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# Future and Emerging Technologies

### FETPROACT-01-2018: FET Proactive: emerging paradigms and communities[[1]](#footnote-1)

Specific Challenge: To explore and consolidate a new technological direction in order to put it firmly on the map as a viable **paradigm for future technology**. To foster the interdisciplinary communities that are able to drive this forward, extending from the participating consortia to a wider European pool of expertise. To stimulate the emergence of a European innovation eco-system around a new technological paradigm, well beyond the world of research alone.

Scope: proposals are sought for cutting-edge **high-risk / high-reward research and innovation projects** that aim to demonstrate a new technological paradigm within the scope of one of the following sub-topics:

**a. Artificial organs, tissues, cells and sub-cellular structures.** Merging the growing understanding of genome, proteome, metabolome and cell behaviour with strategies for the engineering and use of biological and hybrid functional constructs is the core of this initiative. Proposals should build on recent advances in integrative biology (including modelling and simulation) and bio-engineering for engineering biological, artificial or hybrid sub-cellular systems (e.g., synapses, organelles, vesicles), highly specific cell assemblies (including microbial) and proper differentiation, tissues, organs or multi-organ systems. Examples of long-term research targets include synthetic cell building, cell assembly, and organ reproduction, replacement, control or repair of vital organ functions (e.g., following ageing, trauma or disease), their use in the development of personalised treatment, drugs or vaccines, and high-throughput organ- and body-on-chip technologies.

**b. Time.** This initiative seeks new technological possibilities inspired by notions of time, not seen as a given and singular background against which things unfold, but rather as a resource that can be experienced and used in different ways. Highly interdisciplinary research could address, for instance, technologies for subjective time awareness (and its neural basis) and distortion (e.g., contextual, emotional, pathological); for studying the role of time in processes like aging, healing, learning or evolution and how this can be influenced (e.g., stimulation) or changed in different 'materialities' (combining insights from biological or computational evolution, for instance); or modeling to understand and better anticipate non-linear temporality in complex systems (such as in economies, societies, climate ...). Technologies in, for instance, extreme electronics/photonics, data-streams analytics, time aware artificial intelligence, virtual and augmented reality, bio-engineering or neuroprosthetics could demonstrate new ways to represent, modulate, duplicate or differently experience and use time, thus altering our relationship with time (at individual and collective but differentiated level – e.g., according to gender or culture) and with impacts on, for instance, quality of life, therapy, learning, productivity, social and environmental awareness or the better understanding and management of natural hazards.

**c. Living technologies.** This initiative seeks to build on the emerging understanding from evolutionary biology, ethology, micro-, plant- and animal biology of essential features of living systems such as physical autonomy, growth, interaction and enaction, adaptation and evolution, among others. The aim is to create new functional biological, technological or hybrid artefacts, with similar capabilities of purposeful stability and change. This can also lead to hybrid materials and systems with programmable features of shape, structure, functionality and evolvability (including for their use in bio-robotics or bio-engineering), potentially constructed from naturally existing complexes, through synthetic biology, systems biology and /or chemical biology. New insights into the multi-level mathematics and complexity of living systems or the boundaries/characteristics of life may also emerge from this. Work on ethical implications should be included.

**d. Socially interactive technologies.** There is a growing understanding of the changes at cognitive, neural and physiological levels from group interactions in realistic settings, from pairs to large groups and crowds. Based on this, this initiative seeks new technologies for deeper social interaction involving, for instance, context, culture, emotion, and factors of embodiment and cognition. Realistic and larger contexts require new experimental tools and paradigms, combining social sciences and humanities with neuroscience, engineering and computing in new ways. This will lead to new socially interactive media with radical improvement for building trust and understanding, social integration, engagement, collaboration, learning, creativity, entertainment, education and wellbeing, among others. Work on ethical implications and gender should be included.

**e. Disruptive micro-energy and storage technologies**. This initiative seeks radically new approaches to energy for embedded, personal or local use (including bio-mimicking, the use of soft or intelligent materials to generate, capture or store energy or the development of new types of batteries). Proposals could target in particular the lower end (i.e., micro-energy or nano-scale energy transfer, dissipation and conversion) and/or new technologies for optimal local (close to where-needed) energy storage/release and their smart integration within hybrid/distributed energy systems. Proposals should also address aspects of sustainability and environmental impact.

**f. Topological matter**, strongly based on topology and quantum physics, is a rapidly emerging area that after an initial focus on insulators now touches the whole range of material properties, providing advances in spintronics, photonics, plasmas, mechanics, superconductivity, elasticity, acoustics and their combinations, among others. Here concept development together with design, realisation and testing of topological devices are called for to unleash the promise of topological matter beyond the pure physics and mathematics aspects. The much expected robustness, wide spectral range and topologically-protected spin- and transport properties call for an engineering approach to apply the multi-physics of wave-matter interactions to novel, potentially lossless communication components and circuits. Challenges to be addressed include compact designs and fabrication technologies, setting figures of merit and benchmarks relevant to functions.

FET Proactive projects shall establish a solid baseline of knowledge and skills and assemble the interdisciplinary communities around them. They shall further foster the emergence of a broader innovation ecosystem and create a fertile ground for future take-up of its new technological paradigm (e.g., public engagement, informal education, policy debate).

The Commission considers that proposals requesting a contribution from the EU of EUR 4 to 7 million (but up to EUR 5 million for proposals on the sub-topics of 'Time' and 'Topological matter') and with a duration of up to 5 years would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals of different size and duration.

This topic allows for the provision of financial support to third parties established in an EU member state or country associated with Horizon 2020 in line with the conditions set out in General Annex K, either to enhance impacts through punctual small scale experimentation and use of project results by third parties, or to award a prize following a contest organised by the beneficiaries.

Expected Impact:

1. Scientific and technological contributions to the foundation and consolidation of a radically new future technology.
2. Potential for future returns in terms of societal or economic innovation or market creation.
3. Spreading excellence and building leading innovation capacity across Europe by involvement of key actors that can make a difference in the future, for example excellent young, researchers, ambitious high-tech SMEs or first-time participants to FET under Horizon 2020[[2]](#footnote-2).
4. Build-up of a goal oriented interdisciplinary community (within and beyond the consortium).
5. Emergence of an innovation ecosystem around a future technology in the theme addressed from outreach to and partnership with high potential actors in research and innovation, and from wider stakeholder/public engagement, with due consideration of aspects such as education, gender differences and long-term societal, ethical and legal implications.

Type of Action: Research and Innovation action

### FETHPC-01-2018: International Cooperation on HPC

Specific Challenge: The aim is to develop strategic partnership in HPC with Brazil and Mexico that enables advancing the work on HPC applications in domains of common interest. Brazilian and Mexican partners will not be funded by the EU and they are expected to participate in the project with their own funding.

Scope: a) Cooperation with Mexico: in the frame of the Bilateral Agreement on Science and Technology between the European Union and the United States of Mexico[[3]](#footnote-3), collaboration for the development of state-of-the-art HPC applications (codes, algorithms, software tools, etc.) in domains of common interest such as energy (including oil, renewables, wind, etc.), life sciences, earth sciences, climate change and air pollution, and natural disasters, among others.

b) Cooperation with Brazil: developing state-of-the-art HPC applications in domains of common interest, such as in eHealth and drug design (e.g., related to diseases such as Zika and Dengue) or energy (e.g., renewables or management of natural resources). Proposals should put emphasis on application development towards exascale performance, develop codes, algorithms, other software tools, big data analytics, and hardware where appropriate. Proposals should ensure access to and using relevant big data suites as needed.

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

Expected Impact:

1. Improved international cooperation of EU-Mexico and EU-Brazil research and industrial communities on advanced HPC application development.
2. Improved sharing of information and expertise to solve common societal problems with the use of advanced computing.

Type of Action: Research and Innovation action

### FETHPC-02-2019: Extreme scale computing technologies, methods and algorithms for key applications and support to the HPC ecosystem

Specific Challenge: To develop world-class extreme scale, power-efficient and highly resilient High Performance Computing and data technologies, and to provide support for a sustainable exascale HPC ecosystem in Europe, enabling collaborations among the relevant stakeholders.

Scope: A. Research and Innovation Actions

Proposals should address the development of extreme scale computing technologies, methods and algorithms through **a strong co-design approach driven by ambitious extreme computing and data applications** and in close cooperation with the scientific disciplines and stakeholders concerned.

The designs of the technology should respond to critical demands of performance, energy efficiency, scale, resilience, programmability, dynamic workflows etc. Proposals should describe clear metrics and targets when addressing these demands, quantify progress with respect to the state-of-the-art, and address the research challenges with a holistic view and their impact on the whole computational process including data movement and storage.

Proposals should clearly articulate how research will have a significant impact in enabling ambitious extreme-scale scientific and engineering applications.

Where relevant, proposals should also provide a path towards long-term standardisation of the technologies (e.g. system software architecture, programming models, APIs, etc).

Proposals should clearly identify and address at least one of the following areas:

**a. System software and management**, addressing adaptive and dynamic scheduling; heterogeneity of system components; efficient data access, transfers and communication, novel execution models for emerging HPC and High Performance Data Analytics (HPDA) usages, etc.

**b. Programming environments,** reducing programming complexity and increasing scalability through advancements throughout the programming model and system software stack, and addressing code maintainability and functional portability across existing and future architectures and systems. Interoperability throughout the programming environment should be addressed.

**c. I/O and storage environment for data-centric extreme scale computing** addressing overall system performance predictability, feature-rich and flexible data access and storage system API’s, backup and retrieval of extreme volumes of data and systems operation in virtualised operating environment.

**d. Data-intensive supercomputing and emerging HPC use modes** addressing efficient implementation of established Big Data software frameworks and workloads on extreme-scale HPC systems, including the integration of Big Data and HPC programming models; algorithmic research addressing Machine Learning on HPC systems; interactive use of HPC resources for real time data analysis.

**e. Mathematical methods and algorithms** for extreme scalability of computing and data with impact in system energy reduction and resilience, and addressing the usability and the efficient implementation on different HPC architectures. Work should link to HPC and extreme scale data architectures and technologies as well as to relevant applications (e.g. challenges identified by the European Centres of Excellence on HPC).

The Commission considers that proposals for Research and Innovation Actions requesting a contribution from the EU of between EUR 5 and 10 million and a duration of 3 years would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts and duration.

Note that special Grant Conditions will apply for projects granted under this topic. Please see under Call Conditions.

B. Coordination and Support Action

To boost a sustainable European HPC ecosystem by providing activities to structure the community, to promote collaborations and synergies among Horizon 2020 HPC projects, Centres of Excellence on HPC (CoEs), Extreme scale Demonstrators (EsD), to create links with Big Data related activities, and to follow up and cooperate with other relevant international HPC activities. A specific focus will be given to the convergence of HPC and HPDA (High Performance Data Analytics). Activities should also address the following:

1. coordinate the European HPC strategy, and monitor and measure its implementation,
2. produce roadmaps for HPC technology and applications, covering also the post-exascale, and evaluate them through impact monitoring
3. promote the European strategy and the results of the European HPC ecosystem (including at international level), engage with HPC users and foster industry take-up
4. build and maintain relations with other relevant international HPC activities
5. support the generation of young talent.

This coordination and support action should be driven by the relevant actors in the HPC field. It is expected that only one proposal will be selected.

The Commission considers that proposals for Coordination and Support Actions requesting a contribution from the EU of up to 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: A. Research and Innovation Actions

1. Contribution to the realisation of the ETP4HPC Strategic Research Agenda
2. Addressing important segments of the broader and/or emerging HPC markets, especially extreme-computing, emerging use modes and extreme-data HPC systems, and addressing where relevant the path to industrialisation of results
3. Strengthening competitiveness and leadership of European industry & science, in particular of European technology supply
4. European excellence in mathematics and algorithms for extreme scale HPC systems and applications working with extreme scale data
5. Impact on key scientific or industrial applications with relevance to societal challenges

B. Coordination and Support Action

1. strengthening the European research and industrial leadership in the supply, operation and use of HPC and HPDA systems
2. contribution to the realisation of the ETP4HPC Strategic Research Agenda
3. structuring the efforts of stakeholders for implementing the European HPC strategy
4. reinforced cooperation in international endeavours on HPC

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

### FETFLAG-01-2018: Preparatory Actions for new FET Flagships

Specific Challenge: FET Flagships are science- and technology-driven, large-scale, multidisciplinary research initiatives built around a visionary unifying goal. They tackle grand science and technology (S&T) challenges requiring cooperation among a range of disciplines, communities and programmes. FET Flagships should provide a strong and broad basis for future innovation and economic exploitation, as well as novel benefits for society of a potential high impact. The overarching nature and magnitude implies that they can only be realised through a collaborative, long-term sustained cooperation effort. This topic aims at launching Coordination and Support Actions (CSA) to prepare new candidate FET Flagships.

Scope: Proposals should contain a description of a potential FET Flagship and how this is to be matured over the course of the preparatory action into a more complete blueprint.

Firstly, proposals should describe the FET Flagship initiative they propose to further develop through this preparatory action, by specifically addressing the following three key issues:

1. **What makes this a FET Flagship**: what is the unifying goal, the grand S&T challenge and the underlying vision; why is this a grand challenge and what makes it a "game-changer"; what are its main goals and objectives; and what are the technologies, including digital technologies, that it would advance.
2. **Impact (why it is good for Europe)**: will it bring major impact on economy and society as well as on science and technology; why and how is it relevant for the European industry; how does it build on existing scientific excellence in Europe; what is its innovation potential that would benefit Europe's economy and/or society; how would it uniquely position Europe with respect to relevant developments and initiatives existing in other regions in the world.
3. **Integration and European added value**: is it well positioned to address its grand S&T challenge in terms of large-scale integration across disciplines and the involvement of relevant stakeholders from academia, industry and society at large; does critical mass in terms of research excellence and industrial capabilities exist in Europe needed to address the challenge; what is the estimated scale of the effort required to reach the objectives and how long will it take to do so; and, are there similar initiatives existing at regional, national or European level and what is the added value of such an effort.

Secondly, proposals should describe how the activities of the preparatory action will involve stakeholders over the course of up to 12 months (indicative), to arrive at a complete design and description of a candidate FET Flagship initiative. Specifically, they should describe the proposed activities for further developing the Flagship's unifying goal and its underlying S&T roadmap; attracting industry's endorsement and participation; further developing their consortium and its governance structure and attracting large public support.

Proposals should consider multidisciplinary aspects, including where relevant social sciences and humanities. They must also describe a clear strategy for dissemination and citizen engagement; and, in close cooperation with other proposals for preparatory actions that will be selected from this call, jointly organise and participate in an event addressing stakeholders including scientific communities, policy makers and the wider public and aiming at disseminating the main objectives and findings of the actions.

At the end of the action, the design and description of the candidate Flagship should include the following elements:

1. **A consolidated vision** based on a well-defined unifying goal articulated in terms of S&T objectives and of its targeted impact on economy and society.
2. **A strategic long-term research roadmap**, showing how the unifying goal can be realised and what the major milestones are, situating the Flagship in the global landscape and demonstrating a credible path towards societal impact, technology development, innovation and exploitation.
3. **A blueprint for the Flagship's implementation** setting out the overall collaboration and S&T framework, the identification of necessary competencies and resources including infrastructure aspects, and openness of the initiative.
4. **An effective scientific leadership and governance structure** based on lessons learned from the present Flagships, describing the coordination and decision-making structures of the Flagship, the role of industry and the relations with Member States and countries associated with Horizon 2020, with the Commission and with the relevant funding agencies and national research initiatives.
5. **Support from and involvement of industry**, giving a view on avenues for exploitation and further strengthening of European industry in the global landscape, including stimulating the emergence and growth of innovative value chains.
6. **An approach to address responsible research and innovation**, in particular aspects such as education, gender aspects and societal, ethical and legal implications.

Proposals for candidate FET Flagships must target a visionary unifying goal within one of the following three main areas: **ICT and Connected Society; Health and Life Sciences; or Energy, Environment and Climate change**. They should present a multidisciplinary approach that brings together the relevant communities to address their unifying goal. Proposals must clearly specify which of the three areas they target. In each of these areas at least one and at most two proposals for Flagship preparatory actions will be selected for funding.

***(1) ICT and Connected Society***

The proposal should address any of the following sub-areas in part or in whole:

1. **Smart Materials and Nanoscale Engineering:** Novel nano-engineered materials and systems with properties enabling the design and manufacturing of radically new ICT components and devices creating disruptive technologies and market opportunities, for example in energy efficiency, data processing, smart manufacturing, smart interfaces, nano-bio devices, etc.
2. **Robotics, Interfaces and Artificial Intelligence:** a new generation of robotics technologies including soft and flexible robotics, bio-inspired robotics, new approaches to human-machine interaction and cooperation, cognition and artificial intelligence, giving rise to much smarter systems performing sophisticated functions opening radically new opportunities to address societal and economic challenges.
3. **ICT for Social Interaction and Culture:** new ICT technologies and approaches for empowering deep social interactions across diverse cultures, languages, goals, values, etc.; for understanding large-scale complex socio-technical systems and their interactions, interdependencies and evolutions and avenues for exploiting this understanding; and/or for collecting, preserving, studying and promoting Europe's unique cultural heritage and exploiting these to achieve major societal or economic benefits.

***(2) Health and the Life Sciences***

The proposal should address any of the following sub-areas in part or in whole:

1. **Disruptive technologies to Revolutionise Healthcare**: New technologies and approaches aiming at a paradigm shift in the field of individualised prevention, prediction and treatment of diseases. This includes among others bioinformatics and modelling approaches to use patients' genetic expression patterns, metabolism and derived systems; novel and innovative nano-medicine approaches (e.g. technologies for novel sensors and imaging, organ-on-a-chip and bio-electronic medicine, drug delivery, …); network medicine; neuro-prosthetic technologies; regenerative medicine and biofabrication techniques to reprogram or replace human cells, tissues and whole organs and to integrate these in functioning body systems.
2. **Understanding Life by Exploring the Genome and the Cell:** Novel technologies and approaches that enable a paradigm shift in studying and understanding the foundational building blocks of life, for example the functioning of the cell, and of cells within organisms, including structure and dynamics, and the full multi-omics (genome/epigenome/proteome/metabolome/connectome etc.) and their interactions. This will open up radically new opportunities such as developing novel nano-bio devices and technologies, advanced screening methods and analytical and morphological technologies, advanced therapies and contribute to the understanding of biological processes and pathological mechanisms.

***(3) Energy, Environment and Climate change***

The proposal should address any of the following sub-areas in part or in whole:

1. **Earth, Climate Change and Natural Resources:** New technologies and approaches for high-precision modelling and simulation, including the necessary data integration, that enable an in-depth understanding of the earth, natural hazards and climate change. Their exploitation and use should open up new opportunities for helping to manage/mitigate their effects and impacts on human activity and natural resources in a sustainable way in specific areas such as: agriculture (ensuring food security and sustainable farming), forestry, fisheries, protecting/restoring natural ecosystems, energy supply and demand, etc.
2. **Radically new Energy Production, Conversion and Storage devices and systems:** Disruptive technologies aiming at a paradigm shift in renewable energy by exploring and exploiting radically new principles and novel materials that can substantially reduce Europe's dependence on fossil fuels and open new industrial opportunities for their exploitation and sustainable development.

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

Expected Impact: For the CSA:

1. Fully developed candidate FET Flagship initiatives supported by key stakeholders (e.g., academic research communities, industry, public authorities …).

For the proposed Flagships:

1. Key benefits for economy and society based on significant advances on science and technology. This should be demonstrated by e.g. potential for S&T breakthroughs, industrial support, added value for Europe, potential for increasing European competitiveness, potential for societal benefits, etc.
2. Long-lasting structuring effect on research efforts in Europe, anchor point for international cooperation and the nurturing of talent through the training of a new generation of researchers.

Type of Action: Coordination and support action

# Research Infrastructures

### INFRAIA-01-2018-2019: Integrating Activities for Advanced Communities

Specific Challenge: European researchers need effective and convenient access to the best research infrastructures in order to conduct research for the advancement of knowledge and technology. The aim of this action is to bring together, integrate on European scale, and open up key national and regional research infrastructures to all European researchers, from both academia and industry, ensuring their optimal use and joint development.

Scope: 'Advanced Communities' are scientific communities whose research infrastructures show an advanced degree of coordination and networking at present, attained, in particular, through Integrating Activities awarded under FP7 or previous Horizon 2020 calls.

An Integrating Activity will mobilise a comprehensive consortium of several key research infrastructures in a given field as well as other stakeholders (e.g. public authorities, technological partners, research institutions) from different Member States, Associated Countries and other third countries[[4]](#footnote-4) when appropriate, in particular when they offer complementary or more advanced services than those available in Europe.

Funding will be provided to support, in particular, the trans-national and virtual access provided to European researchers (and to researchers from Third Countries under certain conditions[[5]](#footnote-5)), the cooperation between research infrastructures, scientific communities, industry and other stakeholders, the improvement of the services the infrastructures provide, the harmonisation, optimisation and improvement of access procedures and interfaces. Proposals should adopt the guidelines and principles of the [European Charter for Access to Research Infrastructures](http://https://ec.europa.eu/research/infrastructures/pdf/2016_charterforaccessto-ris.pdf).

To this extent, an Integrating Activity shall combine, in a closely co-ordinated manner:

(i) Networking activities, to foster a culture of co-operation between research infrastructures, scientific communities, industries and other stakeholders as appropriate, and to help develop a more efficient and attractive European Research Area;

(ii) Trans-national access or virtual access activities, to support scientific communities in their access to the identified key research infrastructures;

(iii) Joint research activities, to improve, in quality and/or quantity, the integrated services provided at European level by the infrastructures.

All three categories of activities are mandatory as synergistic effects are expected from these different components.

Access should be provided only to key research infrastructures of European interest, i.e., those infrastructures able to attract significant numbers of users from countries other than the country where they are located. Other national and regional infrastructures in Europe can be involved, in particular in the networking activities, for the exchange of best practices, without necessarily being beneficiaries in the proposal.

Proposals from advanced communities will have to clearly demonstrate the added value and the progress beyond current achievements in terms of integration and services, of a new grant. The strongest impact for advanced communities is expected typically to arise from focusing on innovation aspects and widening trans-national and virtual access provision, both in terms of wider and more advanced offer of scientific services, than in terms of number of users and domains served. Furthermore, in particular for communities supported in the past under three or more integrating activities, the creation of strategic roadmaps for future research infrastructure developments as well as the long-term sustainability of the integrated research infrastructure services provided at European level, need to be properly addressed. The latter requires the preparation of a sustainability plan beyond the grant lifecycle as well as, where appropriate, the involvement of funders.

In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), Integrating Activities should, whenever appropriate, pay due attention to any related international initiative (i.e. outside the EU) and foster the use and deployment of global standards.

Integrating Activities should also organise the efficient curation, preservation and provision of access to the data collected or produced under the project, defining a data management plan, even when they opt out of the extended Pilot on Open Research Data. Data management (including ethics and privacy issues), interoperability, as well as advanced data and computing services should be addressed where relevant. To this extent, proposals should build upon the state of the art in ICT and e-infrastructures for data, computing and networking, and ensure connection to the European Open Science Cloud.

Integrating Activities should in particular contribute to fostering the potential for innovation, including social innovation, of research infrastructures by reinforcing the partnership with industry, through e.g. transfer of knowledge and other dissemination activities, activities to promote the use of research infrastructures by industrial researchers, involvement of industrial associations in consortia or in advisory bodies.

Integrating Activities are expected to duly take into account all relevant ESFRI and other world-class research infrastructures to exploit synergies, to reflect on sustainability and to ensure complementarity and coherence with the existing European Infrastructures landscape.

Proposals should include clear indicators allowing the assessment of the progress towards the general and specific objectives, other than the access provision.

As the scope of an integrating activity is to ensure coordination and integration between all the key European infrastructures in a given field and to avoid duplication of effort, advanced communities are expected to submit one proposal per area.

Further conditions and requirements that applicants should fulfil when drafting a proposal are given in part D of the section “Specific features for Research Infrastructures”. Compliance with these provisions will be taken into account during evaluation.

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

On the basis of a multiannual plan drafted taking into account the assessment and the timing of previous grants as well as strategic priorities and needs, in term of research infrastructures services, emerging from other parts of Horizon 2020, this work programme invites proposals addressing the following areas listed under the different domains. A balanced coverage of the various domains, in line with the distribution of areas per domain, is expected as outcome of this topic.

