tools to identify potential hot spots for risk,

b) Scientific foundation of the ‘risk bands’, by linking the hazard based with ‘dose’ relevant exposure banding,

c) Inclusion of data and monitoring strategies on the efficacy of risk mitigation measures and

d) Alignment with user capacities and needs.

The selected project should identify the major processes of individual and societal decision making, placing particular attention on the aspect of uncertainty. To ensure the highest possible quality in regulatory decision making, emphasis should be given to the development of guidance for important issues in Risk Assessment, based on in-depth analysis of the current scientific basis concerning the addressed hazards and the possible exposure, and joining forces with other projects

Activities expected to be implemented at TRL 5.

Expected impact:

- A framework for the risk governance of nanomaterials entering the market by developing tools for risk appraisal and guidance for risk communication;

- Demonstration in specific industrial settings or industrial sectors of the feasibility of the developed approaches and tools through worked examples as case studies and pilots with outcomes as guidance, good practices and tools for risk management and risk communication;

- Leveraging and building on current knowledge related to hazard mapping, exposure and control banding and risk prioritization as well on inter/national and company level risk governance and risk dialogue efforts.

Type of action: Research & Innovation Action (100% funding); no more than one project will be funded

Addressing generic needs in support of governance, standards, models and structuring in nanotechnology, advanced materials and advanced manufacturing and processing

To deploy the key enabling technologies of nanotechnology, advanced materials and advanced manufacturing and processing for the benefit of European industry and society, it is essential to address a number of general, structural needs. These needs are in areas including infrastructure, metrology and standards, skills and networking, dissemination and communication issues, and business models. Sources of funding other than Horizon 2020, such as structural funds, are vital and appropriate links will be explored.

In order to better align the research and innovation outcomes to the values, needs and expectations of European society, the concept of Mobilisation and Mutual Learning (MML) Action Plans or Platforms will be supported.[15]

The increasingly important international dimension of industrial research requires a proactive approach to working with third countries in these fields and this will also be explored and supported.

NMK 32 – 2014: Novel visualization tools for enhanced nanotechnology awareness

Specific challenge: Recent surveys show that the awareness in the public about nanotechnology based products is very low and that awareness without detailed information creates insecurity. In that respect, novel visualization tools are a key element for enhanced communication and improvement of societal understanding of nanotechnology.

Scope: The major efforts of the project should be dedicated to the development of content aimed at enhanced communication, outreach and balanced information on nanotechnology with youngsters, civil society organisations, the media, and the lay public as the target audience. The content should be made available using novel visualisation, , which is not only characterised by a geometry but also has attributes, semantics, and possibly interaction with time. The content should be built either from existing data (e.g. from finished or on-going FP7 projects) or from new data (e.g. from modelling efforts on nano-toxicology phenomena). The projects should make use of commercially available technologies to create an interactive environment for the information visualization. This can be a single user environment (e.g. immersion), but the project should also have a significant component where the environment can be experienced collectively (e.g. 3D projection techniques). Gender aspects should be taken into account, avoiding stereotypes. Furthermore, the project should also involve appropriate disciplines of Socio-Economic Sciences and Humanities.

Media produced within the project should be made available under a public copyright license such as e.g. under a creative commons license.

The Commission considers that projects requesting a contribution from the EU of around EUR X would allow this topic to be addressed appropriately. Nonetheless, this does not

[15] A Mobilisation and Mutual Learning (MML) Action Plan or Platform is a mechanism to bring together a wide range of actors and pool their knowledge and experience, and to facilitate mutual understanding and develop joint solutions and research agendas to address societal challenges.

preclude submission and selection of proposals requesting other amounts. A maximum of one project will be funded.

Expected impact:

- contribute effectively in raising the awareness of Europe's citizens, and in particular the target groups mentioned above, on nanotechnology and enhance their understanding through media available under a public copyright licence (e.g. a creative common license);
- enhance the use of novel visualisation techniques beyond the project lifetime for outreach activities in the area of nanotechnologies
- support, beyond the lifetime of the project, the communication and education activities of various stakeholders: researchers, industrialists, investors, museums and/or schools;
- enhance support to good governance in nanotechnology;
- contribute to the implementation of the European Commission's Action Plan for Nanotechnology.

Type of action: Coordination and Support Action – Support Action

NMK 33 – 2015: Societal engagement on responsible nanotechnology

Specific challenge: Transparency, knowledge and societal engagement are key factors in addressing societal concerns regarding the use of nanotechnology, including nanomaterials. An essential element of a safe and responsible nanotechnology governance is an effective and informed dialogue with all stakeholders, enhancing public confidence in nanotechnologies.

Scope: The proposed action should identify current best practices in societal engagement to establish a multi-stakeholder platform at EU and/or at national level in a number of EU Member States, involving a balanced representation of researchers, Civil Society Organisations (CSOs), and NGOs, industry and policy-makers to develop a shared understanding of the current and potential future (economic, social and environmental) benefits and risks of advancing nanotechnology. This action is to be based on the concept of Mobilisation & Mutual Learning (MML) Platforms[16].

The two main activities to be undertaken within this platform are a series of multi-stakeholder dialogues and training activities to address knowledge gaps between various types of actors. These dialogue meetings should consider the various questions of interest or information needs that emerge across the entire value chain (from R&D to production and distribution to use and waste processing or recycling), discuss how to employ nanotechnologies to the benefit of society addressing societal challenges and identifying desired fields of innovation, whilst contributing to Responsible Research and Innovation. The outcomes of the dialogue are to be fed back into policy making and research and innovation processes with joint stakeholder undertakings. In order to ensure that all participants have a common knowledge

[16] A Mobilisation and Mutual Learning (MML) Action Plan or Platform typically includes following types of partners: research performing and/or funding organisations, civil society organisations, industry/business and policy-makers and should involve a wide range of EU Member States or Associated countries. The MML Action Plan or Platform should have a minimum duration of three years.

base, various training or information sessions should be organised to address any knowledge gaps that may impede a constructive dialogue.

The design of this platform and its activities should take into account and build on previous FP6 and FP7 activities and relevant EU and international policies and initiatives in this field. Gender balance should be taken into account in the make-up of the platform and gender should be embedded in the dialogues on the content and impacts of nanotechnology research.

The Commission considers that projects requesting a contribution from the EU of around EUR X would allow this topic to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A maximum of one project will be funded.

Expected impact:

- The direct and sustainable impact of this action will be to enhance the interaction between society, science and nanotechnologies in order to contribute to a responsible nanotechnology research and innovation at EU and national policy level and research processes.

- Involving civil society and industry groups in decision-making procedures and/or societal dialogue and engagement on nanotechnologies will increase awareness, enhance understanding between stakeholders' on their positions, needs, expectations and concerns, and enhance trust between them.

- The outcomes of the multi-stakeholder platform will contribute to responsible policy-making, better acceptability of nanotechnologies outcomes, a more inclusive European society and will lead to a roadmap to enhance societal engagement in nanotechnology.

Type of action: Coordination and Support Action – Support Action

NMK 34 – 2014: The Materials "Common House"

Specific challenge: The fragmentation of research efforts has long been identified as a major European weakness. A significant part of national R&D budgets is spent without substantial coordination across the Union, a formidable potential waste of resources at a time of shrinking funding possibilities.

A dynamic structure, following materials research and innovation across the European Union, is called for. The goal is to make Europe a more coherent system, and also to help in better coordinating future European materials activities with those in Member States, industry and academia, to avoid duplications and gaps.

Scope: Support to a monitoring system and a forum to debate developments and needs, identify gaps and opportunities, establish priorities in order to create a sound, authoritative, consensual, science-based, economy pushed, society-driven Europe-wide knowledge base of materials science and engineering. Synergy with or use of present structures and existing schemes is welcome.

The proposal for the support action should describe the expected level of detail in the study, definitions and limitations, the parameters to be observed, and the targeted application fields.

The support action may include assessment, benchmarking, road mapping, foresight, coordination, organisation of events, and communication, and give indications in which application areas research and innovation may have most impact. A study of activities carried out within and outside Horizon 2020, through other EU schemes (structural funds and national activities etc.) may be included. The proposal should also provide elements for a constant monitoring system, as well as success cases and best practices stemming from FP-supported research. The organisation of major events of relevance for better structuring the ERA in the materials field, with priority to those federating individual events that in the past took place separately, may also be included.

The Commission considers that projects requesting a contribution from the EU of around EUR X would allow this topic to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A maximum of one project will be funded.

Expected impact:

- Consolidation of scattered research and development efforts for a more cohesive, efficient approach to materials advancement, avoiding duplications and gaps;

Coordination of research activities also with Member States, contributing to strengthening the European Research Area.Type of action: Coordination and Support Action – Support Action

NMK 35 – 2014: Networking and sharing of best practises in management of new advanced materials via eco-design of products

Specific challenge: The production, distribution, use and end-of-life management of materials is associated both with costs and important impacts on the environment, such as consumption of energy, (raw and other) materials and resources consumption, waste generation, emissions and possible generation/management of hazardous substances. It is estimated that approximately 80% of all product-related environmental impacts are determined during the design phase of a product (Aldersgate Group). Eco-design aims at reducing the environmental impact of products, including the energy consumption throughout their entire life cycle.

Scope: Projects should network actors (such as enterprises, academia and research institutions) to :

- share knowledge and practices on eco-design, in line with the Commission Communication "Innovation for a sustainable Future – The Eco-Innovation Action Plan" (COM(2011)899), minimise use of material, maximise the number of consecutive cycles of reuse, remanufacturing, or recycling, and/or the time in each cycle, diversify reuse across the value chain, or extend product longevity and thus increase advanced material productivity and profitability with final economic benefits for the European industrial economy as a whole; and

- provide models to decouple economic growth from resource constraints. Eco-design principles, recyclability, required materials performance and cost-effectiveness could be part of the study. Life cycle assessment, including cost effectiveness aspects, should be used to justify proposed solutions, where appropriate.

The Commission considers that projects requesting a contribution from the EU of around EUR X would allow this topic to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected impact:

- Better focusing of further Horizon 2020 work programmes targeting the sustainability and competitiveness of European industry through understanding of how improved design principles will reduce consumption of energy and resources;
- Contributions to a circular economy approach by fostering product design that facilitates recycling and reuse;
- Contribute to achieving EU policy on Ecodesign. COM(2011)899 final: Innovation for a sustainable Future - The Eco-innovation Action Plan (Eco-AP).

Type of action: Coordination and Support Action – Support Action

NMK 36 – 2014: Business models with new supply chains for sustainable customer-driven small series production

Specific challenge: For small series production of, for instance, consumer goods, the traditional supply chains are not suitable. Although internet sales, both B2C and B2B, are fast growing, most of the underlying supply models are still traditional. The change to a faster supply of smaller series and fully personalised products, is hampered by the fact that current industrial supply chains are mainly cost-driven, resulting in large series and long lead times. Supply and demand are not in balance. Quality and customer satisfaction are often compromised. Moreover actual production is taking place anywhere in the world and does insufficiently take into account issues of social, environmental and energy sustainability.

Scope: The internet has the potential to support a fully new supply chain model that is fully customer driven. New business solutions should enable consumers to become designers and "customisers"; retailers to become virtual business brokers; manufacturers to produce in a distributed and small scale manner; and suppliers to be more flexible and demand-driven.

Research activities should focus on all of the following areas:

- Integrated business model solutions for customer-driven supply chain management.
- Practical solutions for the ownership, control and management of the related supply chain data
- Novel distributed manufacturing, sourcing and design solutions linking individual "home-based" designers and manufacturers to the supply-chain promoting social inclusion and deploying skills locally available.
- Solutions for local sourcing and supply, thus reducing the environmental footprint.

The projects are expected to include use-case demonstrations aiming at rapid deployment of the novel business solutions in particular consumer-targeted domains. All relevant supply-chain stakeholders are expected to participate.

Activities expected to be implemented at TRL 6-7.

Expected impact:

- Return of delocalised manufacturing to Europe, in the order of at least 5% of the total manufacturing capacity, in the application area targeted by the project, within 5 years after the end of project;
- Reduction in the environmental footprint compared to products produced in the traditional value chains by 20% through less stock, less waste, and less transportation;

- Creation of a novel supply network involving at least 100 organisations and individuals at the end of the project and 1000 organisations and individuals within 5 years after the end of project;
- Creation of new embedded services supporting the customer-driven supply chain.

Type of action: Innovation Actions (70% funding).

NMK 37 – 2014: Facilitating knowledge management, networking and coordination in NMP

Specific challenge: The Horizon 2020 programme for the key enabling technologies of nanotechnology, advanced materials and advanced manufacturing and processing needs to function as a catalyst within the larger European Research Area. To be effective, the programme needs to be supported by a knowledge management system capturing the key performance indicators in industrial policy. Member States should be aware how their research systems for enabling and industrial technologies relate with each other and with Horizon 2020, and support is needed for this coordination.

Another aspect of the networking and coordination involves the ERA-NETs in the field of NMP. ERA-NETs have been set-up in FP6 and FP7 on a wide range of scientific subjects and disciplines relevant to the NMP Programme. While focusing on different scientific areas, they all work towards achieving a common goal of the transnational networking and coordination of national research programmes and address a number of horizontal issues, such as the mapping of existing research potential and foresight activities, the launching of joint calls and addressing the challenges of IPR rules.

Scope: The coordination action should bring together the experience in the various networks to address issues of common interest including foresight activities, education and training needs; opportunities and strategies for international cooperation; [communication and societal dialogue;] synergies with other actors (i.e. ETPs and PPPs) and widening participation. The project should foresee the inclusions of existing and new ERA-NETs in the NMP area.

