



EN

Horizon 2020

Work Programme 2018-2020

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

Important notice on the Horizon 2020 Work Programme

This Work Programme covers 2018, 2019 and 2020. The parts that relate to 2019 and 2020 are provided at this stage on an indicative basis. Such Work Programme parts will be decided during 2018 and/or 2019.

(European Commission Decision C(2017)7124 of 27 October 2017)

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Introduction

In this part of the Work Programme, LEIT-NMBP stands for 'Leadership in enabling and industrial technologies – Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing'.

OPEN RESEARCH DATA:

Grant beneficiaries under this work programme part will engage in research data sharing by default, as stipulated under Article 29.3 of the Horizon 2020 Model Grant Agreement (including the creation of a Data Management Plan). Participants may however opt out of these arrangements, both before and after the signature of the grant agreement. More information can be found under General Annex L of the work programme.

GENDER ASPECTS:

Where relevant, research and innovation activities should explore, analyse, and respond to possible sex and gender differences¹ and take into account biological characteristics as well as the evolving social and cultural features of women and men, and other relevant factors of diversity (e.g. age, weight, user/consumer preferences and needs) in a given context. Responding to the gender dimension in technology development and use can lead to better designs and improve the marketability of products. Proposals should also pay due attention to the gender dimension of research and innovation in the proposed actions.

LESSONS LEARNED FROM INTERIM EVALUATION:

The Work Programme 2018-2020 reflects lessons learned from the Interim Evaluation, which covered the first three years of Horizon 2020.²

The interim evaluation showed the effectiveness of the NMBP part, with 75% of the projects intending to develop a new product; 60% a new process; 24% a new service; and 4% an organisational or business model innovation. Particularly relevant are demonstrators on technology integration in an industrial environment, for example those from the dedicated Pilot Lines call, which include also open access pilot lines for SMEs. Hence, this Work Programme emphasises such demonstrators and pilot lines.

The NMBP part has successfully engaged industry, including SMEs, with a large number of newcomers, predominantly SMEs. Participants have stressed the opportunities that projects provided in terms of market access.

The NMBP part responds to problems and needs that have not changed fundamentally in the last few years, namely the need for research, innovation and industrial investments in key enabling technologies. Recent developments such as the 'fourth industrial revolution', the

¹ "Gendered Innovations" employs methods of sex and gender analysis to create new knowledge, please refer to: http://ec.europa.eu/research/swafs/gendered-innovations/index_en.cfm?pg=home

² https://ec.europa.eu/research/evaluations/index_en.cfm?pg=h2020evaluation

increased attention to the potential of digital technologies for manufacturing and in industrial applications, and the shift to services have added weight to the relevance of the programme.

However, the NMBP part has suffered from underfunding, like Horizon 2020 as a whole, potentially discouraging researchers and industry from participating. In response to this problem, the number of topics in this Work Programme has been significantly reduced compared to previous work programmes (by more than 40%), with a corresponding increase in the average funding per topic.

It was found that there is room to increase the leverage of industrial partners in demonstrators, to allow larger projects to be funded and increase industrial commitment. This has led to the piloting of 50% funding in some topics.

The interim evaluation also showed a need for greater outreach, to involve the widest range of users in the activities through co-creation. This Work Programme reflects this by including 25 topics in 2018-19, which explicitly promote open innovation through cooperation with other projects; enhanced user involvement; and the accessibility to the results produced. Furthermore, the 'Exploitation booster', a pilot involving NMBP projects, reflects the need for systematic and specific support for exploitation.

This Work Programme responds to the need to deliver on the targets for climate action and sustainable development, through a dedicated call on industrial sustainability, which makes substantial contributions to the focus areas 'Connecting economic and environmental gains – the Circular Economy' and 'Building a low-carbon, climate resilient future'.

Finally, this Work Programme responds to the need to intensify international cooperation through three flagships.

OPEN INNOVATION, OPEN SCIENCE and OPEN to the WORLD:

Open innovation and open science will be served with Open Innovation Test Beds for upscaling, characterisation, modelling, and safety. These will provide the widest possible access and users' involvement, in one open innovation ecosystem. Open innovation will be further served through the inclusion of more companies that will use the technologies developed to produce breakthrough innovations in products and processes, and through extensive societal engagement.

Openness to the world will be reflected in three flagships: one in nanosafety; one on global health care; and one biotechnology for the environment. It will further be served by inviting multilateral cooperation in more topics, notably in the area of catalysis for the circular economy.

PILOTING 50% FUNDING:

As a pilot in this Work Programme, some topics provide for funding at 50% for profit-making entities (instead of the standard 70% rate for Innovation Actions). The main criterion is that

these are topics for Innovation Actions reaching Technology Readiness Level 7 and covering high-cost demonstrators integrating several different technologies in industrial settings.

INDUCEMENT PRIZES:

Under this Work programme part two Inducement Prizes have been developed for the European Innovation Council (EIC) pilot, and this part contributes budget to the first of these:

- EIC Horizon Prize for 'Innovative Batteries for eVehicles'
- EIC Horizon Prize for 'Affordable High-Tech for Humanitarian Aid'

Full descriptions of the prizes, their expected results, eligibility criteria, award criteria and indicative timetables are provided under the Horizon 2020 Work Programme Part –Towards the next EU Framework Programme for Research and Innovation: European Innovation Council (EIC) Pilot (Part 17 of this Work Programme).

Contribution to Sustainable Development Goals

This Work Programme part will contribute to the Sustainable Development Goals (SDGs) 7 (affordable and clean energy); 8 (decent work and economic growth); 9 (industry, innovation and infrastructure); 11 (sustainable cities and communities); 12 (responsible consumption and production); and 13 (climate action).

Contribution to focus area(s)

Focus Area 'Digitising and transforming European industry and services' (DT): EUR 703.30 million

Focus Area 'Connecting economic and environmental gains - the Circular Economy' (CE): EUR 369.76 million

Focus Area 'Building a low-carbon, climate resilient future' (LC): EUR 271.10 million

Call - FOUNDATIONS FOR TOMORROW'S INDUSTRY

H2020-NMBP-TO-IND-2018-2020

The purpose of this call is to lay the foundations for tomorrow's industry in Europe, and to create jobs and growth through an innovation ecosystem for the design, development, testing, and upscaling of advanced materials and nanotechnologies. This should enable a vast array of applications and facilitate innovators to bring their disruptive ideas to the market. Success will be seen in an effective eco-system allowing innovators to overcome the technological and regulatory barriers.

The call covers:

- Open Innovation Test Beds will provide the development and upscaling of advanced materials and nanotechnologies, combining digital, chemical and physical advances for innovative new products and services.
- Advanced characterisation tools, predictive modelling of materials at different scales, and support for a framework to ensure public safety in nanotechnology.

The call is expected to create about 20 Open Innovation Test Beds for materials development and upscaling in six technology domains, four Open Innovation Test Beds for materials characterisation and four Open Innovation Test Beds for modelling, in addition to the already existing NanoSafety Platform³. These are expected to collaborate in order to create a European ecosystem.

The call will contribute to the focus area on Digitising and Transforming European Industry and Services, by supplying the innovation test beds for upscaling, characterisation and modelling that will complement the digital innovation hubs.

Proposals for Research and Innovation Actions and Innovation Actions submitted under this call should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme except for topics under chapters 1.2 and 1.3.

1.1 OPEN INNOVATION TEST BEDS

Open Innovation Test Beds are physical facilities, established in at least three Member States and Associated Countries, offering technology access and services. The objective of Open Innovation Test Beds is to bring nanotechnology and advanced materials within the reach of companies and users in order to advance from validation in a laboratory (TRL 4) to prototypes in industrial environments (TRL 7).

These test beds will allow European industry and SMEs to develop leadership in nanotechnologies and advanced materials across the whole value chain with significant impact on jobs creation and growth.

³ <http://www.nanosafetycluster.eu>

This should be achieved by developing new or upgrading existing facilities, both private and public, and making them accessible to users for the development, testing and upscaling of nanotechnologies and advanced materials in industrial environments. The Open Innovation Test Beds will also set up networks amongst them to offer complementary services, share experiments and knowledge and offer a single entry point to users.

The Open Innovation Test Beds are expected to form European networks of competences along the entire value chain matching the demands of industry. These networks should reach out to all regions of Europe and create a sustainable ecosystem. This is especially important to European regions that are building or improving their capacities. They will also offer the necessary support environments for users who are planning to set up viable ventures.

They will be expected to become sustainable, by making their facilities and services accessible to industry at fair costs and conditions, and to demonstrate their ability to attract, and interact with, a community of users, investors and other stakeholders from regional to European level.

Proposals should therefore include a business case and exploitation strategy, as outlined in the LEIT Introduction in this Work Programme. In particular, they should demonstrate the likelihood of an additional turnover of at least 4 times the requested EU funding, within 5 years after the end of the grant.

Appropriate disciplines of Social Sciences and Humanities should be included from the outset, including broader forms of expertise at early stages of the innovation process, to consider relevant socio-economic, ethical and environmental considerations in the relevant research decisions.

The Open Innovation Test Beds will help users including SMEs to:

- Minimise costs and lower technological risks when adopting new materials and new technologies;
- Tap into relevant competencies and services (including those provided by other test beds and similar initiatives), like computational modelling; characterisation; risk-benefit assessment to ensure regulatory compliance; and the implementation of standardisation efforts early in the technology development process;
- Gain access to services driven by their business needs, such as mentoring, IPR and market analysis.

Open Innovation Test Beds for upscaling nanotechnology and materials will be funded in the following technology domains:

- Lightweight nano-enabled multifunctional materials and components
- Safety Testing of Medical Technologies for Health
- Nano-enabled surfaces and membranes

- Bio-based nano-materials and solutions
- Functional materials for building envelopes
- Nano-pharmaceuticals production

The activities will be supported through the establishment of Open Innovation Test Beds in Characterisation and Modelling (see section 1.2), as well as the already established NanoSafety Platform⁴.

Proposals are invited against the following topic(s):

DT-NMBP-01-2018: Open Innovation Test Beds for Lightweight, nano-enabled multifunctional composite materials and components (IA)

Specific Challenge: The field of new smart lightweight nano-enabled materials has made remarkable progress in recent years. Many different types of materials, with radically enhanced properties and functionalities, are today available for a wide range of industrial applications; e.g. lightweight solutions for transportation and construction, enhanced properties for packaging materials and processes, incorporating smart interacting sensors or indicators, and materials offering enhanced electrical performance and reliability, high-performance thermal and/or electrical conductivity, and UV shielding. The challenge is to scale up and enable industry and users, in a cost-effective and sustainable way, to develop, test, and adopt new lightweight, high performance, multifunctional, and environmentally friendly materials for high-value composite components and structures.

Scope:

- Open Innovation Test Beds should upgrade or develop materials facilities and make available to industry and interested parties, including SMEs, services for the design, development, testing, safety assessment, and upscaling of specific materials compositions, including nano-particle/objects;
- Attention should be given to materials new functions, features, capabilities, and properties (functionalisation), and to processing techniques and optimisation of process parameters, from uniform dispersion and distribution of nano-particles within the materials (or nanoparticle aggregates) to the association of dissimilar materials;
- Potential regulatory, economic and technical barriers should be identified and assessed;
- A methodology for providing open access at fair conditions and cost as well as outreach and dissemination across Europe;
- Quality control processes and tools should be validated to allow on-line quality controls;
- Materials should be demonstrated in relevant industrial environments.

⁴ <http://www.nanosafetycluster.eu>

Proposals submitted under this topic should include actions designed to facilitate cooperation, across Europe, with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 4 and achieve TRL 7 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU between EUR 7 and 15 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Open and upgraded facilities at the EU level for the design, development, testing, safety assessment, and upscaling of lightweight, nano-enabled and multifunctional materials and components, easily accessible to users across different regions of Europe;
- Attract a significant number of new SME users, with at least a 20% increase for existing test beds;
- Increased access to finance (for SMEs in particular) for investing in these materials or in applications using them;
- At least 15% improved industrial process parameters and 20% faster verification of materials performance for highly promising applications;
- At least 20% improvement in industrial productivity, reliability, environmental performance, durability, and reduction of life-cycle costs of these materials;
- At least 15% indirect reduction in energy consumption across sectors using lighter materials in their products and processes.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

DT-NMBP-02-2018: Open Innovation Test Beds for Safety Testing of Medical Technologies for Health (IA)

Specific Challenge: The medical technology industry is an important economic and social player in Europe. The challenge is to provide companies and users in this sector access to affordable and advanced testing facilities and services to facilitate the development of new

and safe medical technologies. The two new EU regulations⁵ governing medical technologies (medical devices and in-vitro diagnostics) are introducing a new set of rules to improve the safety of medical devices for the benefit of patients. To preserve timely access to innovative healthcare solutions and support the competitiveness of the European industry, testing facilities support services are needed to help industry and users develop and test medical devices in compliance with EU safety regulations. A bonus would be to define new methodologies for clinical testing, when relevant.

Scope:

- Open Innovation Test Beds should upgrade or develop materials facilities and make available to industry and interested parties, including SMEs, services for the design, development, testing, safety assessment, and upscaling of new/existing medical devices in compliance with EU regulatory frameworks since the beginning of the development process;
- Test Beds could also contribute to develop methodologies to accelerate and simplify the subsequent pre-clinical and clinical testing in accordance with EU rules;
- Potential regulatory, economic, organisational and technical barriers should be identified and assessed. Where applicable, considerations regarding risk-assessment procedures that take into account potential gender differences should be considered;
- Open access at fair conditions and cost as well as outreach and dissemination across Europe, based on a distinct methodology;
- Quality control processes and tools should be validated to allow on-line quality controls;
- Medical devices should be demonstrated in relevant industrial environments.

Proposals submitted under this topic should include actions designed to facilitate cooperation, across Europe, with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 4 and achieve TRL 7 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU between EUR 7 and 15 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

⁵ Regulation (EU) 2017/745 of the European Parliament and of the Council of 5 April 2017 on medical devices, amending Directive 2001/83/EC, Regulation (EC) No 178/2002 and Regulation (EC) No 1223/2009 and repealing Council Directives 90/385/EEC and 93/42/EEC
Regulation (EU) 2017/746 of the European Parliament and of the Council of 5 April 2017 on in vitro diagnostic medical devices and repealing Directive 98/79/EC and Commission Decision 2010/227/EU

- Open and upgraded facilities at the EU level for the design, development, testing, safety assessment, and upscaling of new medical devices easily accessible to users across different regions of Europe;
- Attract a significant number of new SME users, with at least a 20% increase for existing test beds;
- Cost effective, innovative, and safe healthcare medical devices in compliance with EU safety regulations;
- Faster assessment of new medical devices' compliance with EU safety regulations;
- Reduced time to market of new medical devices (earlier determination of safety profile and facilitation of subsequent pre-clinical and clinical testing);
- Indirect substantial benefits for European citizens' safety and access to new and innovative medical products;
- New market opportunities for providing services to non-EU players interested in testing facilities to ensure compliance with EU regulatory frameworks for their export products to Europe.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

DT-NMBP-03-2019: Open Innovation Test Beds for nano-enabled surfaces and membranes (IA)

Specific Challenge: Nano-enabled surfaces and membranes have a vast range of applications in final products across many industry sectors. The challenge is to enable a cost effective and sustainable industrial upscaling and deployment of nano-enabled surface and membrane technologies, including thin film architecture, coating, surface structuration for improved properties (optical, surface energy, durability, reduced friction, etc.), and nanostructured membrane's functionalities. This will require the integration of state-of-the-art nano-scale processes for modification, functionalisation, and structuring/coating of surfaces or membranes.

Scope:

- Open Innovation Test Beds should upgrade or develop materials facilities and make available to industry and interested parties, including SMEs, services for the design, development, testing, safety assessment, and upscaling of new nano-enabled surfaces and membranes;

- New materials functionalities may include, among others, improved scratch and abrasion resistance, super hardness and mechanical resistance, improved corrosion, wear and friction properties, bio-functionality, bio-compatibility, control of reflectivity, sensing ability, self-cleaning, antimicrobial, permeability and selectivity properties;
- Open access at fair conditions and cost as well as outreach and dissemination across Europe, based on a distinct methodology;
- Applications can cover industrial as well as consumer products. Potential regulatory, economical and technical barriers should be identified and assessed;
- Quality control processes and tools should be validated to allow on-line quality controls;
- Materials should be demonstrated in relevant industrial environments;

Proposals submitted under this topic should include actions designed to facilitate cooperation, across Europe, with other projects and existing Pilot Lines; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 4 and achieve TRL 7 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU between EUR 7 and 15 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Open and upgraded facilities at the EU level for the design, development, testing, safety assessment, and upscaling of nano-enabled surfaces and membranes;
- Attract a significant number of new SME users, with at least a 20% increase for existing test beds;
- Increased access to finance (for SMEs in particular) for investing in these nano-enabled surfaces or membranes or in applications using them;
- At least 15% improved process parameters and 20% faster verification of nano-enabled surfaces or membranes performance for highly promising applications;
- At least 20% improvement in industrial productivity, reliability, environmental performance, durability, and reduction of life-cycle costs of these nano-enabled surfaces or membranes;
- At least 15% indirect reduction in energy consumption for applications using novel nano-enabled surfaces or membranes.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

DT-NMBP-04-2020: Open Innovation Test Beds for bio-based nano-materials and solutions (IA)

DT-NMBP-05-2020: Open Innovation Test Beds for functional materials for building envelopes (IA)

DT-NMBP-06-2020: Open Innovation Test Beds for nano-pharmaceuticals production (IA)

1.2 MATERIALS CHARACTERISATION and COMPUTATIONAL MODELLING

The next generation of industrial products will require further advances in state-of-the-art characterisation tools as well as computational modelling. This can be achieved through the development of new techniques and a new generation of instrumentation, responding to industrial demands. Multi-scale, multi-technique and real-time characterisation and integration with the latest knowledge in materials modelling would lead to a better understanding of and/or discovery of new phenomena and complex functional material systems that are essential for new breakthrough products and industrial competitiveness.

Material characterisation determines materials properties, structure and performance. These activities are central to materials research and development, upscaling and manufacturing of such materials and to materials performance validation in products, to comply with regulation, safety and quality requirements. With the recent growth in available computational power, predictive modelling of materials is now in a position to be used to predict trends, to design new materials, to understand phenomena occurring in measurements and reduce the need of massive experimental testing. This can accelerate innovation and favour economically viable paths to new technological solutions for manufacturing. This is a key application area of High-Performance Computing (HPC) and closely linked with the Digital Single Market (DSM) strategy as a driver for growth.

Materials characterisation and modelling should become an integrated part of industrial R&D, leading the way to the reliable design of new and safe materials and processes, rapid upscaling, and effective quality control. This requires support for the coordination of a wide range of actors and disciplines, covering standards, data quality, Open Research Data, information management, and advances in characterisation tools and modelling.

There is the need to provide industrial users with central access to models and characterisation tools that can meet their specific requirements throughout the value chain. This should be achieved via user-driven Open Innovation Test Beds dedicated to characterisation and to modelling.