***(a) 2018 deadline***

*Biological and Medical Sciences*

**Microbial Resource Centres.** This activity aims at integrating the key Microbial Resource Centres and opening them up to European researchers for biotechnology research and development. Emphasis should be on widening the user base, enlarging and strengthening the offered services, sharing resources at global level, fostering the innovation role of such infrastructures and ensuring long term sustainability to their integration.

**Facilities for high throughput DNA sequencing.** This activity aims at integrating the key research infrastructures in Europe as well as leading-edge research infrastructures located in third countries, to open them up to European researchers and offer services beyond the state-of-art which is already ensured by commercial providers. Adequate consideration should be taken of the produced data and its availability for research.

**Centres for replacement, reduction and refinement (3 Rs) of non-human primate testing**. This activity aims at integrating the key non-human primate centres in Europe promoting 3 Rs, i.e. replacement, reduction, and refinement. The proposal will contribute to the objective of 3Rs, reinforcing the implementation of ethical and good practices at European level, and the protection of animals used in scientific experiments[[6]](#footnote-6). The proposal should also develop the necessary collaborations outside Europe.

**High throughput facilities for proteome analysis.** This activity aims at integrating the key high throughput facilities in Europe for proteome analysis, based on state-of-the-art proteomics techniques and tools for data handling and analysis, including structural proteomics and structural bioinformatics. Emphasis should be on widening the user base, enlarging and strengthening the offered services, fostering the innovation role of such infrastructures and ensuring long term sustainability to their integration.

*Energy*

**Research Infrastructures for solar energy: concentrating solar power**. This activity should bring together the key European research infrastructures in solar concentrating systems (solar concentrators and relating research infrastructures) for carrying out energy and materials research as well as research in other fields using the extreme temperature conditions in solar concentrators, e.g. thermal storage equipment and reuse of stored energy. This topic would support the European Strategic Energy Technology Plan (SET-Plan).

**Research Infrastructures for solar energy: photovoltaic**. This activity aims at integrating and opening the key research infrastructures in Europe for all aspects of photovoltaic research: buildings, transport, new materials, grid connection, efficiency, etc. This topic would support the European Strategic Energy Technology Plan (SET-Plan).

*Environmental and Earth Sciences*[[7]](#footnote-7)

**Research infrastructures for forest ecosystem and resources research.** This activity aims at further integrating and facilitating broad access to forest research facilities, methodologies and data on genetic and species diversity to enable environmental and biological research including biological effects of air pollution, mitigation and adaptation to climate change, and development of forest management approaches. Emphasis will be on widening the user base and ensuring long term sustainability to the service integration.

**Natural history collections.** This activity aims at integrating and improving access to key European Natural History collections and to their related instrumentation facilities. Emphasis should be on improving accessibility to collections to a wide range of scientists, on developing innovative research services to answer the needs of a broader scientific community of users from climate change to human health and food security, and on ensuring long term sustainability of the integrated services.

**Research aircrafts for environmental and geo-science research.** This activity aims at integrating key research aircrafts and improving their availability to European researchers from larger multidisciplinary scientific communities. It should develop a long-term strategy towards sustained integrated services and innovative synergies with complementary observing systems and models to study atmospheric processes and the Earth's surface.

**Research vessels.** This activity aims at further providing, integrating and improving access to the key European research vessels and associated major equipment. It should include innovative initiatives to ensure a more efficient and coordinated operation of European fleets, to develop synergies with complementary observing systems and infrastructures and to set-up sustained integrated services to the user communities.

**Research infrastructures for Earth's climate system modelling.** This activity aims at further integrating and opening the research infrastructures (e.g. data repositories, models) used by the climate modelling community in Europe, promoting the ongoing development of a common distributed modelling infrastructure. Emphasis should be on widening the user base, expanding the interdisciplinary research fields addressed, enlarging and strengthening the offered services, and ensuring long term sustainability to the service integration.

**Sites and experimental platforms of anthropogenic impacts for ecosystem functioning and biodiversity research**. This activity aims at bringing together highly instrumented experimental, analytical and modelling facilities, across all major European ecosystem types and all major pressures on them. It will optimise the collaborative use of these sites by a wider scientific community and develop efficient methods and techniques for rapid data sharing and processing at the European level.

*Mathematics and ICT*

**Visualisation facilities.** This activity aims at further integrating and opening key virtual reality visualisation facilities, holographic image processing facilities and other computer graphics and animation facilities for advanced visualisation of scientific information and massive data, either resulting from academic research or being produced in collaboration with the industrial sector. Emphasis should be on widening the user base, enlarging and strengthening the offered services, and fostering the innovation role of such infrastructures.

*Material Sciences, Analytical facilities and Engineering*

**Electron Microscopies for advanced imaging, diffraction, spectroscopy and metrology of materials.** This activity aims at further integrating and opening advanced electron microscopies for material research and technological development. Emphasis should be on widening the user base, strengthening and enlarging the offered services, stimulating new scientific activities, facilitating access, fostering the innovation role of such infrastructures and ensuring long term sustainability to their integration.

**High and low energy ion beam labs.** This activity aims at further integrating and opening key ion beam facilities for material, biomedical and environmental research and technological development. Emphasis should be on widening the user base, enlarging and strengthening the offered services, fostering the innovation role of such infrastructures and ensuring long term sustainability to their integration.

**Infrastructures for Neutron Scattering and Muon Spectroscopy**. This activity will provide and facilitate wider access to the key research infrastructures in Europe for Neutron scattering and Muon Spectroscopy. It should present a long-term sustainable perspective on the integration of these facilities and related resources.

**Facilities for research on materials under extreme temperature conditions.** This activity aims at integrating research facilities in physics and materials science dealing with extreme low and high temperature conditions, e.g. nanoscience at microkelvin temperatures. Emphasis should be on widening the user base, enlarging the offered services, fostering the innovation role of such infrastructures and ensuring long term sustainability to their integration.

**Infrastructures for studying turbulence phenomena and applications.** This activity aims at further integrating key facilities enabling the study of high turbulence phenomena in various areas of science and technology. Emphasis should be on combining modelling and experimental in situ testing, widening the user base, enlarging the offered services, fostering the innovation role of such infrastructures and ensuring long term sustainability to their integration.

*Physical Sciences*

**Research Infrastructures for hadron physics.** This activity will provide and facilitate access to key research infrastructures in Europe for studying the properties of nuclear matter at extreme conditions, turning advances in hadron physics experimentation into new applications. It should present a long-term sustainable perspective on the integration of relevant facilities and related resources.

**Research Infrastructures for high resolution solar physics.** This activity aims at further integrating and opening key research infrastructures in the field of high resolution solar physics. It should foster cooperation between theory and observations.

*Social Sciences and Humanities*

**Research infrastructures for the assessment of science, technology and innovation policies.** This activity aims at further integrating and opening research data infrastructures in the field of science, technology and innovation (including social innovation). Emphasis should be on facilitating trans-national access and widening the user base, enlarging and strengthening the offered services, fostering the innovation role of such infrastructures and ensuring long term sustainability to their integration.

**Digital archives and resources for research on European history.** This activity aims at further integrating and opening key data collections and services in Europe for European History. Emphasis should be on widening the user base, enlarging and strengthening the offered services, e.g. by covering further historical periods, and ensuring long term sustainability to their integration.

**Archaeological data infrastructures for research.** This activity aims at further integrating and opening key archaeological data infrastructures to facilitate research in all fields of archaeology (from prehistory to contemporary society). Emphasis should be on widening the user base, enlarging and strengthening the offered services, including fields such as paleo-anthropology, bioarchaeology and environmental archaeology, sharing resources at global level, and ensuring long term sustainability to their integration.

***(b) 2019 deadline***

The areas to be addressed under the different domains will be defined at a later stage, before the opening of the related call.

Expected Impact:

1. Researchers will have wider, simplified, and more efficient access to the best research infrastructures they require to conduct their research, irrespective of location. They benefit from an increased focus on user needs.
2. New or more advanced research infrastructure services, enabling leading-edge or multidisciplinary research, are made available to a wider user community.
3. Operators of related infrastructures develop synergies and complementary capabilities, leading to improved and harmonised services. There is less duplication of services, leading to an improved use of resources across Europe. Economies of scale and saving of resources are also realised due to common development and the optimisation of operations.
4. Innovation is fostered through a reinforced partnership of research organisations with industry.
5. A new generation of researchers is educated that is ready to optimally exploit all the essential tools for their research.
6. Closer interactions between larger number of researchers active in and around a number of infrastructures facilitate cross-disciplinary fertilisations and a wider sharing of information, knowledge and technologies across fields and between academia and industry.
7. For communities which have received three or more grants in the past, the sustainability of the integrated research infrastructure services they provide at European level is improved.
8. The integration of major scientific equipment or sets of instruments and of knowledge-based resources (collections, archives, structured scientific information, data infrastructures, etc.) leads to a better management of the continuous flow of data collected or produced by these facilities and resources.
9. When applicable, the integrated and harmonised access to resources at European level can facilitate the use beyond research and contribute to evidence-based policy making.
10. When applicable, the socio-economic impact of past investments in research infrastructures from the European Structural and Investment Funds is enhanced.

Type of Action: Research and Innovation action

### INFRAEDI-02-2018: HPC PPP - Centres of Excellence on HPC

Specific Challenge: This topic covers two interrelated and synergic areas:

**(a)** *Supporting Centres of Excellence* *(CoE)* that promote the use of upcoming exascale and extreme performance computing capabilities in areas where user communities in collaboration with other HPC stakeholders can develop or scale up existing parallel codes towards exascale and extreme scaling performance, resulting into tangible benefits for addressing scientific, industrial or societal challenges.

**(b)** *Addressing the fragmentation of activities* *for excellence* *in HPC applications*, and fostering the widening of the use of HPC codes in the EU, by establishing a focal point for the consulting skills and training available from the CoE, and from other HPC centres or organisations, including PRACE.

Scope:

***(a) Research and Innovation Actions***

CoEs will be user-driven and inherently committed to co-design activities so as to ensure that future HPC architectures are well-suited for the applications and their users, providing them with a high performance and scalable application base. CoEs will federate capabilities around Europe, exploiting available competences, and ensuring multidisciplinarity (combining application domain and HPC system, software and algorithm expertise) and synergies with national/local programmes.

Proposals for CoEs should clearly identify one of the following areas as the main focus of their work and the challenges addressed:

1. Engineering: aeronautics, automotive and/or new combustion engines;
2. Environmental sciences: climate and weather simulation, natural hazards forecast and prevention;
3. Biomolecular research: combined research in chemical, biological, physical and computational science;
4. Health/medicine:, computational methods and simulation in the biomedical domain;
5. Materials science and engineering: materials design, simulation and modelling;
6. Energy: optimising energy consumption and supporting the transition to a reliable and low carbon and clean energy supply;
7. Big Data and Global Challenges: Big Data analytics for strategic global issues;
8. Performance optimisation: optimisation and productivity services for HPC academic and industrial code(s) (including support to selected Centres of Excellence)
9. Other domains (with a focus not addressed by any of the areas above)

Proposals should address all the following points:

1. Research in HPC applications towards highly scalable, optimised codes and the path to exascale performance (both computing and extreme data);
2. The provision of services supporting different usage models for the community needs, and contributing to the potential convergence of HPC, High Throughput Computing (HTC), and HPDA (High-Performance Data Analytics). This includes developing, maintaining, optimising (if needed re-design) and scaling HPC application codes, addressing the full scientific/industrial workflow, particularly covering data aspects; testing and validating codes and quality assurance;
3. Commitment to the co-design approach (hardware, software, codes), including the identification of suitable applications relevant to the development of HPC technologies towards exascale;
4. In collaboration with PRACE, address the skills gap in computational science in the targeted domain by specialised training and capacity building measures to develop the human capital resources for increased adoption of advanced HPC in industry (including SMEs) and academia;
5. Data management and long term data stewardship, in particular towards exascale;
6. Widening the access to codes and fostering transfer of know-how to user communities, including specific and targeted measures for industry and SMEs;
7. Business plans for long-term sustainability embracing a wide range of service models and funding options;
8. In collaboration with the support action foreseen for CoEs (specific challenge (b) of this topic), addressing the fragmentation of HPC activities for excellence in applications, and fostering the widening of the use of HPC codes in the EU

Proposals should include clear KPIs allowing the assessment and monitoring of the progress towards the objectives, both in terms of outputs and ultimate impact.

*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*.

***(b) Coordination and Support Action***

*Proposals will address the following activities:*

1. Coordinate the services (including e.g. consultancy to other organisations), training and skills development, and outreach activities for the CoE projects and potentially other initiatives and HPC stakeholders (e.g. PRACE), ensuring that best practices are shared;
2. Act as a clearing house for HPC training and consultancy, working with relevant stakeholders to ensure gaps are filled and overlaps avoided where possible;
3. Promote outreach to industry and SMEs, especially targeting specific industrial sectors and their events, and in view of supporting the INFRAINNOV-01-2019 action for stimulating the innovation potential of SMEs as users of advanced HPC services.

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

Expected Impact:

***(a)*** *Research and Innovation Actions*

1. European leadership in exascale and extreme-scale -oriented codes and innovative algorithms/solutions that address societal challenges or are important for key scientific and industrial applications;
2. Improved access to computing applications and expertise that enables researchers and industry to be more productive, leading to scientific excellence and economic and social benefit;
3. Improved competitiveness for European companies and SMEs through access to CoE expertise and services;
4. Federating capabilities and integrating communities around computational science in Europe;
5. A large number of scientists and engineers, in particular female and young ones, trained in the use of computational methods and optimisation of applications.

***(b)*** *Coordination and Support Action*

1. Access to consultancy and services (including training) offered by CoEs for external potential users and learners;
2. Maximise visibility and outreach of Centres of Excellence, in particular to industry;
3. Promoting the use of HPC by identifying industrial and SMEs users in the different business areas, and matching their needs with the available expertise in the CoEs;
4. Improved coordination and increased availability of training activities on HPC in Europe, in particular with PRACE.

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

# Information and Communication Technologies

### DT-ICT-01-2019: Smart Anything Everywhere

Specific Challenge: "Smart anything everywhere" stands for the next wave of products that integrate digital technology. The challenge is to accelerate the design, development and uptake of advanced digital technologies by European industry - especially SMEs and mid-caps - in products that include innovative electronic components, software and systems, and especially in sectors where digital technologies are underexploited[[8]](#footnote-8).

Scope: **a. Innovation Actions SAE**

As Phase 3 of Smart Anything Everywhere, this sub-topic calls for Digital Innovation Hubs that strengthen European SMEs and mid-caps by experimenting and testing with one or more of the following technologies, or by supporting them to manufacture these products. Projects should also support eco-system building for promising platforms developed in earlier R&I products.

1. Area 1: Cyber-physical and embedded systems: the goal is to help businesses from any sector uplift the quality and performance of their products and services by including (semi)-autonomy, paying special attention to security and privacy and to the collaboration between humans and machines.
2. Area 2: Customised low energy computing powering CPS and the IoT: the goal is to help businesses who are developing products for situations where high computing capacity and low energy would be a competitive advantage.
3. Area 3: Flexible and Wearable Electronics: the goal is to help businesses in further maturing, innovating and validating their products with thin, organic and large area electronics technologies, including wearable, portable and embedded objects. Focus is on i) access to design, technology and prototyping which are ready to use, and ii) application experiments driven by concrete user requirements and business cases.
4. Area 4: Widening Digital Innovation Hubs: it addresses all three technology areas mentioned above and the technologies addressed in I4MS[[9]](#footnote-9). It calls for Digital Innovation Hubs in industrial regions which are so far underrepresented in Smart Anything Everywhere and I4MS[[10]](#footnote-10), and builds upon a mentoring programme developed by I4MS[[11]](#footnote-11). These hubs should strongly collaborate with other Innovation Actions funded under SAE and I4MS, e.g. through joint highly innovative cross-border experiments.

All proposed innovation actions may involve financial support to third parties (typically in the order of EUR 20 000 – 100 000[[12]](#footnote-12) per third party).

For this topic, the four requirements described in the introductory section 'Support to Hubs' have to be applied.

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

**b. Coordination and Support Activities SAE**

The action will support the SAE network and help achieve broad coverage in technological, application, innovation, and geographic terms, and to link up with regional/national innovation initiatives, and other Digital Innovation Hubs. Its tasks and services shall include maintaining a single innovation portal, sharing of best practices, dissemination, brokering, leveraging further investment and training. For these support actions, close cooperation with ECSEL, and other CSAs funded under the Digitising European Industry focus area is looked for.

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

1. Attract a significant number of new users of advanced ICT in the manufacturing sector, and more innovative technology suppliers, in particular SMEs and mid-caps.
2. Creation of a sustainable network of Digital Innovation Hubs, providing European added value to investments done at national and regional level in Digital Innovation Hubs.
3. Availability of Digital Innovation Hub services across Europe and its regions with strong industrial capacities

Type of Action: Innovation action, Coordination and support action

### DT-ICT-10-2018-19: Interoperable and smart homes and grids

Specific Challenge: When energy production is becoming decentralised and ICT is increasingly present in homes, the integration of renewable energy sources (RES) and promotion of energy efficiency should benefit from smarter homes, buildings and appliances, as well as (the batteries in) electric vehicles. Smart homes and buildings are one crucial element because system integration and optimisation of distributed generation, storage and flexible consumption will require interoperable smart technologies installed at building level. Internet of Things (IoT) enables a seamless integration of home appliances with related home comfort and building automation services allowing to match user needs with the management of distributed energy across the grid, and to gain access to benefits from Demand Response. Novel services should lead to more comfortable, convenient and healthier living environment at lower energy costs for consumers whilst enabling an active participation of consumers in the energy system and energy markets.

Scope: The aim of the pilot is to exploit IoT reference architectures models that allow for combining services for home or building comfort and energy management, based on platforms that enable the integration of relevant digital technologies like IoT, AI, cloud and big data services and where applicable, combined with blockchain technologies. Energy services, where appropriate, can be combined with additional non-energy services and foster the take-up of smart energy communities (in particular peer-to-peer energy markets). The aim is also to demonstrate platforms through a large-scale pilot for experimentation and co-creation with users under real-life conditions in interaction with the electricity and wider energy system, and to demonstrate the benefits of energy management through IoT application and services for the users. The envisaged architecture should allow for third party contributions that may lead to new value added services both in energy and the home/building domain.

This shall be done by developing interoperability and seamless data sharing, through aligning existing standards from the utility and ICT domains, across the devices and systems to enable innovative building energy management services, with the aim to save costs to consumers, to facilitate the integration of renewable energy from distributed intermittent sources and to support energy efficiency. The pilot needs to demonstrate plug-and-play energy management solutions within the home, by taking into account legacy of existing smart home or building solutions, mapping their approach to common architecture models and implementing relevant standards (such as SAREF). Pilots need to ensure interoperability in the communication interfaces between smart devices and from the smart device to the gateway/energy manager and/or to the cloud, i.e. a service provider that uses the data generated from the device, so that smart home services can also be used for the benefit of the electricity and wider energy system. Selected pilots should promote the use of these interoperable solutions as widely as possible involving many different types of appliances (e.g. including white-goods, heating, cooling and ventilation, home & building automation energy management, metering and control, batteries, photovoltaic panels, charging for electric vehicles), and explore the need for further standardisation and legislation. Pilot work plans should include feedback mechanisms from the users to allow adaptation and optimisation of the technological and business approach to the particular use case.

The selected large-scale pilot shall in particular address all of the following issues:

1. demonstrate scalability and stimulate spill-over effects; demonstrate that such platforms lead to a marketplace for new services in EU homes and buildings; identify best-practices, inter alia for consumer involvement, in installation, and in sales packages of devices and services;
2. for large-scale piloting and ecosystem building, proposals shall involve financial support to third parties, in particular SME's and start-ups, to support the incorporation of users of the pilots, developers of additional applications, replication of the pilots through new sites or new connected devices, and complementary assessment of the acceptability of the use case where appropriate;
3. the selected project shall cover the whole value chain for IoT-based services: appliance manufacturers and technology providers, ICT suppliers, energy suppliers, as well as independent aggregators or energy service companies (ESCOs), and one or more grid service operators (transmission system operators (TSOs) and distribution system operators (DSOs));
4. the selected project is expected to contribute to the consolidation and coherence work in cooperation with similar EU-funded projects[[13]](#footnote-13) through the BRIDGE initiative [[14]](#footnote-14) and the CSA supporting the activities defined under "DT-ICT-13-2019: Digital Platforms/Pilots Horizontal Activities a)" below by contributing their results of horizontal nature (interoperability approach, standards, security and privacy approaches, business validation and sustainability, methodologies, metrics, etc.);
5. link with Member States' and Associated Countries' initiatives in this area.

For this topic, the four activities and impact criteria described in the introductory section 'Platforms and Pilots' have to be applied. The Commission considers that proposals requesting a contribution from the EU up to EUR 30 million for Innovation Actions would allow the areas to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

1. Increasing number of energy apps/services and home devices and appliances that are connected through the Internet allowing to shift consumption according to wholesale market or grid-constraints-related price signals.
2. Validation of user acceptance, as well as demonstration of viable concepts that ensure privacy, liability, security and trust in connected data spaces.
3. Accelerated wider deployment and adoption of IoT standards and platforms in smart homes and buildings in Europe and development of secure, cost-effective and sustainable European IoT ecosystems and related business models.
4. Demonstration that such platforms lead to a marketplace for new services in EU homes and buildings with opportunities also for SMEs and start-ups.
5. Contribution to increasing the use of renewable energy and increased energy efficiency, offering access to cheaper and sustainable energy for consumers and maximising social welfare.

Type of Action: Innovation action

### DT-ICT-11-2019: Big data solutions for energy

Specific Challenge: Tomorrow's energy grids consist of heterogeneous interconnected systems, of an increasing number of small-scale and of dispersed energy generation and consumption devices, generating huge amounts of data. The electricity sector, in particular, needs big data tools and architectures for optimized energy system management under these demanding conditions.

Scope: **Innovation Actions** targeting large-scale pilot test-beds for big data application in the electricity sector. The aim is to develop/pilot and deploy a reference architecture for large-scale multi-party data exchange, management & governance and real-time processing (including distributed/edge processing) in the electricity sector and to translate this reference architecture into an open, modular data analytics toolbox for the safe and effective operation of grids and provision of innovative energy services. The reference architecture should ensure compatibility with legacy formats, interfaces and operating systems of the energy system, allow replication and scale-up, be compliant with applicable EU standards, and should enable the integration of relevant digital technologies like IoT, AI, cloud and big data services. The analytics toolbox shall be able to handle a wide variety of data and support the development of a wide range of energy services, at least to increase the efficiency and reliability of the operation of the electricity network (e.g. by predictive maintenance), to optimize the management of assets connected to the grid (in particular small-scale/renewable electricity generation and those used for demand response), to increase the efficiency and comfort of buildings, and to de-risk investments in energy efficiency (e.g. by reliably predicting and monitoring energy savings). Proposers should demonstrate that they have access to appropriate large-scale and realistic datasets, and should involve as many as necessary of the following types of participants: network operators, suppliers, independent aggregators, ESCO's, power exchanges, building management and renovation sectors, software integrators/developers. Proposals should address, as appropriate, analytics, simulation, prediction, cloud computing. Projects shall collaborate with EU-funded projects through the BRIDGE initiative [[15]](#footnote-15).

For this topic, the four activities and impact criteria described in the introductory section 'Platforms and Pilots' have to be applied.

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

All grants under both subtopics will be subject to Article 30.3 of the grant agreement (Commission right to object to transfers or licensing).

Expected Impact: Proposals should address the following impact criteria, **providing metrics to measure success** where appropriate:

1. Effective integration of relevant digital technologies in the energy sector, resulting in integrated value chains and efficient business processes of the participating organizations;
2. Enhancing energy asset management, increasing consumer participation and innovative network management, creating new data-driven business models and opportunities and innovative energy services;
3. Contribution to increasing the use of renewable energy and increased energy efficiency based on optimised energy asset management, offering access to cheaper and sustainable energy for energy consumers and maximising social welfare;
4. New data-driven paradigms for energy management systems able to deal with increased complexity of the energy systems;
5. Improving availability of big data and big data management & analysis facilities for real-life scale research, simulation and test purposes.