The project will also prepare and facilitate the future of the ERA-NET instrument and act as a venue for identifying emerging needs and sharing of interests between the national funding agencies, which will eventually lead to joint call definition under the new instrument.

The Commission considers that projects requesting a contribution from the EU of around EUR X would allow this topic to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected impact:

- Structuring and integration of European Research Area in the field of the key enabling technologies of nanotechnology, advanced materials and advanced manufacturing;
- processing through shared understanding of key performance and coordinated formulation of needs beyond the core Horizon 2020 funding.

Type of action: Coordination and Support Action – Coordination Action

NMK 38 – 2014: Practical experience and facilitating combined funding for large-scale RDI initiatives

Specific challenge: Industrial investments into research, technological development and innovation in Europe, in particular with the aim to bridge the valley of death and prepare new manufacturing capacities, will often need a combination of funding instruments, including EU, national and regional funding, making use of structural and regional funds, as well as private financing. The KET High Level Group underlines the need for efficient combination of funding as a key factor for investments into large-scale pilot lines as a crucial step towards commercial exploitation of new developments. New public programmes are being developed and implemented in connection with the next EU multi-annual financial framework including Horizon 2020 and regional and structural funds. While the responsible authorities are committed to make the instruments compatible, industrial stakeholders including SMEs need to understand what this means, how best to use this for their project, and how to combine public support with private financing as needed. They need to satisfy the different requirements in relation to project quality, cooperation arrangements, reporting, risks and other aspects, while also smart specialisation strategies, competition and state aid rules as well as the industrial decision structures need to be respected.

Scope: A coordination action should bring public and private stakeholders together to structure the key questions for the funding of large-scale RDI projects through different funding sources. A number of different though typical cases, should be prepared for concrete investments combining different public and private funding and financing sources, eg representing specific KET or preferably cross-KET applications, large and small organisations, larger or smaller consortia etc. On this basis practical needs, decision parameters, need for advice and support and best practices will be analysed, covering the entire process of decision making and preparation of actions on the private as well as public side, and taking into account the situation of individual organisations as well as consortia. Overall, the action should help to provide guidance for stakeholders as well as policy makers on the combination of funding instruments and establish recommendations for European policy measures as relevant.

Expected impact: Increasing the number of projects using combinations of funding instruments, acceleration of investments into pilot lines and other relevant RDI follow-up activities towards commercialisation, lessons learned for EU policy making, better definition of public funding instruments in view of their compatibility, improving the awareness and knowledge on funding and financing strategies in industry.

No more than one action will be funded. The Commission considers that an action requesting a contribution from the EU of around EUR X would allow this topic to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Type of action: Coordination and Support Action – Coordination Action

NMK 41 – 2014/2015: Presidency events

[NB: The scope may be extended to major events of relevance for better structuring the ERA in KETs, with priority to those federating individual events that took place separately in the past.]

Specific challenge: *to be developed*

Scope: The commitment of the national authorities to support the event(s) (from a political point of view, but also with resources) should be a pre-requisite to submit a proposal.

The Commission considers that projects requesting a contribution from the EU of around EUR X would allow this topic to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. A maximum of one project will be funded for each Presidency (possibly covering more than one event).

Expected impact: *to be developed*

Type of action: Coordination and Support Action – Coordination Action

NMK 42 – 2014: Support for NCPs

Specific challenge: Facilitate trans-national co-operation between NCPs within the Industrial leadership Part with a view to identifying and sharing good practices and raising the general standard of support to programme applicants.

Scope: Support will be given to a network of formally nominated NCPs in the area of Leadership in enabling and industrial technologies (Nanotechnologies, Advanced Materials, Advanced manufacturing and processing). The activities will be tailored according to the nature of the theme, and the priorities of the NCPs concerned. Various mechanisms may be included, such as benchmarking, joint workshops, enhanced cross-border brokerage events, training, and twinning schemes. Special attention will be given to helping less experienced NCPs rapidly acquire the know-how accumulated in other countries.

The focus throughout should be on issues specific to the Industrial Leadership part.

Proposals can only include NCPs from EU Member States, and Associated Countries, who have been officially appointed by the relevant national authorities.

The consortium should have a good representation of experienced and less experienced NCPs.

If certain NCPs wish to abstain from participating, this fact should be explicitly documented in the proposal. These NCPs are nevertheless invited and encouraged to participate in the project activities, and are eligible for reimbursement of their participation.

Participation of NCPs from third countries is welcome, but these NCPs are not eligible for reimbursement of their participation.

The Commission expects to receive and fund a single proposal under this topic.

The Commission considers that a project requesting a contribution from the EU of around EUR X would allow this topic to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposal requesting other amounts.

Expected impact:

- An improved and professionalised NCP service across Europe, thereby helping simplify access to Horizon 2020 calls, lowering the entry barriers for newcomers, and raising the average quality of proposals submitted.

- A more consistent level of NCP support services across Europe.

Type of action: Coordination and Support Action – Coordination Action

Call for Biotechnologies

H2020-BIOTEC-2014/2015

Biotechnology has achieved spectacular progress as an enabling technology to drive long term sustainability and growth across economic sectors. Generation of scientific and technological know-how and its translation into industrial products and solutions of societal challenges is paramount in securing European leadership in this key enabling technology, and it is as such at the very core of the current call.

Within the challenge "Biotechnology-based industrial processes driving competitiveness and sustainability" activities are aimed at bridging the gap from lab to market and at creating a path for participants in projects, in particular SMEs and large industries, to continue investing in an array of possibilities for the commercialisation of the knowledge generated. The challenges "Cutting-edge biotechnologies as future innovation driver" and "Innovative and competitive platform technologies" develops generic technological enablers across economic sectors such as health, agriculture and industry. Topics are broad, however with scale and scope, to allow one or several projects with complementary approaches to be financed under the same topic.

Some biotechnology areas such as synthetic biology raise potential ethical and safety concerns. Ethical issues will be embedded in the corresponding topics.

Cutting-edge biotechnologies as future innovation drivers

This challenge is driven by the vision that cutting edge-biotechnologies are paramount to assure that the European industry is to stay at the front line of innovation, also in the medium and long term. Among cutting-edge biotechnologies, synthetic biology has a high potential to influence, or even transform a range of areas of our economy and society. In terms of supporting tools, progress in bioinformatics is critical to avoid clear-cut limits on the ability to realize the full value of biotechnology. These fields deserve appropriate measures in terms of research and development to facilitate effective transfer and implementation into new applications.

BIOTEC 1 - 2014: Synthetic biology – design of organisms for new products and processes

Specific challenge: Enabling the construction and redesign of biological systems which display functions that are not known in nature, synthetic biology has the potential to transform a range of economic sectors. Applications include, among others, the manufacture of drugs and diagnostic agents, the production of fine or bulk chemicals or the detection of pollutants and their breakdown or removal from the environment. While the prospects of combining engineering and biology are enormous, harnessing this potential requires further development of synthetic biology techniques while embedding the notion of responsible innovation upfront in its development.

Scope: The projects should be industry driven, aiming on innovative approaches for different applications. RTD challenges relate to the artificial design and/or simplification of the

microbial genomes and their use for the predictable engineering of biotechnological applications; the design of robust and sustainable biomolecular circuits and pathways as well as the need to develop standards and creation of orthogonal biological systems. Risk assessment, ethical, societal and intellectual property aspects should be integral part of any project. The projects should liaise with other on-going FP7 and international activities on responsible governance of the science and society relationship related to synthetic biology. Activities will span between TRLs 3 and 5.

Expected impact: Projects should result in scientific breakthroughs spurring innovation across sectors such as healthcare, energy, materials, environmental technologies and agriculture. Bringing a number of synthetic biology derived products currently approaching proof-of-concept phase towards technological validation. Cooperation with academia will allow European industry including SMEs to capitalise on the European knowhow of synthetic biology and keep the prospects for European synthetic biology at the front of global competition. Contribute to an educated societal debate on synthetic biology by addressing ethical, safety, and intellectual property aspects.

Type of action: Research & Innovation Actions (100% funding)

BIOTEC 2 - 2015: New bioinformatics approaches in service of biotechnology

Specific challenge: One of the greatest challenge facing the biotechnology community today is to be able to make use of the vast and dynamic influx of "omics" data. The synchronised development of bioinformatic concepts is a prerequisite to enable the exploitation of this wealth of biological data as a source of new biotechnological applications. These can range from industry and health to the environment and agriculture. Ethical aspects such as those related to confidentiality, sensitive data and data property are relevant to some bioinformatics applications.

Scope: Projects should develop new innovative bioinformatics approaches to close the gap between data availability and the discovery of new biotechnological applications. Projects should in particular address the needs of SMEs active in the bioinformatics sector and should take into consideration international activities with the objective of fostering global solutions, standards and interoperability. Ethical aspects are to be addressed if relevant to the targeted research. Activities will span between TRLs 3 and 5. Key challenges in this endeavour are:

- Development and/or integration of application-oriented databases taking into account the physical distribution, semantic heterogeneity, co-existence of different computational models and data and, as a consequence, of different interfaces.

- New efficient statistical approaches for increased interpretative and predictive capacity of data, which are taking into account of the molecular complexity of living systems.

- Innovative visualization methods, dedicated to an integrative and synthetic representation of large and heterogeneous datasets involving intuitive tools for visualising and examining data.

Expected impact: New bioinformatics tools will lead to facilitated access, handing and exploitation of existing databases paving the way for new biotechnological applications. Bridging existing information from various application areas. Bioinformatics tools such as modelling and prediction will result in accelerated process design and reduced time-to-market. .

Type of action: Research & Innovation Actions (100% funding)

Biotechnology-based industrial processes driving competitiveness and sustainability

Industrial biotechnology enables industries to deliver novel products which cannot be produced by current industrial methods; in addition it makes possible replacing industrial processes by more resource efficient biotechnological methods with reduced environmental impact. Industrial Biotechnology represents for chemical industry and chemistry-using sectors a unique opportunity for innovation and green growth in an increasingly competitive environment. Current global revenues for goods produced using industrial biotechnology are estimated between EUR 50 billion and EUR 60 billion annually. Predictions for future market values include an estimate that by 2030 the global market for industrial biotechnology could reach EUR 300 billion. This challenge addresses technology driven R&D targeting industrial bottlenecks. The overall aim is to maintain the European leadership in industrial biotechnology.

BIOTEC 3 - 2014: Widening industrial application of enzymatic processes

Specific challenge: Biocatalysis is increasingly used in synthetic routes to complex molecules. However, the lack of a broad range of reactions platforms catalysed by enzymes and the long development timelines are hindering the full potential of biocatalysis. As a result, while the industry is in need of sustainable routes for a number of important chemical reactions (e.g some oxidation, C-C bond formation reactions, etc) biocatalytic alternatives with reduced environmental footprint are still not accessible to large scale chemical synthesis.

Scope: Development of specific robust biocatalysts for application at a large scale. Attention should be given to oxidoreductases, oxygenases, lyases. Proposals will have a strong industry drive and include demonstration activities to bridge the gap between lab and industrial scale and to assess the technoeconomic viability of the targeted biotransformation. Proposals should address the development of generic platform technologies and methods for fast and accurate enzyme activity determination and enzyme optimization enabling the design of highly efficient biocatalysts with an expanded range of substrates and for industrially important conversions. Strong weight will be put on industrial leadership of the projects which are aimed at introducing a real innovation focus. Activities will span between TRLs 5 and 7.

Expected impact: The demonstration of biocatalytic routes to new chemical reactions at large scale will pave the way for a subsequent market replication. The industrial concepts demonstrated should have the potential for a significant economic and environmental benefit. Enhancing industry's capabilities for rational design of biocatalysts and their fast quantitative evaluation, will be key for ensuring the worldwide leading position of the EU biocatalysis sector. Increase sustainability and competitive-edge of biotech’s concomitant sectors such as chemical, pharmaceutical intermadiates, food additives, cosmetics etc. The project should contribute to realising the objectives of industrial and innovation policy, such as the EU Strategy for Key Enabling Technologies.

Type of action: Innovation Actions (70% funding)

BIOTEC 4 - 2014: Downstream processes unlocking biotechnological transformations

Specific challenge: A general bottleneck for biochemical processes is the fact that product concentrations are typically low and it is common that several by-products are produced. These two factors make downstream processing (DSP), isolation and purification having an important impact on the economics of the system causing up to 80 % of the production costs. Achieving high efficiency at low costs calls for approaching the design and scale up of the bioprocess and downstream separations as a single integrated process. The development and demonstration of downstream processes is expected to unlock a number of biotechnology transformations that are not economically viable at present.

Scope: The aim is to develop and demonstrate downstream processes which overcome the often low and complex productivity of bioprocesses. This includes tools and technologies such as *in-situ* product removal, separation and purification technologies, newly developed materials (e.g. membranes, adsorbents, resins, etc), reliable scale-up methods. Demonstration activities should aim at proving the industrial relevance of the developed downstream processes in the overall biochemical process should be at the centre of every project. Strong weight will be put on industrial leadership of the projects which are aimed at introducing a real innovation focus. Activities will span between TRLs 5 and 7.

Expected impact: Efficient and integrated downstream processes will lead to a tangible reduction of investment and operating costs of the targeted biochemical process. The industrial concepts demonstrated should have the potential for a significant environmental benefit. Enhance the competitiveness and sustainability of European industries through increase efficiency in bioprocess development. The project should contribute to realising the objectives of industrial and innovation policy, such as the EU Strategy for Key Enabling Technologies.