All funded projects should contribute actively to the on-going relevant European initiatives, in particular to the EMCC (European Materials Characterisation Council), the EMMC (European Materials Modelling Council), the EPPN (European Pilot Production Network), and similar European clusters and networks.

Proposals are invited against the following topic(s):

DT-NMBP-07-2018: Open Innovation Test Beds for Characterisation (IA)

Specific Challenge: Efficiency of materials up-scaling and use in new products in European manufacturing industries depends on advances in characterisation and testing. Essential industry competencies comprise technologies, know-how and proficiency in interpretation of results, data, and characterisation standards in order to help bring new materials into products. The challenge is to establish open user-driven characterisation test beds including all aspects of novel multi-scale and multi-modal characterisation solutions management, analytics and mining of the resulting data (Materials Informatics). Interaction is required between the stakeholders regarding the latest technological solutions, such as non-destructive characterisation approaches.

Scope: Proposals should establish an open innovation characterisation test beds that will create, sustain and drive the use of novel materials characterisation techniques to support industrial innovation and will network materials characterisation stakeholders and concretely implement an integrated approach. In particular:

- Collectively develop novel advanced solutions for specific and relevant industrial problems. Support advanced data analysis and storage, standardisation, reference materials, regulation and safety;
- Facilitate common approaches to common problems for fast adoption of innovative tools for characterisation by industry and strengthen the interface between academia and industry;
- Enable the integration of information based on materials modelling and characterisation through the development of widely agreed and standardised datasheets to enhance value chain interactions;
- Network relevant stakeholders across Europe for defining roadmaps, application of real-time methods, implementation of regulatory and safety requirements, training and management of information (including Materials Informatics) and development of new skills.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project by agreeing on metadata for the description of materials characterisation and databases.

Activities should start at TRL 4 and achieve TRL 6 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU around EUR 9 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Translation of industrial needs into characterisation workflows, increased awareness and uptake by industry, and effective access of materials manufacturing companies to the know-how and advanced tools;
- Measurable reduction of costs for product design and time-to-market by means of faster and cheaper evaluation of production process deviations;
- Increased ability and quantifiable cost reduction for industry to comply with regulations.

Type of Action: Innovation action

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

DT-NMBP-08-2019: Real-time nano-characterisation technologies (RIA)

Specific Challenge: Enterprises using and producing nanomaterials face a constant increase of requirements in regard to fast process and product quality control, regulatory compliance and quicker market introduction of high quality products.

This calls for real-time measurements, necessitating process-adapted nanoscale metrology for the manufacturing industry. Tools and devices for materials characterisation need increased speed and reliability, suitable for industrial demands, while at the same time retaining the same or better measurement accuracy and precision.

Scope: Proposals should advance and establish nano-scale, multimodal and multi-scale materials characterisation tools and methods, allowing rapid and reliable high-resolution analyses. These should be suitable for characterisation during processing and manufacturing of advanced materials, i.e. real-time and reliable. This includes the optimisation of existing or the development of new technologies, characterisation equipment, data processing routes and data analysis strategies, or a combination of these. In particular:

- Proposals should deal with one or more industrial applications;
- In addition to the characterisation speed (relative to the manufacturing process), proposals should cover the requirements for real-time nano-scale characterisation during manufacturing (e.g. in situ characterisation, multiple acquisition etc.);
- Proposals should demonstrate measurable improvement with respect to the state of the art of nano-scale characterisation technologies adequate for industrial use (adaptability to the industrial process, product quality, etc.);

- Developed characterisation protocols should consist of faster methods to be exploited in close connection with manufacturing enterprises, or be suitable online or inline use in the factory;
- Detailed training and dissemination activities should be planned to ensure appropriate transfer of knowledge and/or expertise to industry, and SMEs in particular.

Funded proposals will be invited to participate in clustering activities, to agree on metadata for the description of materials characterisation and databases.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 4 and achieve TRL 6 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU between EUR 4 and 5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Measurable improvement of speed by at least a factor 2 of nanoscale characterisation procedures, in comparison to already established performance and reliability for the application leading to a significant increase in industrial competitiveness;
- Significant reduction of the time and resources needed for nanomaterial development and upscaling, and for nanomaterials-based product development, which should be quantified with respect to established conditions for specific market sectors, with a return of investment in less than 5 years;
- Quantifiable enhancement of the ability to control the quality and reliability of products, with consequent improvement of product lifetime and associated environmental benefits.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

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

DT-NMBP-09-2018: Accelerating the uptake of materials modelling software (IA)

Specific Challenge: European modellers have created a large set of materials modelling software of which a major part remains an untapped and unused source of information while having a large potential for exploitation. Further model development and software

engineering is needed to make this available to third parties in order to provide industry ready software solutions.

Scope: Development and adaption of existing models and interoperability software developed by academics and SMEs should provide industry-ready integrated, standardised, interoperable software solutions.

- Existing academic codes (models, solvers, post-processors and interoperability modules) or codes owned by European RTO's and SMEs, are to be further developed and integrated into commercial software according to industrial needs;
- Software packages to be developed should form a modelling framework allowing the seamless integration with and re-use of various existing models used in industry. Coupling and linking of models should allow reliable top-down and bottom up design of new materials and processes for faster product development;
- The new packages should use existing and emerging standards for semantic interoperability across domains;
- Apps should be developed to remove the underlying complexity of the models in order to facilitate the use by the end-user;
- The upscaled software and services for maintenance and support should be available via the existing and future European Materials Modelling Marketplace and the network of modelling translation environments and the Open Innovation modelling test beds.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 4 and achieve TRL 7 at the end of the project.

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

Expected Impact:

- Increased use of discrete and continuum models in manufacturing industry, which will reduce the number of trial and error experiments by a factor of 5 and thus support the Digital Single Market (DSM) objectives and significantly reduce the development cost for industry;
- Additional exploitation channels for academics and research organisations in Europe which should increase the impact of earlier model developments by a factor 2;

- Widening and upscaling of software of commercial companies into better, faster, optimised materials modelling suites enlarging application possibilities in all industry sectors.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

DT-NMBP-10-2019: Adopting materials modelling to challenges in manufacturing processes (RIA)

Specific Challenge: Improved decision making for materials producers and product manufacturers needs an environment that gives fast access to information and thereby allows reacting to changing feedstock, markets and regulatory demands. This would need an open translation environment that translates a specific manufacturing challenge into a materials modelling workflow that provides knowledge to support optimal material and process design.

Scope: The translation environment should be one coherent and seamless system for optimised development of novel materials and products. This environment should allow reuse of materials modelling software, knowledge and expertise in different industrial domains, by use of the models, protocols and systems in other relevant areas or sectors.

- The environment should contain a suite of integrated and interoperable apps that combine existing materials models, and databases of materials properties in a standardised manner;
- Apps should be developed that will enhance the ability for manufacturing companies (end-users) to do an effective search of numerical tools and/or providers of numerical simulations. They should facilitate the building of the required workflows, while removing the underlying complexity of the model in order to address a specific challenge;
- Apps should improve decision making on the level of differentiating materials and processes.

These translation environments should facilitate the operations of a pan-European network supported by Open Innovation Test Beds.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 4 and achieve TRL 6 at the end of the project.

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

Expected Impact:

- Remove barriers to the use of materials models by lowering the learning curve, increase the knowledge-base of European industry and the total cost of ownership leading to an industrial user base of companies increased by a factor 2;
- Increased speed of material/and or product development time and rapid design from concept to market by factor 5 and allow industry to react to changing market and regulatory demands;
- Change the operational practice of companies by making them more data driven, agile, light and competitive and thus support the Digital Single Market (DSM) objectives and thus drastically reduced development costs for industry by a factor 2;

Allow reuse of materials modelling knowledge and expertise in different industrial domains and cross-industry fertilisation by use of the protocols and systems in other relevant areas or sectors beyond the ones covered by the proposal.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

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

DT-NMBP-11-2020: Open Innovation Test Beds for Materials Modelling (IA)

DT-NMBP-12-2019: Sustainable Nano-Fabrication (CSA)

Specific Challenge: Nanotechnology research has led to a remarkable development of nanoscale materials in bulk form with unique properties. Several of these materials are in the market or are expected to enter the market in the near future. The challenge is to establish industrial scale manufacturing of functional systems based on manufactured nanoparticles with designed properties for use in semiconductors, energy harvesting and storage, waste heat recovery, medicine, etc. This action will therefore establish synergy between EU stakeholders (research laboratories, industry, SMEs, etc.) active in this domain and to identify and resolve common challenges.

Scope:

- Establish a network of EU stakeholders that will manage information and communication among its members in the technical domains such as nano-synthesis, nanofabrication, nanostructuring, additive nanomanufacturing, nanostructure assembly, roll-to-roll nanofabrication, etc.;

- Cover research and new standards for functional nanoparticles, nanomaterials, components, devices and processes. Establish common approaches for nomenclature, metrology, measurements and characterisation applied for nanomaterials by design, three-dimensional nanostructures, multi-layer nanodevices, multi-material and multi-functional nanosystems, dynamic nanosystems, etc.;
- Provide access across Europe to services and infrastructure for SMEs;
- Cover sustainability in terms of human health, ethics, environment, life-cycle analysis;
- Cover development of the necessary skills for this new industry.

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

Expected Impact:

- Integrate nanoscale building blocks into complex, large scale systems that will become the basis for a new European high-value industry;
- Link and consolidate existing infrastructure, create a sustainable community of stakeholders managing information and communication within and outside the group and develop an EU wide research and innovation strategy;
- Establish a network of existing EU funded projects and initiatives, which will solve common issues through cross-project collaboration, and will strengthen technology take-up across Europe;
- Establish international cooperation in particular with the nanomanufacturing programme of USA-NSF and the NNI Signature initiative of Sustainable Nanomanufacturing.

Type of Action: Coordination and support action

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

1.3 GOVERNANCE, SCIENCE-BASED RISK ASSESSMENT AND REGULATORY ASPECTS

Managing the risks of every emerging technology is of key importance for its societal acceptance and consequent possible success. The overall challenge is to establish a suitable form of nanotechnology risk governance and to ensure that beyond the state of the art technologies are accepted by stakeholders (civil society, industry, regulators).

This requires working on three different layers: (i) a scientific research layer for sound foundations, (ii) a regulatory research layer to validate and translate the scientific findings

into appropriate regulatory frameworks and implementation, and (iii) a market layer dealing with the daily management of risks and safety. These three distinct layers should be integrated through actions for risk governance, risk assessment and safe by design. Notably nano-informatics approaches offer good chances for innovation. These will include the challenge of ensuring consistency in all EU Member States in terms of risk management.

The present convergence of several sciences and the rapid evolution of novel technologies in the healthcare sector create a need for fast advance in regulatory science in that sector. Development and adoption of reference methods and of technical standards should be based on solid scientific foundation, hence the need for additional activities within regulatory science for medical technology products.

In terms of resources, the regulatory layer should be jointly supported by Horizon 2020, Member States governments and industry whereas at market level, Horizon 2020 should support only the networking and coordination. Proposals in all layers can foresee modalities for integrating additional public or private funding or foresee specific calls for proposals funded by these additional sources. Costs for the organisation of the calls and coordination of the work can be foreseen in proposals' budgets. Such calls can also be used to foster international cooperation in nanosafety.

Proposals in this area should apply the Open Access and the Open Data Access policies and strongly support the activities of EU regulatory bodies and agencies, and of international organisations like ISO, CEN and OECD. To maximise overall synergy and joint impact, projects should take account of the strategy and roadmaps in place, respect and complement the established ontology and the data logging format (ISA-TAB-NANO⁶), contribute to the objectives of relevant platforms (such as the EU NanoSafety Cluster⁷ or The Nanomedicine Translation Hub) and foresee the necessary resources to this effect.

Nanosafety issues are global and, therefore, international collaboration is strongly encouraged. In particular, all projects in this area are expected to collaborate with similar projects under the established scheme of Communities of Research with the USA NNI programme⁸ and/or to include direct participation of relevant USA entities. In addition, participation from countries actively involved in the work of OECD -WPMN, the NanoSafety Cluster and the NANoREG⁹ project (e.g. South Korea, Brazil, Canada, Australia, China, Japan, South Africa) is strongly encouraged.

Proposals should consider risk-assessment procedures for both men and women, where relevant, and enable a reduction of animal testing in the regulatory compliance.

Proposals are invited against the following topic(s):

⁶ <http://enanomapper.net/>

⁷ <http://www.nanosafetycluster.eu>

⁸ <http://www.us-eu.org/>

⁹ <http://www.nanoreg.eu/>

NMBP-13-2018: Risk Governance of nanotechnology (RIA)

Specific Challenge: Significant progress has been achieved in relation to research regarding the safety of engineered nanomaterials and the transfer of this knowledge into regulation. Still, more needs to be done as nanotechnology reaches the market. To fill this gap, transdisciplinary risk governance is required based on a clear understanding of risk, its management practices and the societal risk perception by all stakeholders. It should propose and apply clear criteria for risk evaluation and acceptance and for transfer of acceptable risk. It should develop reinforced decision making tools incorporating those aspects and facilitate risk communication to relevant stakeholders, including industry, regulators, insurance companies and the general public.

Scope:

- Data and information management and framework tools with regard to the safety of nanomaterials for risk assessment, hazard and exposure, human health and environment, and risk mitigation including regulatory aspects of safe-by-design;
- Responsible communication with stakeholders and the civil society based on good quality information and valuable feedback;
- Plans for future scientific and regulatory research paying attention to social, ethical and environmental aspects, to achieve completeness, consistency, maximum synergy of actions and international cooperation;
- Mechanisms to monitor progress in several industrial sectors and to revise plans.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 4 and achieve TRL 6 at the end of the project.

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

Expected Impact:

- A transparent, self-sustained and science-based risk governance council;
- Governance framework tools for managing possible nanotechnologies risks in regard to social, environmental and economic benefits;
- Availability of high quality data for industry and regulators decision making;
- Sustainable solutions demonstrated at a level that will allow both consistent integration of scientific results and regulatory application of scientifically sound concepts;

- Consistency of science based risk management approaches in all EU Member States and synergy with similar actions internationally.

Type of Action: Research and Innovation action

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

NMBP-14-2018: Nanoinformatics: from materials models to predictive toxicology and ecotoxicology (RIA)

Specific Challenge: Despite the significant amounts of data on physico-chemical and toxicological and ecotoxicological properties of nanomaterials generated over the last decades, detailed knowledge on how these properties are linked to specific physico-chemical characteristics is only beginning to emerge. The challenge is to develop and implement modern methods, more cost effective and less reliant on animal testing, for toxicity investigations in each stage of product innovation, through making best use of joining existing and emerging data with the help of progress in nanoinformatics.

Scope:

- Development of models that support the prediction of both specific functionalities and hazard and are crucial to establish safe-by-design principles at early stages of material development;
- Development of a sustainable multi-scale modelling framework, based on the integration/linking of different types of nanoinformatics models in order to advance towards predictively linking of physico-chemical NM property models to NM functionality and hazard;
- Uptake and valid use of these tools and nanoinformatics models, user-friendly interfaces to enhance accessibility and usability of the nanoinformatics models, and clear explanations of their applicability domains, especially regulatory compliance, should be provided for different stakeholders (industry, regulators, and civil society).

In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation is particularly encouraged.

Activities should start at TRL 4 and achieve TRL 6 at the end of the project.

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

Expected Impact:

- Reliable nanomaterials safety data systems, models and strategies to allow material characteristics to be linked to adverse outcomes;

- A validated accessible framework, designed to predict human and environmental toxicological hazards;
- Increased confidence in nanosafety nanoinformatics predictive models through agreed standards, harmonised standard operating procedures, considering OECD validation principles.

Type of Action: Research and Innovation action

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

NMBP-15-2019: Safe by design, from science to regulation: metrics and main sectors (RIA)

Specific Challenge: Risk management involves quantifying hazard (toxicity) and exposure, and taking the necessary steps to reduce both to acceptable levels, ideally at an early stage of the nanomaterial development process (Safe-by-Design). Various industrial sectors, and in particular structural or functional materials, coatings and cosmetics, as well as pharma and health technology are currently searching for ways to mitigate possible risks from nanomaterials and nano-containing products. The challenge now is to distil existing methods into simple, robust, cost-effective methods for monitoring and modelling of physical-chemical properties and biological effect assessment of nanomaterials in relevant use conditions including in product-relevant matrices.

Scope:

- Degradation of nano-enabled products and ageing of nanomaterials, and mixture toxicity;
- New Safe by Design methods that enable reduction of hazard and exposure through design to an acceptable risk level without affecting the material performance and guide development of safer products at different stages;
- Implementation of control measures and mitigation strategies for nanomaterials specific scenarios in various industrial sectors to reach acceptable regulatory risk level on the effectiveness of such measures, and develop computational approaches to model them;
- For this topic the parallel calls scheme is envisaged with the USA-NNI. Resulting projects should establish close cooperation mechanisms. Legal, policy making and Responsible Research and Innovation aspects should be integrated in the proposal.

In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation is particularly encouraged.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 4 and achieve TRL 6 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU between EUR 5 and 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Safe by design approaches and tools at an early stage of the nanomaterial development process;
- Quality workplaces that ensure maximum technical and economic performance in line with acceptable risk levels;
- Control and mitigate exposure to acceptable risk level in case after release of nanomaterials from products;
- Develop and validate low-cost techniques for delivering an integrated exposure driven risk assessment and the associated design of the required post-use monitoring.

Type of Action: Research and Innovation action

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

NMBP-16-2020: Safe by design, from science to regulation: behaviour of multi-component nanomaterials (RIA)

NMBP-17-2020: Regulatory science for medical technology products (RIA)

Conditions for the Call - FOUNDATIONS FOR TOMORROW'S INDUSTRY

Opening date(s), deadline(s), indicative budget(s):¹⁰

Topics (Type of Action)	Budgets (EUR million)			Deadlines
	2018	2019	2020	

¹⁰ The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

The Director-General responsible may delay the deadline(s) by up to two months.

All deadlines are at 17.00.00 Brussels local time.

The deadline(s) in 2019 and 2020 are indicative and subject to separate financing decisions for 2019 and 2020.

The budget amounts for the 2018 budget are subject to the availability of the appropriations provided for in the draft budget for 2018 after the adoption of the budget 2018 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2019 and 2020 budget are indicative and will be subject to separate financing decisions to cover the amounts to be allocated for 2019 and for 2020.