Type of Action: Innovation action

### ICT-01-2019: Computing technologies and engineering methods for cyber-physical systems of systems

Specific Challenge: Cyber-physical Systems of Systems (CPSoS), like transport networks or large manufacturing facilities, interact with and are controlled by a considerable number of distributed and networked computing elements and human users. These complex and physically-entangled systems of systems are of crucial importance for the quality of life of the citizens and for the European economy. At system level the challenge is to bring a step change to the engineering techniques supporting the design-operation continuum of dynamic CPSoS and to exploit emerging technologies such as augmented reality and artificial intelligence. At computing level the challenge is to develop radically new solutions overcoming the intrinsic limitations of today's computing system architectures and software design practices.

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

The focus is on dependable physically-entangled systems for applications in industrial sectors. Work is complementary to the initiative on European low-power microprocessor technologies, which addresses technology for HPC applications, and to the ECSEL programme, which addresses computing for CPSoS at higher TRL.

**Computing software and systems design for physically-entangled systems** supporting the creation of reliable, robust and energy-aware solutions for autonomous and safety-critical systems. The issues of energy efficiency, testability, trust and cyber-security should be considered, as well as the support of different levels of criticality on the same computing platform where needed.

**Models, tools and methods for design-operations continuum of dependable CPSoS** supporting the complete lifecycle of Cyber-Physical Systems of Systems (CPSoS), from requirements capture to design, test, operation and decommissioning. Projects shall focus on autonomic solutions capable of guaranteeing the overall reliability and security even when the components or subsystems are not fully reliable and unforeseen conditions emerge in the course of operation.

Projects will target TRLs 2-5, and will deliver a working prototype tested in at least two different use cases, demonstrating improvement over the state of the art in industrial and professional domains. The Commission considers that proposals requesting a contribution from the EU of between EUR 3 and 5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. In each area at least four proposals will be funded.

**b. Coordination and Support Activities**

The objective is to structure, connect and cross-fertilise the European academic and industrial research and innovation communities in Embedded Computing and Cyber-Physical Systems. The action should implement technology watch, facilitate take-up of technologies in real-world use cases and support know-how transfer. Activities will include constituency building, clustering of related projects, liaison with related programmes such as ECSEL and EUREKA, impact analysis, communication of project results, pre-normative activities and road-mapping for future research and innovation. One proposal will be funded.

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

1. Availability of innovative technologies supporting compute-intensive applications in industrial and professional domains, demonstrating significant and measurable improvement over the state of the art.
2. Availability of engineering practices and tools for CPSoS, resulting in a demonstrable improvement in quality and cost of development and operation for large SoS.
3. Increased synergies and collaboration between industrial and academic communities; dissemination of high-quality roadmap for future research and innovation activities in the relevant areas.

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

### ICT-15-2019-2020: Cloud Computing[[16]](#footnote-16)

Specific Challenge: Develop competitive cloud solutions based on advanced cloud platforms and services and cloud-based software and data applications, as well as the opportunities brought by considering the edge devices capacities. Such solutions should also address stringent security, data protection, performance, resilience and energy-efficiency requirements to respond to the future digitisation needs of industry and the public sector. Addressing these challenges will also be part of and contribute to the technological ambitions for the Next Generation Internet (NGI) and the Internet of Things (IoT).

Scope: *a) Research and Innovation Actions (RIA)*

Proposals will address at least one the following areas:

1. New modelling techniques and mechanisms are needed to compose and coordinate resources across heterogeneous clouds, including micro local clouds, private enterprise clouds, aggregated and hybrid cloud models facilitating interoperability and data portability between cloud service providers. Techniques that guarantee privacy, security, identity are essential.
2. Edge computing (fog computing) technologies that integrate the limited memory, storage and computation of fog nodes that are closer to where data are generated into the cloud architecture and allow to make intelligent decisions when to move computation from the edge to the cloud, while taking into account the network capabilities as well as the security and/or sensitivity of data.
3. New management strategies aimed to design and develop an efficient, coordinated, robust, secure and service agnostic management of the set of resources brought by combining cloud, IoT, Big Data and fog computing. Solutions for consistent resources categorization, abstraction and monitoring are fundamental. Proposed solutions should also envision the development of novel collaborative (sharing) scenarios and innovative service execution approaches that allow the dynamic allocation of cloud services to improve performance, and to facilitate automatic discovery and composition of cloud services at IaaS, PaaS and SaaS levels (Infrastructure, Platform and Software as a Service). The provision and its user-friendly combination, usage and orchestration of such services should particularly look at SMEs and public sector users.

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

*b) Coordination and Support Actions (CSA)*

Proposals in this action will address the following:

1. Facilitate awareness of stakeholders in research and policy matters related to Cloud Computing.
2. Coordinate stakeholders in Cloud Computing and act as support to R&D programmes/activities by disseminating project results and organising scientific and policy events, developing research and innovation roadmaps, and addressing pre-standardisation initiatives.

Expected Impact: *a) Research and Innovation Actions (RIA)*

1. Contribute to the development of an ecosystem that will respond to the future digitisation needs of industry and the public sector;
2. Assist the development of new cloud-based services and infrastructures in Europe and foster an industrial capability in the cloud computing sector;
3. Create new opportunities to encourage European-based providers, in particular SMEs, to develop and offer cloud-based services based on the most advanced technologies;
4. Leverage research and innovation projects to support the development and deployment of innovative cloud-based services and next generation applications, for the public and private sectors (including standardisation and applications for Big-Data and other sector-specific applications).

*b) Coordination and Support Actions (CSA)*

1. Creation of a sustainable European forum of stakeholders representing the Cloud Computing research, industry and users.

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

### ICT-20-2019-2020: 5G Long Term Evolution[[17]](#footnote-17)

Specific Challenge: Whilst 5G early introduction targets "local" network improvements (e.g. at radio access level), the longer term vision targets the realisation of pervasive mobile virtual services, through a network managing compute, storage and transport connectivity functions[[18]](#footnote-18) in an integrated way. The challenge is to transform the network into a low energy distributed computer, where processes and applications are dynamically created, moved and suppressed, depending on the information flows, customer needs, and where new terminal types in cars, objects, appliances, and new interfaces based on gestures, facial expressions, sound and haptics may be the basis of the interaction between humans and the infosystems.

Scope: Proposals may cover only one strand or cut across several strands.

- Strand 1: Extension of virtualisation technologies and architectures for Network Management to support i) recursive deployments of functional components for multi-tenancy; ii) high device heterogeneity through virtualisation of resource-constrained devices with load reduction approaches and new network control solutions to effectively handle the authentication, naming, addressing, routing and related functions for massive number of terminals; iii) end to end resource self-configuration and management according to service, traffic, channel or mobility conditions; iv) SDN intelligent network interface selection; v) ultra-dense network deployment with massive user generated traffic; vi) unified management of compute, storage and connectivity resources.

- Strand 2: Security[[19]](#footnote-19): hardware, software technologies and architectures, level of abstraction for information sharing enabling tenants workloads to trust the host systems. It enables trusted deployment of critical workloads across infrastructure and for infrastructure owners, differentiated services offers to tenants, whilst also improving their own control of their systems, vulnerabilities and compromises. It covers Trusted Execution Environments (TEEs) secure provisioning and their remote management, with categorisation of sensitive operations supporting trust domain definition and set up, with real -time identification of possible compromises or security breaches.

- Strand 3: Radio network enabling technologies, architectures and advanced signal processing targeting i) differentiated service requirements, including broadcast/multicast and strategies for spectrum sharing and usage optimisation in licensed and unlicensed bands; ii) terminals as moving nodes for coverage or service extension; iii) network assisted self-driving objects with optimised information fusion/processing from maps, sensors, and events communication; iv) simplified access points through distributed computing and optimised function placement; v) ultra-low latency services; vi) applicability of mmWave frequency bands to use cases beyond eMBB; vii) usability of novel spectrum at Teraherz frequencies (incl. visible light communications).

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: - Evolution of networks towards OTT like platforms integrating connectivity, storage and computing resources opening for new service models to telecom/ISP providers - (Strand 1).

- Network scalability towards high number of resource constrained devices, multiplicity of service requirements, and new connectivity paradigms (user controlled) – (Strand 1).

- Characterisation and availability of secure and trusted environments for software based virtualised networks, enabling trusted multi-tenancy - (Strand 2).

- Improvements of radio spectrum usage, novel strategies for coverage/service extension, support of novel use cases and mobile edge cloud applications, usability of today unexplored spectrum - (Strand 3).

- Dynamic scalability of network capabilities through availability of managed and enhanced resources - (Strands 1 and 3).

- Network energy consumption reduction, a factor of at least 10 is targeted - (Strands 1 and 3).

Type of Action: Research and Innovation action

### EUJ-01-2018: Advanced technologies (Security/Cloud/IoT/BigData) for a hyper-connected society in the context of Smart City

Specific Challenge: Following the integration and federation of IoT with Big Data and Cloud, which has been explored in past coordinated calls, a remaining challenge to address is **enhanced security and privacy** and how the human user deals with the ever-increasing amount of sensors, smart objects and data. Both EU and Japan have excellent competences in the fields of cybersecurity systems and visualisation technologies. Especially, security aspects are of increasing importance in these years. **There is a need for simple, efficient and trustable systems based on advanced technologies combining Security, Cloud and IoT/Big Data technologies** that can provide **intelligent** detection and countermeasures for device malware attacks, automatic vulnerability discovery and patching, analytics and IoT/Big Data applications. All of these require **advanced cloud and edge computing technologies** and **interoperable IoT devices and platforms.**

These new requirements, including security aspects, will have an enormous impact on the underlying cloud/IoT platforms and associated services, especially for cross-border demonstrations of technologies and applications.

Furthermore, **interoperability** of IoT devices/platforms is of particular interest in the context of Smart Cities (the areas of energy, social infrastructure, traffic/transport, healthcare, and disaster/crime prevention) in order to promote collaboration between a variety of business operators and platforms connecting to various IoT devices, open source, standards, SDKs, common APIs, are the cornerstone of the EU-Japan collaboration.

Scope: The proposals should address one of the two following areas:

**1) Advanced technologies combining Security, IoT, Cloud and Big data for a hyper-connected society**

The focus is to research, develop and test advanced technologies combining Security, IoT, Cloud and Big data. The following technologies are expected for research and development: agility against emerging threats; automatic vulnerability discovery and patching; open-sourcing of security tools; IoT security; cloud security; data security; privacy protection; data anonymization; blockchain in the context of IoT/Cloud; critical information infrastructure protection, cross border application demonstrations; etc.

**2) Interoperable technologies of IoT devices/platforms in the context of Smart Cities**

The focus is to research, develop and test interoperable technologies of IoT devices/platforms in the context of Smart Cities. The following technologies are expected for research and development: edge/fog/cloud computing; low power; scalability; open-standards-based platforms; system and reference architectures; open application programming interfaces (API); data sharing among cross-market/cultural platforms; managing distributed data among different communities and regions; bridging different standardizations; technical verification; cross border application demonstrations; energy management; transportation systems; maintenance systems for life infrastructure; etc. A further objective is to contribute to standardization activities under the cooperation of EU-JP research institutes and IoT-related consortia (e.g. the Alliance for IoT Innovation (AIOTI) and IoT Acceleration Consortium), and promote a global expansion of research results in Smart Cities.

The Commission considers that proposals requesting a contribution from the EU up to EUR 1.5 million would allow this specific challenge to be addressed appropriately by one project of EUR 1.5 million in each of the suggested areas. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

1. Credible demonstrations based on cross-border business and/or societal applications of robust interoperable technologies identifying policy/legal obstacles (i.e., free flow of data, data protection, data portability etc.).
2. Concrete implementations of interoperable solutions that integrate IoT, Cloud and Big Data including security that are candidates for standardisation.
3. Facilitation of the development of cloud-enabled, secure and trustworthy IoT/big data applications (i.e., integrating intelligent security systems and visualisation technologies and devices/interfaces).
4. Promotion of the use of data related to Smart Cities and the creation of new increasingly efficient services in urban and regional administrative management.
5. Joint contributions to standardization activities under the cooperation of EU-Japan research institutes and IoT-related consortia (e.g. AIOTI and IoT Acceleration Consortium).

Type of Action: Research and Innovation action

# Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing

### 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:

1. 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;
2. Duly consider safety aspects depending on the application, e.g. by consideration of polymer or solid electrolytes for solid-state batteries;
3. 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;
4. 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;
5. 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]](#footnote-20) The new developments should respond to all of the following requirements:

1. 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;
2. 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;
3. More sustainable products, with a recycling efficiency beyond currently legal obligations, as established in the Batteries Directive,[[21]](#footnote-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

### 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 electrolysers. Advanced materials solutions may be high-capacity, durable proton exchange membranes and solid oxide electrolysis cell (SOEC) electrolysers 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]](#footnote-22)

1. Improving technical and economic competitiveness of EU stationary storage production suitable to store large amount of energy;
2. 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;
3. 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

### 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 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]](#footnote-23)

1. Reduction of greenhouse gases and air pollutants through the enhanced deployment of electric vehicles enabled by high performing, cost efficient and “user friendly” batteries;
2. 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;
3. 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;
4. 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;
5. Cyclability should be suitable for automotive long term application, and ideally reach 5000 cycles for second life-use batteries by 2030;
6. 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;
7. 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

### 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:

1. 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);
2. 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;
3. Demonstrate the recyclability and reliability of new smart materials, as well as a reduction in the dependence on rare elements;
4. Integrate sensor technologies (e.g. MEMS based sensor concepts) and the potential linkage with the Internet of Things (IoT);
5. 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:

1. New materials facilitating technology systems for sustainable energy supply allowing a reduction of greenhouse gas emissions by at least 40% based on lifecycle analysis;
2. Reduction of hazardous waste by 50% through efficient manufacturing practices and/or materials selection;
3. 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

### 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:

1. 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, heath diversion, storage and directional transfer;
2. solutions capable for use in both new buildings and for retrofitting existing ones;
3. solutions allowing for installation without modifying the structure of the building (or without overloading existing structures) and demonstrating a high replication and industrial potential;
4. 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;
5. 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:

1. Improvement by at least 25% of the insulation properties at component level for a given weight, when in isolation (passive) mode;
2. 10% improvement in energy-storage capability when in active mode(s);
3. Water and air tightness should be at least 10% higher than existing solutions (when it is proposed a controllable solution);
4. 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

### 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:

1. 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);
2. The modelling of the building energy should include existing parameters, as well as the environmental and GIS data;
3. 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);
4. Be flexible to adapt to work planning, as-buildings documentation and procedures to process changes;
5. Allow the development of applications to benefit from inputs of inhabitants;
6. 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:

1. A reduction of the renovation working time of at least 15-20% compared to current practices with the baseline defined in the proposal;
2. 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;
3. 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

### 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 levering 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:

1. Similar costs as compared to the 2020 nearly zero-energy buildings as an incentive to erect energy-plus-houses;
2. Increase of the share of plus-energy houses with the view of 10% market uptake by 2030;
3. Contribute reducing of CO2 emissions in the residential sector by 88% in 2050 compared to the 1990 levels;
4. 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

### 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:

1. Reach improved heat exchange in and between storage material and heat carrier as well as high performing storage reactor over time;
2. 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;
3. The overall system should be easy to maintain with low cost associated to this activity;
4. 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:

1. Demonstrate solutions that have a stable, reliable long term performance in multi-cyclic seasonal and use of at least 20 years;
2. 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;
3. Solutions should demonstrate a potential to reduce the net energy consumption of a building by at least 25% and a have return-on-investment period below 10 years;
4. 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

### 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:

1. Develop an advanced digitalised and industrialised construction and building process utilising smart combinations of materials/components;
2. Assess the overall life cycle of construction, in order to deliver more efficient buildings in terms of sustainability and construction, maintenance and operation costs;
3. 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:

1. Reduction of CO2 with 15-20% for the total life-cycle compared to current situation shown through Life Cycle Assessment;
2. Construction cost reductions of at least 15% compared to current situation;
3. Buildings shortened construction time (reduced by at least 10-15% compared to current State of the art);
4. Reduction of the gap between predicted and actual energy consumption;
5. Improved indoor environment;
6. Significantly improved integration of the value chain (design, procurement, manufacturing, construction, operation and maintenance);
7. Contribution to new standards and regulations;
8. 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

### 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:

1. Show potential for integration in a renewable electricity grid, and consider the relevant limitations (fluctuating nature of the electricity stream);
2. Provide significant advantages in terms of resource and energy efficiency, compared to the current state of the art processes (or similar ones, as relevant);
3. Provide improved flexibility, working at variable throughputs without major losses in the overall process performance;
4. Be applicable to continuous processes and/or show potential enabling the replacement of current batch ones;
5. Consider, where relevant, the possibility for containerised and/or mobile (e.g. biomass in situ processing) technologies;
6. Consider Life Cycle Assessment proving a reduced environmental footprint;
7. 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:

1. Allowing for a -30% to +30% energy input within RES fluctuations timeframes, without significant losses in specific energy efficiency;
2. Improvement in energy efficiency of 30%;
3. Improvement in resource efficiency of 30%;
4. Decrease in CO2 emissions by 40% (without considering the electricity generation and at steady state);
5. Decreased OPEX and CAPEX by 15%;
6. 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

### 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:

1. 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;
2. Novel advanced energy systems, could include new combustion and gasification techniques applied to the highly resource and energy intensive industries have to be developed;
3. 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:

1. 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);
2. 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:

1. 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;
2. Improved process efficiency through re-utilisation of energy and/or material process streams by at least 15%;
3. 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%;
4. 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

### 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:

1. 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;
2. Complex downstream operations, integrating different separation techniques and purification steps;
3. Modularity and flexibility of the solutions, as well as, potential for transition from batch to continuous operations;
4. The technologies proposed should enable increased productivity, purity and quality of products, while lowering the process environmental footprint and increasing resource and energy efficiency;
5. The potential for integration in the current industrial scenario, and the replicability of the concept in different sectors of the process industry;
6. 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:

1. 20% decrease in greenhouse gas emission;
2. Increased in resource and energy efficiency by at least 20%;
3. Novel modular and scalable integrated (upstream-downstream) pilot line technologies with 10% decrease in CAPEX and OPEX;
4. 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

### 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:

1. 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;
2. The development of tools and methodologies to streamline and support retrofitting;
3. Find the most efficient operational input conditions to optimise the performances;
4. Develop indicators to modify input variables and its potential of replication across the industry;
5. 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;
6. 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:

1. Increasing the resource and energy efficiency of the targeted processes by 20%;
2. Decrease GHG emissions through retrofitting by at least 30%;
3. Decreased utilisation of fossil resources in the process industry of at least 20%;
4. Reduced OPEX by 30% and increased productivity by 20%;
5. 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

### 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:

1. Improvement of online monitoring and innovative control technologies in terms of process performance and flexibility, maintenance needs and product quality;
2. 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);
3. 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;
4. 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:

1. Show potential for improved performance in cognitive production plants;
2. 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;
3. 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;
4. 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

### 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:

1. Improve selectivity and efficiency by rational engineering of the bandgap and electronic structures;
2. Realise a new design of multi-heterojunction materials with scalable preparation for Z-scheme mimicking;
3. Design multifunctional photocatalysts for simultaneous CO2 reduction and H2O oxidation;
4. Optimise solar photoreactors (light harvesting, mass transfer, reactivity);
5. 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 photo catalytic system which should enable upscaling and process intensification, with:

1. Increased efficiency of the system with sunlight to chemical energy conversion efficiency (to chemicals other than H2) higher than 5%;
2. Improved stability/robustness of the system under extended operational conditions, with loss of performances <5% in 1000h;
3. 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

# Space

### LC-SPACE-04-EO-2019-2020: Copernicus evolution – Research activities in support of cross-cutting applications between Copernicus services

Specific Challenge: Copernicus produces a wealth of data and information regarding the Earth sub-systems (land, atmosphere, oceans) and cross-cutting processes (climate change, emergency and security). The wealth of information delivered by the Copernicus operational programme is not fixed but needs to evolve further with recognised and emerging user requirements and state of the art methodologies. The potential for new products and applications needs to be exploited, especially as regards cross-cutting cases not yet realised. A process has been set-up by the Entrusted Entities, together with the Copernicus User Forum and Copernicus Programme Committee, operating the core services to review the evolution of the services and any emerging adaptation needs as to their urgency, closeness to the operational delivery process, and availability of capacities. Specific and well-targeted applications involving the outcome from multiple core services need to be developed in the mid-term. R&D activities are to be conducted such that results are available in a sufficiently timely manner to support an informed discussion, if and under which conditions the proposed new applications should be integrated into the operational service portfolio of the Copernicus programme. Furthermore proposers should highlight where results could also be valuable for GEO, considering Copernicus as the European contribution to this global initiative.

Scope: Proposals shall demonstrate the technical operational feasibility of one specific cross-cutting thematic application. The proposers are expected to demonstrate that their proposal is relevant for the enhancement of Copernicus core services and capitalise from the corresponding product portfolio.

The output of this research and innovation action should provide a proof-of-concept or a prototype including a benchmarked selection of concurring methodological approaches, where feasible, that shall complement and broaden the panoply of information made currently available by the core services and which can act as reference for the independent assessment of Copernicus services evolution, in light of product extensions and service improvements.

These applications may concern areas in relation to domains such as energy, agriculture and forestry, health, water resources, security, resilience of built environment, cultural heritage, coastal monitoring, urban planning, climate adaptation, biodiversity and eco-system preservation, exploration and mineral resources, and others. Copernicus DIAS[[24]](#footnote-24) facilities leveraging the big data collection and processing should be taken into account, in order to exploit the potential of data fusion to its maximum, especially in the case of huge data extent (i.e. long time series of multisensory data, which may bring additional value to cross-cutting new applications).

The proof-of-concept or prototype should allow demonstrating the relevance and suitability to implement the proposed application later on at European level in a cost efficient manner, i.e. potentially with operational Copernicus funding. To allow a discussion of such potential operational funding, the activity should also result in one or more possible scenarios on how this application could potentially be integrated into the existing service architecture.

Proposers are advised to consult information on the Copernicus programme in general at [http://copernicus.eu](http://copernicus.eu/), the evolution topics identified there, the guidance document provided[[25]](#footnote-25) together with this work programme, as well as the availability of Copernicus Sentinel Data, access to Copernicus Contributing Mission data available via the Commission’s website[[26]](#footnote-26).

The proposal should:

1. Demonstrate to what extent the proposed evolution could be a candidate for the operational Copernicus service in terms of cost-benefits, calendar and operational feasibility;
2. Specify the conditions for making available, for use and exploitation, the results (including IPR) to the entities implementing the EU Copernicus programme, including its contractors and service providers;
3. Foster innovation and enhance applications which exploit Copernicus service information from across the service domain.

Participation of industry, in particular SMEs, is encouraged.

The Commission considers that proposals requesting a contribution from the EU of between EUR 2 and 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

This topic contributes to the Horizon 2020 focus area "Building a low-carbon, climate resilient future".

Expected Impact:

1. Enable Copernicus services to better serve cross-cutting applications on European scale;
2. Enhance European industry’s potential to take advantage of emerging market opportunities and capacity to establish leadership in the field;
3. Reinforce the link with academic and scientific sector for scientific exploitation of Copernicus data;
4. Boost competitiveness of the industrial actors in EU and national procurements;

Type of Action: Research and Innovation action

### SPACE-11-TEC-2018: Generic space technologies

Specific Challenge: In the mid- and long-term the competitiveness of the space sector and its ability to serve the Union's internal and external policies, including the Space Strategy for Europe and the Common Security and Defence Policy, depends on the continuous incorporation of advanced basic technologies of common interest to all applications, including cross-cutting technologies such as power management, thermal control, materials and structures.

Advancements in these technology domains are necessary to enable new spacecraft or mission concepts with higher performances, higher power demand, lower mass and cost, such as higher data throughput systems and mega-constellations. As well, they can contribute to mitigate the risks related to the European dependence in space technologies. Moreover, a number of related challenges have parallels to terrestrial challenges, for example in the fields of aeronautics, energy, environment, advanced materials and production methods. Complementarity and synergy with on-going or planned European developments both in the space and non-space sectors is a challenge to address.

Scope: Activities shall advance, or spin-in from other fields, space technologies in the domain of power management, thermal control, materials, structures and processes. Incremental or potentially disruptive advancements can be both targeted.