Type of action: Innovation Actions (70% funding)

BIOTEC 5 - 2015: SME boosting biotechnology-based industrial processes driving competitiveness and sustainability

Specific challenge: The large number of SMEs which characterise the EU biotechnology sector are playing a crucial role in the move to competitive and sustainable biotechnology-based processes. These SMEs are characterised by their research intensity and long lead times between early technological development and market introduction. They therefore need to be supported to overcome the so-called “valey of dealth”.

Scope: Innovation projects will be supported that address biotechnology-based industrial processes and that demonstrate high potential in terms of company competitiveness and growth underpinned by a strategic business plan. Activities should focus on innovation activities such as demonstration, testing, prototyping, piloting, scaling-up, design, market replication and the like aiming to bring an innovation idea close to deployment and market introduction, but may also include some research. For technological innovation a Technology Readiness Levels of 6 or above (or similar for non-technological innovations) are envisaged.

Expected impact:

- Enhancing profitability and growth performance of SMEs by combining and transferring new and existing knowledge into innovative and competitive solutions seizing European and global business opportunities.
- Overcome the "valley of death" leading to market uptake and distribution of innovations tackling bio-based industrial processes in a sustainable way.
- Move technology readiness levels up to 6 or above allowing SMEs to build business alliances.
- Increase of private investment in innovation, notably leverage of private co-investor and/or follow-up investments.
- The expected impact should be clearly described in qualitative and quantitative terms (e.g. on turnover, employment, market seize, IP management).

Type of action: SME Instrument, 70%

Innovative and competitive platform technologies

Platform technologies are the main tools and techniques shared by nearly all biotechnology applications. Their influence is pervasive, enabling biotechnology applications across economic sectors. Some of them are at the cutting edge, like those developed in the first challenge. Others such as genomics and meta-genomics are already incorporated in the industry toolbox. The challenge aims at furthering technological development of a metagenomics toolbox to expand its potential.

BIOTEC 6 - 2015: Metagenomics as innovation driver

Specific challenge: Metagenomics has the potential to provide unprecedented insight into the form and function of heterogeneous communities of microorganisms and their vast biodiversity, without the need for isolation and lab culture of particular organisms. Microbial communities affect human and animal health, support the growth of plants, are critical components of all terrestrial and aquatic ecosystems and can be engineered to produce fuels or chemicals. However, in order to expand their potential further, the metagenomic methodologies need to overcome a number of challenges such as those related mainly to standardisation of experimental design, screening, sequencing technologies and bioinformatics relevant techniques.

Scope: Projects should address the development of technologies that form the metagenomic toolkit to guide future developments in the field with view to enable metagenomic approaches responding to societal and industrial needs.. Similarly, epigenetic modifications and the RNA and protein-level data could be addressed to elucidate functional dynamics of communities of microorganisms. Activities will span between TRLs 3 and 5.

Expected impact: The development of metagenomic methodologies will result in a better understanding of communities of living organisms and empower agricultural, industrial, medical and other applications. This should bring significant and measurable improvements in

productivity, yields, quality and functionality, as well as reduction of costs for the end-users. It is expected to reduce time-to-market thus strengthening competitiveness of European industry and SMEs. Results can be expected with identification of, for instance, human drug targets, commercially useful traits in agricultural plants, genes in microorganisms with industrial applications or unravelling pathogens, as well insights into microbial biodiversity for environmental applications.. Finally, this will contribute to on-going and future standardisation work in the field, at the European and international level.

Type of action: Research & Innovation Actions (100% funding)

Call for FoF - Factories of the Future

H2020 – FoF – 2014/2015

Caveat concerning the 2015 topics which are not yet open – Standard text to be added

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 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.

FoF 1 – 2014: Process optimisation of manufacturing assets

[topic contributed by LEIT-ICT part]

Specific Challenge: Today's manufacturing is increasingly challenged by uncertainties of continuously and rapidly -changing market conditions and increasingly shorter time-to-market requirements. 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.

Scope:

a. R&I Actions: proposals are expected to cover one or more of the themes identified below, but not necessarily all of them.

CPS-based process optimisation (Cyber-Physical Systems) for adaptive and smart manufacturing systems bringing together novel concepts for CPS, progress in advanced control and new modelling and simulation technologies.

- Methods for Integrative Control and Optimization of Discrete and Continuous Processes supporting engineers in their aim of detecting, measuring and monitoring

the variables, events and situations which affect the performance, energy-use and reliability of manufacturing systems. Research should encompass progress in smart sensor technologies, smart system design, embedded systems and advanced control.

- Scalable CPS architectures for adaptive and smart manufacturing systems to dynamically enable the continuous design, configuration, monitoring and maintenance of operational capability, quality, and efficiency. Self-learning capabilities closing the feedback loop between production and design should be included as appropriate.

Collaborative and mobile manufacturing: Development of agile collaboration tools for process optimisation of manufacturing assets across the supply chain towards the Cloud-enabled Manufacturing Business Web. Research should address real-time architectures to master complexity of the supply network and underlying logistics resources.

Towards zero-failure laser-based manufacturing: Fast and accurate process monitoring systems allowing feedback control of laser process parameters in highly dynamic manufacturing processes. Actions should cover in particular the development of (in-line) process monitoring sensors, measurement and non-destructive testing tools including the related high speed data processing and reduction. Actions should include validation/demonstration elements and involve stakeholders covering the whole value chain.

b. Support Actions

Consensus building for a factory-wide interoperability framework for CPS engineering and manufacturing environments; concepts for a European smart specialisation strategy in manufacturing building on the model of virtual value chains; concept and roadmap building in relation to smart and safe workspaces for laser-based manufacturing.

Expected impact:

- Increased capability for better and faster reaction to market changes by being able to use holistic global and local optimization algorithms in a collaborative value chain.
- Reduced complexity of production systems by at least an order of magnitude through an interoperable de-centralised architecture approach and interoperability frameworks.
- Productivity increase of about 30% through the enhanced utilisation of resources and information taking a holistic view in a collaborative value chain.
- Strengthened market position of European producers of laser-based manufacturing equipment, their suppliers and of the users of the equipment.
- Reinforced capacity to manufacture high-quality and innovative products and to penetrate new application areas.

Types of action:

a. Research & Innovation Actions (100% funding)
b. Coordination and Support Actions

FoF 2 – 2014: Manufacturing processes for complex structures and geometries with efficient use of material

Specific challenge: In current market and technological context, mechanical products have to be designed and produced taking into account structural optimisation (which often involves complex structures and geometries) and economically efficient production (i.e. productive and flexible manufacturing). Automated manufacturing of complex geometries can be related to issues such as 3D structured, multi-layered and hybrid materials, joining issues or the joint-

free realisation of complex shapes. Moreover, newer constraints are coming from requirements of sustainability in production processes (resource and energy efficiency), both through additional regulations and through the increased materials and energy costs. The main aims in the manufacturing of complex structures are quality and productivity with minimum use of material and energy.

Scope: Three complementary approaches can be considered: Innovative resource-efficient manufacturing processes (through tolerance to recycling / remanufacturing or through first time right approaches), innovative energy efficient machinery, and developments in process control allowing both to cope with more recycling in the process and to increase output quality (i.e. reduce out-of-tolerance products that have to be refused).

Research activities should address several of the following areas:

- Manufacturing process control and monitoring strategies based on integrated models of both processes and machines, with modules for resource and energy efficiency planning and monitoring, and with capability of selection of the best process and machine for the part to be manufactured.
- Innovative process concepts and tools, including design, for resource efficiency in complex geometries manufacturing.
- Innovative machinery improving resource efficiency from the current state of the art in complex geometries manufacturing.
- Remanufacturing and recycling, with novel or improved use of waste streams.

Activities expected to be implemented at TRL 4-6.

Expected impact:

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

- Reduction of at least 30% in the material usage pertaining to the manufacturing of complex structures and geometries when compared to current average values.
- Reduction of at least 20% in the overall energy consumption related to the manufacturing of complex structures and geometries when compared to current average values.
- Elimination of faulty manufactured parts by the adequate combination of integrated process-machine approaches with a continuous control of process parameters.

Type of action: Research & Innovation Actions (100% funding).

FoF 3 – 2014: Global energy and other resources efficiency in manufacturing enterprises

Specific challenge: The consumption of energy and other resources often represents a major part of the cost of manufactured products. Energy and other resources savings need to be considered at several levels: machine, process, the whole factory and along the entire value chain. The development of new business models focusing on the collaboration of companies operating in the same value chain to increase resources and energy efficiency can bring important cost savings in products and increased competitiveness. Inter-company cooperation can be further facilitated by geographic proximity (Industrial Symbiosis). The ultimate objective is to increase competitiveness of the EU manufacturing sector while at the same time improving environmental performance.

Scope: Research activities should be multi-disciplinary and address all of the following areas:

- Energy and resource consumption data collection along the entire value chain, modelling and integration of data into the decision making tools and procedures.
- Development and implementation of new business models aimed at reducing energy and resource consumption along the whole or a relevant part of the value chain including final users when possible and recycling or reprocessing companies.
- Clustering of factories, suppliers or any other company in order to implement common resources optimization or intelligent demand side management strategies. That may require the development of adapted Manufacturing Execution Systems (MES).
- Development of strategies for enabling energy characterisation of enterprises as a means for obtaining energy certifications coherent with the European Eco-design provisions.
- Development of coherent detailed business cases, including economic, strategic and commercial analysis, of the business models developed during the project.

Projects are expected to use appropriate Life Cycle Assessment and Life Cycle Cost techniques with rigorous baseline values in order to estimate the impact of the results of the project.

Activities expected to be implemented at TRL 4-6.

Expected impact:

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

- Energy consumption and CO_2 emission reduction (LCA) for the final product of at least 20% from cradle to gate (use and disposal omitted).
- Energy consumption and CO_2 emission reduction for the product of at least 30% from cradle to grave.
- Product's Life Cycle Cost (LCC) reduction of at least 10% from cradle to grave.

Type of action: Research & Innovation Actions (100% funding).

FoF 4 – 2014: Developing smart factories that are attractive to workers

Specific challenge: In a very competitive environment, manufacturing enterprises will need to be attractive to potential workers. This will require new thinking both on scheduling of work and design of attractive workplaces. The aim is to demonstrate the operation of a real smart factory, in which image processing will allow for "knowing and recognising in the background" users gestures, their interaction among each other and provide them with on the spot possibilities to access or develop knowledge needed for their respective tasks. By using interactive displays and reassessing the definition of gestures, machine-man interaction will be improved while providing an attractive workplace in which workers can develop their own competences and skills as well as their implication in the future of the organisation.

Scope: Demonstration activities should be multi-disciplinary, involving in particular as appropriate disciplines of Social Sciences and Humanities, and address all of the following areas:

- Methodologies and tools for efficient design or re-adaptation of production facilities based on co-evolving product-process-production systems considering simultaneously productivity aspects and the wellbeing and autonomy of the workers, through the integration of technologies.

- New methods and technologies for an optimised take-up and use of workers' knowledge, to stimulate team interactions and to enhance work related satisfaction taking into consideration safety and ergonomics of the working areas.
- Integration of innovative production technologies supporting increased productivity and flexibility.
- Incorporating aspects linked to education and to attractiveness to youth (e.g. in-factory teaching, "factory-lab" concepts).

Attractive research will support manufacturing enterprises in Europe in their respective efforts for talents to be employed in attractive manufacturing jobs. Proof of concept in terms of at least one industrial pilot demonstrator should be delivered before the end of the project, convincingly demonstrating a solution to industrial needs.

Activities expected to be implemented at TRL 5-7.

Expected impact:

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

- In economic terms, an increase of 20% in productivity due to an increased commitment of people, better organisation of work, reduction of absenteeism in the workplace and by increasing the pool of potential workers through widening the skill profile.
- In social terms, an improvement in the working conditions in factories and in the attractiveness of the working environments in particular for young people.
- Improved work satisfaction of employees within the factories of the future.
- Strengthened global position of European manufacturing industry through the introduction of the new technologies.

Type of action: Innovation Actions (70% funding).

FoF 5 – 2014: Innovative product-service design using manufacturing intelligence

Specific challenge: Manufacturing intelligence requires a high integration of (ICT-based) engineering tools and secure middleware solutions that facilitate easy, ubiquitous (e.g. Cloud-enabled) and fast sharing of product and process information/knowledge across the entire lifecycle. Today's ever faster product lifecycles and ever higher quality requirements necessitate manufacturing engineering capability that is able to exploit to the maximum the concurrency of product and service engineering with immediate, cross-disciplinary feedback loops to relevant shop floor knowledge.

Scope: Research should aim at developing open, multi-disciplinary and holistic product-service engineering environments with the following features:

- Collaborative management of engineering knowledge and its multi-directional exchange between product design, service design and manufacturing, enabled by rapid search for design functionality and reusability.
- Tools and methodologies to effectively involve customers and suppliers across the value chain.
- Multi-disciplinary search, simulation and optimisation of designs.
- Quantification of overall (time-to-market) improvements and reduction of the lifecycle CO_2 footprint of new products.

Activities expected to be implemented at TRL 4-6.

Expected impact:

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

- Improved time-to-market for European manufacturers.
- Improved sustainability across the entire product-service lifecycle.
- New and better product-service offerings addressing customer needs.
- Increased support for open standards targeting security and interoperability of shared engineering data.

Type of action: Research & Innovation Actions (100% funding).