Opening: 31 Oct 2017				
DT-NMBP-01-2018 (IA)	75.00			23 Jan 2018 (First Stage)
DT-NMBP-02-2018 (IA)				28 Jun 2018 (Second Stage)
DT-NMBP-07-2018 (IA)	44.00			23 Jan 2018 (First Stage)
DT-NMBP-09-2018 (IA)				28 Jun 2018 (Second Stage)
NMBP-13-2018 (RIA)	30.00			
NMBP-14-2018 (RIA)				
Opening: 16 Oct 2018				
DT-NMBP-03-2019 (IA)		50.00		22 Jan 2019 (First Stage)
				03 Sep 2019 (Second Stage)
DT-NMBP-08-2019 (RIA)		37.80		22 Jan 2019 (First Stage)
DT-NMBP-10-2019 (RIA)				03 Sep 2019 (Second Stage)
NMBP-15-2019 (RIA)		27.80		
DT-NMBP-12-2019 (CSA)		4.00		03 Sep 2019
Opening: To be defined				
Focus area topic(s) for 2020			104.60	To be defined
Overall indicative budget	149.00	119.60	104.60	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

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

For two stage procedure:

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

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

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

DT-NMBP-01-2018, DT-NMBP-02-2018, DT-NMBP-03-2019, DT-NMBP-07-2018, DT-NMBP-08-2019, DT-NMBP-09-2018, DT-NMBP-10-2019, NMBP-13-2018, NMBP-14-2018, NMBP-15-2019	The threshold for the criteria Excellence and Impact will be 4. The overall threshold, applying to the sum of the three individual scores, will be 12.
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Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme. The following exceptions apply:

All topics of this call	<p>Under 3 (a) Proposals are first ranked in separate lists according to the topics against which they were submitted ('topic ranked lists'). When comparing ex aequo proposals from different topics, proposals having a higher position in their respective 'topic ranked list' will be considered to have a higher priority in the overall ranked list.</p> <p>Under 3 (b) For all topics and types of action, the prioritisation will be done first on the basis of the score for Impact, and then on that for Excellence.</p>
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The full evaluation procedure is described in the relevant [guide](#) published on the Participant Portal.

Consortium agreement:

All topics of this call	Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.
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Call - TRANSFORMING EUROPEAN INDUSTRY

H2020-NMBP-TR-IND-2018-2020

The purpose of this call is to transform European industry through the integration of digitisation and other enabling technologies and achieve global industrial leadership. Success will be seen in global industrial leadership, notably in manufacturing, and in opportunities for re-industrialisation.

The call covers:

- the manufacturing process itself, ranging from manufacturing excellence and flexibility to increased reliability, accuracy and durability, from improving energy efficiency and re-use of materials or re-manufacturing to skills development and novel ways for human-machine interaction;
- the development of emerging and potentially disruptive biotechnologies;
- the development of medical technologies for diagnosis and treatment.

It complements the call 'Foundations for Tomorrow's Industry', and contributes to the focus area on Digitising and Transforming European Industry and Services, by combining digital and physical advances for innovative new products and services.

Proposals for Research and Innovation Actions and Innovation Actions submitted under this call should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

2.1. FACTORIES OF THE FUTURE (FOF)

Manufacturing is a key driver of employment and wealth creation in Europe, thus contributing significantly to improving the quality of life of citizens. Manufacturing industry produces more than three-quarters of Europe's exports and generates more than 15% of European GDP. The fundamental challenge for European manufacturing is to shift from a cost-based to a high-value-added competitive advantage. Factories of the Future delivers European added value by helping manufacturing enterprises, including SMEs, to make the necessary adaptations in terms of manufacturing excellence and flexibility, including skills development, to capitalise on the increasing demand for more customised and higher-quality products. This necessitates a transition to a flexible, digitalised and demand-driven manufacturing sector with lower energy consumption and waste generation, which characterises the fourth industrial revolution.

Topics under Factories of the Future (FOF) will support industry to develop new manufacturing technologies, optimise work environments so that its workforce can drive the transition to new technologies, enable more customised products and underlying production flexibility, optimise environmentally sustainable production and increase accuracy, efficiency

and reliability in various fields of production ranging from micro assemblies to very large parts.

Proposals are invited against the following topic(s):

DT-FOF-01-2018: Skills needed for new Manufacturing jobs (CSA)

Specific Challenge: Breakthrough education and training paradigms for continuous training of the existing workforce are needed, that will enable the European industrial workforce to develop new skills and competences in a quick and efficient way. This should put workers, both women and men, at the forefront of innovation and drive industry towards a smooth transition to the use of increasingly sophisticated machines and new technologies.

Advanced Manufacturing, one of the six Key Enabling Technologies (KETs), is a highly innovative sector in Europe. In line with the New Skills Agenda for Europe, there is a need to strengthen human capital, employability and competitiveness for this KET. The Blueprint for Sectoral Cooperation on skills is one of the ten actions in this Agenda. This topic will support the implementation of the Blueprint beyond Additive Manufacturing within several areas from the Factories of the Future priorities.

Scope:

- Identify shortages and mismatches in technical and non-technical skills, knowledge and competences in Advanced Manufacturing (including digital capabilities);
- Map the most relevant existing national initiatives upskilling the existing workforce in order to develop an EU wide strategy;
- Put in place activities related to lifelong learning and granting of qualification for personnel in industrial settings. Develop real case scenarios providing efficient methodologies that can be applied in a variety of industrial areas;
- Innovative and hands-on approaches, including Social Sciences and Humanities (SSH) elements, in upskilling of the existing workforce and attracting more women to the field, through training activities (including training of trainers) and knowledge management with direct involvement of senior employees. On-site, modular and e-learning education should be offered free of charge for re-use;
- Exchange of information between industry, trade unions, educational centres, national employment agencies at European scale.

Proposals are also encouraged to seek synergies with national initiatives funded under the European Social Fund, projects from the Skills Alliances and, where relevant, other future initiatives launched at European level.

The Commission considers that proposals requesting a contribution from the EU between EUR 1 and 2 million would allow this specific challenge to be addressed appropriately.

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

Expected Impact:

- Real and measurable steps towards the reduction of identified skill gaps leading to the upskilling of the existing workforce in Europe and, as a consequence, increased innovation performance in the industry concerned;
- At least 15 new job profiles per industrial area analysed, leading to a longer work life for jobholders;
- Close and continuous engagement between relevant industry, trade union, academia, educational centres (including vocational schools) across Europe to stimulate networks in the European Research Area as a whole.

Type of Action: Coordination and support action

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

DT-FOF-02-2018: Effective Industrial Human-Robot Collaboration (RIA)

Specific Challenge: Human-Robot Collaboration (HRC) on the factory floor has a high potential economic impact for European industry.

Past research to implement HRC in an industrial setting concentrated largely on safety of humans, allowing workers and robots to share working space without fences. Most of the developments started from existing industrial robotic arms, augmenting it with technologies to make it safe for humans to interact with the robot. This has already led to production environments with safe interaction between humans and robots. However genuine collaboration between humans and robots require more holistic solutions encompassing smart mechatronic systems designed to improve the quality of the job performed and to increase flexible production. Such systems have not yet been demonstrated for manufacturing purposes.

In order to move from a structured factory floor where robots work behind closed fences to an open environment with smart mechatronic systems and humans collaborating closely, interdisciplinary research in the fields of robotics, cognitive sciences and psychology is required, also taking into account regulatory aspects. More attention has to be paid to develop novel inherently-safe robotic concepts where collaboration with humans is taken up already in the design phase. In order for effective HRC to be taken up by industry, beyond safety aspects, including ergonomics, adaptability, liability issues, inclusiveness of vulnerable workers, acceptability and feedback from users need to be considered in a holistic way.

Scope: Proposals need to extend the current state of the art of individual HRC to work environments where robots and workers function as members of the same team throughout the factory.

Proposals should cover two of the following three areas:

- Integration in industrial production environments of novel human-centred designed smart mechatronic systems such as for example soft robotics for high payloads;
- Implementation of novel artificial intelligence technologies capable of massive information processing and reacting in real-time to enable new levels of autonomy, navigation, cognitive perception and manipulation for robots to collaborate with humans in the process;
- Development of methods for robotic hazard assessment and risk management to clarify trade-offs between productivity and safety for mixed human-robot smart devices environments.

Proposals need also to take into account Social Sciences and Humanities (SSH) elements regarding human-related barriers for the uptake of smart mechatronic systems including robot technology in industrial environments such as ergonomics, user experience, comfort, trust, feeling of safety and liability in modern production facilities, taking into account age and gender aspects.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 4 and achieve TRL 6 at the end of the project.

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

Expected Impact:

- Demonstrating the potential to bring back production to Europe;
- 15% increase in OECD Job Quality Index through work environment and safety improvement;
- 20% reduction in production reconfiguration time and cost.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

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

DT-FOF-03-2018: Innovative manufacturing of opto-electrical parts (RIA)

Specific Challenge: Optoelectronics and opto-electrical components involve the interactions of photons and electrons. They are used in parts such as lasers, photodiodes, image sensors, optical amplifiers, modulators, solar cells, embedded optics and light-emitting diodes.

Previous research led to rapid developments and new applications in optoelectronics and photonics. However, new processes need to be introduced into production systems. When going into the scale-up phase, many processes need to be adjusted to fit the production of complex, often free-form components. The adjustments include both component specific changes as well as standard process steps. Due to the need to produce large varieties of parts in small batches, process adjustments have to be both rapid and accurate.

The equipment for testing, failure analysis and control equipment needs to follow a fast pace of technical advancement, and cover a range of sensors, such as electrical, optical, magnetic and thermal sensors.

Scope: Proposals need to present a variety of new processes applicable to the production of opto-electrical components, for instance material handling, material strain engineering, patterning, material deposition, assembly, joining and bonding. Furthermore, quality needs to be ensured by reliable sensors throughout the production line. The processes need to include a level of sustainability that allows the final products to be recycled and reintroduced into the value chain. Proposals need to cover all of the following areas:

- New, flexible, and innovative process chains to handle complex designs that include opto-electrical functionalities;
- Improved sensor equipment for quality control in the different processing steps as well as the final functionality of the component;
- Methodologies for improving quality through high-precision automation using the sensor data, including non-destructive in-process evaluation of material and functional component properties;
- Re-use and requalification of key components and precious materials within the process chain from products at their end of life.

Proposals are expected to include a variety of use-case demonstrations of typical opto-electrical components, in which the robustness of the processing, work piece handling, sensing and the automation approach can be demonstrated.

Activities should start at TRL 4 and achieve TRL 6 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU between EUR 6 and 8 million would allow this specific challenge to be addressed appropriately.

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

Expected Impact:

- 15% yield improvement because of the introduction of new sensor equipment, related metrology and automatic non-destructive control;
- 15% time reduction for reconfiguration of key process tools in a production line due to change of type of component;
- A tangible part (> 10%) of the production cost of the parts should originate from recycled products and materials.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

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

DT-FOF-04-2018: Pilot lines for metal Additive Manufacturing (IA 50%)

Specific Challenge: Costs and unpredictable defects in final parts and products are preventing complete deployment and adoption of Additive Manufacturing (AM) in the metalworking industries.

The industrial demonstration in a pilot line will show the full potential of metal AM in real manufacturing conditions and it will serve as a flagship example for other stakeholders. Quality aspects to be significantly improved include robustness, stability, repeatability, speed and right-first-time manufacturing.

Scope:

- Multi-scale and multi-physics simulations of the process and of the whole system from the early design phase, to avoid costly trial and error runs. The prediction and minimisation of distortion and their effect on durability and expected lifetime for post processing steps will also avoid propagation of defects to downstream stages;
- In-line non-destructive testing and in-situ analysis of product, including metrology aspects;
- Integration and inter-operability of AM processes into multi-stage production systems, with in-process monitoring, feedback and control;
- Hybridisation of Additive Manufacturing with other manufacturing and assembling processes;

- Certification, regulatory and standardisation activities related to the proposed solutions and AM produced parts;
- Occupational exposure in terms of health, safety and environment should be carefully observed together with the recycling of unused materials.

Proposals are expected to cover demonstration activities driven by the industrial community.

Activities should start at TRL 5 and achieve TRL 7 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU between EUR 12 and 15 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

As an exception from General Annex D, the funding rate for eligible costs in grants awarded under this topic will be differentiated: 100% of the eligible costs for beneficiaries and linked third parties that are non-profit legal entities; and 50% of the eligible costs for beneficiaries and linked third parties that are for profit legal entities.

Expected Impact:

- Increase in robustness of metal AM-based processes by 40% and production speeds by 25%;
- Reduction of time to market by 25% and ‘right first time’ capability by 40%;
- Reduction of uncertainties of selected material quality parameters by 50%, resulting in improving product quality by 40%;
- New certification schemes for industrial "3D-Printed" parts and products in collaboration with relevant certification stakeholders;
- New standardisation of specific categories not included in current ISO/ASTM/CEN CENELEC TCs.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

DT-FOF-05-2019: Open Innovation for collaborative production engineering (IA)

Specific Challenge: The transfer to industrial companies of the Do It Yourself (DIY), fablabs, micro-factories and makers approaches can pioneer ways towards engineering solutions throughout the whole value chain. These innovative methods can lead to new processes, machines and products with new functionalities and shorter time to market.

Industry is not yet widely using such innovative approaches to engage consumers and respond to societal needs, also taking into account the individual preferences of women and men. Collaborative production liaising companies, especially SMEs, with these new approaches can however create Open Innovation networks that can unroll a wide range of entirely new business opportunities for the benefit of consumers.

Scope: Proposals should particularly cover consumer-goods sectors and couple design, creativity and knowledge with a customer-driven production. The co-creation of products in both ends of the value chain represents customer involvement in the production. In particular, proposals should cover at least three out of the following areas:

- Novel approaches to capitalise on the knowledge and ideas of design and engineering coming from different and even new actors;
- Design of new strategies based on creative and agile methodologies for analysis;
- Development of knowledge, technologies and tools to share and analyse relevant data and demands from users as well as to fully enable collaborative engineering in the production network, allowing all actors to propose innovative solutions;
- Development of open source product data exchange and standard representations of products and processes that ensure the compatibility of modelling and simulation with different process information systems;
- Development of new Manufacturing Demonstration Facilities (MDFs), where companies will test new technologies in cooperation with fablabs and makers in order to develop real industrial products and where training is offered.

Proposals also need to take into account Social Science and Humanities (SSH) aspects regarding creativity.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 4 and achieve TRL 6 at the end of the project.

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

Expected Impact:

- Establish Open-Innovation networks for manufacturing that support customer-driven production all around Europe;

- Creation of specific business models for the engineering of customised solutions, particularly for SMEs, rapid demand changes and shorter time to market;
- Improvement of the co-design and co-development capabilities towards a reduction of development costs of new products and services;
- Increase of product variety and personalisation for higher customer satisfaction and loyalty.

Type of Action: Innovation action

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

DT-FOF-06-2019: Refurbishment and re-manufacturing of large industrial equipment (IA)

Specific Challenge: In line with the circular economy, lifetime extension can limit high replacement costs of major industrial infrastructures. This can be achieved through refurbishment, re-manufacturing, re-use, upgrading, in-situ repair, improved maintenance and more conservative utilisation of large industrial equipment of the kind used in manufacturing. These actions can significantly extend the useful life of heavy machinery, and improve the return on investment from major capital items.

Scope: This topic is for demonstration projects to establish the feasibility of lifetime extension of large industrial equipment of the kind used in manufacturing, including modernisation of equipment for data collection and interfaces. Proposals should cover one or more of the following areas:

- refurbishment and/or upgrading of large industrial equipment;
- re-manufacturing and re-use of equipment;
- inspection, functional diagnosis and in-situ repair of damage;
- maintenance and optimised utilisation of large industrial equipment.

These measures can improve the return on investment from major capital items. The scope covers large-scale electrical and/or mechanical machinery in plants rather than electronic equipment, which earlier projects have already covered. Demonstration activities need to take place in real industrial settings and include validation of at least two industrial demonstrators in different sectors, enabling the integration and scale-up of the parameters to other industrial environments.

Activities should start at TRL 5 and achieve TRL 7 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU between EUR 12 and 15 million would allow this specific challenge to be addressed appropriately.

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

Expected Impact:

- Material and resource efficiency increased by at least 10%;
- Life time extension of the targeted large machinery and plants by at least 20%;
- Increased return on investment from major capital items.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

DT-FOF-07-2020: Reliable and accurate assembly of micro parts (RIA)

DT-FOF-08-2019: Pilot lines for modular factories (IA 50%)

Specific Challenge: Rapid changes in a production line require a significant flexibility of reconfiguration. Modular production equipment can create highly adaptable production lines to enable efficient production of small series tailored to customer demands. Previous research has shown that the modularity can be at two levels, either as complete machines with their own interface and material handling system or as interchangeable tool heads. In both cases, the advantage of modularity should be demonstrated by the ease of use and plug-and-produce features allowing for rapid modification.

The functionality of the modules should enable the production of the widest variety of complex products. The modules need to allow rapid physical rearrangements, through either automated processes or manual intervention; and have accessible, secure interfaces in order to be connected to a common data system for production control. The interfacing with the existing hardware and legacy software is another aspect that needs to be covered.

Scope: Proposals are expected to start from existing test beds that are flexible enough to allow for the introduction of multiple modular process units. Proposals should cover all of the following areas:

- The development of a range of production modules covering several different disciplines such as mechanical cutting tools, thermal processes, laser treatments and additive manufacturing technologies, taking into account safety aspects;
- The integration of comprehensive production management systems, including real-time process control in a reconfigurable line, which includes considerations for data interoperability between modules and process line (including legacy hardware and software);

- Pilot production of different products covering processing technologies and features such as multi-functionality (mechanical, electrical, thermal, optical, etc.), multi materials, and complex shapes.

The production modules could be considered as demonstrators on their own. However, their integration in the pilot line as well as an actual production demonstration with a variety of components or product prototypes should be achieved before the end of the project.

Proposals are expected to cover demonstration activities driven by the industrial community.

Activities should start at TRL 5 and achieve TRL 7 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU between EUR 12 and 15 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

As an exception from General Annex D, the funding rate for eligible costs in grants awarded under this topic will be differentiated: 100% of the eligible costs for beneficiaries and linked third parties that are non-profit legal entities; and 50% of the eligible costs for beneficiaries and linked third parties that are for profit legal entities.

Expected Impact:

- At least 15% reduction of time to reconfigure the production line (alternatively 15% reduction in downtime);
- 10% higher resource efficiency due to more suitable processing equipment for customised products;
- Reduction of at least 15% of the overall cost of production;
- Measurable yield improvement from run-to-run for small lot sizes.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

DT-FOF-09-2020: Holistic energy-efficient factory management (IA)

DT-FOF-10-2020: Pilot lines for large-part high-precision manufacturing (IA 50%)

DT-FOF-11-2020: Quality control in smart manufacturing (IA)

DT-FOF-12-2019: Handling systems for flexible materials (RIA)

Specific Challenge: The handling of soft materials with the involvement of robots remains limited. The control systems of the robot need to be very sensitive, accurate and fast to prevent unwanted irreversible deformations and damages. Further research is needed in order to develop handling devices which are not pre-programmed for one specific task, but are intelligent and universally dexterous.

Future robots will have to be able to handle soft products while controlling their level of deformation, e.g. in situations where the objects are being manipulated with multiple contact points. Low-cost robots are essential. New handling technologies for flexible materials will lead to disruptive innovations in textile, paper and food processing, and will support a widespread implementation, in particular by SMEs.

Scope: In order to automate production processes involving soft and flexible materials, Proposals need to cover both of the following areas:

- Innovative technologies for the handling of the soft and flexible materials such as gripping, moving, positioning, sorting, joining etc. so that it can be included in larger automated production processes. Low-cost and universal dexterity are key concepts;
- System solutions that can manage all product and material related data (size, shape, weight, colour, material composition, defects, etc.), so that their automated handling can be embedded in larger production and process management systems.