Proposals based on low TRL technologies are solicited. The target is to demonstrate these up to medium TRL (4-6).

Each proposal shall address only one of the following sub-topics:

**a) Innovative solutions for very high power systems,** including solutions for power generation, storage, control and distribution able to support highly dissipative missions requirements. Innovation is sought in the areas of the high power electrical propulsion (> 20 kW) consistent with activities under the "In-space electrical propulsion and station keeping" SRC, very high throughput satellites, high power active antennas in high frequency bands, high capacity battery cells, low-cost ultra-capacitors, technologies for flexible/foldable arrays (aiming at >25 kW, addressing mechanical architecture and flexible solutions), regenerative fuels cells, low cost direct drive units, solar cells;

**b) Innovative thermal control solutions for high temperature missions**: high power communications, high voltage and high power systems, pose growing challenges to the thermal budget of the spacecraft or re-entry vehicle. Innovation is sought in the area of materials and thermal control solutions (e.g. heat pumps, advanced loop heat pipes, mechanical pumped loops, flexible self-regulated heaters), addressing thermal protection, thermal regulation, thermal stability, materials with variable emissivity/absorptivity; innovative thermal control surfaces, conductive/dissipative carbon fibre reinforced plastic (CFRP) panel;

**c) Spacecraft bus stability and line-of-sight technologies**: critical sensors and actuator solutions for high stability and line-of-sight control at spacecraft platform level, including sensors and actuators, focusing on competitiveness through efficiency and miniaturisation (and hybridisation);

**d)** **Advanced materials, structures and production techniques** (**e.g. additive manufacturing)**: activities shall address technologies applied to space flight elements manufacturing with a focus on low-cost on-ground manufacturing processes in support to mega-constellations or on on-orbit manufacturing processes in support to space exploration;

**e) Ground systems with massive processing**: data processing capabilities of missions for different applications, including ground control stations for remote sensing operations; processing power and speed, post-processing, data fusion, data networks, configuration life-cycle management and operations (particularly for constellations, including mega-constellations), integration of new technologies in ground systems and data processing (big data archiving and retrieval, smart data optimisation, automated data processing, distributed data platforms, artificial intelligence, full automation), distributed data exploitation platform.

Low cost solutions based on components off the shelf (COTS) are encouraged.

Participation of industry, in particular SMEs, is encouraged too.

Activities shall be complementary and create synergy with other European activities in the same domain either in the space or non-space fields. Technological spin in and/or bilateral collaborations should be enhanced between European non-space and space industries.

To this end, proposals shall include the following tasks:

1. Analysis of relevant available roadmaps, including roadmaps developed in the context of actions for the development of Key Enabling Technologies supported by the Union;
2. Analysis of how their selected space technologies can contribute to different space applications or, where applicable, to non-space sectors (such as through technology transfer or spin off);
3. Commercial assessment of the supply chain technology in the space or non-space domains and, if applicable, a business plan for commercialisation with a full range (preload) of recurring products.

The Commission considers that proposals requesting a contribution from the EU of between EUR 2 and 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

1. Development or spinning-in of new enabling technologies to space systems;
2. Lead to radical improvements in performance, enabling emerging missions, as for instance high data throughput satellites or constellations.
3. Lead to drastic improvements in efficiency, versatility, functionality and autonomy.

Type of Action: Research and Innovation action

# SC2: Food security, sustainable agriculture and forestry, marine, maritime and inland water research and the bioeconomy

### BG-05-2019: Multi-use of the marine space, offshore and near-shore: pilot demonstrators

Specific Challenge: Combining several activities such as renewable energy, aquaculture, marine bio-resources and biotechnologies, maritime transport and related services, in the same marine space, including in multi-use platforms, can serve to divide and reduce the costs of offshore operations and the demand on the space needed for different activities. Research on multi-use platforms funded under the FP7 call ‘The Oceans of Tomorrow’ has provided promising designs, technological proposals and models for combining activities in terms of economic potential and environmental impact. Horizon 2020 funded projects have helped to identify and tackle regulatory and technological barriers and develop business models to reduce the risk for operators and investors. Before reaching a stage enabling large scale installations, it is necessary to develop pilots for demonstration in a real environment of multi-use platforms or co-location of activities in a marine space with their logistic support, including service vehicles and port facilities.

Scope: Activities shall develop pilots by involving industrial actors and by integrating the available knowledge, technologies and facilities, in particular capitalising on the results of EU and national projects for the development of multi-use platforms or co-location of different activities in a marine space, and relevant support offshore vessels and autonomous vehicles. Pilots could include the reconversion/reuse of decommissioned platforms. The pilots shall aim to demonstrate in a real environment the viability (economic, social and environmental) of the multi-uses of a marine space for the output of at least two economic activities (such as renewable energy, aquaculture, marine bio-resources and biotechnologies, maritime activities and related services or tourism). The aim is to demonstrate the economic, social and environmental added-value of the multi-use of a marine space around coastal or deep sea environments and should include a business plan and a commercial economic feasibility assessment (informed by the Pilot's results), addressing possible trade-offs and costs for other sectors, for the combined activities to generate revenue. The pilots should also address health and safety issues, including for the logistics, ancillary infrastructure and maintenance services. Societal acceptance should also be integrated, especially by involving local communities. The interdisciplinary and cross-sectorial nature of the project should also apply to training activities improving the professional skills and competencies and supporting the creation of new jobs in the blue economy.

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

Expected Impact: In order to contribute to the implementation of the EU Integrated Maritime Policy and its environmental pillar, the EU Blue Growth Strategy, the EU Marine Strategy Framework Directive, the EU Maritime Spatial Planning Directive, the EU International Ocean Governance Communication, the EU Communication for a Sustainable European Future, the EU Bioeconomy Strategy, the EU Integrated Maritime Policy and in order to reinforce European competitiveness in the blue economy, activities shall:

In the short term:

1. Starting from technology readiness level (TRL) 5, bring selected designs of multi-purpose and multi-use facilities to TRL 7, ensuring validation in the real environment.
2. Improve health and safety in multi-use platforms or co-location of activities.
3. Reduce costs of implementation and increase economic viability of multi-use of marine space for the European maritime industry.
4. Raise societal awareness, involve local communities and secure acceptance of these new developments by society-at-large.

In the medium term:

1. Improve the professional skills and competences of those working and being trained to work within the blue economy.
2. Contribute to policymaking in research, innovation and technology.

Type of Action: Innovation action

### LC-RUR-11-2019-2020: Sustainable wood value chains[[27]](#footnote-27)

Specific Challenge: Forests play a vital role in Europe's economy, society and environment[[28]](#footnote-28). Scenarios likely to keep the global warming below 2oC (Paris Agreement goal) would entail a substantial reduction of anthropogenic GHG emissions, through far-reaching changes to energy systems, land use and associated value chains. The second consumer-driven factor of GHG emissions is the construction sector (ca. 15%), implying a significant role for forest-based products. The forest-based sector can contribute to climate change mitigation through increasing sinks in and reducing emissions from living biomass, soils and wood products, and the substitution of fossil fuels through the material and energy use of wood-based materials. The combined sink and substitution effects of wood value chains can provide a key mitigation option, provided that changes in fossil and biogenic carbon are taken into account in a comprehensive and balanced manner. Several research projects[[29]](#footnote-29) and COST Actions[[30]](#footnote-30) launched in FP7 looked into the development of innovative, resource efficient wood-based products. While ensuring the sustainability of forest production systems under changing climate conditions remains a long-term objective for the sector, a key challenge now is to further develop and deploy the technological advancements of micro/macroclimate-friendly wood-based value chains on the ground.

Scope: **A. [2019] Building with wood**: Proposals shall develop and test new technologies and environmental friendly solutions for the use of wood-based materials in the (re)construction and/or retrofitting of buildings. Proposals should also explore options for building with wood in combination with composite/hybrid materials, linkages with other nature-based solutions, make use of ICT, and consider LCA and carbon accounting, ‘environmental documentation’ (i.e. standards and construction codes), performance standards, public policies and regulations, consumer perception and engagement/co-creation. Activities could include limited research and shall produce plans and arrangements or designs for new, altered or improved products, processes or services. For this purpose they may include prototyping, testing, demonstrating, piloting, large-scale product validation and market replication. Proposals shall ensure that relevant actors (researchers, citizens, policy makers from urban/rural areas, businesses, architects, site-managers, etc.) work together during the whole research and innovation process in order to better align the process and its outcomes with the societal values, needs and expectations.

**B. [2020] Resilient forest systems**

Both sub-topics (A and B) are suitable for INCO and SMEs participation, and are expected to integrate technology with SSH and RRI aspects.

The Commission considers that proposals requesting a contribution from the EU of the order of EUR 10 million for sub-topic A and 5 million for sub-topic B would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: In the framework of SDG 9, 11, 13 and 15, the EU's Bioeconomy Strategy 2012, the EU's Forest Strategy 2013, the Circular Economy Package 2015 and Paris Agreement 2015, proposals are expected to assess how they will contribute to:

1. Increased resource and/or energy efficiency and added value and minimising pollution and the environmental footprint (emissions of GHG and air pollutants included) in the construction sector in the cities, by specific amounts/proportions to be specified in the proposals, by 2030 [sub-topic A];
2. Enhanced connectivity of rural-urban areas and their overall contribution to a resilient, circular and competitive, forest-based bioeconomy, by 2025 [sub-topic A];
3. Increased long-term resilience of forest production systems and associated value chains to enhanced climate/environmental change and societal demand [sub-topic B];
4. Enhanced contribution of forest-based sector to long-term climate change mitigation and rural development objectives [sub-topics A & B];
5. Also in the long-term, prompt a sizeable positive change to European landscapes and economies, by keeping the countryside green and serving to make the cities greener, and increasing the share of both decent and green jobs [sub-topics A & B].
6. Advance available solutions from TRL 4-5 to TRL 6-7 for sub-topic A and from TRL 3-4 to TRL 5 sub-topic B

Type of Action: Innovation action

# SC4: Smart, green and integrated transport

LC-MG-1-7-2019: Future propulsion and integration: towards a hybrid/electric aircraft (InCo flagship)

Specific Challenge: This action is part of the Aviation International Cooperation Flagship called "Safer and Greener Aviation in a Smaller World" mentioned in the introduction to this work programme 2018-2020.

The third challenge of Flightpath 2050 is related to environmental protection and the security of energy supply. At the Paris climate conference (COP21), countries agreed to limit climate change to well below 2°C. Without considerable contributions from the aviation sector to global mitigation efforts, this goal cannot be achieved. Carbon Neutral Growth from 2020 is possible through a combination of non-market and market measures. Regarding aircraft technologies, there is growing evidence that indicates that for airframe as well as for Propulsion and Power Systems (PPS), the projected cumulative impact of developed technologies will fall short of the year 2035 target. These projections account for the latest developments in airframe, weight gains from more-electric aircraft systems as well as advanced gas-turbines, such as expected high thermal efficiencies through intercooling and recuperation and propulsive efficiencies from Open Rotor.

Against this background it is necessary to develop future aviation propulsion and integration technologies with emphasis on hybrid-electric and full-electric propulsion. There is also a need for establishing a common roadmap and prioritize the key enabling technologies for the hybrid/electric configurations, including energy storage (batteries), for the aviation sector.

Scope: Proposals are expected to address feasibility design studies for aircraft energy system with integrated hybrid/electric propulsion and power generation architectures as well as sub-systems enablers in the context of appropriately projected advances in the next twenty-year framework. Each proposal may aim at several of the following areas:

1. Development of tools for tightly-coupled inter-disciplinary new architectural feasibility assessment for the hybrid/electric propulsion and power systems, including detailed feasibility design studies for innovative energy distribution, use and storage solutions.
2. Explore concepts on energy harvesting technologies to identifying, capturing, storing and re-using energy in flight and/or during take-off, landing, breaking and taxiing, which have potential to offer synergies with hybrid-electric architectures.
3. Explore emerging storage technologies that have potential to comply with aerospace requirements (e.g. performances, safety, dispatch…) for hybrid/electric propulsion and power systems.
4. Advance further Electro-Magnetic Interference solutions as well as thermal management trade-offs at system level.

Projects are expected to perform an assessment on the applicability, availability and upgrade of research infrastructures for testing and validation with focus on electrical and propulsion benches and computational tools. (incl. wind tunnels, electrical and propulsion benches and computational tools). Projects are also expected to develop updated roadmap with reference to key enabling technologies towards fully electric or hybrid-electric aircraft and explore new relevant regulatory frameworks.

The implementation of the proposed areas of this topic should cover TRLs ranging from 1 to 4.

In line with the strategy for EU international cooperation in research and innovation[[31]](#footnote-31), multilateral international cooperation is encouraged, in particular with countries such as Japan and Canada.

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

Expected Impact: Overall, the topic is expected to contribute to Flightpath 2050 goals, namely towards “environmental protection and the security of energy supply” as well as “maintaining global leadership”. Specific impact is expected in the following areas:

1. New paradigm shift towards emission-free aviation.
2. Strengthen the medium and long-term European aeronautics competitiveness.
3. Engagement of European aviation research community to a highly ambitious topic.
4. Establishment of roadmaps and prioritization key enabling technologies.
5. Foundations for next-generation European demonstrators.
6. Contribution to UN's Sustainable Development Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all.

Type of Action: Research and Innovation action

LC-MG-1-8-2019: Retrofit Solutions and Next Generation Propulsion for Waterborne Transport

Specific Challenge: Emissions from waterborne transport remain a challenge particularly concerning the water and air quality around coasts, ports and urban areas. For shipping and inland waterway transport retrofit technology including for example engine modifications, engine replacement, exhaust gas cleaning systems, PM filters, hybrid batteries, fuel changes, efficient emissions capture and storage system can potentially improve the environmental performance (CO2, NOx, SOx, PM) of existing fleets within the next five to ten years. However, new next generation vessels are expected to be both cleaner and more CO2 efficient. Vessels will be increasingly electrified and hybridised use clean fuels, on board energy storage and employ new technologies such as optimised design, batteries and high power fuels cells integrated within dual cycles and with combined heat and power. Novel large area propulsion systems also offer the possibility of large efficiency gains. To maximise efficiency gains from these technologies a radical rethink of ship design is needed.

Scope: To address these challenges, proposals should address one of the following two subtopics and clearly indicate which subtopic is addressed:

Subtopic A) To be implemented through Research and Innovation Action.

1. Develop and validate a concept for a passenger ship powered primarily by high power fuel cells and if more efficient, in combination with a combustion engine or turbine as a combined cycle. On board power should exceed 5 MW and the concept should address issues concerning; combined heat and power, battery hybridisation, reliability, environmental performance on the whole life cycle, safety, regulatory, cost, ship design and layout, power system weight, volume and service requirements. The concept should be founded using LNG or LBG or CBG or synthetic fuels with the additional consideration of the consequences of 100% hydrogen operation. In addition, the critical barriers to development and deployment should be identified together with a road map for their solution. Work is expected to focus on the integration of fuel cell technology within the ship and not the detailed internal design of the fuel cell. Work should build upon other relevant activities such as the development of the IGF code within IMO.

Subtopic B) To be implemented through Innovation Action.

Proposals should address one or more of the following aspects:

1. Develop and validate to at least TRL 5 innovative next generation high efficiency propulsion systems for ships using electrification and or clean fuels and or renewable energy sources. Consider all aspects of the ship propulsion system including related materials, electrical systems, energy storage and impact on ship design leading towards a zero emission maritime transport.
2. Develop and validate to TRL 5 highly innovative large area high efficiency or renewable energy assistance propulsion systems such as whale tales, novel wind power or bio mimic devices and their integration into the ship design. Demonstrate and assess on the whole life cycle, reliability, materials and efficiency at large model scale within a variety of conditions. Consider hydrodynamic and overall efficiency, endurance, reliability, materials, biofouling, noise, manufacture and cost.
3. Develop and demonstrate to TRL 6 innovative, cost effective retrofit solutions for marine shipping which will provide substantial improvements in terms of environmental impact and life cycle cost. Solutions must significantly reduce emission in line with water and air quality objectives and even exceeding current legislative requirements, particularly around ports and urban areas. In combination with distillate fuels, solutions must significantly reduce NOX, SOX and particulate matters (PM), particularly for the most harmful particle sizes, particularly within coastal and port areas. Operational requirements, cost benefits, including effluent disposal costs and procedures shall be considered. Disseminate outcomes and facilitate take up by key stake holders.
4. Develop and demonstrate to TRL 6 innovative, cost effective retrofit solutions for inland waterways which will provide substantial improvements in environmental performance. Solutions must significantly reduce emissions at least in compliance and preferably exceeding water and air quality requirements, particularly around terminals and urban areas. In combination with current compliance options (distillates or other low sulphur fuels, required engine operating parameters,…) solutions must meet regulatory requirements and significantly reduce NOX, SOX and ultrafine particulates, particularly for the most harmful particle sizes (including ultrafine particles), particularly within urban, port and terminal areas. Operational requirements, approvals, financing, cost benefits, including effluent disposal costs and procedures shall be considered. Disseminate outcomes and facilitate take up by key stake holders.

The Commission considers that proposals requesting a budget from the EU of between EUR 3 to 5 million each for Subtopic A and between EUR 4 to 6 million each for Subtopic B, would allow this specific challenge to be addressed appropriately. Nonetheless this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Next generation propulsion solutions will enable a large (>10%) increase in energy efficiency and CO2 reduction. Enable integration of large high power marine fuel cells into ship design and demonstrate their feasibility, cost effectiveness and identify technical barriers to adoption. Enable innovative high efficiency low emission ship propulsion system that may integrate several power sources. Demonstrate the feasibility, efficiency gains, reliability and cost effectiveness of large area propulsers. Retrofit solutions will reduce SOx, NOx and PM pollution from waterborne transport, particularly around ports, terminals, urban and coastal regions and in compliance with urban air quality standards but also at open sea since air pollution can travel large distances. Significantly, increase the take up of retrofit emission reduction solutions in existing vessels. Enhance European competitiveness and support European jobs and growth. Facilitate deployment of innovative green waterborne transport technology.

Type of Action: Innovation action, Research and Innovation action

### LC-GV-03-2019: User centric charging infrastructure

Specific Challenge: The market share of full electric vehicles is still low in many European member states. Several reasons have been identified for this. Charging infrastructure is considered as one of the central reasons when the urban model does not allow for widespread garage availability, or when frequent long range travel is involved. Currently most EV owners have their own garage and live in peri-urban areas.

Innovative solutions need to be evaluated and developed to allow EV drivers to have a similar or even better mobility experience than with conventional fossil fuel vehicles in terms of availability, convenience, performance and costs of the necessary charging infrastructure. At the same time, the infrastructure should not affect the noise environment around them, in order not to create resistance to their installation in urban contexts.

In the longer term, electric roads can be considered for further streamlining the user experience and optimising vehicle design, starting from urban and peri-urban applications such as bus, taxi and LDV lanes, for later extension to extra-urban applications.

The challenge will be to support the accelerated deployment of recharging infrastructure, on one hand a slow charging one for cities with low garage availability, on the other to support occasional ultrafast charging for long range travel. The responsible stakeholders need to be incentivized to take clear steps for a wide availability of charging points and to improve the conditions for a broad market acceptance in the electrification of transport.

Scope: Proposals will have to address all following technical areas including demonstration of the final solutions and their interoperability in multiple cities and TEN-T transnational road links:

1. Analysis of subjective perception of charging options and identification of decision influences and concerns of users. The results should provide the basis for strategies or solutions to encourage or incentivize users of different social groups to overcome acceptance barriers in order to accelerate widespread usage of EVs.
2. Attractive and convenient charging infrastructure access with connected vehicle systems avoiding waiting times (through for instance, charging facility reservation and scheduling, integration with route planning of multiple vehicles). User preferences like use of renewable energy and avoidance of frequent handling of heavy cables have to be considered. Automated conductive or wireless solutions are expected with highly reliable and interoperable devices. Test methods need to be further optimized, for instance to assess interoperability. Optionally, further extension of the developed stationary wireless charging technology towards urban and periurban "electric road" applications, with the aim of creating an installed base of wireless-ready vehicles to provide the critical mass needed for the deployment of electrified roads at a later stage.
3. Transparent, flexible and interconnected payment systems for maximum availability of the charging infrastructure also for drivers who do not regularly use the same car (company/family sharing, commercial car sharing, rental cars, …) or travel across Europe.
4. User survey about parking habits, considering for instance how much time is spent at a given location; what type of services are needed or expected during charging; how should the future charging station look like.
5. Improvement of the currently deployed or planned superfast charging systems according to the previous survey to convince all car owners of the advantages of electric mobility including a sufficient convenience for long trips. All technical possibilities for optimization, both on the vehicle (like temperature preconditioning), or for energy demand rationalisation (e.g. local renewable power support for solar panels, battery storage for peak shaving and other grid services, demand control by interconnected route management systems for incoming vehicles while taking into account the electricity grid availability and voltage and frequency control constraints in real-time) need to be taken into account.
6. Scalable charging infrastructure for ramp-up of expected electric mobility needs in terms of power levels and number of charging posts at one site, adequately managing the impact on the grid.
7. Cheap low power DC-Charging for highly efficient connection to future home and office energy systems based on DC-Networks with possibility of V2G by smartening the link between vehicle, charging infrastructure and the grid.
8. Low power DC-charging for LEV’s in combination with theft-proof parking for two-wheelers.
9. Analysis of market models, regulatory and harmonization recommendations to foster the deployment of EV charging infrastructure in all member states of the EU. Demand control also for slow charging in public or private parking garages shall be enabled by standardized communication to remove barriers of electricity installations in existing apartment blocks and garages considering smart grid implications.
10. Development of planning methods to optimize the location of charging sites, taking in consideration user needs and habits (volume of EVs in the area, type of mobility needs, accessibility to charging points, traffic volume, …) as well as time and costs associated to the availability and reinforcement of the necessary electricity network with easy scalability according to the different stages of EV penetration. Analysis and cost effective solutions for specific cases like availability of infrastructure in isolated mountain or seaside locations, or for special events, where high peak demand is associated with short periods of use. Consideration for local storage benefits in the different cases studied.

The Commission considers that proposals requesting a contribution from the EU between EUR 8 and 15 million depending on the level of involved demonstration would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

1. Wide user acceptance beyond early adopters, urban users and garage parkers;
2. Foster investors to invest in charging infrastructure;
3. Determine legal gaps which slow down infrastructure expansion and propose solutions;
4. Develop test methods and set up procedures to improve interoperability issues of vehicle-to-charger and charger-to-infrastructure communication;
5. Facilitate grid integration of high-power chargers;
6. Improve and standardize charging solutions and payment systems for LEVs for price reduction and higher market acceptance

Type of Action: Innovation action

### LC-GV-04-2019: Low-emissions propulsion for long-distance trucks and coaches

Specific Challenge: Long-distance transport is a main consumer of energy and contributor to CO2 and air pollutant emissions in Europe, and requires specific attention due to very high demand on efficiency, dependability, reliability and cost. This topic considers heavy-duty trucks and bus-coaches in long-distance operation, and the challenge will be to reduce their energy consumption, CO2 ,regulated and non-regulated emissions (to anticipate future legislation and emerging issues such as extremely fine nanoparticles) through multi–technology vehicles operated on a mix of alternative and renewable fuels as well as recuperated heat and regenerated and externally supplied electricity.

Scope: Proposals will have to address all the following technical areas:

1. Sub-systems and component concepts including electro-hybrid drives, optimized ICEs and after-treatment systems for alternative and renewable fuels, electric motors, smart auxiliaries, energy storage and power electronics, suitable for real life operation under different mission conditions
2. Concepts for connected and digitalized fleet management, predictive maintenance and operation in relation to electrification where appropriate to maximise the emissions reduction potential.
3. Implementation of required adaptations in VECTO accordingly to facilitate early take-up of the innovations.

The Commission considers that proposals requesting a contribution from the EU between EUR 20 and 25 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:

1. The internal combustion engine performance shall be further enhanced to reach a peak thermal efficiency target of 50%
2. Reduction of CO2 emissions based on new ICEs optimized (where sufficiently large benefits can be demonstrated) for different combinations using alternative and renewable fuels with additional energy savings using heat recuperation or plug-in hybrid. Emissions with high global warming potential will have to be taken into account in the total CO2 equivalent emissions target and methodologies to introduce such emissions in VECTO devised accordingly.
3. A total energy saving, excluding the effect of alternative fuels and plug-in electricity, of at least 10% with respect to the best in class conventional vehicle of 2018 (according to the ongoing monitoring exercise) is targeted at calculated vehicle level VECTO results, validated by propulsion system measurements
4. 30% reduction of NOx, CO and hydrocarbons in an extended range of environmental conditions
5. Reduction of unregulated components (N02, N20, NH3, CH4 for NG powertrains, PN measured with a lower threshold of 10nm
6. Reduction of noise in environmental zones in electric modes
7. Implementation of needed simulation methodologies in VECTO.