FoF 6 – 2014: Symbiotic human-robot collaborations for safe and dynamic multimodal manufacturing systems

Specific challenge: Immersive and symbiotic collaboration between human workers and robots is a key element to be addressed for the further automation of tasks and processes in the European manufacturing industry. It offers a solution leading to higher profitability to robot-reluctant industries where current tasks and processes are too complex to be automated. Currently novel methods for human-robot interaction have been proven in structured non-industrial environments. In order to enhance the introduction of robots on the shop floor in a real industrial setting, several important human and organisational issues, such as safety and difficult working environments, have to be dealt with.

In particular, future human-robot-systems will have to be dynamic and cost-effective, act safely in a shared fenceless working space and allow for the development of specific competences and skills for workers in their interactions with robots.

Scope: While the focus will be on demonstrating the multimodal manufacturing systems, R&D activities supporting the integration and scale-up are expected as well.

Two key obstacles to overcome to facilitate the introduction of robots on the shop floor of robot resistant production plants are the safety of the worker and the symbiotic collaboration.

Demonstration activities should focus on at least two topics of each of the two areas:

- Safety of the worker:
    - Innovative strategies for online safety monitoring such as the interactive perception of the whole workspace as well as directed perception focused on the task.
    - Development of intrinsically safe robot hardware on industrial scale leading to high power robots which are both safe and precise.
    - Safety during a mechanical failure of the robotic system during tight collaboration of humans and robots.
- Human-Robot interaction:
    - Intuitive and multimodal programming to allow robot systems to be rapidly and easily programmed without prior knowledge on robot systems, while still allowing for a cost-efficient deployment of the robotic system in an industrial setting.

- New methodologies for the initial planning and online dynamic replanning of the shared tasks, taking into account the organisation contexts of the addressed industrial sectors.
- New innovative, fast and cost-effective sensors for detection in combination with the application of innovative strategies to analyse real-time large amounts of sensor data.

In close interaction with the research activities, relevant certification issues should be addressed. In order to allow a wide use of the newly developed robotic system in new production areas and sectors, a clear case for maintaining reduced investment costs has to be made, including a return-on-investment study.

Activities expected to be implemented at TRL 5-7.

Expected impact:

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

- Industrial-scale demonstrator of safe human-robot tight collaboration by sharing workspace and tasks, paving the way for potential improvements of the normative aspects.
- Increasing use of robot installation in traditional European robot-reluctant industries. In particular SMEs, manufacturing plants with highly manual processes and continuous production lines. Further improvement in robotics solutions deployment will contribute to higher employment as more manufacturing capacity will remain in Europe.
- Increasing industrial-readiness and adaptability of human-robot collaborating manufacturing systems by increasing the robustness of those systems for noisy and extreme industrial environments and by combining the flexibility inherent to humans with the enhanced potential of cooperative production systems.

Type of action: Innovation Actions (70% funding).

FoF 7 – 2014: Support for the enhancement of the impact of FoF PPP projects

Specific challenge: Dissemination, exploitation and transfer of projects results are crucial activities during project life-time and beyond in order to make sure that projects have the expected impacts. Clustering of project activities, according to 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. Adequate monitoring of such activities during project life-time and beyond is also needed to ensure effective implementation at programme level. An effective monitoring of those activities during the project duration and beyond is needed and will ensure an effective implementation at programme level.

Scope: The coordination actions shall aim in particular to actively cluster existing activities under the FoF PPP. The initiative, which is expected to last 2 years, will require close collaboration with relevant industrial associations and technology transfer programmes.

The Commission considers that projects requesting a contribution from the EU of around EUR X would allow this topic 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 FoF PPP projects.
- Stimulation of networks and alliances for further RTD and industrial innovation in the addressed technology and application areas, including the development and practical application of a clustering model.
- Additional added value beyond the original scope of the FoF PPP projects by exploiting synergies and sharing best practice. Increased public presence and awareness of FoF PPP activities.
- More effective execution of activities of common interest, such as IPR management and standardisation.
- Review of recent technological developments, publications, international RTD and innovation programmes to assess recent technological developments.
- Workshops with top-ranked international experts from various disciplines aiming at the elaboration of future FoF priorities.
- Anticipation of business trends and market prospects.

Type of action: Coordination and Support Actions – Coordination Actions

FoF 8 - 2015: ICT-enabled modelling, simulation, analytics and forecasting technologies

[topic contributed by LEIT-ICT part]

Specific Challenge: Simulating continuous and discrete manufacturing processes, forecasting the behaviour of manufacturing systems and processes, and designing products to an even larger extent through virtual mock-ups integrated in the design and production chain are key enablers for Europe's future manufacturing sector. Advances in ICT in terms of high performance computing power and communication speed, smart sensor technologies for generating and exploiting "big data", the convergence of the embedded world and the Internet/Cloud world in cyber physical systems (CPS), multi-modal visualisation and interaction technologies, are leading to a new generation of modelling, simulation and forecasting methods and tools. These offer a huge potential for making the whole manufacturing chain more competitive.

Scope:

a. R&I Actions: proposals are expected to cover one or more of the themes identified below, but not necessarily all of them.

Innovative modelling, simulation, analytics and forecasting tools for manufacturing at large, building on advances in ICT. Projects should be driven by industrial use-cases and should include proof-of-concept demonstrations for validation. They should address as appropriate several of the following issues:

- Modelling and simulation methods involving multiple phenomena (physical, mechanical, energetic, chemical, energy, material characteristics, cost, …); including multi-scale and integrated discrete/continuous models and multidisciplinary design optimisation tools taking a holistic approach; and/or integrating virtual and physical experiments building on the combination of simulated, experimental, and real world data in real time.
- Integrated knowledge-based systems covering the complete product life-cycle with advanced analytics and self-learning capabilities exploiting the availability of "big data" from smart sensors, historical process files, or human-authored data; and addressing aspects like interactivity, real-time, data-fusion, advanced visualisation, security and privacy.

Integrated modelling, simulation and information management systems benefiting from recent advances in ICT. Projects are expected to stimulate pre-normative or standardisation activities related to aspects such as information/knowledge exchange, data sharing, semantic technologies, tool integration, etc. Projects must include reference implementations and demonstration and validation in minimum two comprehensive and complementary industrial use cases. Focus is on:

- Integrated information management systems for product-process-production systems that are well embedded into their social, environmental and economic context.
- Advanced computer aided technologies (CAx), modelling and simulation toolboxes tailored for novel manufacturing processes like laser-based and additive manufacturing.

b. Support Actions: Road mapping and constituency building for novel ICT-enabled concepts in manufacturing supporting the wide adoption of virtual, integrated, scalable, semantic factory models; merging design and production models; and integrating novel ICT for creativity. Stimulating EU-US collaboration on R&I related to modelling and simulation.

Expected impact:

- Increased productivity during design and ramp-up phases and for higher mass customization capacity for big enterprises as well as SMEs through access to on-demand scalable manufacturing services and through agreed data standards.
- Improved cost efficiency and accuracy, reliability and speed of simulation techniques for manufacturing processes and/or full complex products.
- Reduced time to production and optimised supply chains enabled by increased tool interoperability and data integration.
- Enhanced interoperability of integrated product and factory design systems and global state monitoring enabling new type of services related to the data analysis, simulations and visualization techniques in each manufacturing stage.

Types of action:

a. Research & Innovation Actions (100% funding)
b. Coordination and Support Actions

FoF 9 - 2015: ICT Innovation for Manufacturing SMEs (I4MS)

[topic contributed by LEIT-ICT part]

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.

Scope: As Phase 2[17] of I4MS this objective 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 along the value chain by adopting new concepts and business models based on servitisation, for product operation, or for end-of-life use.

Two types of **innovation experiments** are supported: Driven by the requirements of first-time users, **Application Experiments** bring together all actors of the value chain and experts necessary to equip new users with novel products or services and assist them in customising and applying these in their respective environments. In **Equipment Assessment Experiments,** suppliers of innovative high-tech equipment install and assess their prototypes or products in production-like environments and validate them in a manufacturing line or in an industrial environment that is very close to manufacturing conditions.

Activities are expected to be clustered in larger projects to achieve critical mass and to better exploit EU-added value. Common tasks include: targeted dissemination; management of calls for new actions; exploitation of synergies across actions. To better cope with the speed of innovation in ICT, implementation must be flexible and fast. Part of the actions and partnership are to be defined from the outset, while additional experiments or users, may be identified through open calls during the action (max. 50% of the total budget).

a. Three areas of technologies are targeted for the **Innovation actions**::

[17] Information of Phase 1 available in http://cordis.europa.eu/fp7/ict/computing/home-i4ms_en.html

- Highly flexible and near-autonomous robotics systems (application experiments).
- HPC Cloud-based modelling, simulation and analytics services for modelling multiple interconnected phenomena; for integrating multiple tools across the process chain; for exploiting the dynamic availability of "big data"; for integrating novel mobile interfaces for data management and decision support; and/or for achieving real-time response (application experiments).
- Integration of Cyber-Physical-System modules in manufacturing processes and process chains (application or assessment experiments) to increase sophistication and automation in production SMEs and to create novel value added services linked to process surveillance and maintenance.

b. Support actions: network of Innovation multipliers leveraging investment in research and innovation is to be reinforced:

To advance the European I4MS **innovation ecosystem**: 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; brokering between users and suppliers in view of open calls; leveraging further investment by stimulating replication, by brokering access to venture capital or other private investment, and by exploiting regional funds in the context of the European strategy on "Smart Specialisation".

Expected impact:

- 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.
- Exploration of new application areas for advanced ICT in manufacturing at large.

Types of action:

a. Innovation Actions (70% funding)
b. Coordination and Support Actions

FoF 10 – 2015: Manufacturing of custom made parts for personalised products

Specific challenge**:** The manufacturing of customised products requires the development of new strategies integrating design with manufacturing and incorporating appropriate control methodologies to ensure small or large lot quantities which meet the specifications. Examples include new custom made parts or spare parts on demand either to sub-divisions of sectors/products or personalised to an individual as well as unique identification marking of products. New manufacturing processes and machines will need to be developed which are flexible at the local level to meet specific consumer demand and mass customisation where rapid translation between different specifications is required. In order to address customisation, advanced manufacturing processes need to enable processing of multi-materials or functionally graded materials as well as more flexibility and rapid reconfiguring capabilities. For all customised manufacturing, it is necessary to have quick realisation from

design to production in one process step as well as economic production systems down to single and small lot sizes.

Scope: Research activities should be multi-disciplinary and address several of the following areas:

- Development and integration of advanced design and manufacturing technologies able to transform such new product-service data descriptions and protocols into manufacturing operations and processes exploiting.
- Development of new machines and processes integrating new multi-materials for the manufacturing of personalised parts and products.
- Seamless data integration across the process and supply chains for the fast production and distribution of custom made parts and products.
- Methodologies and tools for the management and running of effective value chains for the fast production and delivery of personalised products.

Activities expected to be implemented at TRL 4-6*; a leading role of the participating SMEs with R&D capacities is expected*

Expected impact:

- Increased capability to provide value added products/services and to rapidly follow the market dynamics by means of fast production and delivery of customised parts and products.
- Reduction by 50% in the lead-time for manufacturing one new custom part with respect to current values for same requirements.
- Cost reduction of personalised products manufacturing by 20%, by decreasing lead times in products and processes development and the time to market of customised parts and products by 30%.
- Reduction of waste parts and materials by 25%.

Type of action: Research & Innovation Actions (100% funding).

FoF 11 – 2015: Flexible production systems based on integrated tools for rapid reconfiguration of machinery and robots

Specific challenge: Easy and fast reconfigurable machinery and robots are essential to answer to the increasing need for highly complex products and to react to rapid changes in market demands. Smaller lot sizes and more product variations require a highly flexible production capacity. New tools are required to support more rapid and autonomous reconfiguration of production systems. Powerful tools addressing self-adjustment, correction, and control of individual machines and robots, the production system as a whole and the link with existing production planning and scheduling systems have been developed over recent years but integration and deployment of those tools require further R&D and demonstration. While the focus will be on demonstrating the tools on existing production capacity, R&D activities supporting the integration and scale-up are expected as well.

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

- Integrated tools for the management of agile production systems as a whole (Manufacturing Execution Systems) and the fast reconfigurable individual machines and robots, optimising the changeover times and costs.

- Standardisation of the communication protocols and data structures fitting the plug and produce philosophy.
- Protocols for interconnecting the production system information with higher level plant management systems.
- Integration of automatic monitoring and optimisation of energy usage in the production system.
- Demonstration of the integrated solution in at least one existing production environment.

Activities expected to be implemented at TRL 6-7.

Expected impact:

- Enabling existing production systems to produce on average at least 50% smaller lot sizes and 50% more product variations in an economical way, as a result production will be demand driven and waste will be significantly reduced.
- Reduction of at least 30% of the set-up and changeover times and costs for existing production systems leading to a significant increase in production capacity.
- Reduction of average energy consumption by 5% through an optimised use of production capacity.
- Strong support for standardisation of communication protocols, data structures and tool connectivity.

Type of action: Innovation Actions (70% funding).

FoF 12 – 2015: Industrial technologies for advanced joining and assembly processes of multi-materials

Specific challenge: Multi-material design of components and structures provides an opportunity to develop products which are able to operate under more exigent requests demanded by market and society such as increased strength-to-weight ratio, multi-functionality, highly aggressive environments and low carbon footprint. By smart use of adequate joining technologies, and the incorporation of multi-material design into the assembly chain, the final product performance can be improved. This is particularly relevant when high cost, scarce or hazardous materials are involved.