Activities should start at TRL 4 and achieve TRL 6 at the end of the project.

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

Expected Impact:

- Demonstrating the potential to bring back production to Europe;
- 15% increase in OECD Job Quality Index through work environment and safety improvement;
- 20% increase in productivity.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

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

DT-NMBP-18-2019: Materials, manufacturing processes and devices for organic and large area electronics (IA)

Specific Challenge: Europe is a leader in the development of materials for organic and large area electronics (OLAE) but the materials still need to be improved to maintain this position. In addition, there have been attempts to combine dissimilar manufacturing technologies in order to achieve seamless integration of the new technology into traditional products at constant/lower production cost and in a new generation of smart devices.

Scope: Activities should include material development and improvement (electrical performance, processability, stability and lifetime during device operation), as well as prototyping of advanced OLAE based electronic products. New materials and process development should cover all of the following:

- Combine materials with high uniformity and with high mobility in industrial quantities with high reproducible quality;
- Improved environmental stability to enable operation in more robust environments and to reduce barrier requirements;
- Seamless integration of the new technology into traditional and new products;
- Advance the TRL of OLAE and enhance its manufacturability including high speed processes for the integration of flexible OLAE components onto flexible substrates;
- Cost reduction for the structuring and processing of organic electronic materials into device structures;
- Demonstration of OLAE-enabled prototypes in selected applications of flexible and wearable electronics.

Activities should start at TRL 3 and achieve TRL 5 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU of between EUR 4 and 5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- New products based on the combination of printed and OLAE processed electronics in flexible and wearable electronics;

- Improvement in cost competitiveness, lifetime and processability as well as manufacturing capability for OLAE materials and electronics;
- Improved environmental stability, water vapour transmission rates $< 10^{-6} \text{ gm}^{-2} \text{ d}^{-1}$ at $20^{\circ}\text{C}/50\% \text{ RH}$ and oxygen transmission rates $< 10^{-6} \text{ cm}^3 \text{ m}^{-2} \text{ d}^{-1} \text{ bar}^{-1}$, of organic electronic materials for products. Improved printable commercial material charge carrier mobility $> 5 - 10 \text{ cm}^2/\text{Vs}$;
- Improved business opportunities and value creation in Europe by strengthening cooperation along the value chain as demonstrated by prototypes at TRL 5 that are taken to early-concept market trials with market introduction of new products in 2-4 years after project completion.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

This topic will be co-funded by LEIT-NMBP and LEIT-ICT, for a total budget of EUR 20 million.

Type of Action: Innovation action

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

DT-NMBP-19-2019: Advanced materials for additive manufacturing (IA)

Specific Challenge: Additive manufacturing (AM) is now applied in the processing of most industrial metals, ceramics, polymers and composites, albeit at quite different levels of industrial readiness. The challenge is to develop equipment that allows the additive layer manufacturing of multi-materials items and multi-functional materials (for research, transport including aeronautic, consumer customised goods, communications, biomaterials and energy).

The development of novel materials is a primary challenge in the future development of AM. The challenge is also to use nanotechnologies to aggregate multiple materials within a single process, while improving or expanding their functionality, and enhancing their performance. This may include optical, rheological, mechanical, RF, electrical, magnetic, surface, thermal or process properties, controlled release, durability (accelerated aging and life time prediction) and quality.

Scope: By combining several materials, proposals should advance the state of the art through the development of ready assembled multifunctional devices. Proposals should demonstrate several simultaneous activities:

- Quantification of improved functionalities, properties, quality and lifespan of fabricated pieces;
- Evaluation of matching materials properties to the production process to enable the joining of dissimilar materials for AM tools;

- Demonstration of a better understanding of the nanotechnology integrated materials properties and manufactures;
- Integration and validation at early stage of the qualification and certification considerations of the materials;
- Joint development with material suppliers and end-users is required for a rapid uptake by industry;
- Modelling, standardisation and regulatory aspects (especially safety and nanosafety) and the process and materials qualification.

Activities should start at TRL 4 and achieve TRL 6 at the end of the project.

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

Expected Impact:

- Improvement of the efficiency, quality and reliability of the product by at least 40%;
- Better use of raw materials and resources with reduced environmental impact and to lower cost by 35% as demonstrated by Life Cycle Assessment;
- New opportunities and business for SMEs across Europe (which are key players in advanced materials research for Additive Manufacturing).

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

DT-NMBP-20-2018: A digital 'plug and produce' online equipment platform for manufacturing (IA)

Specific Challenge: One of Europe's strengths in manufacturing is its abundance of SME equipment manufacturers with the capability to offer world-class products of highest quality and precision. A further strength is the large number of actors having off-the-shelf prototypes ready for experimentation and for market uptake. To increase their visibility towards global users of equipment and to further support digitisation of manufacturing, industrial online platforms needs to be developed and set up for use on the market.

Scope: (a) design and build the digital platform that brings together suppliers and users in a transparent and efficient way; and (b) populate it with adequate product information. This will constitute a set of pilot implementations intended to sell 'plug and produce' industrial

equipment and services to customers globally. The platform should therefore facilitate B2B transactions and host associated services in the form of digital product models allowing users to simulate (e.g. digitally test) the capabilities of the equipment on offer and its compliance to standards. This will ultimately boost product quality, transparency and usability based on Return on Experience. The digital platform should enable all of the following:

- Transparency of product features, capabilities, resource use, associated add-on services and price;
- Customer feedback, real-time use feedback (anonymised as needed) and associated options;
- Scalability with respect to technological development and manufacturing application domains;
- Information about standards and regulatory compliance (e.g. the facilitation of re- and de-manufacturing) as well as security requirements.

Social Sciences and Humanities (SSH) elements should cover issues such as business model/ownership economics and adequate administration. Work should cover in particular user interface aspects to encourage active customer feedback.

Activities under (b) include the incorporation of suppliers or users of the equipment pilots and/or developers of additional applications and services where appropriate. Beneficiaries may provide support to third parties as described in part K of the General Annexes of the Work Programme. The support to third parties can only be provided in the form of lump sums. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied.

Each consortium will define the selection process of the third parties for which financial support will be granted. The typical amount per party shall be in the order of EUR 50 000 to 100 000, as these parties are responsible for achieving the objective of activities under (b).¹¹ Around one third of the EU funding requested by the proposal shall be allocated to the purpose of financial support to third parties.¹²

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 5 and achieve TRL 7 at the end of the project.

¹¹ In line with Article 23(7) of the Rules for Participation the amounts referred to in Article 137(1) of the Financial Regulation may be exceeded where it is necessary to achieve the objectives of an action.

¹² It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SMEs.

This topic is part of the lump sum funding pilot scheme¹³. Funding for grants awarded under this topic will take the form of a fixed lump sum of EUR 7.5 million.

Expected Impact:

- Deliver a B2B online platform covering at least one key industrial equipment domain and mobilising actors across Europe;
- Demonstrate the full capability of the platform in one dedicated industrial domain, including associated product services (e.g. digital models enabling functional simulation) and including the services from all third parties selected in line with the conditions set out in Part K of the General Annex;
- Showcase the platform's scalability capability (towards all relevant industrial domains) via a reference architecture;
- Deliver a credible business plan that ensures long-term deployment and profitability, as well as scalability beyond the initial public financing phase;
- Demonstrate industry-wide support through an inclusive governance structure;
- Increase market opportunities for the users of the platforms, including SMEs.

Type of Action: Innovation action

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

2.2 BIOTECHNOLOGY

The exponential development of emerging and potentially disruptive biotechnologies has broadened their applicability, improving the quality and quantity of products in a wide variety of sectors (wellbeing, environment, food, etc.), improving quality of life and becoming an important economic engine. Given that biotechnology has become crucial for industrial growth, an important objective is to deliver added value by securing an important market share for leading European industries. In addition, Europe continues to excel in its scientific know-how and the means to discover new biotechnological ideas. However, for Europe to retain its comparative advantage in biotechnology, sustained investments are needed both for feeding its research base and for translating knowledge into tangible industrial innovation. Moreover, streamlined governance for new biotechnologies will facilitate reaching their full potential.

These biotechnology topics will support European industry through the continued development of cutting-edge biotechnologies, new biotechnologies for the global challenge of

¹³ [Commission Decision on the adoption of a lump sum pilot model grant agreement for multi-beneficiaries Innovation actions and Research and Innovation actions under Horizon 2020.](#)

environmental protection and breakthrough solutions to transform industrial processes using environmentally friendly and sustainable methods outcompeting conventional alternatives.

Proposals are invited against the following topic(s):

BIOTEC-01-2018: Standardisation in Synthetic Biology (CSA)

Specific Challenge: Systems biology and synthetic biology are scientific fields with potential to transform our way to understand and interact with nature. Synthetic biology combines knowledge and tools from biology and engineering for the design of biological systems that are thus programmed to do what we want them to do, be it for pharmaceutical products (e.g. active pharmaceutical agents or enzymes), in the environment (e.g. bio-pesticides), or industry (e.g. biochemicals).

Standardisation in electric and mechanical engineering has underpinned the success of global industrial production. However, the question remains about how much of this can be imported into the biological domain. Standards for the biological components used by synthetic biology will facilitate creating the blueprint of a given component with identical representation methods. This could bring major advancement in biotechnology and strengthen European leadership in future biotechnological research and production.

Scope: Proposals will be based on equivalent standardisation experiences that can be imported into the biological realm along with a thorough analysis of the functions of live systems that can be amenable to standardisation, generating new approaches where previous experiences do not apply. It will involve a dialogue with experts of the relevant disciplines on the necessary steps to set up principles for understanding, measuring, refining and, to the extent possible, standardizing the engineering of biological systems in support of their broad application in different industrial sectors. Standardisation will be considered in the following fronts: designation of the component/part, specifications, methodologies involved and assembly. Proposals will take into consideration worldwide actions to create synergies and partnerships between leading EU and international scientists, engineers and industrialists.

Proposals will include Social Sciences and Humanities (SSH) elements regarding the ethical dimensions and the environmental impact of products issued from synthetic biology research.

In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation is particularly encouraged.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

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

Expected Impact:

- A list of the most urgent standardisation needs via current practice leading to homogeneity in research and production;
- Identified scientific research gaps whose elucidation would accelerate standards-driven biological engineering;
- A realistic strategy based on research programmes, resources, facilities and structures needed to sustainably support the establishment of and compliance with standards for synthetic biology in the EU in the medium to long term.

Type of Action: Coordination and support action

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

BIOTEC-02-2019: Boosting the efficiency of photosynthesis (RIA)

Specific Challenge: Agricultural productivity that does not keep up with the current population increase, the growing demand for biomass production (as feedstock for biofuels) and the nonstop rise of global CO₂ emissions with its consequences for climate change, are all circumstances that make it urgent to increase the yield of biomass. Indeed, increased agricultural yield efficiency can have huge impacts in a society driven by the bio-economy.

Plants use photosynthesis to grow, converting energy from the sun into storable carbohydrates. Chloroplasts are the minute energy factories in the plant leaves that absorb the sun's energy, release oxygen into the air and use hydrogen plus CO₂ to make the compounds that plants need to grow. Biotechnology has succeeded in the engineering of nuclear and chloroplasts genomes for the production of enzymes, raw materials and building blocks for the chemical industry. However, research to increase the efficiency of the enzymes that drive photosynthesis has not yet produced the desired results. Currently available ground-breaking and disruptive technologies coupled with the integration of knowledge from diverse scientific disciplines have the potential to propose new solutions to boost the efficiency of photosynthesis.

Scope: Proposals should work towards the optimisation of photosynthesis by capitalising on multidisciplinary approaches, such as functional genomics, systems biology, metabolic modelling, enzyme engineering, computational biology, synthetic biology, directed evolution and gene editing techniques.

Proposals should work with plants or algae and deal with any of the biological components underlying the diversity of photosynthesis. Proposals can involve new strategies to engineer the chloroplast genome, new strategies to engineer relevant enzymes, the development of metabolic models that contribute to a higher understanding of the properties of photosynthesis, among others.

Proposals should cover at least one of the following:

- new tools improving the performance of the catalytic enzymes involved in photosynthesis;
- new tools to increase the rate of CO₂-fixation;
- engineered enzymes for novel CO₂-fixation pathways.

Proposals should include Social Sciences and Humanities (SSH) elements regarding the technologies used and the environmental and socio-economic impact of the expected output.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 3 and achieve TRL 5 at the end of the project.

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

Expected Impact:

- A strategy based on the new resources to obtain an enhanced photosynthetic efficiency of at least 10% under diverse environmental conditions;
- A detailed and accurate research and innovation roadmap to attain higher photosynthetic performance for applicable results in the field by 2030.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

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

BIOTEC-03-2018: Synthetic biology to expand diversity of nature's chemical production (RIA)

Specific Challenge: For years, industries have relied upon living organisms as a source of compounds or natural products, most of which result from interactions between them. Finding these compounds has very much depended on massive screening assays. Moreover, these compounds are chemically complex and their production often involves dozens of genes controlled by intricate regulatory networks. Both the nature of these molecules and the difficulties to obtain them via chemical synthesis have restricted their commercial utilisation.

However, now synthetic biology offers unique opportunities to create analogues of natural products or even to go beyond those. It has the capacity to modify the genomes of microorganisms, discovering novel routes to obtain complex chemicals, thus expanding the

chemical diversity of molecules for the production of new compounds. The use of engineering principles and tools in biological systems overcomes the bottlenecks of molecules which are not amenable for large-scale production and expands the options of new compounds for applications ranging from medicine to agriculture and materials.

Scope: Proposals will consist of the bioengineering of the genome of organisms (e.g. yeast, algae, bacteria) to be used in industrial processes in order to optimise molecular pathways. This should lead to the design and synthesis of naturally unavailable and efficient pathways for the production of new complex and high value added chemicals for the pharmaceutical, agricultural or material sectors. Emerging synthetic biology techniques (engineering of large genomic regions, synthetic regulation for the control of gene expression and gene editing, among others) can be combined with knowledge of synthetic chemistry, enzyme engineering, systems biology and bioinformatics.

Activities should start at TRL 3 and achieve TRL 5 at the end of the project.

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

Expected Impact:

- New approaches for the production of complex chemicals;
- Pathway design and validation for the production of at least two new compounds that would be difficult to make exclusively by chemistry, including an assessment of the related environmental benefits and risks;
- Proved contribution to the standardisation of synthetic biology genetic parts and gene clusters.

Type of Action: Research and Innovation action

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

CE-BIOTEC-04-2018: New biotechnologies for environmental remediation (RIA)

Specific Challenge: Contamination of soils, sediments, ground and surface water caused by waste resulting from human action and leakage into water sources is a serious problem. This pollution contains compounds having toxicity and durability which creates important concerns from the health and environmental viewpoints. Moreover, it represents a significant economic burden for society.

In some standard remediation strategies, for example burying polluted soils in landfills, pollutants are not destroyed and the problem is merely postponed. Chemical remediation and the disposal of contaminated waste increase the health risk for workers. Bioremediation,

which uses naturally occurring microorganisms, is a more sustainable and gentle alternative to physicochemical options.

Microorganisms have developed countless strategies to depollute their environment and to transform harmful environmental contaminants into harmless end products. However, the effectiveness of bioremediation faces a number of challenges, for instance the concentration of the contaminant, the combined biological activity of the microbial community over time and space and the consumption of energy.

Scope: Proposals should include research and innovation for efficient and low cost remediation strategies using microorganisms by means of (bio-)electrochemical systems, or alternate systems that require minimum or zero external energy or chemicals. The work should ensure that an acceptable performance for field applications can be attained. Remediation should cover hydrocarbons and their derivatives, metals, nutrients, antibiotics or micropollutants. Moreover, the system developed should remove different contaminants, including complex mixtures, the remediation time should be accelerated and it should work with mixed microbial communities.

This topic is part of the EU-China flagship initiative on Biotechnology for Environment and Human Health, which will promote substantial coordinated and balanced research and Innovation cooperation between the EU and China. China-based participants have the possibility to apply for funding under the Chinese co-funding mechanism and other Chinese sources¹⁴.

Activities should start at TRL 3 and achieve TRL 5 at the end of the project.

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

Expected Impact:

- Remediation of at least two toxic contaminants;
- Proof of the feasibility of scaling up the technology for field testing, including an assessment of the related environmental benefits and risks;
- A demonstration of the benefits over standard physicochemical remediation approaches, including energy efficiency.

Type of Action: Research and Innovation action

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

¹⁴ <http://www.nsf.gov.cn/publish/portal1/>

CE-BIOTEC-05-2019: Microorganism communities for plastics bio-degradation (RIA)

Specific Challenge: The global market for plastics continues to grow due to their physical properties and benefits such as light weight, reduction of food waste, durability and cost. After being used, plastics should be separated in order to be subject to the most appropriate waste treatment processes. This is increasingly difficult and inefficient due to, for example, consumers' inaccurate identification of the appropriate types of plastics for recycling. Other plastic types, such as polystyrene, can even not be recycled if they have traces of food.

Despite the worldwide efforts for degradation or recycling, large amounts of mixtures of plastics and other polymers end up in landfills or are used for the generation of energy. These methods lead to environmental contamination through the production of CO₂ or due to plastics reaching water courses and the sea where they persist and become toxic for the whole food chain. Novel biotechnological approaches should be applied for the sustainable biological degradation of mixtures of recalcitrant and degradable plastics.

Scope: Proposals will develop environmentally friendly and sustainable solutions for managing the waste of plastics mixtures based on the use of communities of microorganisms with a set of complementary enzymes. The enzymes may be native or engineered using state of the art biotechnologies. The microbial organisms will turn plastic mixtures into chemical constituents facilitating mineralisation, composting of otherwise recalcitrant and toxic polymers and facilitating production of high value products. Polymers such as polystyrene can also be included in the proposals.

Proposals should:

- produce cocktails of enzymes using communities of microorganisms capable of degrading mixtures of biodegradable and currently non-biodegradable plastics into more basic chemical constituents;
- use a multidisciplinary approach based on biotechnology;
- create high value products and valorise mixed plastic waste.

This topic is part of the EU-China flagship initiative on Biotechnology for Environment and Human Health, which will promote substantial coordinated and balanced research and Innovation cooperation between the EU and China. China-based participants have the possibility to apply for funding under the Chinese co-funding mechanism and other Chinese sources¹⁵.

Activities should start at TRL 3 and achieve TRL 5 at the end of the project.