Type of Action: Innovation action

### LC-GV-05-2019: InCo flagship on “Urban mobility and sustainable electrification in large urban areas in developing and emerging economies”

Specific Challenge: Climate change, energy security and local air pollution are some of the key questions for the 21st century. Urban areas in developing and emerging countries are major driving factors in growing global energy demand and Greenhouse Gas emissions.

Although cities cover only 2% of the earth's surface, 50% of the world’s population lives in cities, but they are responsible for three-quarters of the global energy consumption as well as approximately 80% of the global greenhouse gas emissions. While the trend towards urbanisation and the associated increase of personal and freight transport creates massive challenges, in particular in developing and emerging economies, it also offers the unique opportunity to shape energy use especially in the transport and urban form towards a low carbon pathway. Moving towards sustainable mobility will also help addressing urban congestion, access to jobs and public services, and local air pollution.

This is why urbanisation requires integrated mobility solutions that bring together technology opportunities with local and national policy, including land use and mobility planning. Efficient transport and mobility, based on a balanced mix of public and private transport and dependent on the characteristics of each city, is and will continue to be the backbone of cities’ growth and competitiveness.

Whereas environmental issues are very high on urban mobility agendas, the importance of transport in urban social and economic structures is often neglected in discussions. All three aspects of urban sustainability must be treated with equal importance and have to be examined in parallel.

Scope: Actions should bring together European, Asian (e.g. China), CELAC (Community of Latin American and Caribbean States) and African research partners, government agencies and urban authorities, private sector and civil society with relevant expertise and competence within the corresponding cooperation framework and foster participatory engagement in urban electrification in order to reduce air pollution and CO2 emissions. All types of vehicle are considered under this topic (powered 2 wheelers, cars, buses, trucks and LDV).

Proposals should address all of the following activities:

1. Development of a toolbox for advanced management strategies towards a more efficient private and public electric mobility: E-mobility management strategies, focusing on smart deployment and operation of vehicles, in particular electrified vehicle, to increase mobility and energy efficiency, emission reduction and user acceptance of electrified vehicles
	1. A smart and cooperative management of the vehicle in urban operation, (intermodal route planning, ecorouting eco-driving charging and parking infrastructure availability…).
	2. Deployment and operation of infrastructure use charging infrastructure (conventional and wireless) and network, availability of parking places. Adaptation and integration of existing/ adapted vehicles of different types if necessary.
	3. Efficient integration of the operations of different electrified road public transport, from e-bike to bus rapid transit ( e- BRT) including mini-buses, taxi and mobility services on demand through smart navigation and routing, coordinated traffic management, demand-responsive service and dispatching
2. Comparative demonstrations activities and pilots in cities in Europe, Asia, African and/or CELAC countries: Innovative concepts for electrified road public transport (passenger andfreight), jointly designed through International Partnerships as a contribution to a wider sustainable mobility concept, from the perspective of a seamless mobility, taking in account the acceptance of users (travellers or freight operator). Comparative demonstrations activities and pilots (in European and Chinese’s Cities, African, CELAC countries) of such jointly designed concepts developed by local partners.
3. Implementation concepts to scale up the demonstration activities. Evaluation of the relative outputs and accordingly the development of implementation concepts to scale up the demonstration activities and exploration of the sustainable mobility planning in the city transformation process :
	1. Sustainable planning of city and transportation infrastructure: link city planning with policy discussion and implementation solutions and city goals and with any Air Quality Plans
	2. Dedicated plans for financing solutions, including public and private operations.
	3. Regional and international replication conditions to reach out to a larger number of cities and countries

Cooperation and synergies with ongoing activities undertaken with international initiatives such as Decarbonising Transport (International Transport Forum) and the Urban Electric Mobility Initiative (UN-Habitat) and other joint initiatives of European Member States international cooperation initiatives and the European Commission (e.g. Mobilise Your City) should be sought where appropriate.

In line with the strategy for EU international cooperation in research and innovation[[32]](#footnote-32), international cooperation is encouraged.

Applicants are invited to read the eligibility and admissibility conditions for this topic.

The Commission considers that proposals requesting a contribution from the EU in the range of EUR 15 and 18 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Proposals are expected to contribute to:

1. Capability to quantify the potential reduction of greenhouse gas and pollutant emissions as well as traffic congestion, by demonstrating improvements that can be achieved with new urban mobility systems and electrification, for each stakeholder in the value chain (in line with the objectives set by the COP21 and the New Urban Agenda)
2. Reference models of the mobility system to provide a basis in order to assess the ability to replicate sustainable concepts by demonstrating the short- and long-term benefit for the stakeholders involved, and especially considering the relevant boundary conditions (i.e infrastructure, vehicle, usage needs and patterns, governance, financing schemes, urban organisation, etc) and how the result contributes to key EU policy goals ( including climate goals and competitiveness of European industry
3. A basis for strengthening the collaboration of the European Union with Asia (e.g. China, India, etc), Latin America (CELAC) and Africa, which also offers both a common starting point for common future legislative efforts, as well a favourable setting for new business opportunities for innovative local and European entrepreneurs.

Type of Action: Innovation action

# SC5: Climate action, environment, resource efficiency and raw materials

### LC-CLA-01-2018: Supporting the development of climate policies to deliver on the Paris Agreement, through Integrated Assessment Models (IAMs)

Specific Challenge: Under the Paris Agreement (PA), Parties of the UNFCCC have to submit and periodically update Nationally Determined Contributions (NDCs), which represent their undertaking to pursue the objectives the Agreement. Parties have also committed to formulate and communicate their mid-century low greenhouse gas emission development strategies by 2020. The collective progress towards achieving the objectives of the PA will be periodically assessed, with the first ‘global stocktake’ envisaged to take place in 2023. These critical processes for global climate action must be underpinned by authoritative scientific results at national, regional and global level and supported by knowledge co-created through adequate frameworks that enhance legitimacy, inclusion, effectiveness and sustainability. Science should provide the necessary tools and knowledge-base in order to support the above mentioned processes, and contribute to the high impact and quality of the major emitters’ submissions.

Scope: Actions should address only one of the following sub-topics:

**a) Supporting the design and assessment of climate policies:** Actions should provide new and more comprehensive scientific knowledge on the design, requirements, governance and impacts of climate action at national, European and global level, for the effective implementation of NDCs, the preparation of future action pledges, the development of 2050 decarbonisation strategies in major emitting countries and for supporting the 2023 global stocktake under the UNFCCC. The potential and feasibility for dynamically increasing decarbonisation ambition over time should be considered, together with related socio-economic impacts and co-benefits (for example those related to water, air pollution or avoided impacts of climate change), also taking into consideration market-driven actions. This action should be based on the use of ensembles of Integrated Assessment Models (IAMs), covering the entire economy, all greenhouse gases, and the wide range of climate, air quality/environment, energy and other sectoral policies contributing to decarbonisation, and should provide useful information at global and national level. Beyond the EU, proposals should extend their analysis to some major emitters outside Europe and to selected less developed countries.

**b) Improving Integrated Assessment Models (IAMs):** Actions should further improve the state-of-the-art of IAMs, in order to provide robust and transparent assessments to support the design and evaluation of all mitigation policies – including those on energy efficiency and renewables – in the short to mid-term, as well as to address the challenges and opportunities related to long term decarbonisation with a time horizon beyond 2050. Improvements in one or more of the following areas should be addressed: sectoral coverage across the entire economy (including more accurate representation of bunker fuels and land-based emissions/sinks), inclusion of all greenhouse gases, representation of issues such as structural and behavioural change and uncertainty, inequality, interaction with other relevant development goals, negative emission technologies, co-benefits of actions due to avoided impacts and reduced adaptation needs. Furthermore, actions should also improve the geographical coverage of global models including through in-country development of national modelling capacity.

Under both a) and b) subtopics and in line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation is encouraged with major emitters and with less developed countries requiring support for the design and implementation of current and future NDCs.

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

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

1. supporting EU climate policy and the preparation of EU submissions to the UNFCCC and the 2023 global stocktake exercise under the UNFCCC;
2. major international scientific assessments such as the IPCC reports;
3. enhanced international cooperation
4. fostering innovative policy-making through robust methodologies and tools and reduction of uncertainties;
5. improved legitimacy of models, methods and tools through greater transparency.

Type of Action: Research and Innovation action

### LC-CLA-02-2019: Negative emissions and land-use based mitigation assessment

Specific Challenge: Most low-carbon pathways leading to well below 2°C (or 1.5°C) stabilisation of the global temperature – in line with the Paris Agreement goals – include negative emissions to compensate for residual emissions and/or temperature overshoot and highlight the critical role of land-use based mitigation. There is therefore a need to quantitatively assess the potential, effectiveness and impacts of negative emission technologies/practices and of land-use mitigation options, in achieving the long-term goals of the Paris Agreement, as well as linking these to what it would mean for concrete policy challenges.

Scope: Actions should address only one of the following sub-topics:

**a) Feasibility of negative emissions for climate stabilisation:** Actions should assess the potential, effectiveness, efficiency, risks and costs of existing and emerging negative emission technologies and practices for climate stabilisation and their impact on: land, subsurface, water, oceans and other resources, bio-diversity, human safety, food security, ecosystems and their ability to deliver services to society, including implications for resilience, sustainability, feedbacks on climate and the global carbon cycle, and other relevant issues. Actions should also cover the issue of public acceptance and explore the international governance requirements associated with large-scale deployment of negative emission technologies and practices.

**b) Land-based mitigation:** Actions should provide a comprehensive analysis of various land-use based mitigation options at the global and regional level, assessing their potential and effectiveness in providing large-scale reductions of greenhouse gases, in the context of trade-offs and/or co-benefits in relation to other pressures and goals (e.g. food, energy and water security, biodiversity) and should analyse feedbacks between land-use based mitigation and climate change impacts. Actions should also improve current methodologies to estimate emissions and removals associated with land use measures, also by leveraging observations from GEOSS and in particular the Copernicus programme.

For both of the sub-topics, in line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation is encouraged.

For both of the sub-topics, actions should envisage resources for clustering with other actions funded under this topic.

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

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

1. major international scientific assessments such as the IPCC reports and the IPBES, as well as to national and EU impact assessments of possible mitigation options;
2. developing a comprehensive medium-to-long term vision and analytical framework on pathways to achieve climate neutrality[[33]](#footnote-33) in the perspective of reaching the PA goals;
3. improved ex-post, spatially explicit monitoring of the mitigation performance of the land sector;
4. enhanced international cooperation.

Type of Action: Research and Innovation action

### LC-CLA-03-2018: Climate change impacts in Europe

Specific Challenge: Climate change is likely to make it harder to address *inter alia* poverty, disease, food and water insecurity in Europe. Rising temperatures and changing precipitation will affect the availability of food, energy and water, leading to likely increased volatility in food prices, and heightened regional tensions, affecting international stability and security. An increased frequency and/or intensity of extreme weather events may adversely affect human, animal and plant health, disrupt the flow of natural resources and commodities, and threaten infrastructure globally. Moreover, the inherent uncertainty of climate impacts is likely to increase risks for the business and financial sectors.

Scope: Actions should address only one of the following sub-topics:

**a)** **Climate change impacts on health in Europe**: Actions should review, report and progress on the current state-of-the art knowledge on the links between climate change and impacts on human health in Europe that have thus far been poorly addressed or understood. Actions should also identify associated costs and suggest effective adaptation strategies, quantify health co-benefits from mitigation and early adaptation, target research actions to address key issues and identified research gaps[[34]](#footnote-34) and prioritise those that are of significance for Europe. Actions may, where appropriate, cluster with activities of global collaborative research actions (e.g. Belmont Forum) on climate change and health. Applicants are encouraged to seek synergies with relevant actions under Societal Challenge 1.

**b) Global climate change impacts from a** **European perspective**: Actions should consider how direct and indirect impacts beyond European borders will affect supply and value chains of relevance for the European economy and society, and related sectors such as finance, business, infrastructure, resources and commodities. Actions should also consider how these impacts will affect relevant European policies, such as those on climate change, foreign affairs, security, agriculture and/or others, and analyse how perceived associated risks may further impact on Europe. Actions should consider different climate (including high-end) scenarios and undertake a risk analysis for Europe at the most appropriate geographic and time scales.

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

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

* improved capability in assessing impacts of climate change;
* enabling evidence-based decision making through better understanding of mitigation and adaptation costs and co-benefits, and of potential new climate-related pressures on the EU;
* enhanced information base relevant for the 2023 global stocktake exercise under the UNFCCC;
* informing major international scientific assessments such as the IPCC reports and the IPBES, as well as to EU and national adaptation strategies and plans;
* cohesive European resilience to climate change.

Type of Action: Research and Innovation action

### CE-SC5-03-2018: Demonstrating systemic urban development for circular and regenerative cities

Specific Challenge: Cities struggle in their transition to implement a full circular economy model incorporating regenerative practices. There is a clear need for cities to become circular in order to alter urban consumption patterns and value chains, and to stimulate innovation, business opportunities, and job creation in both established and newly created sectors. New, more flexible systemic urban planning instruments enabling the design and implementation of circular urban processes would make urban and peri-urban areas regenerative and facilitate their adaptation to emerging economic, social and environmental challenges.

Scope: Actions should demonstrate how cities[[35]](#footnote-35) can be transformed into centres of circular innovation and stimulate regenerative practices in both urban and peri-urban areas (including the surrounding industrial areas and commercial ports).

Actions should develop and implement innovative urban planning approaches and instruments (e.g. dynamic and semantic 3D real time flexible geospatial data and planning tools, innovative governance and legislation enabling new practices, design approaches, business models, etc.) to support and guide the transition towards circular and regenerative cities in terms of their built environment, public space, urban spatial use and programming. They should demonstrate innovative solutions for closing the loop of urban material and resource flows within the nexus of water, energy, food, air, ecosystem services, soil, biomass, waste/wastewater, recyclables and materials and for supporting an increase in the regenerative capacity of the city while limiting pollution of the environment, for example by reducing the emissions of air pollutants. At the same time, these solutions should ensure sound management of trade-offs and synergies among and across sectors. They should include ways of sustainably reusing and (mixed-use) reprogramming of existing buildings, open spaces and (infra)structures. The action should actively involve public authorities, societal stakeholders and community-based partners such as city-makers, urban (fab-) labs, urban planners, (urban) designers, cultural & creative organisations, and start-ups in close collaboration with the cities to find practical and durable solutions.

In addition actions should develop and implement innovative local governance structures and networks to enhance circular economy innovation in the urban fabric and help prioritise flexible implementation of urban space programming for circular initiatives. Actions should enable the continuous monitoring and optimisation of “urban metabolic” processes and rapid management interventions, where needed, deploying new indicators enabling easy assessment, comparison and sharing of best practice on the ground as well as digital solutions comprising networks of sensors, big data, geo-localisation, observational programmes such as Copernicus and GEOSS, satellite navigation and positioning services offered by EGNOS/Galileo, and citizens’ observatories.

Actions are expected to establish long-term sustainable data platforms securing open, consistent data on the impacts of the deployed approaches, and to ensure interoperability of relevant data infrastructures for effective communication, public consultation, and exchange of experiences.

An interdisciplinary approach, including the participation of applied natural sciences, social sciences and humanities disciplines (such as behavioural economics, gender studies, urban planning and governance) is considered crucial to properly address the complex challenges of this topic.

Proposals should pay attention to the special call conditions for this topic.

To enhance the impact and promote upscaling and replication of these solutions, actions should engage in substantial networking and training activities to disseminate their experience, knowledge and deployment practices to cities that are planning to design and implement similar solutions in a successive phase beyond the duration of the project. To enhance impact, cooperation and synergies with the activities undertaken within the Global Covenant of Mayors for Climate and Energy initiative, and in particular the regional component for Europe[[36]](#footnote-36)(supported by the EC) should be sought where appropriate.

Furthermore, actions should envisage resources for clustering with other ongoing and future projects on sustainable cities through nature-based solutions funded under the 'Smart and Sustainable Cities' call in part 17 of the 2016-2017 Work Programme as well as under the topics SC5-20-2019 and SC5-14-2019 of this Work Programme. They should also ensure that there will be no duplication with work undertaken by relevant projects funded under the topic 'CO-CREATION-02-2016 - User-driven innovation: value creation through design-enabled innovation'.

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

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

1. measurable reduction of materials, natural resource consumption and environmental footprint in urban and peri-urban areas;
2. measurable increase of the regenerative capacity of urban and peri-urban areas due to a measurable increase in material and natural resource creation in cities, as well as increased productivity through maximisation of (multi)-functional use and programming of urban spaces;
3. set of social behavioural, economic, environmental performance and geospatial indicators to monitor and assess the urban and peri-urban circularity and regenerative capacity;
4. local governance innovation in response to the needs and concerns of stakeholders and the affected public as well as boosted creativity and entrepreneurship related to circularity and regenerative processes;
5. the implementation of the EU Circular Economy Action Plan with a direct link to the urban fabric (built and public space), and the Habitat III New Urban Agenda's commitment to transition to a circular economy.

Type of Action: Innovation action

### CE-SC5-04-2019: Building a water-smart economy and society

Specific Challenge: There is a growing demand for water from various economic activities and increasing stress on natural water sources. To secure water for our society, there is therefore a need to make available alternative water resources of various qualities and which are appropriate for different functions and multiple users, and to better exploit water resources and all the valuable substances that could be obtained through the wastewater treatment and reuse process. However, innovations in this domain remain fragmented and/or only experimented at small scales; testing and deployment in operational environments and at scales suitable for encouraging wider uptake is still missing.

Scope: Actions should demonstrate the feasibility of a 'water smart' economy and society in which all available water resources, including surface, groundwater, waste water, and process water, are managed in such a way as to avoid water scarcity and pollution, increase resilience to climate change, appropriately manage water-related risks, and ensure that all valuable substances that could be obtained from waste water treatment processes, or are embedded in used water streams, are recovered.

Actions should address only one of the following sub-topics:

**a) Symbiosis between industry and water utilities:** Actions should demonstrate resource-efficient solutions derived from the systemic exploitation of symbiotic inter-linkages between wastewater treatment in industry and by water utilities. These might address, for instance, the reuse of treated wastewater, the use of substances or energy derived from wastewater treatment, or might demonstrate the concept of dynamic allocation of the right quality of water for the right purpose, while ensuring health and safety. Innovative solutions do not need to be only technological, but may also encompass other types of innovation such as innovative governance and stakeholder engagement or business models in industrial environments.

**b) Large scale applications with multiple water users at various relevant scales:** Actions should test and demonstrate systemic innovation in real life, large scale operational environments. Actions should address multiple water users (urban, industrial, rural and agricultural) and various relevant scales (regional/national/international) for:

1. stimulating efficient and multiple use, recycling and reuse of water; recovery of energy and materials (such as nutrients, minerals, chemicals and metals) from water;
2. managing water demand and efficient allocation;
3. exploiting alternative water sources;
4. prevention of water pollution and degradation of the aquatic environment and soil; and
5. cost-effective and smart management of the water system and infrastructure.

As far as possible, the innovative solutions should include all of the above-mentioned activities. Actions should also consider: new marketing and financing concepts and strategies to maximise the multiple values of water and increase the attractiveness of the water sector for investors; new governance approaches and decision-making instruments for water managers; water systems vulnerability approaches and other sustainability assessments (e.g. footprint, Life Cycle Assessment).

The participation of social sciences and humanities, also addressing the gender dimension, is considered crucial to properly address the complex challenges of this topic, especially those related to human behaviour and attitudes towards water, the inter-linkages between policy and implementation, and acceptance of the solutions developed by both the public and other water users.

For both sub-topics, deployment of enabling digital solutions for the monitoring, control and optimisation of data and processes is also encouraged. Where appropriate, related regulatory and institutional barriers which prevent the wide application of developed innovative solutions should be addressed. Where technological innovation is concerned, TRL 5-7 should be achieved. To assure applicability and wide deployment of the innovative water technologies in different conditions (including different water resources, economic, social and regulatory settings) involvement of market take-up partners and/or end users from a wide range of different European regions is strongly encouraged, as well as SME participation.

The Commission considers that proposals requesting a contribution from the EU of between EUR 10 million and EUR 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: The project results are expected to contribute to:

1. significantly reduced use of water from freshwater sources;
2. improved recovery and use of resources (materials and water itself), including energy;
3. mobilisation of water-related investments and synergies with other funding instruments.
4. the creation of new business opportunities and increased competiveness of EU industries;
5. supporting, as appropriate, the implementation of EU water policies, the transition to a more circular economy at different scales and economic and social conditions[[37]](#footnote-37), water security, water use efficiency, enhanced resilience to climate change and achievement of the relevant Sustainable Development Goals;
6. the implementation of the objectives of the EIP Water and, where appropriate, supporting the implementation and evaluation of technology verification schemes, including the EU Environmental Technology Verification Pilot (ETV) programme.

Type of Action: Innovation action

### CE-SC5-06-2018: New technologies for the enhanced recovery of by-products

Specific Challenge: Securing the sustainable access to raw materials, including metals, industrial minerals and construction raw materials, and particularly Critical Raw Materials (CRM), is of high importance for the EU economy. There is a need for innovative and sustainable raw materials production solutions at lower TRLs to increase the range and quality of raw materials recovered from primary and secondary resources.

This specific challenge is identified in the Priority Area 'Technologies for primary and secondary raw materials production' of the European Innovation Partnership (EIP) on Raw Materials.

Scope: Actions should develop sustainable systemic solutions through industrially- and user-driven multidisciplinary consortia covering the relevant value chain of non-energy, non-agricultural raw materials.

Actions should develop sustainable solutions finishing at the level of Technology Readiness Levels (TRL) 3-5.

Actions should evaluate the potential by-products[[38]](#footnote-38) existing in primary or secondary raw materials and should develop energy-, material- and cost-efficient new sustainable mineral processing and/or metallurgical technologies and processes to increase the selectivity and the recovery rates of valuable by-products, particularly critical raw materials. The importance of the targeted sources of by-products for the EU economy should be duly demonstrated in the proposal. Recycling of end-of-life products is excluded from this topic.

All actions should contribute to achieving the objectives of the EIP on Raw Materials and to building the EU knowledge base of primary and secondary raw materials by feeding into the EC Raw Materials Information System – RMIS[[39]](#footnote-39). Actions should also contribute to improving the awareness of relevant external stakeholders and the general public across the EU about the importance of raw materials for society, the challenges related to their supply within the EU and about proposed solutions which could help to improve society's acceptance of and trust in sustainable raw materials production in the EU.

Actions should include a task to cluster with other projects financed under this topic and – if possible – with other relevant projects in the field funded by Horizon 2020, in support of the EIP on Raw Materials.

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

The Commission considers that proposals requesting a contribution from the EU of between EUR 3 million and EUR 7 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

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

1. pushing the EU to the forefront in the area of raw materials processing technologies and solutions through generated know-how (planned patents, publications in high impact journals and joint public-private publications etc.);
2. significantly increased process selectivity, broader range and higher recovery rates of valuable raw materials, particularly critical raw materials, thereby unlocking substantial reserves of new or currently unexploited/underexploited resources within the EU;
3. significantly increased economic performance in terms of higher material-, water-, energy- and cost-efficiency and flexibility in minerals processing, metallurgical or recycling processes;
4. in the longer term, improving the competitiveness of and creating added value and new jobs in raw materials processing, refining, equipment manufacturing and downstream industries;
5. improving significantly the health, safety and environmental performance of the operations throughout the whole life cycle which is considered, including a reduction in waste, wastewater and emissions generation and a better recovery of resources from generated waste.