Scope: Traditional joining leads to loss of the performance that materials offer in their final product, because of modifications in composition and properties or geometric distortion. Improved, new or hybrid joining and assembly processes are therefore needed to be developed for specific combinations of designs and materials in order to overcome the mentioned limitations. Technologies to be addressed can be welding processes, bonding using adhesives, mechanical joining or any other joining process. Formulation of new adhesives is excluded from the scope of the topic. The novel joining integration capabilities will feature a high degree of process automation and quality control and they will make use of sustainable manufacturing practises. Assembly and disassembly efficiency, product quality, recycling and cost targets will also be considered. While the focus will be on demonstrating the technologies, R&D activities supporting the integration and scale-up are expected as well.

Demonstration activities should focus on all of the following priorities:

- Joining and assembly processes that will lead to maximise performance of the joints, based on a deep understanding of the cause-effect relationships as well as of materials process interactions.
- The implementation of numerical simulation techniques that will lead to a better understanding of the considered joining processes as well as product development along all its different phases.
- The development of high efficient, cost-effective and flexible surface condition solutions (e.g. surface modification, thermal treatments, gap avoidance) to provide joints with the maximum performance.
- The implementation and set up of reliable, efficient and automated non-destructive inspection techniques for joint quality evaluation, together with in-situ monitoring and control systems for critical variables of the joining operations that will guarantee reliable, robust and safe production conditions in industrial environments.

At least one prototype or pilot implementation in pre-industrial settings aiming at demonstrating the scalability should be delivered before the end of the project as a proof of concept.

Activities expected to be implemented at TRL 6-7.

Expected impact:

Application of multi-material design to products through the developed joining and assembly processes will bring:

- At least 30% decrease in the consumption of high cost and critical materials.
- At least 30% improvement of the product performance, without increasing the final price.
- A higher level of automation and lower production times compared to current technologies.

Type of action: Innovation Actions (70% funding).

FoF 13 – 2015: Re-use and re-manufacturing technologies and equipment for sustainable product life cycle management

Specific challenge: In order to increase the competitiveness of EU industry and reduce the environmental footprint, manufacturing industries should develop innovative technologies and approaches to manufacture added-value products with fewer resources and to ensure a sustainable product life cycle based on reuse and re-manufacturing methods and technologies.

Innovative product recovery approaches would need to be developed in other to extract useful components from obsolete or malfunctioning modules in order to re-use useful functions and/or materials for new products. This will help save time, money, energy, and resources.

Modern high-tech products adopted in the electronics, medical and energy industries are made of advanced materials that are at present poorly recovered and reused. Such materials with low substitutability and low recycling rates include advanced materials such as long and short fibre composites, nano-materials and bio-materials as well as more conventional materials that are today not considered for re-use due to absence of data on reprocessed performance.

This unsustainable scenario requires systemic solutions which are involving all relevant actors in the supply chain. On the one side, there is the need for new product design approaches (including end-of-life options, re-use and re-manufacturing aspects) with development of the built-in product 'smartness' (for ageing monitoring) and modularity (for improved reuse). On the other side, new re-/de-manufacturing processes with improved resource efficiency, or processes more tolerant to substitute materials are required.

Scope: Research activities should be multi-disciplinary and address all of the following areas:

- Innovative approaches for product design which are capable to take into account re-use and re-manufacturing aspects for enhanced product recovery
- New manufacturing and equipment concepts for re-use and re-manufacturing With improved resource efficiency.
- New technologies and automation solutions for the effective disassembly/separation and recovery of advanced materials.
- Generation and validation of new business models to improve economic viability of closed-loop life cycles which make use of the systemic approaches for product life-cycle management.

Activities expected to be implemented at TRL 4-6.

Expected impact:

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

- A significant reduction of energy consumption in manufacturing activities by 2020.
- A significant reduction in non-renewable materials through a combination of substitution, reuse, remanufacture and recycling of materials.
- Reduction of minimum 20% in greenhouse gases emissions from manufacturing activities.
- Reduction of waste generation by 10% minimum.
- Enabling the manufacturing of eco-products.
- Increase of above 20% in productivity rates.
- Clear illustration of possibilities for new safe and sustainable jobs creation.

Type of action: Research & Innovation Actions (100% funding).

FoF 14 – 2015: Integrated design and management of production machinery and processes

Specific challenge: Production quality significantly depends on the ambient conditions and the process parameters. Computational models capable of simulating the machine-to-part process not only can be used to predict manufacturing quality and productivity but, increasingly, to also compensate wear or partial damage through model-based control. Innovative machines and processes increasingly depend on model-based approaches, including the monitoring and control elements, throughout the whole machine lifecycle.

New integrated approaches are needed in simulation methods, tools and across hierarchical model layers requiring a cross-disciplinary collaboration between (predominantly SME)

machine designers, industrial component suppliers, engineering software developers as well as making use of the process experience of manufacturers.

Scope: RTD and innovation activities should aim at developing and testing suitable model-based approaches for production machinery and at demonstrating the power of model-driven approaches for machine innovation through:

- The development of integrated and accurate simulation models and algorithms for model-based control of production machinery based on cross-disciplinary input and actual machine lifecycle parameters.
- Tool programming strategies that are easy to use and can be rapidly modified or re-adapted by workers on the machine.
- Demonstration of the reliability of model-based machines with respect to production accuracy/quality, maintainability and lifecycle return-on-investment (e.g. through an industrially scalable demonstrator).

Activities expected to be implemented at TRL 4-6.

Expected impact:

- Improved system adaptability and reduction of lifecycle costs by 30 % for manufacturing system and process.
- New maintainability concepts based on predictive "(self-) maintenance" with machine reliability improved by 10 % (MTBF) and reduced maintenance costs by 20 %.
- In terms of environmental impact: Reduced waste and energy efficiency improved by 30%.

Type of action: Research & Innovation Actions (100% funding).

FoF 0 – 2014: Development of novel materials and systems for OLED lighting or displays

[Topic jointly implemented with the ICT part of LEIT]

Specific challenge: The further technological development of solid-state light sources (LEDs and OLEDs) and of energy efficient lighting systems is expected to give Europe a leading position on the world lighting market and create new manufacturing jobs for novel consumer products. Moreover, the move to solid-state lighting based on inorganic (LED) and organic (OLED) semiconductors constitutes an important factor in reducing the amount of electricity consumed by lighting and thus limiting carbon dioxide emissions. Much of the research on lighting will also be relevant to advanced displays.

Scope: Research and Innovation actions should focus on materials, process and device technology for OLED lighting or for OLED displays. The aim is to realise OLED devices over larger surfaces, with higher brightness, larger uniformity and longer lifetimes. A demonstrator should be provided at the end of every project. A specific target for OLED lighting is energy efficacy above 100 lm/W, considering also improved out-coupling efficiency; a specific target for OLED display materials is to enable brightness well above several kcd/m^2. The materials have to allow sufficient lifetime for all colours and white light (lifetime of several hundred hours at 97% of the original intensity). Proposals should involve material suppliers and organic SSL/display manufacturers or suppliers.

Activities expected to be implemented at TRL 4-5. Implemented as cross-KET activities.

Expected impact:

- Cost-performance breakthroughs – lighting systems with production costs of 1€/100 lm;
- Secured and reinforced industrial technology leadership and substantially increased market presence in lighting and displays;
- Improved business opportunities and value creation in Europe in lighting and displays by reinforced cooperation along the value chain.

Call for EeB – Energy-efficient Buildings

H2020 – EeB – 2014/2015

Caveat concerning the 2015 topics which are not yet open – Standard text to be added

The construction sector is on the critical path to decarbonise the European economy by 2050. In order to achieve this objective it must enable reducing its CO2 emissions by 90% and its energy consumption by as much as 50%. This is a unique opportunity for sustainable business growth provided that products and related services for both new and refurbished buildings are affordable and of durable quality, in line with several current or future European Directives. Yet, together with the 2050 deadlines, such Directives are putting more constraints on a sector which is directly impacted by the on-going financial and economic crisis, taking into account that, although Europe has major companies, **this sector is highly fragmented with over 95% of SMEs**.

The objective of the *Energy-efficient Buildings* Public-Private Partnership (PPP) Initiative is to drive the creation of a high-tech building industry which turns energy efficiency into a sustainable business, fostering EU competitiveness in the construction sector on a global level.

This call will complement the call on Energy Efficiency of the Energy societal challenge, by helping deliver, implement and optimise building and district concepts that have the technical, economic and societal potential to drastically reduce energy consumption and decrease CO2 emissions, both in relation to new buildings and to the renovation of existing buildings. This new initiative should have a large payoff, as it will increase the market for energy-efficient, clean and affordable buildings. Research priority will be given to delivering new building technologies, materials and components for energy saving and energy generation, thermal energy storage systems, advanced insulation systems, thermal distribution systems, lighting, windows and glazing, energy generation systems based on renewable sources. Priorities also include reliable simulation and prediction tools, including assessment methods that integrate economic, social and environmental issues, including comfort and safety. To date, the construction industry has failed to effectively integrate key technologies into its operations in order to achieve sustainable, long-term competitiveness and such an integration should also be promoted.

Activities supported under the EeB PPP are expected to contribute to EU industrial leadership and the grand societal challenges.

The participation of public authorities may be an asset for some projects, as public authorities own a large part of the building stock at European level.

EeB 1 – 2014: Materials for building envelope

Specific challenge: When improving the level of energy performance of buildings in operation, embodied energy in materials presents an increasingly high percentage of the

energy spent in the whole life cycle of a building. The same applies for CO_2. Therefore, the development of new sustainable construction materials with lower embodied energy and lower CO_2 emissions is needed, whilst keeping other properties at least equivalent. New approaches in material science and production technologies will help to minimize the embodied energy of the main construction materials such as concrete, glass, gypsum, ceramics or steel, involved in the structure, envelope and other building components of energy efficient buildings. At the same time, components with improved insulation and air tightness properties (which are influenced by construction tolerances) are needed, aiming at the overall target of reducing energy consumption and CO_2 emission during the whole life cycle. Higher insulation can be achieved by improving bulk or surface properties.

Scope: Research proposals should address the development of new materials and/or solutions for building components with reduced embodied energy, lower CO_2 emissions and improved insulation properties during operation. The proposed solutions should go well beyond the state of the art and take into account the final performance properties of the new materials and of the respective building components.

The following factors should also be considered: enhanced durability for increased use duration, reduced maintenance and consequently reduced costs, respect of sustainability principles (the sustainability of each developed solution should be evaluated via life cycle assessment studies carried out according to the International Reference Life Cycle Data System - ILCD Handbook); application to both new build and renovation; ease of installation; realistic solutions at a reasonable price; increased comfort and noise reduction. Recycling/reuse of materials may also be addressed. Standardisation aspects can be considered particularly in relation with the work carried out in CEN/TC 350.

Proof of concept in terms of one (or more) component(s) containing the new materials developed should be delivered within the project, excluding commercially usable prototypes (2006/C323/01), but convincingly demonstrating scalability towards industrial needs. Information guides for applications, installation and training on the new solutions should be provided before the end of the project.

Activities expected to be implemented at TRL 6 and above.

Expected impact: Compared to state of the art materials and components, the newly developed materials should bring:

- Reduction by at least 30% of the embodied energy and CO2 at component level;
- Improvement by at least 20% of insulation properties;
- Reduction by at least 15% of the total costs compared to existing solutions;
- Demonstration of at least a 5% reduction of the energy spent during the whole life cycle of a building;
- Strengthening competitiveness of the European construction sector in the field of “green” construction technologies.

Type of action: Innovation Actions (70% funding).

EeB 2 – 2014: Adaptable envelopes integrated in building refurbishment projects

Specific challenge: The refurbishment of the existing building stock requires ground-breaking strategies in order to meet targets for reduced energy use and greenhouse gas emissions. One of the most important components to be addressed with an innovative approach is the building envelope, which has to develop into an active rather than a passive element, meeting more functions than just the separation of the outer space from the interior with insulation.

The concept of adaptable envelope is twofold. On the one hand, it is designed to accommodate further modifications (such as future renovation or technology upgrades). On the other hand, the envelope is able to adapt to a dynamic and intricate environment by measuring and processing multi-source information (e.g. outdoor and indoor environment conditions, occupancy, behaviour of users and envelope performance) in order to respond to the building occupant's instructions and to evolving environmental conditions in an appropriate timing and extent.

Scope: Proposals should address breakthrough solutions to improve roof and façade functional characteristics to enable the building envelope to adapt to a dynamic, mutable and complex environment during its lifetime. Research is expected to cover for example, advanced materials or technologies for energy generation and storage; smart and performance insulation materials; near infrared reflecting and cool coatings; adaptable innovative pre-cast solutions; strategies for improved air quality, moisture control, ventilation control; enhanced acoustic properties; improved fire resistance; automated blinds or movable sun barriers with interrelated issues of summer overheating, air-tightness and natural light use; as well as integration of innovative sensing systems to control and optimise the real time performance of the envelope.

In addition, proposers should also seek to include in the adaptable envelopes features that could facilitate the future renovation or conversion of the whole or part of the building (fostering creativity and an active role of architects and engineers at design stage), such as:

- Adaptability to different shapes, façade conditions, building orientations and general conditions of the building along its lifetime;
- Conversion of rooms, or buildings, to new usage;
- Possibility to integrate new solutions (upcoming technologies) and systems, covering the whole cycle from component design, to the structural aspects and to their installation;
- Self-adaptation, which is important in relation to current weather and building load situation, and changing use patterns (including new users, or family instead of single users).

Clear evidence of technical and economic viability should be provided by validating and demonstrating the proposed adaptable envelope in real case retrofitting projects.