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

¹⁵ <http://www.nsf.gov.cn/publish/portal1/>

Expected Impact:

- A combination of microorganisms expressing at least three novel or improved enzymatic activities enabling the degradation of mixtures of plastics;
- Degradation of at least 20 percent of non-biodegradable plastics found in plastic mixtures. The objective is to include relevant indicators that prove this impact;
- Identification of the metabolic pathways leading to at least two high added value products that could be sustainably produced in future from plastic mixtures;
- Description of a sustainable and environmentally friendly pilot system for the degradation of plastic mixtures.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

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

BIOTEC-06-2020: Reprogrammed microorganisms for biological sensors (IA)

BIOTEC-07-2020: Multi-omics for the optimisation of genotype-phenotype associations (RIA)

2.3. MEDICAL TECHNOLOGY INNOVATIONS

EU demographic change requires innovation to enhance healthcare delivery, quality of life and active ageing, being also an industrial opportunity and a growing market. To respond to these challenges and opportunities, the topics in this section will develop innovative design, development and manufacture of user-centric medical technologies, including implants, tissue regeneration, and smart nano- or bio-materials. The EU medical industrial sector ecosystem is currently fragmented into diverse approaches and technologies; developing and tuning innovative medical technologies performances to the patients' needs is essential to enable the translatability of inclusive "bench to bedside" solutions into personalised clinical applications. This development could result in a major improvement on the quality of life of patients.

NMBP-21-2020: Custom-made biological scaffolds for specific tissue regeneration and repair (RIA)

Proposals are invited against the following topic(s):

NMBP-22-2018: Osteoarticular tissues regeneration (RIA)

Specific Challenge: EU demographic change requires innovation to enhance active ageing, whereby a growing market for osteoarticular tissue regeneration is created. To reduce patients' sufferings, mitigate the economic burdens to health systems and exploit market

opportunities it is crucial to conceive innovative designs and development of innovative biomaterials that enables the delivery of smart, nanostructured and functionalised tissues to regenerate and integrate bones, cartilages, tendons and joints.

Scope: To design and develop user-centred innovative and smart nanobiomaterials which may be also adaptable to remote control, that will lead to a personalised regeneration of osteoarticular tissues (bones, cartilages, tendons, joints). The nanobiomaterials should be designed to perform in host tissues affected by severe degenerative and/or inflammatory processes, which typically characterise Osteoarticular pathologies. Proposals should cover at least one of the following technologies, leading to a convergence of processes:

(i) 3D-bioprinting; (ii) stem cells seeding, recruiting, activation, functionalisation, and cell printing; (iii) nano functionalisation; (iv) 3D-printable biophoto-polymerisation; (v) use of light to expose/mask tethered signalling molecules, incorporating immune-modulatory materials such as complement regulators; (vi) additive manufacturing by laser sintering, rapid prototyping technologies, stereolithography, inkjet techniques; (vii) relevant cross-cutting KETs; (viii) electrospinning.

The research design should be developed by means of a multidisciplinary approach and involve relevant stakeholders. As relevant, proposals should consider sex and gender specific aspects.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 3 and achieve TRL 5 at the end of the project.

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

Expected Impact:

- Alleviate heavy burdens on patients and healthcare systems by developing smart nano-engineered affordable biomaterials for tissue self-healing and regeneration; improve the well-being, health, quality of life and active ageing of populations;
- Boost industrial competitiveness and leadership of EU companies in personalised bio-intelligent materials responding to patients' clinical specificities;
- Enhanced incorporation of digitalisation and Internet of Things for innovative and affordable biomaterials;
- Increase EU attractiveness for the clinical development of regenerative medicine;

- reinforce the EU sector ecosystem to generate new markets and opportunities for SMEs, translating innovative biomaterials into pre-clinical tests for market uptake.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

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

DT-NMBP-23-2020: Next generation organ-on-chip (RIA)

Conditions for the Call - TRANSFORMING EUROPEAN INDUSTRY

Opening date(s), deadline(s), indicative budget(s):¹⁶

Topics (Type of Action)	Budgets (EUR million)			Deadlines
	2018	2019	2020	
Opening: 31 Oct 2017				
BIOTEC-03-2018 (RIA)	30.00			23 Jan 2018 (First Stage) 28 Jun 2018 (Second Stage)
NMBP-22-2018 (RIA)	24.00			23 Jan 2018 (First Stage) 28 Jun 2018 (Second Stage)
BIOTEC-01-2018 (CSA)	2.00			22 Feb 2018
CE-BIOTEC-04-2018 (RIA)	10.00			25 Apr 2018
DT-FOF-01-2018 (CSA)	2.00			22 Feb 2018
DT-FOF-02-2018 (RIA)	79.00			
DT-FOF-03-2018 (RIA)				
DT-FOF-04-2018 (IA)				
Opening: 28 Nov 2017				

¹⁶ The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

The Director-General responsible may delay the deadline(s) by up to two months.

All deadlines are at 17.00.00 Brussels local time.

The deadline(s) in 2019 and 2020 are indicative and subject to separate financing decisions for 2019 and 2020.

The budget amounts for the 2018 budget are subject to the availability of the appropriations provided for in the draft budget for 2018 after the adoption of the budget 2018 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2019 and 2020 budget are indicative and will be subject to separate financing decisions to cover the amounts to be allocated for 2019 and for 2020.

Horizon 2020 - Work Programme 2018-2020
Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing

DT-NMBP-20-2018 (IA)	15.00			08 Mar 2018
Opening: 16 Oct 2018				
BIOTEC-02-2019 (RIA)		31.00		22 Jan 2019 (First Stage) 03 Sep 2019 (Second Stage)
DT-NMBP-18-2019 (IA)		20.00 ¹⁷		22 Jan 2019 (First Stage)
DT-NMBP-19-2019 (IA)		20.40		03 Sep 2019 (Second Stage)
CE-BIOTEC-05-2019 (RIA)		10.00		24 Apr 2019
DT-FOF-05-2019 (IA)		106.60		21 Feb 2019
DT-FOF-06-2019 (IA)				
DT-FOF-08-2019 (IA)				
DT-FOF-12-2019 (RIA)				
Opening: To be defined				
Focus area topic(s) for 2020			122.00	To be defined
Overall indicative budget	162.00	188.00	122.00	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

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

For two stage procedure:

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

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

¹⁷ of which EUR 10.00 million from the 'Information and Communication Technologies' WP part.

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

BIOTEC-02-2019, BIOTEC-03-2018, CE- BIOTEC-04-2018, CE- BIOTEC-05-2019, DT- FOF-02-2018, DT- FOF-03-2018, DT- FOF-04-2018, DT- FOF-05-2019, DT- FOF-06-2019, DT- FOF-08-2019, DT- FOF-12-2019, DT- NMBP-18-2019, DT- NMBP-19-2019, DT- NMBP-20-2018, NMBP-22-2018	The threshold for the criteria Excellence and Impact will be 4. The overall threshold, applying to the sum of the three individual scores, will be 12.
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Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme. The following exceptions apply:

All topics of this call	<p>Under 3 (a) Proposals are first ranked in separate lists according to the topics against which they were submitted ('topic ranked lists'). When comparing ex aequo proposals from different topics, proposals having a higher position in their respective 'topic ranked list' will be considered to have a higher priority in the overall ranked list.</p> <p>Under 3 (b) For all topics and types of action, the prioritisation will be done first on the basis of the score for Impact, and then on that for Excellence.</p>
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The full evaluation procedure is described in the relevant [guide](#) published on the Participant Portal.

Grant Conditions:

DT-FOF-04-2018, DT- FOF-08-2019	As an exception from General Annex D, the funding rate for eligible costs in grants awarded under this topic will be differentiated: 100% of the eligible costs for beneficiaries and linked third parties that are non-profit legal entities; and 50% of the eligible costs for beneficiaries and linked third parties that are for profit legal entities.
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DT-NMBP-20-2018	For grants awarded under this topic beneficiaries may provide support to third parties as described in part K of the General Annexes of the Work Programme . The support to third parties can only be provided in the form of grants. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied.
DT-NMBP-20-2018	For grants awarded under this topic eligible costs may take form of a lump sum as defined in the Commission Decision on the adoption of a lump sum pilot model grant agreement for multi-beneficiaries Innovation actions and Research and Innovation actions under Horizon 2020 .

Consortium agreement:

All topics of this call	Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.
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Call - INDUSTRIAL SUSTAINABILITY

H2020-NMBP-ST-IND-2018-2020

The purpose of this call is to further strengthen the global leadership of Europe's industry in environmental sustainability, through a combination of mature and disruptive technologies. Success will be seen in making measurable contributions to identified sustainable development goals.

This call contributes to the focus area 'Connecting economic and environmental gains – the Circular Economy' through:

- new technologies for the process industries such as industrial symbiosis and adaptation to new feedstock and sources of energy; and
- radical advances in catalysis.

It also contributes to the focus area 'Building a low-carbon, climate resilient future' through:

- the development of new materials and new technologies for renewable energy and energy storage; and
- new technologies for energy-efficient buildings.

The choice of topics supporting energy innovation reflects the four strategic priorities in Accelerating Clean Energy Innovation¹⁸

- Strengthening EU leadership on renewables;
- Decarbonising the EU building stock by 2050: From nearly zero-energy buildings to energy-plus districts;
- Developing affordable and integrated energy storage solutions; and
- Electro-mobility.

The Research Fund for Coal and Steel Programme complements the Horizon 2020 Framework Programme in the sectors related to coal and steel industry.

Some topics under this call contribute to the objectives of the European Innovation Partnerships (EIPs) on Raw Materials and Water Efficiency.

Proposals for Research and Innovation Actions and Innovation Actions submitted under this call should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

¹⁸ COM(2016) 763 final

3.1. SUSTAINABLE PROCESS INDUSTRY (SPIRE)

The process industry embraces cement, ceramics, chemicals, engineering, minerals and ores, non-ferrous metals, steel and water sectors. Together, these sectors form a key part of Europe's manufacturing base, representing 20% of European industry in terms of both employment and turnover. These sectors are also characterised by a high dependence on raw materials and energy in their production and processing technologies. With these becoming increasingly scarce, resource efficiency, including the use of renewable resources, is now a key factor driving the competitiveness and sustainability of the European process industry. Accordingly, the central objectives in relation to the process industry are to optimise industrial processing, reduce energy and resource consumption and minimise waste in order to deliver European added value by making significant contributions to the Circular Economy and to fighting climate change.

Where relevant, actions under SPIRE are expected to take into account the Industrial Emissions Directive and provide input to the relevant Best Available Techniques reference documents. Research targeting for instance greenhouse gas or energy use reduction should also consider reduction of other emissions such as NO_x and PM in order to avoid undesired side effects.

Topics under SPIRE will support the European industry towards improved integration of industrial operations leading to better valorisation of energy and material streams, sustainable raw materials and enhanced performance and efficiency of particularly high energy-intensive processes.

In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation may be particularly appropriate in some areas of the Sustainable Process Industry, in particular with Eastern Partnership countries (Ukraine, Moldova, Georgia, Armenia, Azerbaijan and Belarus).

CE-SPIRE-01-2020: Industrial symbiosis (IA)

Proposals are invited against the following topic(s):

CE-SPIRE-02-2018: Processing of material feedstock using non-conventional energy sources (IA)

Specific Challenge: Non-conventional energy sources, such as microwave, plasma, ultrasound and laser, as well as electrochemical and photochemical processes, have already been applied in process intensification, mainly at lab scale, showing significant improvements in process performance (e.g. improved selectivity, crystal nucleation, reaction speed easing raw material demand) for the benefit of energy efficiency. The processes powered by non-conventional energy sources are suitable for connection to the electricity grid. They allow variable throughputs to better follow market demand and enable leaner production paradigms (e.g. decreased stock, production on demand). Such technologies are suitable for downscaling and

continuous processing, where they can also be coupled with real time monitoring allowing a finer control of the transformations.

Scope: Proposals are expected to develop technologies applying non-conventional energy sources to processes of high industrial interest. The concepts proposed should:

- Show potential for integration in a renewable electricity grid, and consider the relevant limitations (fluctuating nature of the electricity stream);
- Provide significant advantages in terms of resource and energy efficiency, compared to the current state of the art processes (or similar ones, as relevant);
- Provide improved flexibility, working at variable throughputs without major losses in the overall process performance;
- Be applicable to continuous processes and/or show potential enabling the replacement of current batch ones;
- Consider, where relevant, the possibility for containerised and/or mobile (e.g. biomass in situ processing) technologies;
- Consider Life Cycle Assessment proving a reduced environmental footprint;
- Consider replicability and scalability of the proposed concepts.

Activities should start at TRL 4 and achieve TRL 6 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU between EUR 6 and 10 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Allowing for a -30% to +30% energy input within RES fluctuations timeframes, without significant losses in specific energy efficiency;
- Improvement in energy efficiency of 30%;
- Improvement in resource efficiency of 30%;
- Decrease in CO₂ emissions by 40% (without considering the electricity generation and at steady state);
- Decreased OPEX and CAPEX by 15%;
- Effective dissemination of major innovation outcomes to the current and the next generation of employees of the SPIRE sectors, through the development of learning

resources with flexible usability. These should be ready to be easily integrated in existing curricula and modules for undergraduate level and lifelong learning programs.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

CE-SPIRE-03-2018: Energy and resource flexibility in highly energy intensive industries (IA 50%)

Specific Challenge: Energy intensive industries should adapt their production processes and unit operations to increasingly sustainable, but highly fluctuating energy supply. To this end, energy and resource flexibility in the European process industry can be improved through the development of novel processes utilising more efficiently energy streams, heat recovery and raw materials flows with variable properties (including new or modified materials as well as secondary raw materials and by-products).

The challenge is to establish synergistic integration at a regional level among different production sectors leading to optimisation of production system as a whole and logistics, especially in terms of the supply of energy and raw materials. This should reduce emissions and environmental impact, while maintaining competitiveness and job security.

Scope: Solutions are needed for value chain optimisation through energy efficiency considerations in the design phase of manufacturing equipment and processes, collective demand side strategies, and potential integration of the nearby renewable energy sources.

In particular, proposals are expected to develop:

- Innovative production technologies allowing flexibility in terms of raw material, including new, modified or secondary raw materials, and intermediate or final products are expected to be developed. They have, at the same time, to consider quality of the main products and by-products in view of their valorisation through re-use and recycle;
- Novel advanced energy systems, could include new combustion and gasification techniques applied to the highly resource and energy intensive industries have to be developed;
- New developments should clearly indicate how the use of sustainable electrical energy sources, or heat recovery, could enhance energy efficiency and cope with a fluctuating energy input. These actions have to bring a significant impact on the sustainability profile of the process and/or the final products.

Proposals need to consider the following elements:

- Treatment technologies and process integration solutions allowing a significant reduction as well as the valorisation, re-use and recycling of by-products and waste streams (solid, liquids and gaseous);
- System, process modelling and integration (up and down-stream) within the plant operation terms or symbiosis concepts, improving energy and raw materials efficiency and flexibility, and minimising the impact on the environment of the whole value chain. Taking also into consideration optimisation at a plant/system level. The activities have to be supported by a quantitative Life Cycle Assessment.

Proposals should include multiple demonstrators, including retrofitting of industrial installations, in a highly energy and resource intensive industry-relevant environment. The whole value chain should be considered, as well as relevant regulations which support the recycling of waste materials in Europe. Exploitation of structural and regional funds in connection with smart specialisation strategies is strongly encouraged.

Activities should start at TRL 5 and achieve TRL 7 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU between EUR 8 and 12 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

As an exception from General Annex D, the funding rate for eligible costs in grants awarded under this topic will be differentiated: 100% of the eligible costs for beneficiaries and linked third parties that are non-profit legal entities; and 50% of the eligible costs for beneficiaries and linked third parties that are for profit legal entities.

Expected Impact:

- Cost reduction of the process of at least 10% through the implementation of a flexible scheme in raw materials, including secondary raw materials, process and product quality specifications;
- Improved process efficiency through re-utilisation of energy and/or material process streams by at least 15%;
- CO₂ emissions reduction by at least 5% and reduction of the environmental impact in terms of the main key performance indicators by at least 15%;
- Effective dissemination of major innovation outcomes to the current and next generation of employees, through the development, by education/training experts, of learning resources with flexible usability. These should be ready to be easily integrated in existing curricula and modules for undergraduate level and lifelong learning programmes.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

CE-SPIRE-04-2019: Efficient integrated downstream processes (IA)

Specific Challenge: Today, process industry operations for downstream processing represent on average 50-60% of the total capital (CAPEX) and operating costs (OPEX) and they account for up to 45% of the process energy in industrial operations. These high costs for downstream processing are often linked to the inefficiencies in the upstream process, due to low conversion and formation of co-products, by-products and/or impurities. Hybrid processing technologies (including chemical and biochemical steps) can provide major advantages in terms of primary process selectivity and sustainability. However, they have not been widely deployed in industry so far. The development of novel technologies for upstream and downstream unit operations, as well as their better integration, could provide significant resource and energy efficiency gains.

Scope: Proposals submitted under this topic are expected to provide novel solutions for a deeper integration of upstream and downstream processing operations. Proposals should consider:

- Intensified process technologies presenting multistep upstream processes, potentially exploiting hybrid chemo and bio catalytic technologies as well as process analytical techniques (PAT), in order to maximise production efficiency, selectivity and mitigation of downstream processing;
- Complex downstream operations, integrating different separation techniques and purification steps;
- Modularity and flexibility of the solutions, as well as, potential for transition from batch to continuous operations;
- The technologies proposed should enable increased productivity, purity and quality of products, while lowering the process environmental footprint and increasing resource and energy efficiency;
- The potential for integration in the current industrial scenario, and the replicability of the concept in different sectors of the process industry;
- Increased safety of the work environment.

Proposals should provide proof of economic and industrial feasibility of the technologies involved; and should consider the potential integration in existing installations, as well as their retrofitting. Reduction of production costs and time to market is also expected.

Significant demonstration activities in industrial environments are expected. Demonstration activities in real industrial settings, showing the potential for integration into existing plants and industrial operations, represent a clear added-value to the proposals.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 5 and achieve TRL 7 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU between EUR 10 and 14 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- 20% decrease in greenhouse gas emission;
- Increased in resource and energy efficiency by at least 20%;
- Novel modular and scalable integrated (upstream-downstream) pilot line technologies with 10% decrease in CAPEX and OPEX;
- Effective dissemination of major innovation outcomes to the current and next generation of employees, through the development of learning resources with flexible usability. These should be ready to be easily integrated in existing curricula and modules for undergraduate level and lifelong learning programmes.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

CE-SPIRE-05-2019: Adaptation to variable feedstock through retrofitting (IA 50%)

Specific Challenge: Process industry plants have to be operated for a long time to make their operations viable. They include equipment such as furnaces, reactors, raw materials handling and storage systems which sometimes have a lifetime beyond 30 years. Keeping these facilities up to date from a technological and from regulatory point of view (for instance related to zero waste regulations and to the circular economy) is a major challenge. Even industrial plants which are less than 10 years old, are often not equipped for new or renewable (e.g. biomass) materials and alternative or renewable energy input streams. More generally, this increased variety of inputs along with the need for energy efficiency improvements poses a real challenge and requires technological breakthroughs in the process industry.

Scope: Proposals need to cover the following:

- Implement simulation models and decision support tools for the production chain in an energy intensive sector, including the detection of inefficiencies, in order to allow flexibility with respect to feedstock of variable composition, while offering energy efficiency and product quality;
- The development of tools and methodologies to streamline and support retrofitting;
- Find the most efficient operational input conditions to optimise the performances;
- Develop indicators to modify input variables and its potential of replication across the industry;
- Facilitate and adapt the equipment towards a larger number and more diverse feedstock in order to be ready for a transition in which variability in quality, quantity and price of feedstock are key to make the production competitive and sustainable;
- Solutions should demonstrate the feasibility and suitability of the concepts of retrofitting at industrial scale.