Type of Action: Research and Innovation action

### CE-SC5-07-2018-2019-2020: Raw materials innovation for the circular economy: sustainable processing, reuse, recycling and recovery schemes [[40]](#footnote-40)

Specific Challenge: Securing the sustainable access to raw materials, including metals, industrial minerals, wood- and rubber-based, construction and forest-based raw materials, and particularly Critical Raw Materials (CRM), is of high importance for the EU economy. Complex primary and secondary resources contain many different raw materials. Their processing, reuse, recycling and recovery schemes are complex and imply different steps, ranging from collection, logistics, sorting and separation to cleaning, refining and purification of materials.

The challenge for industry is to scale up promising raw materials production technologies and to demonstrate that raw materials can be produced in an innovative and sustainable way in order to make sure that research and innovation end up on the market, to strengthen the competitiveness of the European raw materials industries, meet ambitious energy and climate targets for 2030, minimise environmental impacts and risks, and gain the trust of EU citizens in the raw materials sector.

This specific challenge addresses the development of "innovative pilot actions"[[41]](#footnote-41), which is one of the major targets of the European Innovation Partnership (EIP) on Raw Materials.

Scope: Actions should develop and demonstrate innovative pilots for the clean and sustainable production of non-energy, non-agricultural raw materials in the EU from primary and/or secondary sources finishing at Technology Readiness Levels (TRL) 6-7.

All actions should contribute to achieving the targets of the EIP on Raw Materials, particularly in terms of innovative pilot actions on processing and/or recycling for the innovative production of raw materials, and to building the EU knowledge base of primary and secondary raw materials by feeding into the EC Raw Materials Information System – RMIS[[42]](#footnote-42). Actions should also contribute to improving the awareness of relevant external stakeholders and the general public across the EU about the importance of raw materials for society, the challenges related to their supply within the EU and about proposed solutions which could help to improve society's acceptance of and trust in sustainable raw materials production in the EU.

All actions should facilitate the market uptake of solutions developed through industrially- and user-driven multidisciplinary consortia covering the relevant value chain and should consider standardisation aspects when relevant.

All actions should justify the relevance of selected pilot demonstrations in different locations within the EU (and also outside if there is a clear added value for the EU economy, industry and society).

All actions should include an outline of the initial exploitation and business plans (with indicated CAPEX, OPEX, IRR and NPV[[43]](#footnote-43)) with clarified management of intellectual property rights, and commitment to the first exploitation.

Actions should also include a task to cluster with other projects financed under this topic and – where possible – with other relevant projects in the field funded by Horizon 2020, in support of the EIP on Raw Materials.

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

The Commission considers that proposals requesting a contribution from the EU of between EUR 8 million and EUR 13 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Applying a circular economy approach throughout the entire value chain, actions for this multi-annual topic should address only one of the following sub-topics:

**a)** **Sustainable processing and refining of primary and/or secondary raw materials (2018, 2019):** Actions should demonstrate new or improved systems integrating relevant processing and refining technologies for better recovery of minerals and metals at increased efficiency in terms of better yield and process selectivity as well as better utilisation of resources (hence reducing wastes). This would include processing of and recovery from low grade and/or complex ores and/or from industrial or mining wastes, and/or the reduction of the content of toxic elements or compounds in the resulting materials. The importance of the targeted raw materials and their sources for the EU should be demonstrated in the proposal. The solution proposed should be flexible enough to adapt to different or variable ore/secondary raw material grades and should be supported by efficient and robust process control. Where relevant, any solution proposed for the reduction of the content of toxic elements or compounds in the resulting materials should also include the appropriate management of the hazardous substances removed. Recycling of end-of-life products is excluded from this option.

**b) Recycling of raw materials from end-of-life products (2018, 2019):** Actions should develop and demonstrate novel and environmentally sound solutions for a higher recycling and recovery of secondary raw materials from end-of-life products such as waste electrical and electronic equipment (WEEE), batteries, wood-based panels, multi-material paper packaging, end-of-life tyres, etc. These products can contain a multitude of minerals, metals, wood and wood-fibre, rubber, etc. (including critical raw materials and other technology metals).

**c) Recycling of raw materials from buildings (2018, 2019):** Actions should develop and demonstrate novel solutions for a high-value recovery of raw materials from buildings. Actions should also benchmark against a series of comparative case studies of construction and demolition waste (C&DW) management in deconstruction of buildings of representative size categories in countries with different types of end-of-life building stocks, showcasing the appropriate use of the following: the EU C&DW Management Protocol[[44]](#footnote-44), pre-demolition audit, smart demolition practices, using appropriate technical equipment, and sorting/processing and quality management of waste fractions such as metals, aggregates, concrete, bricks, plasterboard, glass, polymers and plastics and wood.

**d) Advanced sorting systems for high-performance recycling of complex end-of-life products (2018, 2019):** Actions should develop and demonstrate innovative dismantling and sorting systems enabling functional recycling of critical raw materials, or other types of highly efficient recovery of metals, minerals or construction materials, from complex end-of-life products and scrap thereof. The advanced sorting systems should achieve very high throughput rates in order to allow their economically viable operation on the European market.

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

1. pushing the EU to the forefront in the area of raw materials processing and/or recycling technologies and solutions through generated know-how (planned patents, publications in high impact journals and joint public-private publications etc.);
2. improving significantly the economic viability and market potential that will be gained through the pilot, leading to expanding the business across the EU after the project is finished, as well as creating added value and new jobs in raw materials producing, equipment manufacturing and/or downstream industries;
3. unlocking a significant volume of various primary/secondary raw materials currently unexploited/underexploited within the EU, hence improving their 'circularity' in the economy;
4. improving significantly the health, safety and environmental performance throughout the whole life cycle considered, including better energy and water efficiency, a reduction in waste generation and wastewater and a better recovery of resources from generated waste or a better recovery and recycling of resources from complex end-of-life products;
5. additionally, only for sub-topic b) 'Recycling of raw materials from end-of-life products', in the shorter term, increasing measurably the efficiency and effectiveness (range, yield, quality and selectivity of recovered materials) of the exploitation of complex and heterogeneous secondary raw materials deposits ('urban mines') when compared to the state of the art;
6. additionally, only for sub-topic c) 'Recycling of raw materials from buildings', lead to wider application of smart demolition techniques, C&DW processing, quality assurance practices, traceability and standardization for secondary raw materials in the construction sector, thus improving the material and value recovery rate.

Type of Action: Innovation action

### CE-SC5-08-2018-2019-2020: Raw materials policy support actions for the circular economy [[45]](#footnote-45)

Specific Challenge: In order to secure the sustainable access to primary and secondary raw materials, including metals, industrial minerals, construction raw materials, wood, and particularly Critical Raw Materials (CRMs) for the EU economy, there is a need to tackle a number of specific non-technological challenges at local, regional, national, EU and global levels.

Illegal shipments of waste, both within the EU and to non-EU countries, and poor recycling have adverse effects on human health and the environment, create unfair competition for law abiding operators and give rise to the loss of valuable resources in the case of poor or no treatment. However, port authorities and enforcement authorities have limited resources to control the ever increasing amount of material shipped and this without blocking normal traffic. In addition, at the moment there is no distinction in customs codes between “new goods” and “second hand goods” which implies that illegal waste shipments are often disguised as “second hand goods”.

Currently, at most only one third of waste wood is recycled, the rest being landfilled or incinerated and there are great differences between Member States in wood recycling performance. Increasing production costs combined with stagnating product prices in recent years have put pressure on the profit margins of the EU woodworking industries, mostly dominated by SMEs. There is a need for higher resource efficiency and increased use of recycled wood in wood processing that can provide measurable improvements in company profitability.

Requirements for responsible sourcing in the raw materials value chain have recently been strengthened in one aspect by the new EU Conflict Minerals legislation. However, the need for the industry to engage in responsible sourcing and responsible business conduct and to perform relevant due diligence goes beyond legislative obligations – it is rooted in the growing expectations of consumers, civil society, governments and procurement managers (buyers). While it is very difficult for individual operators to meet such expectations due to the limited availability of the necessary information, downstream industries increasingly require all operators in their supply chain to address risks by performing due diligence. Responsible sourcing of raw materials is becoming a new business reality; in the short term it may offer a competitive advantage to frontrunners and in the long term, it could become a necessary "license to operate" and, given the global character of today's supply chains, it is also a way to be integrated in global supply chains.

Scope: All actions should contribute to building the EU knowledge base of primary and secondary raw materials (EC Raw Materials Information System – RMIS[[46]](#footnote-46)).

Actions should include a task to cluster with other relevant projects in the field funded by Horizon 2020, in support of the EIP on Raw Materials.

Actions should address only one of the following sub-topics[[47]](#footnote-47):

**a) Voluntary scheme for certification of treatment facilities for key types of wastes (2018):** Actions should develop and launch a voluntary scheme for certification – including verification – of treatment facilities for key types of waste/recyclates containing significant amounts of critical raw materials (e.g. electronic waste and/or waste batteries). The scheme should integrate measurable and verifiable minimum quality standards and a verification procedure based on traceability through the supply chain from collection to end-processing. Participation of relevant stakeholders – including waste holders, dealers, brokers and operators of treatment facilities – from the conception phase of the scheme should be ensured. Full compliance with applicable WTO rules and with the rules and principles of the Basel Convention should be ensured, and existing certification schemes for waste should be taken into account.

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

The Commission considers that for this sub-topic, proposals requesting a contribution from the EU of 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.

**b) Resource efficiency in wood processing, recovery and recycling (2018):** Actions should identify, assess and document existing practices in a representative set of EU Member States/Associated Countries and possibly third countries, and create a network to widely disseminate and transfer good practices covering both issues: resource-efficient wood processing and wood waste recycling. Resource-efficient wood processing in the woodworking sector should improve companies' operational performance and hence the EU sector's overall competitiveness. Quality-oriented and cost-efficient wood waste collection systems, sorting and recycling, and design solutions should facilitate increased wood recycling together with increased product quality and market acceptance of recovered wood in new products. Involvement of relevant stakeholders across value chains is necessary, including wood processing industries, research & innovation institutes, woodworking products end-users, municipalities and other parties dealing with wood waste collection, sorting and recycling. Actions should also assess trade-offs between wood waste use for material and energy. This assessment should be based on life cycle analysis and all sustainability pillars, and consider impacts on sustainable forest operations and ecosystems integrity (for all major EU forest regions) and impacts of intra-EU trade[[48]](#footnote-48). Proposals should include the participation of industrial SMEs, as far as possible.

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

**c) Responsible sourcing of raw materials in global value chains (2019):** Actions should create a global business and stakeholder platform for exchange of information and the promotion of responsible sourcing and responsible business conduct involving a network of key international experts and stakeholders. The aim is to engage governmental and corporate partners from the EU/Associated Countries and third countries in developing a globally acceptable concept of a responsible sourcing in minerals and metals value chains.

The platform should develop ideas for creating incentives for responsible sourcing in raw materials value chains, strengthen EU outreach to third countries to promote the concept in intergovernmental forums and to establish responsible sourcing in EU business practice. Interaction with other related existing platforms, networks and initiatives is encouraged. Actions should consider the relevant aspects related to environmental sustainability.

In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation is encouraged, particularly with partners from advanced countries using raw materials[[49]](#footnote-49).

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

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

**sub-topic a)**

1. achieving the objectives and the implementation of both the Raw Materials Initiative[[50]](#footnote-50) and the EIP on Raw Materials, in particular in terms of strengthening the enforcement of the Waste Shipment Regulation and improving access to critical raw materials (CRMs);
2. increased recovery rates in the EU as regards key types of waste/recyclates containing significant amounts of CRMs;
3. in the longer term, reduced EU dependency on imports of CRMs;
4. creating added value and new jobs in metallurgy, equipment manufacturing and/or downstream industries;
5. improving the environmental (control of emissions, residues, effluents), health and safety performance of operations throughout the whole life cycle;

**sub-topic b)**

1. achieving the objectives and the implementation of the EU Forest Strategy[[51]](#footnote-51), Circular Economy Action Plan and the EIP on Raw Materials on resource-efficient use of resources;
2. improving knowledge and conditions for efficient wood processing when compared to the state of the art, resulting in increased competitiveness of the EU woodworking industries;
3. increased wood waste recycling across the EU (including from furniture, construction and demolition, packaging, household) and increased acceptance in the use of secondary wood;
4. better informed decision-making at EU, national and local levels in the private and public sectors on wood recycling and resource efficiency; and improved knowledge of EU stakeholders about proposed solutions, including authorities involved in wood recycling;
5. in the medium and long term, creating added value and new jobs and increasing the overall competitiveness of the EU woodworking industries and related value-chains through an uptake of resource-, water- and energy-efficient solutions;

**sub-topic c)**

1. achieving the objectives of both the Raw Materials Initiative[[52]](#footnote-52) and the EIP on Raw Materials in terms of the access and responsible sourcing of raw materials;
2. improved awareness of consumers/corporates and improved perception of responsible sourcing as a source of competitive advantage through more responsible sourcing and responsible business conduct initiatives with regards to raw materials;
3. increased visibility of responsible sourcing in global political agenda-setting and emergence of a globally accepted definition of responsible sourcing.

Type of Action: Coordination and support action

### SC5-09-2018-2019: New solutions for the sustainable production of raw materials

Specific Challenge: Securing sustainable access to raw materials, including metals, industrial minerals and construction raw materials, and particularly Critical Raw Materials (CRM), is of high importance for the EU economy. However, the EU is confronted with a number of technological and environmental challenges along the entire production value chain of primary and secondary raw materials. There is also a need for very innovative and sustainable raw materials production solutions at lower TRLs to bring the next 'digital generation' to the raw materials field.

This specific challenge is identified in the Priority Area 'Technologies for primary and secondary raw materials production' of the European Innovation Partnership (EIP) on Raw Materials.

Scope: All actions should develop sustainable and resource-efficient solutions through industrially- and user-driven multidisciplinary consortia covering the relevant value chain of non-energy non-agricultural raw materials.

Actions should develop technological solutions finishing at the level of Technology Readiness Levels (TRL) 3-5.

All actions should contribute to achieving the objectives of the EIP on Raw Materials and to building the EU knowledge base of primary and secondary raw materials by feeding into the EC Raw Materials Information System – RMIS[[53]](#footnote-53). Actions should also contribute to improving the awareness of relevant external stakeholders and the general public across the EU about the importance of raw materials for society, the challenges related to their supply within the EU and about proposed solutions which could help to improve society's acceptance of and trust in sustainable raw materials production in the EU.

Actions should include a task to cluster with other projects financed under this topic and – if possible – with other relevant projects in the field funded by Horizon 2020, in support of the EIP on Raw Materials.

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

Actions should address only one of the following sub-topics:

**a) Breakthrough concepts and solutions for sustainable exploration, mining and/or processing (2018):** Actions should develop ground-breaking concepts and solutions for exploration, mining and/or raw materials processing to secure the sustainable access to abiotic raw materials for the EU in the long term and to gain the trust of society in clean and safe production of raw materials. Recycling of end-of-life products is excluded from this topic. Solutions for marine mineral resources are also excluded from this sub-topic.

**b) Digital mine (2019):** Actions should develop an Industrial Internet of Things (IIoT) platform to significantly enhance the efficiency of mining operations by connecting cyber and physical systems and devices to extract valuable insights from their data, in order to improve the decision-making process, better address customer requirements, and to address health and safety aspects, environmental performance, increased automation, predictive maintenance, resource efficiency and real-time coordination of operations. Usage scenarios for mining operations should be presented to demonstrate the viability of the proposed IIoT approach. Actions should promote the adoption of IIoT platforms in the mining sector at EU level.

**c) Recovery of metals and minerals from sea resources (2019):** Actions should develop new technological solutions for the processing of minerals and metals from sea resources, including seawater brines, and/or the seabed in a sustainable way addressing the challenges of industrial viability of the whole process and accessibility, and responsibly addressing the environmental impacts. In the case of minerals and metals dissolved in sea water, actions should demonstrate the technological feasibility and cost-effectiveness of highly efficient and effective recovery processes.

The Commission considers that proposals requesting a contribution from the EU of between EUR 3 million and EUR 7 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

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

1. pushing the EU to the forefront in the relevant areas through generated know how (planned patents, publications in high impact journals and joint public-private publications etc.);
2. safeguarding environmental sustainability (including better energy and water efficiency and a reduction in waste, wastewater and emissions) and improving significantly the health and safety performance of the solutions provided throughout the whole life cycle considered;
3. creating a lower TRL technology base for radical innovations within the next decades in the sectors concerned that would help unlock substantial reserves of new or currently unexploited resources within the EU;
4. in the longer term, improving the economic viability of operations and enhancing the competitiveness of, and creating added value and new jobs in raw materials producing, equipment manufacturing, information and communication technologies and/or downstream industries.

Type of Action: Research and Innovation action

### SC5-10-2019-2020: Raw materials innovation actions: exploration and Earth observation in support of sustainable mining [[54]](#footnote-54)

Specific Challenge: Securing the sustainable access to raw materials, including metals, industrial minerals and construction raw materials, and particularly Critical Raw Materials (CRM), is of high importance for the EU economy.

The challenge for industry is to scale up promising raw materials production technologies, including for exploration, and to demonstrate that raw materials can be produced in an innovative and sustainable way in order to ensure that research and innovation end up on the market, to strengthen the competitiveness of the European raw materials industries, to meet the ambitious energy and climate targets for 2030, to minimise environmental impacts and risks and to gain the trust of EU citizens in the raw materials sector.

This specific challenge addresses the development of "innovative pilot actions"[[55]](#footnote-55) which is one of the major targets of the European Innovation Partnership (EIP) on Raw Materials.

Scope: Actions should develop innovative pilots demonstrating clean and sustainable production, including exploration, of non-energy non-agricultural raw materials in the EU from primary and/or secondary sources, finishing at Technology Readiness Levels (TRL) 6-7.

All actions should contribute to achieving the objectives and targets of the EIP on Raw Materials and to building the EU knowledge base of primary and secondary raw materials by feeding into the EC Raw Materials Information System – RMIS[[56]](#footnote-56). Actions should also contribute to improving the awareness of relevant external stakeholders and the general public across the EU about the importance of raw materials for society, the challenges related to their supply within the EU and about proposed solutions which could help to improve society's acceptance of and trust in sustainable raw materials production in the EU, duly taking into account the applicable EU environmental legislation.

All actions should facilitate the market uptake of solutions developed through industrially- and user-driven multidisciplinary consortia covering the relevant value chain, and consider standardisation aspects when relevant.

All proposals should justify the relevance of the selected pilot demonstrations in different locations within the EU (and also outside if there is a clear added value for the EU economy, industry and society).

All proposals should include an outline of the initial exploitation and business plans (with indicated CAPEX, OPEX, IRR and NPV[[57]](#footnote-57)) with clarified management of intellectual property rights, and commitment to the first exploitation.

Actions should include a task to cluster with other projects financed under this topic and – if possible – with other relevant projects in the field funded by Horizon 2020, in support of the EIP on Raw Materials.

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

Actions should address only one of the following sub-topics:

**a)** **Integrated exploration solutions (2019)**: Actions should develop and demonstrate integrated exploration solutions focused on finding new deep land deposits. They could benefit from any of the advanced geological-geochemical-geophysical-remote sensing integrated (and multi-method) approaches, 3D and 4D modelling, automation and robotisation. Solutions should cover and be tested in both green and brown field mining sites.

**b) Services and products for the extractive industries life cycle (2019):** Actions should develop services and products based on Earth observation data and techniques and GNSS services for the extractive industries life cycle. The services and products should be built upon information and data made available by the Copernicus Programme, and other relevant Earth observation and proximal sensing data. Use of data made available by EGNOS (and in the long term, Galileo) or other relevant Earth GNSS data should be considered where relevant. Services should be developed and tested for any of the different phases of the mining life cycle: exploration, extraction, closure or post closure. Particular attention should be given to services for environmental monitoring (including metals dispersion) and safety and security monitoring associated with open pits (slopes stability/landslides risk), underground mining (e.g. subsidence) and mining waste disposal (e.g. tailings dams and dumps). Services to be developed should include the design and testing of early warning systems and associated monitoring plans to prevent and mitigate risks associated with extraction and mining waste disposal[[58]](#footnote-58).

The Commission considers that proposals requesting a contribution from the EU of between EUR 8 million and EUR 13 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

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

1. pushing the EU to the forefront in the area of sustainable raw materials production technologies and solutions through generated know how (planned patents, publications in high impact journals and joint public-private publications etc.);
2. increasing the reserves of various primary raw materials within the EU;
3. where relevant, reducing the exploration costs for the industry through new cost-effective exploration technologies, while safeguarding long- and short-term environmental sustainability;
4. improving the resolution and interoperability of existing raw materials digital maps;
5. in the longer term, improving the competitiveness of and creating added value and new jobs in raw materials producing, equipment manufacturing, information and communication technologies and/or downstream industries;
6. additionally, only for b) 'Services and products for the extractive industries life cycle', improved validation of global Copernicus land use and land cover products, enhancing the market uptake of the Copernicus based services and products for mining lifecycle, as well as its synergetic use with GNSS.

Type of Action: Innovation action

### SC5-12-2018: EU-India water co-operation

Specific Challenge: In recent years, India and Europe have collaborated extensively to enhance and enrich each other's technological and scientific knowledge and management capacities to cope with increasing stress on water resources. Increasing heterogeneity in the uneven distribution of water resources triggered by climate change, extreme water-related events (floods and droughts) and increasing demand due to population growth and economic development add additional stress to water, environment and food security and to the national economy. Many of these water challenges are common to India and some of the EU Member States. Therefore there is a need for a concerted effort of India and EU to address these issues. This will also help in achieving the Sustainable Development Goals' (SDGs) agenda on water.

Scope: This action should develop new and/or adapt the most suitable existing innovative and affordable solutions for Indian conditions, both in urban and rural areas, addressing one or more of the following broad challenges:

* drinking water purification with a focus on emerging pollutants;
* waste water treatment, with scope for resource/energy recovery, reuse, recycle and rainwater harvesting, including bioremediation technologies;
* real time monitoring and control systems in distribution and treatment systems.

Actions should therefore take into account India's water challenges both with regard to quantity and quality. In doing so, allocation of water should be facilitated and the supply should become more competitive or lead to an optimisation of costs; it should also lead to better water management and quality by finding solutions to the treatment of widely varying pollution loads including those from emerging pollutants. The impact of extreme climate and hydrological conditions (monsoon floods) also need to be taken into consideration.

Actions addressing wastewater treatment should focus on sustainable use/reuse of water in rapidly expanding urban areas, as well as smaller cities lacking any type of suitable wastewater treatment. Actions may also address the development of appropriate decentralised water treatment and wastewater treatment and recycling systems, including the improvement of sewage collection and urban drainage systems. Water and energy efficient and cost-effective processes, optimising use and maximising energy and materials recovery from wastewater treatment, reliable monitoring schemes to ensure safe water use and reuse, and simple and affordable operation and maintenance methods also need to be considered.

Actions focusing on drinking water purification should address multiple contaminants or focus on the identification and removal of specific classes of pollutants (e.g. pesticides, fertilisers, geogenic contaminants, etc.).

In actions on wastewater treatment and drinking water purification, the design, development and deployment of sensors and decision support systems for real time monitoring and control of water quantity and quality, should be considered.

In all cases, the involvement of relevant stakeholders, including industry partners, local authorities, water users, research centres and social communities, and consideration of possible gender differences in the use and need of water, is essential in order to enable a strong demonstration component involving transfer of European knowledge, expertise and technology to facilitate future in-house replication. Understanding and assessing the impacts of the developed innovative solutions to the society, in particular for the vulnerable societal groups, should be duly considered. Moreover, in addressing water allocation, the governance of water management and the efficiency of water use, especially for irrigation which is the largest water consumer, should be considered. Actions may also choose to address a combination of the above challenges at river basin scale and should capitalise on knowledge acquired in the projects supported by the joint coordinated EU-India call on water under FP7. Activities are expected to focus on Technology Readiness Levels (TRL) 3 to 6.

In line with the strategy for EU international cooperation in research and innovation (COM(2012) 497), international cooperation is encouraged, in particular with the EU's strategic partners – which India is, as confirmed at the EU-India Summit on 30 March 2016. Actions should include Indian partners in a balanced way. This call should also contribute to the objective stated in the Memorandum of Understanding on water cooperation between India and the EU adopted on 7 October 2016[[59]](#footnote-59) aiming at strengthening the technological, scientific and management capabilities of India and the EU in the field of water.