Activities expected to be implemented at TRL 4-6.

Expected impact:

- Total (primary) energy consumption reduction by a factor 2 to 4 with respect to the values before installation of the adaptable envelope.
- Improved indoor environment.
- Demonstration of the replicability potential in a real case-study.

- Provide solutions with a return on investment below 7 years.
- Validation and market uptake of active building elements.

Type of action: Research & Innovation Actions (100% funding).

EeB 3 – 2014: Development of new self-inspection techniques and quality check measures for efficient construction processes

Specific challenge: Today's availability of better energy-efficient building components (envelopes, windows, equipment, etc…) calls for ensuring that these benefits will not be lost by lack of knowledge or bad implementation during the construction processes which may affect the final performance of the building. Critical components to energy efficiency have indeed proven to have significant impact for buildings. With today's high energy prices, a proper understanding of critical components to energy efficiency is crucial in terms of savings and comfort. In addition, the construction sector is characterised by a segmented approach involving a variety of skills and expertise with different role and responsibility. During construction, each actor of the construction value chain must ensure that its contribution fits into a quality framework defined collectively at the design level. Self-inspection and quality checks are implemented to guarantee the final thermal, acoustic and energy performance of the building which will be quantified during commissioning. This means that quality control is of utmost importance to guarantee that the energy performance at commissioning stage will meet the one expected at design stage.

Scope: The research focus is on new self-inspection techniques and quality check measures for efficient construction processes enabled by portable and robust systems that can be easily handled in the construction site. In particular methods for energy related self-inspection, for example to avoid the presence of thermal bridges or to ensure and control good air-tightness in low energy or passive buildings should be considered. The possibility to measure U values over large areas with non-contact solutions would allow to assess conformity to design during refurbishment. The technique to be developed should also be able to avoid or reduce economic and time deviations of the construction processes.

The solutions proposed should preferably be cost-effective and easy to use, considering that they will be implemented on-site by workers which are not necessarily highly skilled. The solutions should be validated and demonstrated in a near to operational construction environment.

The research should consider some peculiarities of working environments in the construction sector, geographical dispersion, heterogeneity of subcontractors, ... The participation of SME subcontractors, with experience especially in the execution of the activities considered represents a clear added value.

Activities expected to be implemented at TRL 4-6. A leading role of the participating SMEs with R&D capacities is expected.

Expected impact:

- To guarantee the final thermal, acoustic and energy performance of the building while increasing the efficiency, reliability and productivity of the construction processes.
- To provide innovative techniques to measure the contribution of each critical component to thermal insulation, air-tightness and building services equipment in energy efficient construction.

- To provide guidelines, methodologies for workers and contribute to standardisation activities.

- Reduction by at least 50% of the mismatch of energy performance between design stage and commissioning stage due to construction processes.

Type of action: Research & Innovation Actions (100% funding).

EeB 4 – 2014: Support for the enhancement of the impact of EeB PPP projects

Specific challenge: Dissemination, exploitation and transfer of projects results are crucial activities during project life-time and beyond in order to make sure that projects have the expected impacts. Clustering of project activities, according to 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. Adequate monitoring of such activities during project life-time and beyond is also needed to ensure effective implementation at programme level. An effective monitoring of those activities during the project duration and beyond is needed and will ensure an effective implementation at programme level.

Scope: The coordination actions shall aim in particular to actively cluster existing activities under the EeB PPP. The initiative, which is expected to last 2 years, will require close collaboration with relevant industrial associations and technology transfer programmes.

The Commission considers that projects requesting a contribution from the EU of around EUR X would allow this topic 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 EeB PPP projects.

- Stimulation of networks and alliances for further RTD and industrial innovation in the addressed technology and application areas, including the development and practical application of a clustering model.

- Additional added value beyond the original scope of the EeB PPP projects by exploiting synergies and sharing best practice. Increased public presence and awareness of EeB PPP activities.

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

- Review of recent technological developments, publications, international RTD and innovation programmes to assess recent technological developments.

- Workshops with top-ranked international experts from various disciplines aiming at the elaboration of future EeB priorities.

- Anticipation of business trends and market prospects.

Type of action: Coordination and Support Actions - Coordination Actions

EeB 5 – 2015: Innovative design tools for refurbishment at building and district level

Specific challenge: The development of sustainable solutions for refurbishment of buildings and their proper integration at district level requires major innovations in the design tools, construction methods and management practices, including socio-economic aspects and innovative financing instruments.

For instance, to improve the reliability of design tools for the refurbishment of buildings, a challenge is to ensure the interoperability between tools from various domains and at different scales. Knowledge in the fields of modelling and computation can be applied in order to propose solutions adapted to collaborative multi-disciplinary refurbishing work.

Scope: Research activities should be focused on design at buildings and district level, taking into account the adjacent systems such as district heating/cooling and decentralised thermal energy generation and other interactions with the neighbourhood. Projects should promote and set up an integrated approach in support of innovation, by providing actors with holistic methods and tools. Energy efficiency improving technologies should become elements of design databases that allow stakeholder to select the most suitable approach for performance improving, taking full advantage of geo-clustered data sets. The design phases linked to retrofitting of existing buildings taking into account subsequent operation and maintenance will be considered as priority. Knowledge based design can also be used to provide input into management systems.

Projects should also cover validation actions on a technical level, which apply the tools on refurbishment projects; and on a societal level, i.e. validation with the occupants of the building. For the latter, involvement of organisations within an Integrated Project Delivery Approach, supporting a participatory design approach, could be an asset.

Activities expected to be implemented at TRL 5-7.

Expected impact:

- More effective refurbishment at building and district level.
- Optimised design of integrated energy-efficient buildings, considering the different physical dimensions in a coupled and holistic way (energy, comfort, air quality, acoustics etc.), enabling actors to take validated and quantified choices for the refurbishment at building and district level on the basis of quantified performance objectives with compliance with regulation and user-oriented comfort expectations and constraints .

Type of action: Innovation Actions (70% funding).

EeB 6 – 2015: Integrated solutions of thermal energy storage for building applications

Specific challenge: Storage plays a pivotal role in synchronizing energy demand and supply, both on a short and long term (seasonal) basis. Transformation of our existing building stock towards very low energy buildings and nearly zero energy and Plus-energy buildings requires effective integration and full use of the potential yield of renewable energy. Thermal storage is a key priority to make such a step, particularly considering the energy renovation of the existing stock, where compact building level solutions are required.

Scope: Proposals should address advanced solutions required to reduce thermal losses, reduce pressure drops, and improve heat exchange in and between storage material and heat carrier.

Having in mind a system approach, innovations are required at different levels. High energy density storage materials are needed in terms of long term multi-cyclic stability at tunable temperature levels. These advanced energy storage materials should allow regeneration temperatures in a range below 100 C to enable a higher efficiency and effectiveness of thermal energy storage of at least 6 times the energy storage density of water.. Furthermore, an additional innovation may concern storage reactor components, in particular the heat exchanger. With respect to the entire storage system, advanced energy management is needed, including smart algorithms for (dis)charging at different temperatures, and simple and robust control equipment. These storage solutions should be enabled by material innovations that are safe and environmentally friendly.

Small scale demonstration of the technical (with compactness as a crucial boundary condition) and economic feasibility of such storage systems at the level of components and systems in relation to space heating and cooling and/or domestic hot water systems of a single building are expected, validating a systemic approach in system integration and scalability in near real life operating conditions.

Activities expected to be implemented at TRL 4-6.

Expected impact:

- Provide advanced thermal energy storage solutions.
- Demonstrate solutions that have a stable long term performance in multi-cyclic seasonal use of at least 20 years.
- Validate in the case of pumpable energy storage materials, an energy density comparable to the best solid-gas systems.
- Deliver compact systems with the potential to fit in the limited space available in a single building in the existing housing stock. The storage material volume per dwelling should not exceed 2.5 m3.
- Solutions should demonstrate a potential to reduce the net energy consumption of a building by at least 15% and a have return-on-investment period below 10 years.

Type of action: Research & Innovation Actions (100% funding).

EeB 7 – 2015: New tools and methodologies to reduce the gap between predicted and actual energy performances at the level of buildings and blocks of buildings

Specific challenge: The monitoring of real energy use in energy-efficient buildings frequently shows major differences with respect to the predicted performance. This is even worse if a set of interacting buildings is considered. It is therefore important to capture the real complexities of the actual buildings energy performance. In addition, effective methodologies for the correct understanding of user behaviour need to be addressed.

Scope: At building level, the research focus is on developing methodologies and tools to monitor and assess real building energy performance, including user behaviour, energy systems performance and to be able to predict accurately buildings short-term load forecast and energy consumption taking into consideration weather forecast. The new methods and tools could include energy performance diagnostics for predictive maintenance (related to different construction typologies and their thermal behaviour), and should be accurate enough to support decision making during the different stages in the life of the buildings. The effective monitoring and management of energy flows to help reduce energy consumption

should also be addressed. Common indicators, measuring technologies and data analysis methods should be developed to monitor building performance during operation.

A holistic "open" approach to building control and monitoring systems is required, integrating any possible existing control and monitoring infrastructure. High quality, reliable and non-intrusive (including wireless) data acquisition methodologies are also needed.

At the level of a block of buildings, the focus will be on real time optimisation of energy demand and supply using intelligent energy management systems with the objective of reducing the difference between peak power demand and minimum night time demand.

Cost-effective and interoperable solutions should be demonstrated for a block of buildings consisting of at least 3 different buildings in real life operating conditions.

The role of players such as ESCOs, facility managers and third parties to certify performances should be considered in line with future requirements for energy performance contracts and rating of buildings with a life cycle perspective.

Activities expected to be implemented at TRL 5-7.

Expected impact:

- Significant reduction in the difference between real and predicted energy behaviour in a building or a block of buildings, after the demonstration of the viability of the new tools and methods for measuring and analysing real building energy performance.
- The gap is narrowed down to a value consistent with energy performance contracts.
- Provide solutions with a high replication potential.

Type of action: Innovation Actions (70% funding).

EeB 8 – 2015: Integrated approach to retrofitting of residential buildings

Specific challenge: Europe is facing the challenge of deep rehabilitation of residential buildings (including buildings of historic value) while lowering the costs of refurbishment. Nowadays at the scale of Europe, fossil energy is mainly used in residential buildings for two usages which are space heating and Domestic Hot Water production. Such a large building stock needs innovative, efficient and cost-effective retrofitting solutions to meet the planned net-zero energy standards. Moreover, due to the current economic crisis investment capability in building retrofitting is limited and public incentives tend to decrease. Breakthrough solutions are, therefore, needed which combine affordability along the whole life cycle, reduced maintenance and higher performance reliability with reduced energy use.

Scope: Systemic approaches need to be developed which integrate the most promising cost-effective technologies and materials. The solutions could include, for example, energy use through innovative heat pump systems; combination of renewable energy sources at building level; as well as ICT enabling to adapt the system to the end-user behaviour without losing control of the global efficiency of the system.

In combination and synergy with the efforts addressing envelope improvements to reduce drastically the buildings heat needs, a systemic approach related to space heating and Domestic Hot Water (DHW) needs to be developed, having in mind that in the coming years DWH is going to be the first thermal need in residential buildings. The risk of overheating should be also analysed together with the whole renovation solution.

The district scale, as well as the interactions between the buildings and the thermal and electrical energy networks (i.e. impact on the energy demand) should be taken into account. Innovative solutions with a high degree of flexibility with regard to the grid are required thanks to the use of the full potential of ICT solutions. The integration of (compact) thermal energy storage should play a pivotal role as moving the demand from peak periods to other ones or yielding the full potential of renewable. The approach needs to be based on a methodology incorporating modelling, simulation with the target to identify the optimal cost effective solutions. Standardisation issues to facilitate integration of system components should be addressed.

Energy efficiency should be addressed by proper system integration and installation, e.g. through synergy between technologies which have already been proven at a small scale and need a larger scale demonstration.

Financial models should be validated too, in order to ensure the feasibility of the replication of deep energy efficiency rehabilitation of residential buildings in Europe, where the current economic crisis originates important socio-economic barriers.

A high replication potential is necessary while taking into account the supply chain issues. At least two demonstration sites should be considered in two different climatic conditions in order to ensure that the technologies are as widely applicable as possible. The impact at district level should be taken into account when defining the overall approach and should be reflected in the selection of the demonstrators.

In addition, to ensure appropriateness of business models, the participation of building owners (private or public organisations) is recommended. User involvement in renovation processes will require special attention, in particular when a deep retrofitting is required. Social and behavioural aspects are critical factors for project success. In parallel, new low intrusive techniques and the utilization of tools and technologies that speed up construction processes with high quality standards are welcome.

Activities expected to be implemented at TRL 5-7.

Expected impact:

- Demonstrate innovative retrofitting solutions as real cases approaching net zero energy standards.
- Reduction of at least 60% in energy consumption compared to the values before renovation while ensuring affordability.
- Demonstrate a high replicability potential.
- Return on investment should be below 7 years in the case of deep retrofitting.
- Advent of a new generation of skilled workers and SME contractors in the construction sector aware of the need of a systemic approach towards energy efficiency should be promoted through the proposed activities.

Type of action: Innovation Actions (70% funding).

Call for SPIRE – Sustainable Process Industries

H2020 – SPIRE -2014/2015

Caveat concerning the 2015 topics which are not yet open – Standard text to be added

Resources are becoming increasingly scarce, and resource efficiency has become an exceedingly important factor in 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 and at least 80% by 2050.