Demonstration of the technology in different process industries should be undertaken, covering both the technology (new ‘plug-ins’), as well as the process control (higher variability of the process requires new Monitoring & Control Systems).

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 5 and achieve TRL 7 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU between EUR 8 and 12 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

As an exception from General Annex D, the funding rate for eligible costs in grants awarded under this topic will be differentiated: 100% of the eligible costs for beneficiaries and linked third parties that are non-profit legal entities; and 50% of the eligible costs for beneficiaries and linked third parties that are for profit legal entities.

Expected Impact:

- Increasing the resource and energy efficiency of the targeted processes by 20%;
- Decrease GHG emissions through retrofitting by at least 30%;
- Decreased utilisation of fossil resources in the process industry of at least 20%;

- Reduced OPEX by 30% and increased productivity by 20%;
- Effective dissemination of major innovation outcomes to the current next generation of employees of the SPIRE sectors, through the development, by education/training experts, of learning resources with flexible usability. These should be ready to be easily integrated in existing curricula and modules for undergraduate level and lifelong learning programs.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

DT-SPIRE-06-2019: Digital technologies for improved performance in cognitive production plants (IA)

Specific Challenge: Shortage in raw materials, increased energy prices and environmental constraints require the European process industry to improve its performance and flexibility and there are unexploited opportunities for digitising a large range of enterprises of very different size in the process industry.

Digitisation endows the production system with capabilities for analysis. This should enable the autonomous operation of the system based on embedded cognitive reasoning, while relying on high-level supervisory control. As a consequence, changes in the production process need to be detected and the system needs to be able to respond to these dynamic fluctuations, by adapting the production to stay within the target ranges of production costs and rate, as well as those of and sustainability parameters. A fully up-to-date interactive and self-learning process control integrated with management tools is essential to obtain an optimal efficiency, while maintaining adequate flexibility of the system in regard to changing feedstock, energy sources and product demand.

Scope: Proposals need to develop new technologies to realise cognitive production plants, with improved efficiency and sustainability, by use of smart and networked sensor technologies, intelligent handling and online evaluation of various forms of data streams as well as new methods for self-organizing processes and process chains. Furthermore, proposals should cover the full digital transformation of a complete plant or site(s) including e.g. data acquisition, communication, automation, analytics, modelling, prediction and standardisation of relevant data interfaces. The following elements should be considered:

- Improvement of online monitoring and innovative control technologies in terms of process performance and flexibility, maintenance needs and product quality;
- Digital retrofitting of existing assets, integration towards and holistic optimisation of operations, data-analytics, real-time capability, use role-specific representation of

information, feedback control & detect deviations and adjust operations immediately decision support (e.g. advanced process control, reactive scheduling);

- Several among the following concepts: apply low-cost sensors for on-line assessment of product quality and integration into process control; robust optimisation methods to distributed targeted process monitoring; simulation methods for the analysis, characterisation and study of systems for enhanced operations and decision-making combination of various forms of data with cognitive insight to optimise and enhance resources;
- Replicability and scalability of the concepts should be considered appropriately.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 5 and achieve TRL 7 at the end of the project.

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

Expected Impact: Improved capabilities for valid, reliable and real-time control logics of the properties, efficiency and quality of process streams and final products for existing and for more flexible process operation concepts:

- Show potential for improved performance in cognitive production plants;
- Increased production performance, energy and resource consumption, or waste or by-products production will be significantly improved by more than 20%. The targets should be quantified in the proposal and validated during the execution of the demonstration;
- Project outcomes should demonstrate a positive environmental impact, by reducing CO₂ emissions compared to the state of the art and in the scale relevant for the different applications;
- Effective dissemination of major innovation outcomes to the current next generation of employees of the SPIRE sectors, through the development, by education/training experts, of learning resources with flexible usability. These should be ready to be easily integrated in existing curricula and modules for undergraduate level and lifelong learning programmes.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

CE-SPIRE-07-2020: Recovery of industrial water, thermal energy and substances contained therein (IA)

CE-SPIRE-08-2020: Improved Industrial Processing using novel high-temperature resistant materials (RIA)

CE-SPIRE-09-2020: Making the most of mineral waste, by-products and recycled material as feed for high volume production (IA)

CE-SPIRE-10-2018: Efficient recycling processes for plastic containing materials (IA)

Specific Challenge: Plastics materials are produced mainly from raw materials of fossil origin (e.g. PE, PP, and PET). A variety of bio-based plastic materials are increasingly available. Plastic materials are used in a wide range of applications because of their properties, versatility, lightweight and price, for example for making lightweight polymer composites to substitute metals and in more traditional applications, such as packaging. The wide use of these materials results in a huge amount of plastic waste. Recycling and redesign of plastics are essential in reusing plastic waste material and avoiding landfill. This also allows utilising plastics as carbon sinks in an optimal way, before using them for energy recovery at the end of life. A major challenge lies in the development of process technologies, utilising plastic waste as starting material (at least in part). A better use of underexploited resource (plastic waste) for the production of added value products (not restricted to plastics but excluding fuels) and process streams would support the circular economy.

Scope: Proposals submitted under this topic are expected to cover processes for the production of recyclable materials containing plastics. Aspects to be considered are:

- Improved energy and resource efficiency. The processes proposed are expected to have a lower environmental footprint compared to the current state of the art for the production of added value products; this should be proved by Life Cycle Assessment as well as Life Cycle Cost to prove the economic viability of the proposed technology;
- Integration with the relevant value chains, ensuring the secure supply of the raw material streams. In this respect, a clear strategy to involve the relevant actors along the value chain is expected;
- Process flexibility and ability to utilise waste heterogeneous plastic materials, including plastic composites, as input to allow the recycling and the re-processing of this widely available resource into added value products (excluding fuels). Sustainable raw materials, such as bio-based raw materials and organic waste could also be considered;
- Key issues related to the quality of the raw (including secondary) material streams should be covered, and in particular the heterogeneity of the waste plastic material, as well as the wide variety of substances contained in plastic materials (e.g. plasticisers,

anti-oxidants, etc.). The valorisation of fillers or fibres from composites should also be covered;

- Quality/specifications of the yielded streams ensuring their usability by downstream industries;
- Non-technological hurdles, such as regulations and standards, to enable the prompt deployment in industry of the developed concepts and economic indicators (e.g. CAPEX and OPEX).

Demonstration activities, prototypes and pilot implementations in real industrial settings for the concepts proposed are expected.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 5 and achieve TRL 7 at the end of the project.

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

Expected Impact:

- More efficient and sustainable chemical process and processing technologies utilising plastic waste as starting material for the production of added value products such as recyclable plastic materials (e.g. composites) and chemicals but excluding fuels);
- The technologies proposed should provide a decreased utilisation of primary fossil resources in the process industry of at least 30%;
- The concepts proposed should provide a decrease in CO₂ emissions of at least 20%;
- The concept should utilise at least 70% of waste material including at least 40% of plastic waste;
- Effective dissemination of major innovation outcomes to the current next generation of employees of the SPIRE sectors, through the development, by education/training experts, of learning resources with flexible usability. These should be ready to be easily integrated in existing curricula and modules for undergraduate level and lifelong learning programmes.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

3.2. CATALYSING THE CIRCULAR ECONOMY

Catalysis is ubiquitous in the chemical industry, and a key technology in all future scenarios for a sustainable economy. The progressive substitution of products derived from fossil fuels, at all steps along the industrial value-chain, plays a crucial role to successfully decarbonise industrial processes. Moreover, carbon dioxide (CO₂) or C1 building blocks are promising alternative feedstocks for chemicals, materials and fuels; and breakthroughs in reusing it have attracted strong industry interest. These future disruptive technologies could play a very significant role in lowering the carbon footprint of industry and the entire economy. The foreseen activities will help make the circular economy an industrial reality, and will help decarbonise industry. By making industrial processes more efficient and sustainable, they will also enhance European competitiveness. The activities will reflect the need for integrated research activities at a European level, to bring the limited or fragmented resources in Europe to bear upon the most promising topics. In addition, contributions to the Circular Economy will also be sought through the development of new materials and structures with in-built recycling properties

The ambition is that Europe becomes the world-leader in developing sustainable chemistry, smart materials and intelligent recycling, through a combination of mature and disruptive technologies.

Proposals are invited against the following topic(s):

CE-NMBP-24-2018: Catalytic transformation of hydrocarbons (RIA)

Specific Challenge: Advanced chemical energy conversion, storage and transportation will play a key role in enabling the EU to develop a low-carbon economy and provide more flexibility. As such, increasing the exploitation of natural gas, stranded resources and biogas is creating new opportunities for the utilisation of low cost light alkanes. High value can be added through improved catalytic transformations to C2-C4 olefins, C-C coupling and/or C1 chemistry together with significant impact towards the climate action targets agreed in COP21. The integration of catalysts and process design will be instrumental in creating process improvements and flexibility as well as tackle the global climate challenges.

Scope: Development of novel catalytic materials and routes for the valorisation of currently unexploited light hydrocarbons resources, bio- or stranded gas for chemical and energy production. Proposals should cover at least one of the following:

- Selective direct conversion of light hydrocarbon resources (C1-C4 alkanes) to mono-olefins and/or butadiene, with improved performance (on energy/carbon bases) and competitive costs compared to existing industrial processes;
- Conversion of non-transportable gas resources to liquid hydrocarbons (not passing through CO/H₂ formation);

- Novel energy-efficient and cost-competitive routes for the direct utilisation of light alkanes in the production of high-value chemicals;
- Assessment of environmental and safety issues and should involve industries in a leadership role as well as validate the feasibility of the proposed route in industrial relevant environments.

In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation is particularly encouraged in particular with countries from the Broader EU Neighbourhood (e.g. European Neighbourhood Policy countries, Iran and Iraq) among others.

Activities should start at TRL 3 and achieve TRL 5 at the end of the project.

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

Expected Impact: Novel catalysts and routes for the valorisation of currently unexploited light hydrocarbons resources will:

- Reduce the dependence from the current fossil fuel resources (>30% reduction of current use of fossil fuels for the equivalent production);
- Improve industrial competitiveness by novel processes with improved energy efficiency (OPEX). Reduction of greenhouse gases emissions and investment costs (CAPEX) by >20% with respect to current production route;
- Novel and scalable catalysts and catalytic processes which can handle feedstock variability.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

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

CE-NMBP-25-2019: Photocatalytic synthesis (RIA)

Specific Challenge: The efficient storage and utilisation of solar energy in the form of chemicals or chemical energy will play a key role to transform the European industry into a low-carbon economy. In the long term, there will be a need for highly integrated solutions enabling the carbon-neutral production of high-value chemicals or energy, which is crucial to reduce CO₂ emissions. The development of integrated processes will require a systems-catalysis approach that includes engineering aspects as small-scale and intermittent operation.

Scope: Development of cheap materials and integrated processes/devices for the direct photocatalytic conversion of CO₂ (from anthropogenic CO₂ sources and/or from air) and H₂O to fuels and/or chemicals, with an overall solar-to-hydrogen efficiency of >20%, with the following goals:

- Improve selectivity and efficiency by rational engineering of the bandgap and electronic structures;
- Realise a new design of multi-heterojunction materials with scalable preparation for Z-scheme mimicking;
- Design multifunctional photocatalysts for simultaneous CO₂ reduction and H₂O oxidation;
- Optimise solar photoreactors (light harvesting, mass transfer, reactivity);
- Couple photo-assisted and non-photo-assisted catalytic processes for C-C bond formation.

Proposals should assess the efficiency, reduction of the steps and costs with respect to the overall process, as well as the advantages of the proposed technology in terms of social/environment impact with respect to conventional production of the same chemicals and/or fuels. The scalability and exploitability of the devices should be analysed. The validation of the technology should be carried out by a demonstration of a photo- or photo-electrochemical reactor/integrated device of the size of the existing photovoltaic cells.

In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation is particularly encouraged.

Activities should start at TRL 3 and achieve TRL 5 at the end of the project.

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

Expected Impact: Development of cost-efficient systems based on multifunctional photocatalytic system which should enable upscaling and process intensification, with:

- Increased efficiency of the system with sunlight to chemical energy conversion efficiency (to chemicals other than H₂) higher than 5%;
- Improved stability/robustness of the system under extended operational conditions, with loss of performances <5% in 1000h;
- Cost reduction/effectiveness of the system, including recycling if relevant and continuous product recovery, with cost of production of chemicals comparable to actual

route from fossil fuels, but with an improved energy efficiency and <50% CO₂ emissions (based on Life Cycle Assessment).

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

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

CE-NMBP-26-2018: Smart plastic materials with intrinsic recycling properties by design (RIA)

Specific Challenge: Developing of multifunctional materials based products with smart intrinsic recycling and/or sorting abilities that harmonise with circular economy principles will create a real paradigm shift in the market and a clear benefit for society. It will also help industry to better match the EU environmental targets at the same time as improving their competitiveness.

Scope: Proposals should cover one or more of the following types of materials design:

- Design of polymer material structures with intrinsic sorting/recycling abilities such as: Composite and reinforced composite materials, multilayers, mix of plastics, sequence controlled polymers, reinforced polymers, but also the design of polymer formulations with smart additives, which allow adequate sorting, separation and recycling;
- Design of smart polymer materials for recycling/re-processing: The development of resins of thermoplastic nature, but also the development of new smart polymers (e.g. sequence controlled polymers, vitrimers, nano-structured block co-polymers, self-sorting polymers, click chemistry based materials) and others;
- Further developments of separation and recycling technologies: New separation technologies like the removal of organics, contaminants, but also further developments or novel chemical recycling and/or controlled bio-degradation technologies, which are today not cost effective enough or still need to be validated.

Proposals should demonstrate the actual circular use of such materials through re-processing of recycled products and the evaluation of properties of such re-processed products in an industrial environment.

Proposals should include the full Life Cycle Assessment (LCA) of the material production and life-cycle.

Activities should start at TRL 3 and achieve TRL 5 at the end of the project.

The Commission considers that proposals requesting a contribution from the EU between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately.

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

Expected Impact: The development of novel plastic materials would aid in:

- Meeting the EU's circular economy and environmental targets while demonstrating a clear benefit, i.e. more efficient or economic than the state of the art in order to enable market uptake in the short to medium term;
- Create new technologies and business opportunities for the recycling industry across Europe, especially in the area of composites and plastics where the challenge is high;
- Demonstrate a potential reduction in landfill waste volume by > 50%;
- Reduction of the carbon footprint of the corresponding products by > 30% (based on a full Life Cycle Assessment).

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

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

3.3. CLEAN ENERGY THROUGH INNOVATIVE MATERIALS

To deliver on the Paris agreement (COP21), the updated Europe 2020 targets and the Energy Union policies including the SET-Plan, significant reductions in CO₂ and greenhouse gas emissions are needed in a short time span. Significant reductions will be obtained by electrifying the road transport sector and integrating sustainable energy sources, like wind energy and photovoltaics, in the electricity grid. Both areas need specific energy production technologies, as well as energy storage solutions, based on innovative advanced materials and nanotechnologies, in line with the Communication on Accelerating Clean Energy Innovation.¹⁹

Materials for energy storage: Electric vehicles (EVs) are a solution for a rapid decarbonisation of the transport sector and for solving the problem of polluted city centres. Current EVs however still use heavy and costly batteries, and fast charging is another problem. Significant effort is needed in this area to improve the battery technology and in particular specific battery materials. Materials for energy storage are also needed beyond the transport sector: some industrial and economic sectors will face significant change coming from the more systematic use of sustainable energy production and from digitisation. All this will be based on a more distributed energy supply and decentralised storage. The respective energy storage challenges have to be solved in order to facilitate the transformation towards the use of non-fossil based energy sources. Europe has to search for better performance, and force the development of more price competitive storage solutions, including, where relevant,

¹⁹ COM(2016) 763 final

use of energy magnetic materials. This can be achieved by the development of new improved battery materials and chemistries.

Materials for sustainable energy production: Sustainable energy is offering one of the highest potential to reach climate goals and reduce dependence from fossil fuels. The deployment of respective sustainable energy technology offers thus a possibility to obtain a cleaner air and environment, and at the same time will create new markets and a potential for economic increase. The sustainable energy technologies however are competing with more traditional ones and a key element for their use is energy production cost. European market leadership has to be regained and one way is to invest in advanced materials and nanotechnologies for being able to offer technologically advanced solutions at adequate and competitive cost, with strongly improved performances compared to the available commercial low cost solutions.

Proposals are invited against the following topic(s):

LC-NMBP-27-2019: Strengthening EU materials technologies for non-automotive battery storage (RIA)

Specific Challenge: Driven by the needs for a cleaner environment and the transition towards a low-carbon competitive economy, deployment of solar and wind energy increases. The respective energy supply will be much more decentralised, resulting in enhanced needs for deployment of large to small scale industrial electricity grids, and in an increased share of electricity produced in private households. Also industry 4.0 with its new less centralised production methods will need a more delocalised energy supply. And more and more small robotised devices dedicated for industry or private households appear on the market that need energy. For all these new technologies and markets, the respective energy storage challenges have to be solved. This can be done by specific batteries, and Europe has to use its knowledge and competitive advantage in advanced materials and nanotechnologies to strengthen the related battery storage value chain and prepare European industry to be competitive in these new markets.

Scope: Proposals should cover the following:

- Develop more price competitive, better performant and highly safe battery storage solutions, with improved lifetime by lowering the cost and capital expenditure through development of less expensive and more performant materials (e.g. novel advanced electrode materials, including nanostructured and 2D materials and electrolytes), chemistries, packaging and cell design and battery component production processes. The progress should make use of the advantages of the existing EU value chain. Synergies with the electrified vehicle battery production sector could be explored;
- Duly consider safety aspects depending on the application, e.g. by consideration of polymer or solid electrolytes for solid-state batteries;

- Sustainable materials and environmental friendly production processes, possible second life applications, and materials that are easily available in Europe, in order to avoid market dependence. Recycling should be inherently possible on a large scale, permitting overall costs that will not hamper market acceptance;
- The new solution and respective output targets (such as cyclability, reliability, usage and lifetime) should be demonstrated and tested where possible in a relevant industrial environment; and developments in the European regulatory framework as well as the impact on industrial standards should be considered;
- To allow comparison with currently existing solutions, a full life cycle assessment covering environmental and economic aspects of the proposed alternatives should be included.

Activities should start at TRL 4 and achieve TRL 6 at the end of the project.