Proposals should pay attention to the special call conditions for this topic. Both the Indian Department of Science and Technology (DST) and the Department of Biotechnology (DBT) within Indian Ministry of Science and Technology, are committed to co-fund the Indian entities and thus Indian participants will not be eligible for EU funding. This call text will also be available on the websites of DST and DBT respectively and it will refer to the agreed Co-Funding Mechanism (CFM)[[60]](#footnote-60) between the EC and DST and DBT. Proposals are to be developed jointly with the Indian entities. For funding purposes, the Indian entities must submit the proposal to DST and/or DBT. Evaluation will be done jointly according to the conditions specified in the CFM and respecting the EC peer review rules.

The Commission considers that proposals requesting an overall contribution (including both EU and India funding) of between EUR 3 million and 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. The funding support for the Indian entities will be according to the DST and/or DBT funding guidelines.

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

1. improved and efficient wastewater treatment systems, combined with recovery and reuse of energy, substances and treated water;
2. improved novel drinking water purification technologies for safe drinking water with easy access at affordable cost both in rural and urban regions;
3. improved smart and comprehensive solutions for both quality and quantity monitoring and management of water resources;
4. strengthening the Sustainable Development Goals' ( SDGs) agenda on water;
5. boosting initiatives like the Ganga Rejuvenation Initiative[[61]](#footnote-61), fostering the emergence of quick–win business, affordable, innovative solutions based on integrated Indian and EU best practices;
6. creating a level playing field for European and Indian industries and SMEs working in this area, paving the way for a potential joint venture for manufacturing of water treatment technologies and systems.

Type of Action: Research and Innovation action

### SC5-14-2019: Visionary and integrated solutions to improve well-being and health in cities

Specific Challenge: It is estimated that by 2050 up to 70% of the world’s population will be living in urban areas. Urbanisation affects human health and well-being through factors such as exposure to pollutants, including noise, disasters, stressors and diseases, urban density, lack of physical activity, degraded ecosystems and erosion of natural capital, which can be exacerbated by climate change. As acknowledge by the Habitat III New Urban Agenda, public spaces play a crucial role in urban interaction and systemic urban innovation and they need to be designed and managed sustainably and equitably to ensure that the way citizens produce, consume, commute and interact within the urban fabric has a positive impact on their health and quality of life, enhances resilience to disasters and climate change and reduces the environmental footprint of the cities. The systemic integration of social, cultural, digital and nature-based innovation in the design, development and governance of public space has a tremendous potential to transform these spaces into diverse, accessible, safe, inclusive and high quality green areas that increase well-being and health and deliver a fair and equitable distribution of the associated benefits.

Scope: Actions should deliver visionary and integrated solutions (e.g. therapy gardens, urban living rooms, creative streets, city farms) at the intersection of social, cultural, digital and nature-based innovation to increase citizens' health and well-being in cities[[62]](#footnote-62). These solutions should address social, cultural, economic and environmental determinants of health and well-being and support urban communities in reducing their exposure to climate-related risks, pollution (including noise), environmental stress and social tensions, including the negative effects of gentrification.

Actions should also demonstrate how the integration of these solutions into innovative land-use management, urban design and planning could reduce health-related environmental burdens in socially deprived neighbourhoods, foster equitable access for all to public spaces, enhance their quality and use and promote sustainable urban mobility patterns.

Actions should test new transition management approaches, governance models, legal frameworks and financing mechanisms to re-design public spaces and urban commons and assess their contribution to improving health and well-being. They should promote multi-stakeholder initiatives, citizens' engagement, co-creation and co-ownership of public spaces. Optimal and cost-effective use of behavioural games, networks of sensors, GIS-mapping, big data, observational programmes such as Copernicus and GEOSS, and citizens' observatories should be made as appropriate to enable the integration and visualisation of data for more effective monitoring of the transition towards healthier and happier cities.

The involvement of social sciences and humanities disciplines such as psychology, behavioural science, economics, law, anthropology, sociology, architecture, or design studies, is considered essential to enhance social learning and promote the role of social and cultural innovation in transforming public spaces, with particular attention devoted to gender dynamics and diversity.

To enhance the impact and promote upscaling and replication of these solutions, projects should engage in substantial networking and training actions to disseminate their experience, knowledge and deployment practices to other cities beyond the consortium. To enhance impact cooperation and synergies with the activities undertaken within the Global Covenant of Mayors for Climate and Energy initiative and its regional components[[63]](#footnote-63) (supported by the EC) should be sought where appropriate.

Furthermore, actions should envisage resources for clustering with other ongoing and future projects on sustainable cities through nature-based solutions funded under the 'Smart and Sustainable Cities' call in part 17 of the 2016-2017 Work Programme as well as relevant projects to be funded under topics SC5-20-2019 and CE-SC5-03-2018 of this Work Programme. Cooperation with relevant actions funded under the Horizon 2020 Societal challenge 6 topic 'TRANSFORMATIONS-03-2018-2019:Innovative solutions for inclusive and sustainable urban environments' should also be sought as appropriate.

Funded projects are expected to establish long-term sustainable data platforms securing open, consistent data about the impacts of the deployed approaches and ensure interoperability with other relevant data infrastructures for effective communication, public consultation, exchange of practices, and sharing of experiences.

Proposals should pay attention to the special call conditions for this topic.

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

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

1. high quality, multifunctional, public spaces able to integrate digital, social, cultural and nature-based innovation to enhance health and well-being, while ensuring 'the right to the city' as specified in the Habitat III New Urban Agenda;
2. European cities being world ambassadors of sustainable lifestyles, providing universal access to greener, safe, inclusive and accessible public spaces, also accounting for the gender dimension;
3. participatory approaches in re-designing and transforming public spaces to increase health and well-being in cities through innovative public-private-people partnerships (PPPPs);
4. more comprehensive assessment of the sustainability and resilience of cities through the development of health and well-being indicators;
5. establishing innovative monitoring systems to measure benefits and capture the multiple co-benefits created by nature-based solutions in terms of health and well-being.

Type of Action: Innovation action

# SC7: Secure societies - Protecting freedom and security of Europe and its citizens

### SU-DS04-2018-2020: Cybersecurity in the Electrical Power and Energy System (EPES): an armour against cyber and privacy attacks and data breaches[[64]](#footnote-64)

Specific Challenge: The Electrical Power and Energy System (EPES) is of key importance to the economy, as all other domains rely on the availability of electricity, hence a power outage can have direct impact on the availability of other services (e.g. transport, finance, communication, water supply) where backup power is not available or the power restoration time goes beyond the backup autonomy.

With the transition to a decentralised energy system, digital technologies are playing an increasingly important role in the EPES: they contribute reducing the energy consumption; they enable the integration of higher shares of renewables and promote a more energy efficient system. At the same time, with the growing use of digital devices and more advanced communications and interconnected systems, the EPES is increasingly exposed to external threats, such as worms, viruses, hackers and data privacy breaches.

Without appropriate cyber-defence measures, systems access could be violated (e.g. with the malware spreading over the system) and may cause power outages, damages and cascading effects to interconnected systems, and energy services. Therefore, with increased digitalisation, the EPES will face an increasing range of threats requiring an attentive evaluation of the cyber security risk that allows taking proper countermeasures. For example, the growing use of interconnected smart devices in the EPES will increase the number of access points (e.g. smart meters, IoT), hence increasing the exposure to cyberattacks. Also, even if security improvements may have been made since, older technologies used in legacy systems such as SCADA/ICS (Supervisory Control and Data Acquisition System/Industrial Control Systems) were designed in times when cybersecurity was not part of the technical specifications for the system design.

On the other side, a control system in the EPES that is under attack might not be easily disconnected from the network as this could potentially result in safety issues, brownouts or even blackouts. At the same time, with the decentralisation leading to a distributed energy system, microgrid operations and/or islanding could be further exploited against cyber-attacks and cascading effects in the EPES.

In order to pursue the integration of the renewables within the existing EPES and to ensure that it benefits from the advantages brought by a modern digitalised electricity grid, there is a need for new security approaches detecting and preventing threats with severe impacts and to shield the electric system against cyber-attacks. Without an adequate strategy and measures to protect the energy system from cyber-attacks, the energy transition would be more risky, more costly and possibly in danger.

Scope: The proposals should demonstrate how the actual EPES can be made resilient to growing and more sophisticated cyber and privacy attacks and data breaches (including personal data breaches) taking into account the developments of the grid towards a decentralised architecture and involving all stakeholders. The proposals should demonstrate the resilience of the EPES through the design and implementation of adequate measures able to make assets and systems less vulnerable, reducing its expositions to cyberattacks. Different scenarios of attacks with the expected potential disruptive effects on the EPES should be envisaged and the relative counteracting measures should be designed, described, tested (sandboxing, simulations) on a representative energy demonstrator to verify effectiveness. Depending on the specific application, the proposal should apply measures to new assets or to existing equipment where data flows were not designed to be cyber protected (e.g. SCADA, ICS). The proposals shall implement the following series of activities to make the electric system cyber secure: (i) assessing vulnerabilities and threats of the system in a collaborative manner (involving all stakeholders in the energy components provision supply chain); (ii) on that basis, designing adequate security measures to ensure a cyber-secure system and describing the advantages of the solutions adopted compared to others and which aim to guarantee the level of cybersecurity and resilience vital for EPES in an evolving system; (iii) implementing both organisational and technical measures in representative demonstrator to test the cyber resilience of the system with different types of attacks/severity; and (iv) demonstrating the effectiveness of the measures with a cost-benefit analysis. The activities may include the testing of micro-grid and/or islanding as a means to reduce the vulnerability to cyber-attacks.

The proposals shall also (i) develop security information and event management system collecting logs and other security-related documentation for analysis that can also be used for information sharing across operators of essential infrastructures and CERTs; (ii) define cybersecurity design principles with a set of common requirements to inherently secure EPES; (iii) formulate recommendations for standardisation and certification in cybersecurity at component, system and process level; and (iv) propose policy recommendations on EU exchange of information.

The dimension of a pilot/demonstrator within the proposal should be at large scale level (e.g. neighbourhood, city, regional level), involving generators, one primary substation, secondary substations and end users. The proposals are encouraged to include the following types of entities: TSO, DSO, electricity generators, utilities, equipment manufacturers, aggregators, energy retailers, and technology providers.

The proposals may refer to Industry 4.0 and other proposals and/or projects dealing with cybersecurity in energy.

Projects should also foresee activities and envisage resources for clustering with other projects funded under this topic and with other relevant projects in the field funded by H2020, in particular under the BRIDGE initiative[[65]](#footnote-65).

The outcome of the proposal is expected to lead to development up to Technology Readiness level (TRL) 7; please see Annex G of the General Annexes.

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:

1. Built/increased resilience against different levels of cyber and privacy attacks and data breaches (including personal data breaches) in the energy sector.
2. Ensured continuity of the critical business energy operations.
3. The energy sector is better enabled to easily implement the NIS directive.
4. A set of standards and rules for certification of cybersecurity components, systems and processes in the energy sector will be made available.
5. Cyber protection policy design and uptake at all levels from management to operational personnel, in the energy sector.
6. Manufacturers providing more accountability and transparency, enabling third parties monitoring and auditing the privacy, data protection and security of their energy devices and systems.

Type of Action: Innovation action

# European Innovation Council (EIC) pilot

### 1. EIC Horizon Prize for'Innovative Batteries for eVehicles'

***Challenge***

The challenge is to develop a safe and sustainable battery for electric-vehicles through the development of new materials and chemistries making use of abundant, sustainable low cost materials, which are easily available in Europe. Solutions are required to provide the same or better performance than vehicles with internal combustion engines and to be capable of recharging the electric vehicle within a time equivalent to fill a conventional gasoline/diesel fuel tank.

This prize will contribute significantly to the decarbonisation of Europe for the benefit of the EU's economy and its citizens.

This prize will:

* Foster knowledge, innovation and competitiveness in e-vehicle battery/ energy storage technologies.
* Enhance the European manufacturing base for e-vehicle batteries.
* Strengthen the European Industrial value chain (e.g. through exploitation or synergies with existing European industrial infrastructures).
* Strengthen European value added in the supply and knowledge of advanced materials and chemistries for batteries.
* Encourage electro-mobility, opening up new markets and incentivising technological innovations.
* Enhance employment prospects along the entire electro-mobility value chain.
* Contribute to a significant drop in CO2 and NOx emissions in line with global environmental policies.

***The specific rules of the contest will be published in the fourth quarter of 2017 by the European Commission, which will directly launch and manage the contest and award the prize based on the judgement of independent experts.***

***Expected results***

A prototype battery with fast repowering and long-distance range, high recyclability, and long life cycle.

***Eligibility criteria***

The contest is open to any legal entity (including natural persons) or group of legal entities established in an EU Member State or in a [country associated to Horizon 2020](http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/3cpart/h2020-hi-list-ac_en.pdf).[[66]](#footnote-66)

***Essential award criteria***

The prize will be awarded, after closure of the contest, to the contestant(s) who in the opinion of the jury demonstrates a solution that best meets the following cumulative criteria for a prototype battery (demonstrated and tested in adequate environment):

* Provides high standards for safety, sustainability and recyclability;
* Provides the same experience and user convenience, in terms of range and time required to recharge, as a conventional gasoline/diesel car;
* Has whole-life costs (in terms of battery materials and its functionality) equivalent or better than gasoline/diesel car;
* Demonstrates reliable power delivery without significant loss of performance for an economically acceptable life time (power delivery to be demonstrated for a life time higher than batteries currently available);
* Ensures that other performance criteria (car acceleration, safety, etc.) are maintained in comparison to a combustion engine powered vehicle,
* Demonstrates a significant advance in new material technologies while avoiding dependence on import materials (e.g. expensive, rare, and unsustainable materials);

***Type of action***

Inducement prize

|  |
| --- |
| ***Indicative timetable*** |
| **Opening of contest** | **Fourth quarter of 2017** |
| **Deadline to submit applications** | **Fourth quarter of 2020** |
| **Award of prize** | **Fourth quarter of 2021** |

***Indicative budget***

€10 million from the 2020 budget[[67]](#footnote-67)

### 2. EIC Horizon Prize for'Fuel from the Sun: Artificial Photosynthesis'

***Challenge***

The challenge is to build a fully functional, bench-scale prototype of an artificial photosynthesis based system which is able to produce a useable synthetic fuel.

Artificial photosynthesis is widely considered to be among the most promising new technologies to deliver sustainable alternatives to current fuel supplies. Due to its ability to use a combination of sunlight, water and carbon from the air to produce energy, artificial photosynthesis is regarded as a potential breakthrough energy technology. It can be used to produce hydrogen or carbon-based fuels – collectively referred to as “solar fuels” – which offer an efficient and transportable means of storage of solar energy. Solar energy, in turn, can be used as an alternative to fossil fuels and as a feedstock for a wide range of industrial processes.

The device to be built needs to integrate the whole process from light capture to fuel production and be capable of powering a small engine. The production of fuel in the form of hydrogen and the use of conventional photovoltaic cells for the light harvesting process or to collect light and electrolysers are not permitted.

For the purpose of this prize, artificial photosynthesis (AP) is understood to be a process that aims at mimicking the physical chemistry of natural photosynthesis by absorbing solar energy in the form of photons. The solution is required to use this energy to generate fuel molecules through a synthetic system to be delivered as a single integrated device that utilises either biomimetic, nanotechnology, synthetic biology or a combination of these systems.

Meeting the challenge will stimulate innovation and focus research and development towards energy applications in a new energy technology through increased public and commercial interest. Moreover, it will accelerate the development of new innovative energy conversion systems using solar light and natural elements to produce renewable fuels to be used in industry, housing and transport.

The challenge will also create a stimulus for industrial participation and creation of start-ups, pushing the artificial photosynthesis technology for fuel production to the next level of development.

Considering the innovative approach and the novelty of using artificial photosynthesis for fuel production, the prize will generate interest in the subject and foster interdisciplinary collaboration among potential applicants, such as students, young researchers and engineers. The competition is expected to highlight the diversity of potential solutions.

***The specific rules of the contest will be published in the fourth quarter of 2017 by the European Commission, which will directly launch and manage the contest and award the prize based on the judgement of independent experts.***

***Expected results***

A number of innovative devices and systems demonstrating the use of sunlight to produce a fuel ready to be used.

***Eligibility criteria***

The contest is open to all legal entities (i.e. natural or legal persons, including international organisations) or groups of legal entities.

***Essential award criteria***

The prize will be awarded to the contestant(s) who will, in the opinion of the jury, demonstrate a solution that best meets the following cumulative criteria:

* Degree of system integration from light capture to fuel production;
* Device/system performance;
* Production of fuel that will be used in an engine.
* Widest market potential.
* Commercial potential of the device

***Type of action***

Inducement prize

|  |
| --- |
| ***Indicative timetable*** |
| **Opening of contest** | **Fourth quarter of 2017** |
| **Deadline to submit applications** | **First quarter of 2021** |
| **Award of prize** | **Fourth quarter of 2021** |

***Indicative budget***

€5 million from the 2020 budget[[68]](#footnote-68)

### 4. EIC Horizon Prize for'Blockchains for Social Good'

***Challenge***

The challenge is to develop scalable, efficient and high-impact decentralized solutions to social innovation challenges leveraging Distributed Ledger Technology (DLTs), such as the one used in blockchains.

DLT in its public, open and permissionless forms is widely considered as a ground-breaking digital technology supporting decentralized methods for consensus reaching as well as sharing, storing and securing transactions and other data with fewer to no central intermediaries.

In the wake of the widespread public attention for Bitcoin, several financial applications based on blockchains are already under development. However, the potential of DLTs to generate positive social change by decentralising and disintermediating processes related to local or global sustainability challenges is still largely untapped.

Examples of social innovations in which decentralized solutions based on DLTs have shown clear benefits over conventional centralised platform solutions include, but are not limited to:

* demonstrating the origin of raw materials or products and supporting fair trade and the fair monetization of labour;
* allowing for a greater visibility of public spending and a greater transparency of administrative and production processes;
* participation in democratic decision-making by enabling accountability, rewarding of participation and/or anonymity;
* enabling the development of decentralized social networks or clouds, or of decentralized platforms for the collaborative economy;
* managing property, land registry or other public records; and
* contributing to financial inclusion.

This challenge is targeted at a wide range of actors: individuals, social entrepreneurs, civil society organisations, research centres from technological and social disciplines, creative industries, students, hackers, start-ups and SMEs. Tackling this challenge requires a multidisciplinary expertise.

***The specific rules of the contest will be published in the fourth quarter of 2017 by the European Commission, which will directly launch and manage the contest and award the prize based on the judgement of independent experts. The indicative budget for this prize is €5 million. This is expected to be allocated in five awards of €1 million each, corresponding to different social application areas.***

***Expected results***

* Pioneering decentralized solutions to global and/or local sustainability challenges.
* Generating positive social change by making available novel solutions for decentralizing and disintermediating processes.
* Demonstrating the viability of solutions enabling a more even distribution and sharing of information and resources which respects privacy while providing levels of transparency.
* Stimulating the emerging community of developers and practitioners of "blockchains for social good" applications.

 ***Eligibility criteria***

The contest is open to all legal entities (i.e. natural or legal persons, including international organisations) or groups of legal entities.

***Essential award criteria***

The prize will be awarded, after closure of the contest, to the contestants who in the opinion of the jury demonstrate a solution that best meets the following criteria:

* Social impact: both potential and already achieved by the implementation of the solution (e.g. size of the community of users engaged by the actual implementation).
* Decentralisation and governance: improvements in transparency and accountability (while respecting privacy and/or anonymity).
* Usability and inclusiveness;
* Viability at large scale: cost-efficiency (including energy consumption), scalability, security, and sustainability;
* Clear added value of the demonstrated implementation for European citizens, in societal, economic or environmental terms.

These criteria, scoring and the weighting methodology, as well as the detailed timetable and conditions for participation, will be further defined in the Rules of Contest.

While entrants are free to commercially exploit applications and services based on the developed solutions, their source code is required to be released under an Open Source Licence.

***Type of action***

Inducement prize

|  |
| --- |
| ***Indicative timetable*** |
| **Opening of contest** | **Fourth quarter of 2017** |
| **Deadline to submit applications** | **Second quarter of 2019** |
| **Award of prize** | **First quarter of 2020** |

***Indicative budget***

€5 million from the 2020 budget[[69]](#footnote-69)

### SME Instrument H2020-EIC-SMEInst-2018-2020

**Who should apply to the SME Instrument?**

***Are you an innovative, high-flying small or medium-sized business with European and global ambitions?***

Have you got an idea for an innovation that targets new markets and could boost the growth of your company?

Are you looking for substantial funding to develop and scale up your idea?

And could you make use of business development resources and coaching to take your company forward? Then the SME Instrument is for you.

The SME Instrument supports high-risk, high-potential small and medium-sized enterprises to develop and bring to market new products, services and business models that could drive economic growth.

The SME Instrument is for innovators with ground-breaking concepts that could shape new markets or disrupt existing ones in Europe and worldwide.

***Competition for SME Instrument support is tough.***

The SME Instrument is very selective.

Only the most convincing and excellent proposals can be funded after a thorough evaluation by multinational panels of technology, business and finance experts.

Selected companies receive funding and are offered business coaching to scale up their innovation idea, and can also receive mentoring. They are helped in networking with other SME Instrument clients, with other companies of all sizes, and with potential co-investors and follow-up investors across Europe. As an SME Instrument client, you will gain visibility and boost your chances of success in European and international markets.

***Europe needs more radical, market-creating innovations to improve productivity and international competitiveness and generate new jobs and higher standards of living.***

These innovations must meet user and customer needs and tackle societal, technological and business challenges in a sustainable way.

***Have you got what it takes? Then apply now!***

**Principles and funding of the SME Instrument**

***Who can apply?***

For-profit SMEs, including young companies and start-ups, from any sector. You must be established in an EU Member State or a [Horizon 2020 associated country](http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/3cpart/h2020-hi-list-ac_en.pdf).

**What topics are covered?**

There are no set topics. Negative impacts on climate and the environment should be avoided.

**How does it work?**

The SME Instrument provides full-cycle business innovation support. It has three phases, including a coaching and mentoring service.

***🡺 Feasibility study: Phase 1***

**Phase 1** helps you get a grip on the R&D, technical feasibility and commercial potential of a ground-breaking, innovative idea and develop it into a credible business plan for scaling it up.

Activities can include, for example, risk assessment, market research, user involvement, analysis of regulatory constraints or standards regimes, intellectual property management, partner search, or feasibility assessment.

Your goal in Phase 1 is to formulate a solid, high-potential innovation project with a European or global growth-oriented strategy

Your proposal must be based on an initial business plan and outline the specifications of a more elaborate one, which will be the outcome of the project.

***Phase 1 funding is a lump sum of €50 000[[70]](#footnote-70). Projects should last around 6 months.***

***🡺 From concept to market: Phase 2***

**Phase 2** helps you develop your business concept further into a market-ready product, service or process aligned with your company's growth strategy. Activities could, for example, include trials, prototyping, validation, demonstration and testing in real-world conditions, and market replication. If the activity concerns a primarily technological innovation, [a Technology Readiness Level (TRL) of 6 or above is envisaged](http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-g-trl_en.pdf). You can subcontract work essential for your innovation project.

***You can apply to Phase 1 as a means of preparing for Phase 2, or you can apply directly to Phase 2.***

Your proposal must be based on a strategic business plan that was either developed in Phase 1 or by another means. Your proposal must specify the expected outcome of the project and criteria for success, as well as the expected impacts on your company in both qualitative and quantitative terms (e.g. on turnover, employment, market size, IP management, sales, return on investment, or profitability).

You must pay particular attention to IP protection and ownership, and present convincing evidence or measures to ensure the possibility of commercial exploitation (often known as 'freedom to operate'). You should also address regulatory and standardisation issues.

Grant funding is provided (funding rate 70%) of between €0.5 million and €2.5 million. You can request a higher or lower amount, duly justified, when applying. Your project should normally take 12 to 24 months to complete, but could be longer in exceptional and well-justified cases.

**🡺 *Commercialisation: Phase 3***

**Phase 3** helps you take advantage of additional EU support extended via a range of business support services offered on the [EIC Community Platform](#Community), open to SMEs benefiting from the different EIC calls for proposals. This support can take the form of training, links to investors, partnering and networking with other EIC SME clients and larger firms and services to help you access international markets, e.g. via participation in overseas trade fairs. Phase 3 is not necessarily subsequent to Phase 1 or Phase 2; it provides specific support to EIC SME clients, mainly to help them access new markets or customers and link with investors. It does not provide direct funding. In the 2018-2020 period, Phase 3 is open to SMEs receiving grants under the FTI and FET-Open schemes, in addition to SMEs receiving grants from the SME Instrument budget.