SPIRE 1 – 2014: Integrated Process Control

Specific challenge: Process control of the industrial operations has a major role in assuring high quality standards and optimal operations in terms of resource use and economic viability. Technological progresses in this area that could allow measuring properties of process streams and final products, accurately and in real-time could represent a major step forward towards more reliable and sustainable industrial operations. These real time process data (e.g. chemical composition data) could allow the implementation of “near real time” closed-loop process control concepts making it possible to operate industrial processes at their optimum both economically and ecologically. To obtain real time process data, the development of reliable fast inline measurements will be fundamental. These measurements can easily be integrated into closed loop process control concepts, thus delivering the highest value and near real time process control for industrial operations and decision making support tools. The development of these new “near real time” integrated process control methods is particularly important considering the recently introduced intensified or modularised production concepts, e.g. presenting smaller continuously operated pieces of equipment or integration of process steps that pose new challenges for process analytics in terms of size and speed of analysis.

Scope:

New technologies suitable for “ near real time” integrated process control are expected to introduce significant novelties with respect to sensor technologies, data treatment and data mining, in particular:

- Provision of dynamic information about product properties, stream characteristics and process conditions
- Provision of spatially resolved process data.
- Sensors for intensified process technology.

- Fast inline measurements (instead of extractive ones).
- Robustness and reliability insuring minimum operation and maintenance costs

Proposals submitted under this topic should address several aspects which are considered of major importance in this area; such as:

- Cross-sectorial application of process analyser technology (PAT) in closed-loop process control capable of inline measurements.
- Integration methodologies within a large number of production conditions.
- Swarm sensors.
- Development of new soft-sensors and sensing concepts and models for improved process control using PAT data for the measurement of properties and quality of process streams and final products.
- Miniaturized process analyser technology (PAT) and PAT-based advanced control for intensified processes.
- Disposable sensors in batch and in continuous processes.
- Control strategies for flexible processes or disposable sensors using integrated and validated PAT data.

Proposals submitted under this topic are expected to demonstrate the proposed technologies and control systems in relevant industrial environments, to proof their technical feasibility and economic viability. Activities expected to be implemented at TRL 3-5.

Expected impact:

- Improved capabilities for valid, reliable and real-time measurement of the properties and quality of process streams and final products for existing and for more flexible process operation concepts.
- More sustainable plant operations due to the extensive usage of all information available from validated PAT measurements for model based control.
- Improved monitoring and control of continuous plants.
- Improved support of the operators leading to safer, more reliable and sustainable process operation improving process efficiency.
- Better process operations with respect to resource and energy efficiency.
- Significant decrease in greenhouse gas emissions.
- Strengthening of the competiveness of the European industry both in the domain of PAT technologies and control solutions and with respect to economically sustainable industrial processes.
- Retention and creation of jobs for the European measurement and automation and process industries.

Type of action: Research & Innovation Actions (100% funding).

SPIRE 2 – 2014: Adaptable industrial processes allowing the use of renewables as flexible feedstock for chemical and energy applications

Specific challenge: Use of biomass, residues and waste gases as feedstock in industry to produce green chemical building blocks is expected to increase significantly in the coming years. This will play a vital role in the establishment of a more sustainable and low carbon industry. However, the increased use of biomass, residues and waste gases as feedstock in industry poses a number of challenges that need to be addressed, such as seasonal and fragmented availability, short harvesting windows, environmental challenges, variable availability and/or quality of supply, and presumed competition with animal or human food supply. Changing markets and making new links in the value chains will be an added challenge in the future production systems based on cross sectorial integration. These challenges have to be overcome in order to allow increased utilisation of biomass residues and waste gases in the industry.

New approaches have demonstrated that small mobile and flexible units with chemical processing and process intensification capabilities could provide several advantages in comparison to fixed facilities, such as operation in a distributed manner and mobility to different locations providing higher flexibility. This could provide convenient business opportunities especially for processes presenting a variable feed supply, fragmented feedstock availability and/or need for mobility to different locations to maximise usage time.

Scope: Projects should develop new processes or improved valorisation approaches that would provide efficient biomass, residue and waste gas conversion (or biomass pre-treatment for further refining). These processes should allow an increased utilisation of renewables (not competing with higher value chains) as feedstock for the production of chemicals (including intermediates) and/or fuels as part of an integrated approach to optimise resource and energy efficiency. Such processes should be presented with a containerised, flexible and scalable approach allowing for (pre-)processing of biomass, residues and waste gases at locations closer to the supply. The proposed solutions should be able to cope with the seasonal or even daily fluctuations of the renewable source to be used. In this respect the unit should also be able to process feedstock from different sources in order to guarantee the level of supply.

The proposed solutions should provide economically viable alternatives to current practice in biomass processing and demonstrate business feasibility. Moreover, new innovative technologies and approaches are expected to substitute the current fossil fuels by renewables as feedstock. LCA and LCC analysis for the proposed processes is needed in order to prove the sustainability of the solutions. it is desirable to develop and demonstrate a multi-sectorial and replicable methodology for increasing the renewable resources integration in industrial processing. It is expected that high amounts of biomass, residues and waste gases will be further used in energy intensive industries, enhancing the efficiency in the use of these resources. Substantial demonstration activities in conjunction with the development of solution-adapted equipment are expected.

Activities expected to be implemented at TRL 5-7.

Expected impact:

- Economically viable solutions and technologies allowing a reduction in fossil resources intensity of at least 30%, compared to current practices (for already optimal processes the savings could also come from reduction in fossil energy for feedstock transportation). It should lead to increased utilisation of renewables in the industry as feedstock for the production of chemicals (and/or intermediates) and/or fuels as part of an integrated approach to optimise energy efficiency with a proven sustainability, taking into account environmental issues and competition with food.

- The technologies developed should integrate well in the current industrial landscape providing finished products and/or intermediate and building blocks that could be processed in already existing industries.

- They could also show a direct or indirect impact on rural areas, arising from the increased use of biomass and residues production locally.

Type of action: Innovation Actions (70% funding).

SPIRE 3 – 2014: Improved downstream processing of mixtures in process industries

Specific challenge: Current operations for the separation and fractionation of solid, gas and liquid mixtures represent on average 20-70% of the total capital and operating costs for most of the current plants in the process industry. These operations are also very energy-consuming, as they account for up to 45% of all the process energy used, for example, by the chemical and petroleum refining industries. Major improvements of these processes leading to more efficient and cost effective solutions are paramount in achieving a more sustainable European industry.

In this respect, hybrid technologies combining different techniques, such as distillation, membrane permeation, adsorption, extraction, etc. have already been applied successfully to a number of industrial processes. They can provide a cost effective solution to achieve major improvements in separation and fractionation operations, leading to waste reduction, lowering greenhouse gas emissions, and improved energy efficiency.

To realise the full potential of these technologies, further investigation and a deeper understanding of hybrid separation techniques is required, in particular leading to a better understanding of how the different components interact with each other. This may also facilitate the transition from batch to continuous processes in the next generation of plants, increasing yield, purity and quality of products while improving productivity.

To enable the deployment of innovative highly-efficient separation and fractionation technologies in industry, the development of new approaches for the design and scale up of the overall production processes might also be required. If possible, these innovative approaches should regard the primary process and the downstream separation as one single, integrated process.

The aim is to provide innovative solutions for downstream processing, advance in the integration of different separation techniques into complex hybrid units and provide tools for the design of such units.

Scope: The proposals should provide a proof of economic and industrial feasibility for the new technologies. The proposed solutions should also have potential for integration in the current industrial scenario, and should be suitable for different sectors in the process industry. Important aspects that should be taken into considerations are:

- Compatibility with continuous processes and support to the transition from batch processes to more efficient and reliable continuous operations (where relevant).
- Reduction of production costs and time to market by providing tools for process and separation unit design and optimisation.
- Significant improvements in energy and resource efficiency.
- Significant reduction in greenhouse gas emissions.
- Improvement in safety of the work environment.

Projects are expected to carry out demonstration activities in industrial environments aimed at proving the industrial relevance and feasibility of the proposed technologies, clearly showing the potential integration into current plants.

Activities expected to be implemented at TRL 5-7.

Expected impact:

- Novel and cost effective separation and fractionation technologies applicable to the process industry.
- increasing the resource and energy efficiency for the process industries by at least 20 % while leading to a significant decrease in greenhouse gas emission.
- Strengthen the competitiveness of the European industry developing both engineering know-how as well as economically sustainable industrial processes leading to shorter time to process/market, and higher production capacity.

Type of action: Innovation Actions (70% funding).

SPIRE 4 – 2014: Methodologies, tools and indicators for cross-sectorial sustainability assessment of energy and resource efficient solutions in the process industry

Specific challenge: Innovative technologies for resource and energy efficiency require a consistent sustainability assessment across sectors and along the value chains. There is a need to increase the European knowledge base related to applied sustainability assessment tools, methodologies, indicators and to overcome the bottlenecks for cross-sectorial take-up and further development in the process industry.

Scope: The support action should involve a study across multiple sectors in the process industries considering all aspects of sustainability assessment along the whole product life cycles with regard to resource and energy efficiency. The outcome of the study should incorporate:

- a comparative overview of currently used methodologies, tools, indicators and practices in different sectors,
- a selection of the most appropriate solutions, based on their demonstrated robustness and their ability to provide simplified and easily communicated data,
- an overview of the related opportunities as well as the bottlenecks towards further development and cross-sectorial replication/transfer of these approaches,
- definitions of the required steps to accelerate further uptake of resource efficiency indicators over the value chains, and
- recommendations on the most suitable tools for management and decision making at research lab, plant, company, sector and multi-sectorial level.

The study should allow for the customisation and development of sector-specific tools, for example regarding boundaries of the system, and including technical aspects for each industry.

Strategies should be proposed to work with value chain partners, public authorities and final users, in particular to meet expectations in terms of relevant sustainability assessment (e.g. standards, labelling), and create a broad range of options to raise awareness levels and understanding of sustainability. The study should produce recommendations as input for further research and development projects in the field of sustainability assessment.

Collaboration with standardisation bodies should be addressed**.**

The methodology should also address the needs of companies operating in data -lean environments.

The Commission considers that projects requesting a contribution from the EU of around EUR X would allow this topic to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected impact:

- Identification of best practices over different sectors for environmental, social and economic sustainability indicators to facilitate cross-sectorial deployment.
- Identification of the research needs in this area to achieve a set of environmental, social and economic sustainability indicators suitable for the process industry.
- Identification across the different sectors of the process industry of a set of tools for management and decision making at research lab, plant, company, sector and multi-sectorial level of the process industry.

Type of action: Coordination and Support Actions – Support Actions

SPIRE 5 – 2015: New adaptable catalytic reactor methodologies for Process Intensification

Specific challenge: The reduction of the number of steps and unit operations in industrial processes is a key factor in achieving process intensification, improving the efficiency in the use of resources, and reducing the impact on the environment. Continuous scalable processes using intensified equipment are key to enable flexible and decentralised production at high process performance.

Scope: Projects should develop new adaptable reactor concepts to reduce the number of process steps and unit operations for industrially relevant processes, by the redesign and merging of critical reaction steps and subsequent process steps, such as separation and work-up or by allowing new operating windows that are not accessible using conventional equipment. Projects should include The design of the corresponding reactor equipment, in close co-operation of the engineering and equipment manufacturing sectors with process industries.

Application areas targeted include new adaptable catalytic schemes for chemical production; or reactors and processes allowing for operation at high pressure and/or temperature for a substantially increased space time yield.

The integration and optimisation in relation to full process engineering assessment should be explored. The impact of the new process solutions should be proven through process modelling and assessment, and quantified in terms of resource intensity reduction as well as reduction of emissions. Depending on the scale of the industrial processes included in the project, it would be beneficial to consider their implementation within modular or containerised set-ups.

Activities expected to be implemented at TRL 3-5.

Expected impact:

- Reduction of at least 15% in process energy intensity and material resource use for relevant large volume industrial processes.
- Reduction of at least 15% in emissions compared to the present state of the art. Significant improvements in the flexibility and productivity of industrial processes.

Type of action: Research & Innovation Actions (100% funding).

SPIRE 6 – 2015: Energy and resource management systems for improved efficiency in the process industries

Specific challenge: manufacturing sustainability has been improved considerably in environmental, economic and social terms, by sharing resources (e.g. plants, energy, water and residues) through the integration of multiple production units of a single company or multiple companies on a single industrial production site. Nevertheless, a more general cross-sectorial interaction is needed for a major impact within the process industry. This could take a long time to achieve and the aim is to pave the way for future cross-sectorial interactions and potentialities in the development of holistic measurements and activities.

Currently, poor understanding of each other's processes is hindering the development of technical and non-technical interactions and exchanges, which are necessary for industry to properly face the challenges.

Scope: Projects should enable the implementation of a broad variety of technologies, encompassing a wide range of disciplines, such as fundamental science, and plant engineering and management. The integration into a single management system of all these environmental, energy and economic factors is key for the improvement in efficiency of the process industries.

The proposed research should focus on the following areas:

- Analysis and optimisation tools for flexible energy use and material flow integration should be developed, aiming at a holistic approach for resource management in process industries, suitable both for small and large scale in a flexible approach. To facilitate a proper dissemination and use, it is expected that standards-based software for measuring critical footprint issues and relevant data used into the daily routine of the plants/clusters will be developed.
- Rapid transfer from lab-scale and conceptual design into testing at demonstration sites, using realistic industrial streams and process conditions. Pilot tests should focus on integrated solutions and tools adapted to the specific conditions in real production units. This will facilitate future industrial symbiosis between different sectors, by integrating energy and material flows within existing industrial parks.
- New approaches that perform cost-saving optimisation of energy and resources supply and demand, in order to reduce the residues and costs in intensive industries, taking into consideration both economical and sustainability constraints.