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

Expected Impact: The performance levels of the proposed solution(s) should be in line with those specified in the relevant parts of the SET-Plan.²⁰ The new developments should respond to all of the following requirements:

- Enhanced market success of the new more competitive and sustainable technologies, obtained by strong reduction of the cost for stationary applications, below 0.05 €/kWh/cycle; the reduction of cost should be at least 20% in all other cases;
- More competitive products due to increased life time, with a cycle life for stationary energy storage applications that should be clearly beyond the current standards, and reach at least 5000 cycles at 80% Depth of Discharge; and it should be significantly improved with respect to the state-of-the-art in all other cases;
- More sustainable products, with a recycling efficiency beyond currently legal obligations, as established in the Batteries Directive,²¹ ideally beyond 50%, and a demonstrated economic viability.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

²⁰ Action 7 of the SET Plan on "Batteries for e-mobility and stationary storage", see: https://setis.ec.europa.eu/system/files/integrated_set-plan/action7_issues_paper.pdf

²¹ Batteries Directive, EC/2006/66, <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02006L0066-20131230&qid=1420631813560&from=EN>

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

LC-NMBP-28-2020: Advanced materials for innovative multilayers for durable photovoltaics (IA)

LC-NMBP-29-2019: Materials for non-battery based energy storage (RIA)

Specific Challenge: Sustainable energy production can only work well when the specific different energy storage challenges are solved. So, solar panels and wind generators do not deliver energy when no sun is shining or no wind is blowing. Batteries may not be the best solution to face all energy storage needs, due to cost, safety and environmental issues. Other technologies have to be developed that can respond to these needs, and their readiness for market deployment has to be shown. Specific materials for these technologies have to be developed. Price competitiveness and environmental aspects have to be considered, as well as economic viability.

Scope: Non battery-based storage technologies, such as Power to Gas, Power to chemicals and power to liquids (based e.g. on ethanol, methanol or ammoniac), or compressed air energy storage CAES, can be suitable solutions for different energy storage needs.

These new technologies will need new or considerably improved materials, with increased performance and reduced total costs with respect to currently used ones. Cost reductions may result e.g. from new materials, in combination with new design/architecture (when applicable or suitable) or reduced service and maintenance needs.

With respect to power to gas and power to fuels or chemicals, innovation will result for instance from the improvement of electrolyzers. Advanced materials solutions may be high-capacity, durable proton exchange membranes and solid oxide electrolysis cell (SOEC) electrolyzers for hydrogen production; or cost efficient materials for tanks for hydrogen storage.

Most technologies are still in an experimental phase and have to be prepared for industrial deployment. Price competitiveness and environmental aspects have to be analysed.

The materials should show its economic viability, also considering the cost related to the necessary overall infrastructure.

Special attention should be given to sustainable materials, the circular economy and eventual second life applications, and to materials that are easily available in Europe, in order to avoid market dependence e.g. of critical raw materials. Recycling should be inherently possible on large scale, permitting overall costs that will not hamper market acceptance.

Materials for thermal storage and storage for hydropower are excluded from this call, as well as the development of fuel cells and supercapacitors.

Activities should start at TRL 3 and achieve TRL 5 at the end of the project.

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

Expected Impact: The performance levels of the proposed solution(s) should be in line with those specified in the relevant parts of the SET-Plan.²²

- Improving technical and economic competitiveness of EU stationary storage production suitable to store large amount of energy;
- By enabling low-carbon energy production, help to reach climate goals and CO₂ reduction levels as per international agreements as EU 2020 and 2050 targets and COP21; improving indirectly health of EU society;
- Significant improvements in the levelised costs of energy while maintaining or improving other properties of the storage solution.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

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

LC-NMBP-30-2018: Materials for future highly performant electrified vehicle batteries (RIA)

Specific Challenge: Batteries are still a hampering factor for a clear market acceptance of Electric Vehicles as they are still not able to deliver the required performance considering driving range, fast charging capacity and safety for a reasonable price. This is mainly due to the limitations of the current Li-ion cell technologies especially in terms of safety – due to the use of liquid, flammable electrolytes – and energy density, which approaches their fundamental limits. New solutions have to be developed that will resolve the above mentioned cost and performance constraints of Electric Vehicle (EV) and Plug-in Hybrid Electric Vehicles (PHEV) batteries, for a real breakthrough in the deployment and market share of these vehicles. New successful technologies will strengthen the whole battery cell related value chain and will help to re-establish European competitiveness also in battery cell production.

Scope: New or significantly improved materials and/or chemistries have to be developed to optimise the battery cell and its components, with features clearly beyond the state-of-the-art technologies that are currently used in commercial cells for automotive applications. These could be based, for example, on high voltage, Nickel- or Lithium-rich cathode materials; Lithium-Silicon, Lithium-Sulphur, Lithium-metal, or metal-air systems; new polymer or

²² https://setis.ec.europa.eu/system/files/Towards%20an%20Integrated%20Roadmap_0.pdf

ceramic electrolytes, or any other technology that would be able to generate the required impact (including the so called "advanced Lithium-ion" and "post-Lithium-ion" technologies).

Proposals should in particular investigate phenomena and problems at the interfaces of the components of the battery cell electrode systems that are often not well understood. They should also solve the safety issues encountered by the current Li-ion chemistries, including thermal runaway (e.g. through the use of solid-state electrolytes instead of flammable, liquid electrolytes). Knowledge on the ageing processes in order to know the cell parameters for eventual second life use should be as well gained.

Production aspects should be considered during the prototyping phase. Simulation and modelling for the development phase as well as life cycle assessment, and specially-tailored test procedures for validating the new technology should be included. Scaling-up for production will not be covered under the topic.

Special attention should be given to sustainable materials, the circular economy and eventual second life applications, and as far as possible to materials that are easily available in Europe, in order to avoid market dependence, e.g. of critical raw materials. Recycling should be inherently possible on large scale, thus enabling overall costs that will not hamper market acceptance.

The following aspects should also be considered: prepare for developments in European standardisation and regulation; gain technological and market advantage of a new competitive European technology. Synergies with the stationary battery production sector could be explored.

Activities should start at TRL 3 and achieve TRL 5 at the end of the project.

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

Expected Impact: The performance levels of the proposed solution(s) should be in line with those specified in the relevant parts of the SET-Plan.²³

- Reduction of greenhouse gases and air pollutants through the enhanced deployment of electric vehicles enabled by high performing, cost efficient and “user friendly” batteries;
- Development of a new, market competitive European battery cell chemistry and materials technology that will allow reduction of dependence from foreign supply, and build the knowledge base for the creation of a competitive European automotive cell production;

²³ Action 7 of the SET Plan on "Batteries for e-mobility and stationary storage", see: https://setis.ec.europa.eu/system/files/integrated_set-plan/action7_issues_paper.pdf

- Strong improvement on the technical performance of EV batteries. Gravimetric energy density at cell level is expected to reach 400-450 Wh/kg by 2030, while power density should be beyond 700 W/kg;
- Significant reduction of recharging times compared to current technologies, e.g. by enabling very high charging currents or other design-based solutions, avoiding at the same time battery materials degradation and losses in the longevity as it is currently the case after fast charging;
- Cyclability should be suitable for automotive long term application, and ideally reach 5000 cycles for second life-use batteries by 2030;
- The new solution is expected to be market competitive in 5-10 years and, by 2030, its costs should be below 75 €/kWh at battery pack level;
- Recyclability should be guaranteed with recycling efficiency beyond 50% reaching economic viability (that has to be demonstrated in the project).

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

This work contributes to the running EC-EGVIA agreement and to EGVI related activities of the “Transport Challenges”.

Type of Action: Research and Innovation action

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

LC-NMBP-31-2020: Materials for off shore energy (IA)

LC-NMBP-32-2019: Smart materials, systems and structures for energy harvesting (RIA)

Specific Challenge: The realisation of the European goals of increased energy efficiency, reduction in CO₂ emissions and the circular economy require novel ways of using, harvesting and storing energy. Smart materials and material systems/structures have already demonstrated the potential to reduce energy consumption as well as harvest, generate and store energy. However, implementation has been limited due to the materials' operational reliability as well as issues of recyclability and dependence on rare elements. In addition, cost concerns or lack of efficient manufacturing processes prohibit the wider implementation of such technologies. The next step is the implementation of these technologies in a wide range of commercial applications allowing the exploitation of the characteristics of smart materials. As the application of smart materials and developments in sensor technologies are dominated by SMEs in the EU, extending their innovation potential for smart materials applications is important for maintaining their market position and has a significant impact in improving EU competitiveness.

Scope: Proposals should cover the following:

- The development of new materials and material combinations with energy harvesting and storage capabilities (e.g. lead-free piezoelectric based devices for energy generation and energy storing automotive structural components or magnetic materials systems);
- Clearly demonstrate reduction of around 25% in overall materials and processing costs relative to the state of the art and how the implementation of those technologies would be achieved;
- Demonstrate the recyclability and reliability of new smart materials, as well as a reduction in the dependence on rare elements;
- Integrate sensor technologies (e.g. MEMS based sensor concepts) and the potential linkage with the Internet of Things (IoT);
- Assess market perspectives and patents as well as standardisation;

Activities are expected to start at TRL 3 and achieve TRL 5 at the end of the project.

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

Expected Impact:

- New materials facilitating technology systems for sustainable energy supply allowing a reduction of greenhouse gas emissions by at least 40% based on lifecycle analysis;
- Reduction of hazardous waste by 50% through efficient manufacturing practices and/or materials selection;
- Development of new technologies, applications and services providing direct support for the wider implementation of the DSM and IoT, (e.g. enable the development of wireless sensor networks, or, deployment of energy harvesting powered sensor nodes to monitor remote locations);

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

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

3.4. CULTURAL HERITAGE

Proposals are invited against the following topic(s):

NMBP-33-2018: Innovative and affordable solutions for the preventive conservation of cultural heritage (IA)

Specific Challenge: Preventive conservation (PC) prevents damage or reduces the potential for damage of cultural heritage (CH) artefacts. In the long term, it is more cost efficient than remedial conservation, which can be orders of magnitude more expensive than appropriate PC measures. In particular small and medium sized museums struggle to fulfil international recommendations for PC and to implement necessary technologies, e.g. for environmental control and monitoring, mainly because of lack of budget and/or expertise.

Scope: The proposed solution should include the following three main elements:

- One or more innovative low-cost tools/solution for PC of movable CH artefacts (in storage and/or on display) should be developed;
- The solution(s) should include monitoring of individual or groups of similar artefact types to allow continuous remote data acquisition for key-parameters and/or conservation status of artefacts;
- Multi-scale modelling (i.e. linking different types of models such as electronic, atomistic, etc.) should be an integral part of the activities and should at least allow predictions about the CH degradation based on the monitoring data. Building on on-going efforts is encouraged.

The majority of resources should be spent on the development of actual tools/solutions rather than new models. Proposals should present clearly measurable objectives. Convergent contributions from SSH disciplines should be considered at least for the CH targeting criteria. Standardisation and/or the production of (certified) reference tools and/or pre-normative research should be an integral part of the proposal.

In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation is strongly encouraged, in particular with relevant international organisations (e.g. ICOM).

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities are expected to start at TRL 5 and achieve TRL 7 at the end of the project.

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

Expected Impact:

- Practical and affordable tools/solutions in terms of cost and/or complexity of operation. A cost reduction of at least 50% is expected as compared to existing solutions;
- Improved compliance with PC recommendations, without a negative impact on the budget presently available for PC, in particular for end-users such as small and medium sized museums;
- Improved CH degradation predictions and modelling-based decision-making with regard to the choice between preventive and remedial conservation measures;
- Clear prospect for quantified socio-economic gains from the proposed solutions (e.g. the creation of new services) also beyond their application for CH;
- Effective market uptake across Europe of the proposed solutions within five years after the end of the project;
- Contribution to sustainable open repositories of simulation/experimental/measurement data;
- Contribution to an increased citizens' awareness of PC of tangible CH.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

3.5. ENERGY-EFFICIENT BUILDINGS (EEB)

To deliver on the Paris agreement (COP21), the updated Europe 2020 targets and the Energy Union policies including the SET-Plan, significant reductions in CO₂ and greenhouse gas emissions are needed in a short time span. The construction sector has a crucial impact on energy consumption and carbon emissions in the European Union: buildings account for 40% of the total energy consumption and are responsible for 36% of greenhouse gas emissions in Europe. The challenge in 2018-2020 is therefore to develop further, demonstrate and validate key breakthrough technologies for energy-efficient buildings and districts, in line with the Communication on Accelerating Clean Energy Innovation.²⁴ European added value will result from the impact, on decarbonising the EU building stock and developing affordable and integrated energy storage solutions. Implementation of the activities under EeB should comply with EU, national, regional and local regulations and legislation, in particular regarding health, safety and environmental impact.

Proposals are invited against the following topic(s):

²⁴ COM(2016) 763 final

LC-EEB-01-2019: Integration of energy smart materials in non-residential buildings (IA)

Specific Challenge: Europe is leader in the development of components for buildings retrofitting. Its leadership is based on the use of high-efficient insulation materials including concrete, steel, glass, composites, wood and hybrids, which should lead to achieving recyclable, nearly zero-energy building envelopes (roofs, façades) when applied to new buildings. However, these components do still not allow for the integration of smart energy storage and for an equal performance in existing buildings. This has proved to be very challenging, in terms of complexity, weight control and overall retrofitting costs. Therefore, work is required to advance the technology readiness level. Activities should include the demonstration of new hybrid-enabled prototypes for selected non-residential buildings.

Scope: The development of lightweight components based on high-efficiency insulation materials needs adding active energy management capabilities without increasing weight. Proposals should cover all of the following:

- development of lightweight components for the construction of building envelopes with integral means for combined active/passive management of energy transfer, i.e., for active insulation, heat diversion, storage and directional transfer;
- solutions capable for use in both new buildings and for retrofitting existing ones;
- solutions allowing for installation without modifying the structure of the building (or without overloading existing structures) and demonstrating a high replication and industrial potential;
- modelling of the materials and components as well as to the development of novel testing methodologies oriented towards assessing the long-term performance of the elements. This should include the estimation of durability and service life;
- reduced maintenance costs, possibility of use in a wide range of environmental conditions, favour renewable resources, respect of sustainability principles (International Reference Life Cycle Data System - ILCD Handbook), and the possibility of reuse at the end of service life.

This topic is likely to contribute to standardisation and certification activities.

Resources should be envisaged for clustering with other projects funded under the call, in order to facilitate research cohesion and inter-consortia cooperation.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 5 and achieve TRL 7 at the end of the project.

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

Expected Impact: When compared to state of the art, the newly developed solutions should bring:

- Improvement by at least 25% of the insulation properties at component level for a given weight, when in isolation (passive) mode;
- 10% improvement in energy-storage capability when in active mode(s);
- Water and air tightness should be at least 10% higher than existing solutions (when it is proposed a controllable solution);
- Cost increase of less than 15%, in order to allow market uptake across Europe and contribute to social affordability.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

LC-EEB-02-2018: Building information modelling adapted to efficient renovation (RIA)

Specific Challenge: The Building Information Modelling (BIM) tools developed so far are adapted mainly to new buildings (all types). In order to offer easy, practical, operational tools for all stakeholders, including constructing companies, designers, architects and service companies, we need to deploy attractive tool kits also for existing buildings. A particular important challenge will be to produce compatible tools that would allow collecting of data from existing buildings (e.g. geometric data) and exploit data from different sources. This will also contribute to more accurate knowledge of the existing building stock by providing methods and tools to generate data for existing buildings. Such BIM tools will be exploited first and foremost in existing residential buildings.

Scope: Proposals should develop advanced solutions, including all of the following:

- To harmonise and provide common data exchange formats regarding the components and equipment of a building (e.g. the type of materials and the Heating, Ventilation and Air Conditioning (HVAC) systems in relation to the most actual standards);
- The modelling of the building energy should include existing parameters, as well as the environmental and GIS data;

- Be flexible in coupling the overall BIM system with other additional types of models (e.g. buildings acoustics; including calculator for economic evaluation of various renovations scenarios);
- Be flexible to adapt to work planning, as-buildings documentation and procedures to process changes;
- Allow the development of applications to benefit from inputs of inhabitants;
- A close cooperation with standardisation bodies is required in order to validate the new BIM tools.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 4 and achieve TRL 6 at the end of the project.

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

Expected Impact: Proposals should achieve all of the following:

- A reduction of the renovation working time of at least 15-20% compared to current practices with the baseline defined in the proposal;
- Acceleration of the market uptake across Europe, by speeding-up industrial exploitation, in particular amongst constructing/ renovations companies with a target of 50% of their renovation business based on BIM;
- Creation of best practice examples for the construction retrofitting sector with benefits for the operators and associated stakeholders (architects, designers, planners, etc.).

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Research and Innovation action

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

LC-EEB-03-2019: New developments in plus energy houses (IA)

Specific Challenge: Energy Efficiency targets set at EU level by legislation are currently being reviewed. The related SET-Plan rolls out concrete steps how research and innovation could further reach these targets by 2025. However, the current practice to construct nearly zero-energy houses will be insufficient to reach the CO₂ emission reduction targets for 2050. Therefore, it is necessary to develop further the concept of "Plus Energy Houses", producing

more energy than they use. Buildings have long life cycles until they are replaced. Therefore, it is essential to speed up the development of the required technologies.

Scope: New designs, making use of already developed and validated materials and components and smarter control systems ready to treat vast amounts of data are needed. The surplus of energy should come from renewable sources (geothermal heat, photovoltaics, wind, etc.), obviously optimizing the dynamic character of the energy balance all along the year.

Each proposal should be expected to involve pioneer cities (demonstrations in a multi-storey apartment building situated in each of the 4 climatic zones in Europe). Such buildings should be properly managed and connected to the neighbourhood grid. Proposals should take the lead by leveraging funding with other energy efficiency schemes, including the private sector. Erecting buildings at such pioneer cities should not encounter regulatory problems. For this reason, the proposal will identify any bottlenecks in the existing regulations and standards concerned by the locations chosen.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 5 and achieve TRL 7 at the end of the project.

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

Expected Impact: Proposals should achieve all of the following:

- Similar costs as compared to the 2020 nearly zero-energy buildings as an incentive to erect energy-plus-houses;
- Increase of the share of plus-energy houses with the view of 10% market uptake by 2030;
- Contribute reducing of CO₂ emissions in the residential sector by 88% in 2050 compared to the 1990 levels;
- Improved indoor environment leading to higher rate of users' satisfaction based on their demand and behaviour.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

LC-EEB-04-2020: Industrialisation of building envelope for the renovation market (IA)

LC-EEB-05-2019-20: Integrated storage systems for residential buildings (IA)

Specific Challenge: Optimised storage solutions for thermal and electric energy are needed in order to better synchronise the overall supply and demand, at residential, district and urban level. Efficient management of the peak loads would reduce the overall operational costs of the installations.

The main challenge is to demonstrate integrated thermal storage systems. The current mature technologies for thermal storage are mostly based on water. In order to increase the storage density, it is needed to further develop other systems such as the Thermochemical materials. The next wave of developments needs to be tackled in order to propose attractive equipment with a significant increase in storage capacity efficiency. The combination of renewable energy with storage is key to support the next generation of very low or plus energy houses. Such storage equipment will be exploited first and mostly in the residential buildings (existing and new ones).

Scope: Proposals should develop advanced solutions including all of the following elements:

- Reach improved heat exchange in and between storage material and heat carrier as well as high performing storage reactor over time;
- With respect to the entire storage system, advanced energy management is needed, Not only regarding the building needs but also taking in account external conditions such as grid constraints and price signals;
- The overall system should be easy to maintain with low cost associated to this activity;
- The demonstration should include several prototypes operating in three different climatic conditions (with compactness as a crucial boundary condition).