Prototypes and pilot implementations in real industrial settings represent a clear added-value.

Activities expected to be implemented at TRL 4-6*; a leading role of the participating SMEs with R&D capacities is expected.*

Expected impact:

- Holistic energy and resource management systems should facilitate significant gains in sustainable processing with regard to several parameters (resource efficiency, energy efficiency and the emission performance).
- Optimisation of interdependencies and the identification of technology components allowing for a breakthrough regarding a cost effective reduction in the use of resources, which overcomes the difficult cross-company collaboration.

Optimisation of energy and resources supply and demand in selected areas should reduce the overall costs in energy intensive industries by at least 15%, by taking into consideration both economic and sustainability factors.

Type of action: Research & Innovation Actions (100% funding).

SPIRE 7 – 2015: Recovery technologies for metals and other minerals

Specific Challenge: Metals and other minerals, such as non-ferrous and ferrous metals, ceramics, glass, cement and chemicals are utilised in numerous applications in many industrial sectors. Their demand, in particular those used in specialised applications, will increase in the coming years. Because of their increasing scarcity, a key issue is the development of processes for an effective and efficient recovery of these materials, from primary sources or from waste streams of the current industrial processes. novel integrated recovery processes should result in increased resource efficiency and sustainability for the

European industry, allowing the recovery of significant amount of metals and other minerals, even from low concentration streams. This should lower the dependency on imports of these materials, sheltering Europe from possible shortages in supply and reducing production costs and environmental impacts.

Major improvements in separation processes are needed to achieve an efficient and cost effective recovery from the different streams in the process industries.

Scope: new approaches combining several existing techniques (e.g. precipitation, adsorption, extraction, physical treatment and separation) or new alternative solutions could provide a cost-effective way to achieve major improvements in the efficiency of recovery operations for metals and other minerals, leading to waste reduction and minimising the environmental impact of industrial operations.

The proposed solutions should also have potential for integration in the current industrial scenario, and should be suitable for different sectors in the process industry. It is essential to consider the compatibility of the technologies with currently existing plants, taking into consideration the capital -intensive nature of some industrial sectors involved.

Demonstration activities should focus in the following research areas:

- Novel and innovative solutions for technologies for minerals and metals recovery from waste solid, gaseous and liquid streams.
- Development of new approaches for the design and scale up of industrial processes. In particular, these innovative approaches should regard the primary process and the downstream separation as one single, integrated process aimed at designs that maximise not only productivity, but also resource efficiency.
- The proposed solutions should be easily integrated with the currently existing plants/technologies, taking into account the capital intensive nature of some relevant industrial sectors, providing tools for the design of such units and their integration with primary processes.

The projects selected under this topic are expected to carry out demonstration activities in industrial environments aimed at proving the industrial relevance and feasibility of the proposed technologies.

Activities expected to be implemented at TRL 5-7.

Expected impact:

- Proof of economic and industrial feasibility for the proposed technologies in the process industries and showing the real potential for reducing dependency from imports.
- Life Cycle and Cost Assessments for the technologies developed.
- Significant impact on the resource efficiency of industrial sectors leading to a 40% increase in recovery of materials suitable for reprocessing compared to conventional processes.
- Enhanced sustainable industrial processes, shorter time to market and higher production capacity.
- Cross-sectorial technology transfer

Type of action: Innovation Actions (70% funding).

SPIRE 8 – 2015: Solids handling for intensified process technology

Specific challenge: Decentralised on-site plants and modular approaches towards small- and medium-scale production will play a significant role in tomorrow's process industry. However, the use of highly intensified, miniaturized equipment is largely restricted to gas/liquid and liquid/liquid systems, while most processes applied in the chemical and pharmaceutical industry, as well as industries processing steel, glass, cement, non-ferrous metals, or minerals, involve solids as reactants, catalysts, intermediates or (by-)products. If these processes are to be transferred to intensified process equipment, it is likely that difficulties associated with the presence of particulate solids will be encountered, such as fouling or blockages. Robust and sustainable solutions to these problems are hardly available. This hampers the industrial realization of processes involving solids handling.

A further challenge of increasing importance for these industries are constantly rising customer expectations with respect to product properties. These specific needs have to be met by developing fast and flexible processes that allow for design and development of tailor-made products while keeping the time-to-market as short as possible. One possible solution is to build on continuous processes, which can significantly reduce development time as well as scale-up efforts.

Scope: Methods should be developed for the handling of solids in continuous production units. This can be achieved either by the miniaturisation of currently available devices or – to a great extent – by completely new approaches to the processing of solids. Projects should apply a holistic approach towards relevant processes in which solids are an intrinsic part. Rather than the core processes for solids handling, the whole process design should be considered, in particular downstream processing operations such as catalyst recycling, solids isolation, waste treatment, or waste prevention. This can be realised by means of flexible, e.g. modular and fast process design. Such an approach would foster regionalised production. Case studies should be included on several of the following aspects:

- Metering of solids
- Advanced analytic systems
- Transport of solids
- Control of agglomeration
- Reduction of fouling
- Cleaning concepts, e.g. CIP
- Solid separation and recycling
- Regulatory requirements

Activities expected to be implemented at TRL 5-7.

Expected impact:

- Novel, efficient and cost effective production concepts realized in commercially available process intensified equipment, respectively process equipment modules.
- Innovative modules allowing to process solids in medium to small scale production units (particular emphasis should be given to the SPIRE sectors).
- Amelioration of chemical applications accessible via process intensified reaction systems through whole process design with focus on solids (downstream) processing operations.

- Shorter times to process/market and higher production capacity.
- Cross-sectorial technology transfer

Type of action: Innovation Actions (70% funding).

Fast track to Innovation - Pilot

H2020 – FTI - 2015

Caveat concerning the 2015 topics which are not yet open – Standard text to be added

FTI 1-2015: Fast track to Innovation Topic

Under this Fast Track to Innovation (FTI) pilot, proposals for innovation actions linked to any technology field will be invited, on the basis of a continuously open call (with its first cut-off date in 2015) and a bottom-up-driven logic.

[Any legal entity may participate and proposals may be submitted at any time. The Commission shall initiate three cut-off dates per year to evaluate proposals. Time between a cut-off date and signature of the grant agreement or notification of the grant decision shall not exceed six months. No more than 5 legal entities shall participate in an action. The amount of the grant shall not exceed EUR 3 million.

Proposals shall be ranked according to the impact, quality and efficiency of implementation and excellence, with the criterion of impact given a higher weighting. Factors such as time sensitivity and the international competitive situation shall be taken into sufficient account when evaluating the impact of a proposal, to allow for flexibility according to the various specificities within different fields of applied research.]

Contribution to Focus Area WASTE: A RESOURCE TO RECYCLE, REUSE AND RECOVER RAW MATERIALS (Societal Challenge 5)

H2020 – WASTE – 2014/2015

H2020 – WASTE 1 – 2014: Moving towards a circular economy through industrial symbiosis[18]

[Topic jointly implemented with Societal Challenge 5]

Specific challenge: Growing prosperity leads to the extraction and use of more resources and to the production of more waste. The EU is committed to implement the principles of the waste hierarchy, which implies the prevention of waste, its re-use and recycling where it is not prevented, and its energy recovery as sub-optimal option. This calls for eco-innovative solutions and resource-efficient products, processes and services, and their uptake which will be facilitated by new sustainable lifestyles and consumption behaviour.

Industrial symbiosis, whereby different actors derive mutual benefit from sharing utilities and waste materials, requires large-scale systemic innovation with the aim of turning waste from one industry into useful feedstock for another one. The management of waste material flows coming from different sectors calls for reliable and harmonised data for the estimation of composition, patterns of supply and quantity of wastes generated over the year(s), in order to achieve reliable and predictable feed-stocks of secondary raw materials for industrial plants. Industrial symbiosis needs ample coordination between a variety of stakeholders, such as industry, research, civil society organizations, public authorities and policy makers, and an increased awareness of producer responsibility for waste production.

Scope: Actions should demonstrate innovative processes and services, including organisational and management systems, or a combination thereof, that increase product life-spans, enable material reuse, recycling, recovery, and reduce generation of waste along product chains as well as reduce feedstock materials and the emission of harmful substances. They can either focus on a specific production value chain or have a cross-sectoral approach establishing industrial symbiosis leading to closed-loop processes.

A significant role could be given to SMEs. Opportunities for social innovation, encouraging more sustainable consumption behaviour and lifestyle change, and involving civil society, should be considered, with appropriate attention to the gender dimension.

Systemic and cost-effective solutions will benefit from innovative ICT solutions for waste traceability, waste material flow management, and the estimation of the availability, composition and quality of waste.

Expected impact: Measurable reduction of waste generation and resource use in the medium term. Significant gains in productivity against the state of the art for waste treatment plants and in material and energy efficiency, with reduction of greenhouse gas and other pollutants emissions in the short term. Contribution to standards validated by industrial players and identification of best available techniques and emerging techniques under the Industrial

[18] This topic responds to EU research priorities identified in the FP7 project VOICES under the thematic areas 'model business and consumer behaviour', 'product /production design', and 'policy' including: sustainable lifestyles and consumption behaviour, sharing utilities and waste materials, producer responsibility for waste production, increased product life-spans, enabling material reuse, recycling, recovery, industrial symbiosis leading to closed-loop processes, and consumption behaviour and lifestyle change.

Emissions Directive. Significant increase in European and global market up-take and replicability of eco-innovation solutions, measured by qualitative and quantitative indicators, contributing to an important reinforcement of the eco-industry landscape in Europe in the short term. Support to the implementation and evaluation of technology verification schemes, including the EU Environmental Technology Verification Pilot programme, as well as to the implementation of the objectives of the SPIRE PPP.

Type of action: Innovation actions (70%)

Contribution to [specific initiative on] Green Vehicles (Societal Challenge 4)

H2020 – GV – 2014/2015

GV 1 – 2014: Next Generation of batteries for fully electric automotive applications

Specific challenge: The electrification of road transport is a key towards sustainable and environmentally friendly mobility of persons and transport of goods, in particular for short range transport and transport in urban areas. In order to reach this goal it is important to develop improved battery technologies for Fully Electric Vehicles (FEV) going significantly beyond the current Lithium ion electrochemical storage technology. This is also in line with the Roadmap of the European Green Vehicle Initiative (EGVI). Identified key factors for the improvement are driving range of an FEV, safety of the battery system, as well as battery production knowledge, costs and sustainability. The research and innovation to be done should build on the progress already obtained through previous projects funded within the Green Car Public Private Partnership. It is however important for the European competitiveness that the next generation of batteries will be "made", i.e. developed, tested and produced in Europe.

Scope: Proposals should focus on solutions to design the next generation of batteries for FEVs with features going beyond those offered by the current Li-Ion battery technologies. Various key factors have to be improved at the same time, as: energy density, power density and the ability to work under severe thermal conditions; crash safety and inherent safety of the battery cells, packs and systems have to be guaranteed; and ageing has to be understood and improved. In addition, the future battery has to have a competitive cost; it has also to be produced in an environmental friendly way, considering the availability of raw materials and its recycling potential; and the production knowledge, -technology and -capacity of cells, packs and systems should be made available. The scope may be reached e.g. by addressing new chemistries such as Li-S or Li-Air that allow high-energy densities, and by developing related specific new materials for cathodes and electrolytes. In order to accelerate the industrial take-up of the proposed solution, the development of prototypes or even pilot production lines may be included; this would be positively considered in the evaluation.

Activities expected to be implemented at TRL 6.

Expected impact:

- Significant improvements of the usability of FEVs, with extended driving range and improved battery durability (recharging cyclability and safety);
- Better acceptance of FEV in society, and thus contribution to the improvements of sustainable transport, reducing pollution and noise in urban areas;
- European competitiveness through development of new key technology and related production capacities.

Type of action: Innovation Actions (70% funding).

Other actions (not subject to calls for proposals)

1. External expertise

This action will support:

- The use of appointed independent experts for the evaluation of project proposals and, where appropriate, for the reviewing of running projects.
- The setting up of groups of independent experts to advise on or support the design and implementation of EU research policy.

Type of action: Expert contracts

Indicative budget:

2. Studies

a) Project Technical Assistants (PTAs)

External assistance to enable detailed, prompt, pro-active, and scientifically competent follow-up by the Commission of research and innovation projects in the areas of nanotechnologies, advanced materials and advanced manufacturing and processing.

Type of action: Public Procurement; Up to 6 specific contracts with durations up to end August 2017.

Timeframe: Third quarter of 2014

Indicative budget:

b) Exploitation Strategy and Innovation Consultants (ESIC)

External assistance to identify and address possible or actual obstacles to the future or imminent exploitation of the intended or already achieved results of projects (this includes Exploitation Strategy Seminars, support to standardisation, support to business plan development, and support to patenting).

Type of action: Public Procurement; Up to 12 specific contracts with duration up to 6 months.

Timeframe: Third quarter of 2014

Indicative budget:

c) Providing data for monitoring nanotechnologies

Providing systematic and up-to-date global, national and sectoral monitoring and information for nanotechnologies (nanomaterials, nano-intermediates, nano-enabled products), taking into account all factors affecting the value chains and markets, especially the safety, regulatory

and societal aspects. This will include assessing the impact of nanotechnology related policy measures and action plans.

Type of action: Public Procurement; Up to 5 specific contracts with duration of up to 12 months.

Timeframe: Third quarter of 2014

Indicative budget:

Space Part