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 5 and achieve TRL 7 at the end of the project.

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

Expected Impact:

- Demonstrate solutions that have a stable, reliable long term performance in multi-cyclic seasonal and use of at least 20 years;

- Deliver compact systems with the potential to fit in the limited space available in a single building in the existing housing stock or new buildings. The storage material volume per dwelling should not exceed 1 m³;
- Solutions should demonstrate a potential to reduce the net energy consumption of a building by at least 25% and have a return-on-investment period below 10 years;
- Use of high energy density storage materials allowing storage densities up to 10 times higher than water (based on overall system efficiency).

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

LC-EEB-06-2018-20: ICT enabled, sustainable and affordable residential building construction, design to end of life (IA 50%)

Specific Challenge: The poor energy performance features that buildings may exhibit can be due not only to the characteristics of the building materials used, but also to the use of traditional or unsuitable construction processes. Therefore, the building process needs to benefit from an increased level of industrialisation, including for instance lean construction and higher degree of prefabrication. This is especially true in the case of building retrofitting where the traditional construction methods are not able to plan in advance all the problems to be solved in the variety of renovation sites. Using ICT as an enabler in the building process and operation is a way to meet the challenges. ICT solutions need to incorporate the design, manufacturing, construction, material choice (including reusability, environmental performance and cost aspects), operation and end of life phases affecting the overall building lifecycle. The closer integration of ICT based-building construction tools into the manufacturing, construction and operation phases has a strong impact on the overall building lifecycle, and it will also help reducing the performance gap.

Scope: Existing generic software tools have limited flexibility and lack interoperability concerning models and design cultures. Vertically integrated life cycle design is still missing, mainly due to a fragmented design culture across the various disciplines. ICT tools should be provided for energy and environmental performance related design, analysis and decision-making in early planning phases for new buildings or renovation of buildings. Clear evidence of technical and economic viability should be provided by validating and demonstrating the proposed ICT-driven construction processes in either new or retrofitting projects. For existing buildings, significant effort will be required to first retrieve all relevant information, and to compile and structure it in a meaningful form to be used by new solutions.

Proposals should:

- Develop an advanced digitalised and industrialised construction and building process utilising smart combinations of materials/components;
- Assess the overall life cycle of construction, in order to deliver more efficient buildings in terms of sustainability and construction, maintenance and operation costs;
- Provide for fully integrated systems to be compact, exchangeable, and easy to commission and to operate and demonstrate business solutions for operating such building life-time ICT solutions.

Proposals should include Social Sciences and Humanities (SSH) elements regarding public perception and acceptance of advanced building life solutions at the level of the construction sector in Europe.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

Activities should start at TRL 5 and achieve TRL 7 at the end of the project.

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

As an exception from General Annex D, the funding rate for eligible costs in grants awarded under this topic will be differentiated: 100% of the eligible costs for beneficiaries and linked third parties that are non-profit legal entities; and 50% of the eligible costs for beneficiaries and linked third parties that are for profit legal entities.

Expected Impact: Proposals should achieve all of the following:

- Reduction of CO₂ with 15-20% for the total life-cycle compared to current situation shown through Life Cycle Assessment;
- Construction cost reductions of at least 15% compared to current situation;
- Buildings shortened construction time (reduced by at least 10-15% compared to current State of the art);
- Reduction of the gap between predicted and actual energy consumption;
- Improved indoor environment;
- Significantly improved integration of the value chain (design, procurement, manufacturing, construction, operation and maintenance);
- Contribution to new standards and regulations;

- Demonstration of large scale replicability potential.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Type of Action: Innovation action

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

Conditions for the Call - INDUSTRIAL SUSTAINABILITY

Opening date(s), deadline(s), indicative budget(s):²⁵

Topics (Type of Action)	Budgets (EUR million)			Deadlines
	2018	2019	2020	
Opening: 31 Oct 2017				
CE-SPIRE-02-2018 (IA) CE-SPIRE-03-2018 (IA) CE-SPIRE-10-2018 (IA)	97.50			22 Feb 2018
LC-EEB-02-2018 (RIA) LC-EEB-06-2018-20 (IA)	35.00			22 Feb 2018
CE-NMBP-24-2018 (RIA) CE-NMBP-26-2018 (RIA)	38.00			23 Jan 2018 (First Stage) 28 Jun 2018 (Second Stage)
LC-NMBP-30-2018 (RIA)	25.00			
NMBP-33-2018 (IA)	16.00			
Opening: 16 Oct 2018				
CE-SPIRE-04-2019 (IA) CE-SPIRE-05-2019 (IA)		65.80		21 Feb 2019
DT-SPIRE-06-2019 (IA)		32.90		

²⁵ The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

The Director-General responsible may delay the deadline(s) by up to two months.

All deadlines are at 17.00.00 Brussels local time.

The deadline(s) in 2019 and 2020 are indicative and subject to separate financing decisions for 2019 and 2020.

The budget amounts for the 2018 budget are subject to the availability of the appropriations provided for in the draft budget for 2018 after the adoption of the budget 2018 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2019 and 2020 budget are indicative and will be subject to separate financing decisions to cover the amounts to be allocated for 2019 and for 2020.

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LC-EEB-01-2019 (IA)		53.50		21 Feb 2019
LC-EEB-03-2019 (IA)				
LC-EEB-05-2019-20 (IA)				
CE-NMBP-25-2019 (RIA)		18.46		22 Jan 2019 (First Stage)
LC-NMBP-27-2019 (RIA)		65.10		03 Sep 2019 (Second Stage)
LC-NMBP-29-2019 (RIA)				
LC-NMBP-32-2019 (RIA)				
Opening: To be defined				
Focus area topic(s) for 2020			222.50	To be defined
Overall indicative budget	211.50	235.76	222.50	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

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

For two stage procedure:

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

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

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

All topics of this call	The threshold for the criteria Excellence and Impact will be 4. The overall threshold, applying to the sum of the three individual scores, will be 12.
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Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme. The following exceptions apply:

All topics of this call	<p>Under 3 (a)Proposals are first ranked in separate lists according to the topics against which they were submitted ('topic ranked lists'). When comparing ex aequo proposals from different topics, proposals having a higher position in their respective 'topic ranked list' will be considered to have a higher priority in the overall ranked list.</p> <p>Under 3 (b)For all topics and types of action, the prioritisation will be done first on the basis of the score for Impact, and then on that for Excellence.</p>
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The full evaluation procedure is described in the relevant [guide](#) published on the Participant Portal.

Grant Conditions:

CE-SPIRE-03-2018, CE-SPIRE-05-2019, LC-EEB-06-2018-20	As an exception from General Annex D, the funding rate for eligible costs in grants awarded under this topic will be differentiated: 100% of the eligible costs for beneficiaries and linked third parties that are non-profit legal entities; and 50% of the eligible costs for beneficiaries and linked third parties that are for profit legal entities.
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Consortium agreement:

All topics of this call	Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.
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SME instrument & Fast-Track-to-Innovation

The respective calls for the EIC-SME instrument call (H2020-EIC-SMEInst-2018-2020) and EIC-Fast-Track-to-Innovation (H2020-EIC-FTI-2018-2020) are found under the Horizon 2020 Work Programme Part – ***Towards the next EU Framework Programme for Research and Innovation: European Innovation Council (EIC) Pilot*** (part 17 of this work programme).

Other actions²⁶

1. External Expertise

This action will support the use of appointed independent experts for the monitoring of actions (grant agreements, grant decisions, procurements, financial instruments).

Type of Action: Expert Contracts

Indicative timetable: in 2018 and 2019

Indicative budget: EUR 0.95 million from the 2018 budget and EUR 1.21 million from the 2019 budget

2. Review of the Research and Innovation Approach to key enabling and emerging technologies (Continuation)

The identification of Key Enabling Technologies (KETs) has been a useful tool for policy and programming in the run-up and implementation of Horizon 2020, including notably the LEIT NMBP part. In 2017 an high level expert group was set up to analyse the implementation of current policy and advise the Commission on how an updated approach to key enabling technologies could feed into the design and implementation of future research and innovation programmes and activities. This group will continue its work in the first half of 2018.

The activities carried out by the group will be essential to the development and monitoring of the Union policy on Research, technological development and demonstration.

The highly qualified, specialised, independent experts were selected on the basis of objective criteria, following a call for applications published in accordance with Article 10 of Decision C(2016)3301.

In view of these requirements, these experts, who will be appointed in a personal capacity (i.e. "Type A" members), are entitled to a payment of EUR 450 in the form of a daily unit cost for each full working day spent assisting the Commission in terms of article 21 of Decision C(2016)3301. This amount is considered to be proportionate to the specific tasks to be assigned to the experts, including the number of meetings to be attended and possible preparatory work.

Type of Action: Expert Contracts

Indicative timetable: First half of 2018

²⁶ The budget amounts for the 2018 budget are subject to the availability of the appropriations provided for in the draft budget for 2018 after the adoption of the budget 2018 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2019 and 2020 budget are indicative and will be subject to separate financing decisions to cover the amounts to be allocated for 2019 and for 2020.

Indicative budget: EUR 0.05 million from the 2018 budget

3. Presidency event (conference) in Romania: EuroNanoForum 2019²⁷

Events of a major strategic nature, which are focused and attract a broad spectrum of stakeholders are important in assessing past activities, identifying policy options and priorities, and planning future actions.

The European Commission will support the organisation of an event (conference) in the first half of 2019, in cooperation with the Romanian government, holding the EU Presidency of the European Union at the time.

The conference should cover an issue of direct relevance to the NMBP part of Horizon 2020, in particular nanotechnologies and advanced materials, and the innovation they bring to manufacturing in all industrial sectors.

It should enhance synergies between research and innovation initiatives launched by the Commission and by the Member States. The proposed content should be balanced, encompassing policy, technological, economic and social elements and points of view. The conference should be open to participants outside the EU. Outreach activities may be included, such as a press programme; activities dedicated to the wider public or schools are particularly encouraged.

To ensure impact, the focus and content of the conference should be well defined and clearly aligned with other Presidency events already undertaken or foreseen during the period 2016-2020, while reflecting the specific strengths and needs of Romania and its regional links.

The commitment of the national authorities to support the event, politically as well as financially, is a pre-requisite to submitting a proposal. Proposals should be supported by the competent Minister, evidenced in a letter included in the proposal. In order to ensure high political and strategic relevance, the active involvement of the competent national authorities will be assessed in the evaluation.

In agreement with the Commission services, projects should ensure appropriate flexibility, so as to respond to rapidly changing policy scenarios.

The event is expected to result in: improved visibility of the nanotechnologies and advanced materials areas in NMBP; identification of policy options and priorities through a review and assessment of developments; sharing of information and comparison of points of views; and efficient networking of various stakeholders and support to their activities, e.g. industry, small and medium sized enterprises, businesses, investors, local authorities, non-governmental organisations, trade unions, etc..

²⁷ This grant will be awarded without call for proposals in line with Article 190(1)(e) of the Rules of applications of Regulation (EU, Euratom) 966/2012, Regulation No 1268/2012 and Article 11(2) of the Rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)", Regulation (EU) No 1290/2013.

Legal entities:

National Institute for Research and Development in Microtechnologies – IMT Bucharest,
Strada Erou Iancu Nicolae 126A, Voluntari 077190, Romania

Type of Action: Grant to identified beneficiary - Coordination and support actions

Indicative timetable: first semester of 2019

Indicative budget: EUR 0.10 million from the 2018 budget

4. Presidency event (conference) in Finland: Sustainable Smart Manufacturing²⁸

Events of a major strategic nature, which are focused and attract a broad spectrum of stakeholders are important in assessing past activities, identifying policy options and priorities, and planning future actions.

The European Commission will support the organisation of an event (conference) in the second half of 2019, in cooperation with the Finnish government, holding the EU Presidency of the European Union at the time.

The conference should cover an issue of direct relevance to the NMBP part of Horizon 2020, namely reindustrialising Europe and the transformation towards a digitised, sustainable and clean European industry.

It should enhance synergies between research and innovation initiatives launched by the Commission and by the Member States. The proposed content should be balanced, encompassing policy, technological, economic and social elements and points of view. The conference should be open to participants outside the EU. Outreach activities may be included, such as a press programme; activities dedicated to the wider public or schools are particularly encouraged.

To ensure impact, the focus and content of the conference should be well defined and clearly aligned with other Presidency events already undertaken or foreseen during the period 2016-2020.

The commitment of the national authorities to support the event, politically as well as financially, is a pre-requisite to submitting a proposal. Proposals should be supported by the competent Minister, evidenced in a letter included in the proposal. In order to ensure high political and strategic relevance, the active involvement of the competent national authorities will be assessed in the evaluation.

In agreement with the Commission services, projects should ensure appropriate flexibility, so as to respond to rapidly changing policy scenarios.

²⁸ This grant will be awarded without call for proposals in line with Article 190(1)(e) of the Rules of applications of Regulation (EU, Euratom) 966/2012, Regulation No 1268/2012 and Article 11(2) of the Rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)", Regulation (EU) No 1290/2013.

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The event is expected to result in: improved visibility of the manufacturing part in NMBP; identification of policy options and priorities via review and assessment of developments, and sharing of information and comparison of points of views; and efficient networking of various stakeholders and support to their activities, e.g. industry, small and medium sized enterprises, businesses, investors, local authorities, non-governmental organisations, trade unions, etc..

Legal entities:

Ministry of Economic Affairs and Employment, P.O. Box 32, FI-00023 Government, Finland

Type of Action: Grant to identified beneficiary - Coordination and support actions

Indicative timetable: second semester of 2019

Indicative budget: EUR 0.10 million from the 2018 budget

Calls and other actions for 2020²⁹

²⁹ The budget amounts for the 2020 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2020.

Call - FOUNDATIONS FOR TOMORROW'S INDUSTRY (continued in 2020)

H2020-NMBP-TO-IND-2020

The purpose of this call is to lay the foundations for tomorrow's industry in Europe, and to create jobs and growth through an innovation ecosystem for the design, development, testing, and upscaling of advanced materials and nanotechnologies. This should enable a vast array of applications and facilitate innovators to bring their disruptive ideas to the market. Success will be seen in an effective eco-system allowing innovators to overcome the technological and regulatory barriers.

Indicative topics:

DT-NMBP-04-2020: Open Innovation Test Beds for bio-based nano-materials and solutions (IA)

DT-NMBP-05-2020: Open Innovation Test Beds for functional materials for building envelopes (IA)

DT-NMBP-06-2020: Open Innovation Test Beds for nano-pharmaceuticals production (IA)

DT-NMBP-11-2020: Open Innovation Test Beds for Materials Modelling (IA)

NMBP-16-2020: Safe by design, from science to regulation: behaviour of multi-component nanomaterials (RIA)

NMBP-17-2020: Regulatory science for medical technology products (RIA)

Call - TRANSFORMING EUROPEAN INDUSTRY (continued in 2020)

H2020-NMBP-TR-IND-2020

The purpose of this call is to transform European industry through the integration of digitisation and other enabling technologies and achieve global industrial leadership. Success will be seen in global industrial leadership, notably in manufacturing, and in opportunities for re-industrialisation.

Indicative topics:

DT-FOF-07-2020: Reliable and accurate assembly of micro parts (RIA)

DT-FOF-09-2020: Holistic energy-efficient factory management (IA)

DT-FOF-10-2020: Pilot lines for large-part high-precision manufacturing (IA 50%)

DT-FOF-11-2020: Quality control in smart manufacturing (IA)

BIOTEC-06-2020: Reprogrammed microorganisms for biological sensors (IA)

BIOTEC-07-2020: Multi-omics for the optimisation of genotype-phenotype associations (RIA)

NMBP-21-2020: Custom-made biological scaffolds for specific tissue regeneration and repair (RIA)

DT-NMBP-23-2020: Next generation organ-on-chip (RIA)

Call - INDUSTRIAL SUSTAINABILITY (continued in 2020)

H2020-NMBP-ST-IND-2020

The purpose of this call is to further strengthen the global leadership of Europe's industry in environmental sustainability, through a combination of mature and disruptive technologies. Success will be seen in making measurable contributions to identified sustainable development goals.

Indicative topics:

CE-SPIRE-01-2020: Industrial symbiosis (IA)

CE-SPIRE-07-2020: Recovery of industrial water, thermal energy and substances contained therein (IA)

CE-SPIRE-08-2020: Improved Industrial Processing using novel high-temperature resistant materials (RIA)

CE-SPIRE-09-2020: Making the most of mineral waste, by-products and recycled material as feed for high volume production (IA)

LC-NMBP-28-2020: Advanced materials for innovative multilayers for durable photovoltaics (IA)

LC-NMBP-31-2020: Materials for off shore energy (IA)

LC-EEB-04-2020: Industrialisation of building envelope for the renovation market (IA)

LC-EEB-05-2019-20: Integrated storage systems for residential buildings (IA)

LC-EEB-06-2018-20: ICT enabled, sustainable and affordable residential building construction, design to end of life (IA 50%)

Budget³⁰

	Budget line(s)	2018 Budget (EUR million)	2019 Budget (EUR million)	2020 Budget (EUR million)
Calls				
H2020-NMBP-TO-IND-2018-2020		149.00	119.60	104.60
	<i>from 08.020201</i>	<i>149.00</i>	<i>119.60</i>	<i>104.60</i>
H2020-NMBP-TR-IND-2018-2020		162.00	178.00 ³¹	122.00
	<i>from 08.020201</i>	<i>162.00</i>	<i>178.00</i>	<i>122.00</i>
H2020-NMBP-ST-IND-2018-2020		211.50	235.76	222.50
	<i>from 08.020201</i>	<i>211.50</i>	<i>235.76</i>	<i>222.50</i>
H2020-NMBP-TO-IND-2020				28.00
	<i>from 08.020201</i>			<i>28.00</i>
H2020-NMBP-TR-IND-2020				79.40
	<i>from 08.020201</i>			<i>79.40</i>
H2020-NMBP-ST-IND-2020				
Contribution from this part to call H2020-EIC-FTI-2018-2020 under Part 17 of the work programme		10.10	10.10	10.10
	<i>from 08.020201</i>	<i>10.10</i>	<i>10.10</i>	<i>10.10</i>

³⁰ The budget figures given in this table are rounded to two decimal places.

The budget amounts for the 2018 budget are subject to the availability of the appropriations provided for in the draft budget for 2018 after the adoption of the budget 2018 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2019 and 2020 budget are indicative and will be subject to separate financing decisions to cover the amounts to be allocated for 2019 and for 2020.

³¹ To which EUR 10.00 million from the 'Information and Communication Technologies' WP part will be added making a total of EUR 188.00 million for this call.

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Other actions				
Expert Contracts		1.00	1.21	
	<i>from 08.020201</i>	<i>1.00</i>	<i>1.21</i>	
Grant to Identified beneficiary		0.20		
	<i>from 08.020201</i>	<i>0.20</i>		
Contribution from this part to Prize under Part 17 of the work programme				5.00
	<i>from 08.020201</i>			<i>5.00</i>
Estimated total budget		533.80	544.67	571.60