All Phase 3 support services are accessible through a single, dedicated entry point, which serves as an information portal and networking space. *[See* [*'EIC Support Actions'*](#Support)*]*

**Coaching**

If you are an SME benefiting from grant funding from the SME Instrument, FTI or FET-Open, we offer business coaching to help your business scale up and grow.

***Coaching covers business development, organisational development, cooperation, and financing.***

For SME Instrument clients, up to 3 coaching-days are available in Phase 1, and up to 12 coaching-days in Phase 2. SMEs taking part in FTI or FET-Open are offered up to 12 coaching-days.

The free-of-charge [coaching service](https://ec.europa.eu/easme/en/coaching-under-sme-instrument) is facilitated by the [Enterprise Europe Network](http://een.ec.europa.eu/about/branches) (EEN). Coaching is delivered by one or more qualified, experienced business coaches recruited from a database managed by the European Commission. All coaches meet stringent criteria regarding business experience and coaching skills. Throughout your project, the EEN will complement the coaching support. EEN offers a service package covering an assessment of your firm's innovation management capacities and the identification of a suitable coach or consulting package to address the gaps, EEN also provides access to its innovation and internationalisation services.

**Mentoring**

If you are an SME benefiting from grant funding from the SME Instrument, FTI or FET-Open, we will offer mentoring to individual founders, CEOs and leaders.

***Mentoring aims to develop leadership skills such as resilience, tenacity and strategic insight.***

The mentoring scheme will involve one-to-one meetings with an experienced entrepreneur, who will share expertise and provide impartial guidance and support.

Mentors will be CEOs of firms that have moved beyond the start-up stage. To begin with, mentors will be drawn from a pool of SME Instrument Phase 2 current and former clients willing to act as mentors on a *pro bono* basis.

Mentors and mentees will be matched up via the [EIC Community Platform](#Community) and during [EIC Events](#Innovator_Summits) and other suitable events.

We will introduce the mentoring scheme during 2018, and announce more details nearer the launch-date.

**Call conditions for the SME Instrument**

**Type of funding: SME** instrument Phase 1 / Phase 2

Opening dates, deadlines, indicative budgets

|  |  |
| --- | --- |
| Opening date:7 November 2017 | Deadline of cut-off*All deadlines are at 17.00.00 Brussels local time* |
| *phase*1 | 08 February 201803 May 201805 September 201807 November 2018-------------------------13 February 201907 May 201905 September 201906 November 2019-------------------------12 February 202006 May 202002 September 202004 November 2020 |
| *phase*2 | 10 January 201814 March 201823 May 201810 October 2018-------------------------09 January 201903 April 201905 June 201909 October 2019-------------------------08 January 202018 March 202019 May 202007 October 2020 |
| 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. The deadline(s) in 2019 and 2020 are indicative and subject to separate financing decisions for 2019 and 2020. |

|  |  |
| --- | --- |
| *Budget of the SME Instrument*[[71]](#footnote-71) | *€ millions* |
| 2018 | 2019 | 2020 |
| Overall indicative budget | 479.74 | 552.26 | 600.99 |
| Phase 1*divided equally betweencut-off dates in each year* | 10% | 10% | 10% |
| Phase 2*divided equally betweencut-off dates in each year* | 87% | 87% | 87% |
| Phase 3 | 1% | 1% | 1% |
| Coaching and mentoring | 1% | 1% | 1% |
| Evaluation | 1% | 1% | 1% |

Who can benefit from SME Instrument funding?

A proposal will be considered eligible if:

* Its content corresponds, wholly or in part, to the description of the SME Instrument call.
* The single beneficiary, or every beneficiary of a consortium, is a for-profit SME[[72]](#footnote-72) located in an EU Member State or a Horizon 2020 associated country.
* There is no concurrent submission or implementation with another SME Instrument Phase 1 or Phase 2 project. If an applicant is involved in two proposals that were formally submitted but not yet reviewed under phase 1 and/or 2, only the proposal that was submitted first will be considered eligible.

What are the requirements for an SME Instrument proposal to be admissible?

A proposal will be considered admissible if the following conditions are met:

* it was submitted in the electronic submission system before the final cut-off deadline;
* it is readable, accessible and printable;
* it is complete and includes the requested administrative data, the proposal description, and the obligatory supporting documents specified below;
* for a Phase 2 proposal, it includes a mandatory first commercialisation plan.

How long can my SME Instrument proposal be?

In Phase 1, the maximum length of a proposal (proposal description, sections 1 to 3) is 10 pages.

In Phase 2, the maximum length of a proposal (proposal description, sections 1 to 3) is 30 pages.

The page limits, the sections subject to the limits and the formatting applicable are shown in the ‘proposal templates’ in the Participant Portal electronic submission system.

If your proposal exceeds the page limits, you will receive an automatic warning and be advised to resubmit a version that conforms to the limits.

After the cut-off deadline, excess pages will automatically be made invisible, and will not be taken into consideration by the experts evaluating your proposal.

Evaluation rules for the SME Instrument

Selection criteria

* *Financial capacity:* Applicants for mono-beneficiary grants (single SME applicants) are not subject to an automatic financial viability check. Coordinators of consortia of several SMEs will be invited, at proposal stage, to complete a self-assessment using an online tool.
* *Operational capacity*: During the evaluation of the award criterion ‘Quality and efficiency of implementation’, experts will judge whether each individual participant has, or will have in due time, sufficient operational capacity to successfully carry out their tasks in the proposed work-plan. This assessment will be based on the competence and experience of the applicant, including their operational resources (human, technical, other) and, if applicable and on an exceptional basis, the measures proposed to secure these resources by the time of the implementation of the tasks.

The operational capacity of each applicant is determined on the basis of the following supporting documents, which are required when submitting a proposal:

* A CV or description of the profile of the persons who will be primarily responsible for carrying out the proposed activities.
* A brief description of relevant products, services (including widely used datasets or software) or other achievements (which may also include previous projects or activities connected to the subject of the proposal).
* A description of any significant infrastructure and/or any major items of technical equipment relevant to the proposed work.
* A description of any third parties that are not represented as project partners but who will nonetheless be contributing towards the work, for example by providing facilities or computing resources.

Award criteria

Proposals are evaluated by experts on the basis of three award criteria: 'impact', 'excellence', and 'quality and efficiency of implementation'. The aspects examined under each criterion are described in the table below.

|  |
| --- |
| *Impact* |
| *50% WEIGHTING* |
| Convincing specification of substantial demand (including willingness to pay) for the innovation; demand generated by new ideas, with the potential to create new markets, is particularly sought after.Total market size envisaged. |
| Convincing description of targeted users or customers of the innovation, how their needs have been addressed, why the users or customers identified will want to use or buy the product, service or business model, including compared to what is currently available if anything at all. |
| *Phase 1 (only)*: Good understanding of need for a realistic and relevant analysis of market conditions, total potential market size and growth-rate, competitors and competitive offerings, key stakeholders, clear identification of opportunities for market introduction: potential for market creation is particularly sought after.*Phase 2 (only):* Realistic and relevant analysis of market conditions and growth-rate, competitors and competitive offerings, key stakeholders, clear identification of opportunities for market introduction, market creation or disruption (e.g. via new value-chains). |
| Realistic and relevant description of how the innovation has the potential to scale-up the applicant company (or companies). This should be underpinned by a convincing business plan with a clear timeline, and complemented, where possible, by a track-record that includes financial data. |
| Alignment of proposal with overall strategy of applicant SME (or SMEs) and commitment of the team behind them. Demonstration of need for commercial and management experience, including understanding of the financial and organisational requirements for commercial exploitation and scaling up (and - *Phase 2 only*)as well as key third parties needed. |
| *Phase1 (only)*: Outline of initial commercialisation plan and how this will be developed further (in-house development, licensing strategy, etc.).*Phase 2 (only)*: Realistic and relevant strategic plan for commercialisation, including approximate time-to-market or deployment. Activities to be undertaken after the project.*The 'commercial strategy' aspect is particularly examined in Step 2 of the evaluation of Phase 2 proposals.* |
| European/global dimension of innovation with respect to both commercialisation and assessment of competitors and competitive offerings.  |
| *Phase 1 (only)*: Realistic and relevant description of knowledge protection status and strategy, need for 'freedom to operate' (i.e., possibility of commercial exploitation), and current IPR situation or a plan for obtaining this information. Where relevant, description of potential regulatory requirements.*Phase 2 (only):* Evidence of or realistic measures to ensure 'freedom to operate' (i.e., possibility of commercial exploitation), convincing knowledge-protection strategy, including current IPR filing status, IPR ownership and licensing issues. Regulatory and/or standards requirements addressed. |
| Taken as whole, to what extent the above elements are coherent and plausible.  |
| *Excellence* |
| *25% WEIGHTING* |
| High-risk/high-potential innovation idea that has something that nobody else has. It should be better and/or significantly different to any alternative. Game-changing ideas or breakthrough innovations are particularly sought after.Its high degree of novelty comes with a high chance of either success or failure. |
| Realistic description of current stage of development (*Phase 2 only:* TRL 6, or something analogous for non-technological innovations), and clear outline of steps planned to take this innovation to market.  |
| Highly innovative solution that goes beyond the state of the art in comparison with existing or competing solutions, including on the basis of costs, ease of use and other relevant features as well as issues related to climate change or the environment, the gender dimension, any other benefits for society, or (*Phase 1 only*) includes plans for obtaining this information.  |
| Very good understanding of both risks and opportunities related to successful market introduction of the innovation from both technical and commercial points of view or (*Phase 1* *only*) includes convincing plans for obtaining this information.*Phase 2 only*: Documentation on the technological, practical and economic feasibility of the innovation. *The 'feasibility' aspect is particularly examined in Step 2 of the evaluation of Phase 2 proposals.* |
| *Phase 1 (only):* Objectives for the feasibility study and the approach and activities to be developed are consistent with the expected impact of the project. *Phase 2 (only)*: Objectives for the innovation proposal as well as the approach and activities to be developed are consistent with the expected impact (i.e. commercialisation or deployment resulting in company growth). Appropriate definition provided of specifications for outcome of project and criteria for success. |
| Taken as whole, to what extent the above elements are coherent and plausible.  |
| *Quality and efficiency of implementation* |
| *25% WEIGHTING* |
| Technical/business experience of the team, including management capacity to lead a growing team *Only Phase 1:* If relevant, the proposal includes a plan to acquire missing competences. *Only Phase 2*: If relevant, the proposal includes a plan to acquire missing competences, namely through partnerships and/or subcontracting\*, and explains why and how they are selected (*subcontractors must be selected using 'best value-for-money' principles*).*The 'team' aspect is particularly examined in Step 2 of the evaluation of Phase 2 proposals.* |
| Availability of resources required (personnel, facilities, networks, etc.) to develop project activities in the most suitable conditions. Where relevant, complementarity of partners in a consortium.*Only Phase 2:*Where relevant, realistic description of how key stakeholders / partners / subcontractors could be involved\* (*subcontractors must be selected using 'best value-for-money' principles*).Where relevant, the estimated budget and the procedure planned for selecting the subcontractors are appropriate\*. |
| Realistic timeframe and comprehensive description of implementation (work-packages, major deliverables and milestones, risk management) taking the company's or applicant's innovation ambitions and objectives into account. |
| \**Subcontracting is acceptable to the extent required for the implementation of the proposed activities. Subcontracting may be an essential part of the implementation of the project, but should not be a disproportionate part of the total estimated eligible costs. Subcontractors must be selected using 'best value-for-money' principles.* |
| Taken as whole, to what extent the above elements are coherent and plausible.  |

Evaluation procedure

After each Phase 1 cut-off

* Proposals are evaluated in one step.
* A proposal is evaluated remotely by a number of evaluators with a mixture of technology, industry sector, business and finance expertise.
* Each evaluator scores each of the three award criteria from 0 to 5. Scores with a resolution of one decimal place may be given.
* The quality threshold of each criterion is 4 out of 5. The overall quality threshold, applying to the weighted sum of the three individual scores, is 13 out of 15.
* The consensus score at the level of the three evaluation criteria is the median of the scores given by each evaluator. The overall consensus score is the weighted sum of these separate scores. Proposals that have passed all thresholds are ranked in the order of their final score.
* If necessary, a panel review is organised remotely.

After each Phase 2 cut-off

Applications are evaluated in two steps.

*Step 1: remote evaluation*

* A proposal is evaluated remotely by a number of evaluators with a mixture of technology, industry sector, business and finance expertise.
* Each evaluator scores each of the three award criteria from 0 to 5. Scores with a resolution of one decimal place may be given.
* The quality threshold of each criterion is 4 out of 5. The overall quality threshold, applying to the weighted sum of the three individual scores, is 13 out of 15.
* The consensus score of a proposal at the level of the three evaluation criteria is the median of the scores given by each evaluator. The overall consensus score is the weighted sum of these scores.
* Proposals that pass all quality thresholds will be considered for step 2.

*Step 2: face-to-face interview*

* Starting with the highest-scoring proposal and in descending, sequential order, proposals are passed to Step 2 until, as a batch, either the total amount of EU funding requested is as close as possible to twice the budget available, or all proposals eligible for funding have been accounted for. The actual threshold to pass to Step 2 will therefore be dynamic and depend on the volume of proposals received that pass all quality thresholds.
* Each applicant whose proposal has passed to Step 2 is invited to a face-to-face interview in Brussels.
* Only staff of applicants can represent them. Representation by third parties is forbidden.
* The interview is conducted by evaluators with a mixture of technology, industry sector, business and finance expertise.
* During the interview, the applicant is posed questions designed to clarify aspects of the proposal evaluated in Step 1, in particular those indicated above under 'award criteria'.
* In Step 2, proposals will receive, in addition to the score in Step 1, an 'A' mark or a 'B' mark from the final panel review.
* Only proposals that have passed all quality thresholds and receive an 'A' mark are proposed for funding.

For both Phase 1 and Phase 2

* During the electronic proposal submission process, you can provide up to three names of persons that should not act as an evaluator of your proposal, for commercial or other reasons.
* To set a priority order for proposals given the same consensus score in Phase 1, the following method is used:
* Proposals are first prioritised according to scores given for the award criterion 'impact'.
* Where those scores are equal, priority is then determined using scores for the award criterion 'excellence'.
* If necessary, a further prioritisation is based on the degree of gender balance among the personnel named in the proposal as primarily responsible for carrying out the project.

Communication to applicants after evaluation procedure

Phase 1

For each proposal, applicants receive an evaluation summary report with the scores obtained and a qualitative assessment with respect to each of the aspects considered under each of the three award criteria.

Phase 2

Each applicant invited to an interview in Step 2 receives an invitation at the end of Step 1.

For each proposal, applicants receive an evaluation summary report with the scores obtained and a qualitative assessment with respect to each of the aspects considered under each of the three award criteria (Step 1 of the evaluation). For proposals that have passed to Step 2, the report will contain an A or B mark and an additional qualitative assessment.

Phase 1 and Phase 2 applicants meeting all quality thresholds but not receiving funding will receive a Seal of Excellence.

Consortium agreement

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

Indicative timetable for evaluation and grant agreement signature

* Information about the outcome of the evaluation: Maximum 2 months after the corresponding cut-off date set out above for phase 1 and maximum 4 months after the corresponding cut-off date set out above for phase 2.
* Indicative date for the signing of grant agreements: Maximum 3 months from the final date for submission in phase 1 and maximum 6 months from the final date for submission in phase 2.

### Fast Track to Innovation (FTI)

H2020-EIC-FTI-2018-2020

*This call is expected to continue in 2020*

**Who should apply to FTI, the Fast Track to Innovation?**

***Are you looking for partners that can help you with a fast go-to-market of an industry-driven, innovative concept that has strong potential to make your company grow and scale-up?***

Do you see co-creation or open innovation as ways to advance your innovation cycle and enter the market within three years?

Are you looking for substantial funding to test, demonstrate and validate your innovation with users before full commercial roll-out, potentially via a spin-off company or a joint venture?

***Then FTI is the scheme for you.***

Innovation is fostered when new ideas can emerge and easily translate into socio-economic value, shaping new markets and laying the foundations of a stronger, high-tech industrial base for Europe.

Working together, partners with complementary backgrounds, knowledge and skills, in both new and established value-chains, can turn ideas into world-beating products, processes and services that tackle societal challenges.

***FTI accelerates the market uptake of ground-breaking innovations by providing funding in an open, accessible scheme that nurtures ideas from consortia of innovators of all types and sizes from across Europe.***

Participation by industry — defined as private-for-profit organisations — is mandatory; industry is best-placed to ensure the due commercial exploitation of the innovation developed; in addition, company growth and development in order to strengthen Europe's industrial leadership are explicitly pursued with FTI support.

**Principles and funding of FTI**

FTI supports actions undertaking innovation from the demonstration stage through to market uptake, including activities such as piloting, test-beds, systems validation in real-world working conditions, validation of business models, pre-normative research, and standard-setting.

The maximum EU contribution per action is €3 million (funding rate: 70% for for-profit entities; 100% for not-for-profit entities).

***FTI targets relatively mature, ground-breaking new technologies, concepts, processes and business models that need final development to be able to shape a new market and achieve wider deployment.***

If your proposal involves technological innovation, your consortium should declare that the technology or the technologies concerned are at least at Technology Readiness Level (TRL) 6. The intention will be to bring the TRL up to 8 for technological innovations and to an analogous level of maturity for non-technological innovations during the lifetime of the FTI action. TRLs are described in [General Annex G of the work programme](http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-g-trl_en.pdf).

FTI actions are encouraged to be interdisciplinary, cutting across different sectors and technologies. Actions supporting innovative concepts that have the potential to disrupt or to create new markets are particularly welcome.

In your proposal, you should:

* Specify the intended outcome and describe key performance indicators and success criteria.
* Make reference to and incorporate a business plan clearly describing the market potential, business opportunities for participants, measures to enhance the probability of eventual commercial take-up, and a credible commercialisation strategy that identifies next steps and specifies other actors to be involved.
* Pay particular attention to IP protection and ownership and to the possibility of commercial exploitation (often known as 'freedom to operate').
* Specify the expected impact in terms of competitiveness and growth of the business partners in the consortium, measured in terms of turnover and job creation.
* Clearly describe the expected impact in both qualitative and quantitative terms, with factors such as time sensitivity and international competitiveness considered in the light of the technology field, innovation area and industry sectors concerned.

***The time to initial market take-up should be no more than 3 years from the start of your FTI action.***

In very well-justified cases linked to the specific characteristics of a particular innovation field or industry sector, the time to initial market take-up could be longer.

Possible impacts on sustainability or climate change, in particular, or on other cross-cutting objectives of Horizon 2020, must be highlighted.

Participation from industry in your consortium is mandatory. Universities and research and technology organisations can also participate. Actors with an important role in commercialisation are encouraged to take part, such as cluster organisations, end-users, industry associations, incubators, investors, and the public sector. Including start-ups with ground-breaking ideas that could create new markets is encouraged.

**Call conditions for FTI**

**Type of funding: Innovation Action**

Opening date, deadlines, indicative budgets

|  |  |
| --- | --- |
| **Opening date:**07 November 2017 | **Deadline of cut-offs*****All deadlines are at 17.00.00 Brussels local time*** |
| FTI | **21 February 2018****31 May 2018****23 October 2018****-------------------------****21 February 2019****23 May 2019****22 October 2019****-------------------------****19 February 2020****09 June 2020****27 October 2020** |
| **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. The deadline(s) in 2019 and 2020 are indicative and subject to separate financing decisions for 2019 and 2020.** |

|  |  |
| --- | --- |
| ***Budget of FTI***[[73]](#footnote-73) | *€ millions* |
| **2018** | **2019** | **2020** |
| **Overall indicative budget** | 100.00 | 100.00 | 100.00 |
|  | *divided equally between cut-off dates in each year* |

***Who can benefit from FTI funding?***

The **eligibility conditions** described in [General Annex C of the work programme](http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-c-elig_en.pdf) apply, with the following exceptions:

* Participation of three to no more than five different legal entities, independent of each other, in a consortium.
* Allocation of at least 60% of the overall budget to consortium partner(s) from industry; *or* a minimum of 2 industry partners out of a consortium of 3 or 4; *or* a minimum of 3 industry partners out of a consortium of 5.
* Requested EU contribution not more than €3 million.
* All consortium members established in EU Member States or in [countries associated to Horizon 2020](http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/3cpart/h2020-hi-list-ac_en.pdf).

**What are the requirements for an FTI proposal to be admissible?**

The **admissibility conditions** described in [General Annex B of the work programme](http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-b-adm_en.pdf) apply.

**How long should an FTI proposal be?**

The maximum length of a proposal is **30 pages** (proposal description, sections 1 to 3).

**Evaluation rules for the FTI**

**Award criteria, scoring and threshold**

The criteria, scoring and threshold described in [General Annex H of the work programme](http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-h-esacrit_en.pdf) apply, with the following exceptions:

* Evaluation scores are awarded for each criterion. Each criterion is scored from 0 to 5. Scores with a resolution of one decimal place may be awarded.
* The threshold for the criteria 'Impact' and 'Excellence' is 4. The threshold for the criterion 'Quality and efficiency of the implementation' is 3. The overall threshold, meaning the sum of the three individual scores, is 13.
* The consensus score of a proposal at the level of the three evaluation criteria is the mean (average) of the separate scores given by each evaluator. The overall consensus score is the weighted sum of these separate scores.
* The consensus report comprises the individual reports or key extracts from them, and will provide a summary of the main weaknesses of your proposal.
* The aspects to be considered for each evaluation criterion are set out below.

|  |
| --- |
| ***Impact*** |
| ***50% WEIGHTING*** |
| The objectives of the proposed action are in line with the expected impacts of the FTI, notably **fast development, commercial take-up and/or wide deployment of innovative solutions, time to initial market take-up, leveraging of private investment in research and/or innovation**. In addition, in line with the objectives of the European Innovation Council Pilot, proposals that can create a new market are particularly sought after. |
| The proposed innovation will lead to **enhanced innovation capacity of the consortium partners, and in particular of the industry partners**.  |
| The proposed innovation/solution has a clear European or global dimension, in the sense that it is set to create **substantial demand from European and global markets and/or can create a new market or disrupt an existing one at European or global level**, which is well documented and supported with evidence on customer/user/market needs that can be translated into sales. The proposal provides a realistic and convincing analysis of the targeted market(s) and client/user base and how the innovation will meet their needs.  |
| The way the project will strengthen the **growth/ scale-up and competitiveness of the industry partners** involved is well documented. |
| Framework conditions such as **regulation and standards, market size, prospects for growth, competitive edge and intended positioning of the solution towards possible others (competitor analysis)** are documented, and the outlook can be described as positive for market launch within 3 years' of time. |
| The **commercialisation plan is realistic and convincing** – containing a clear description of the new business opportunity and the way to capitalise on it. The plan includes effective measures to **exploit and disseminate the action's results** (including with respect to IPR management and standards). There is a broader strategy for knowledge management and protection with regards to the proposed innovation/solution, ensuring **"freedom to operate"**. Key stakeholders that can help with market introduction are identified, and a convincing strategy to get them on board exists. Communication, marketing and sales efforts are planned in a coordinated way, on the basis of a realistic timetable, and fit into a solid commercial strategy. |
| Based on the provided market analysis and the projected commercialisation strategy, the likely **return on investment** of the proposed innovation (for instance in the form of **projected rapid scale-up leading to job creation and/or company growth**) is sufficiently attractive to justify EU funding under FTI. |
| The proposed innovation is expected to generate a positive **impact at the European level other than economic** (societal, environmental, scientific, etc.). Wherever appropriate, the minimisation of impacts on climate and the environment is pursued. |
| The proposed **financing plan** for further roll-out of the innovation is realistic and convincing and offers a sufficient guarantee and coverage to allow for further scale-up of the action and companies involved. |
| ***Excellence*** |
| ***25% WEIGHTING*** |
| The **objectives** of the proposal are defined **in a clear and pertinent way**, support Horizon 2020 objectives, and are directed towards fast, wide market uptake. |
| The proposed activities to be executed will contribute to a **credible, realistic and optimal development of the innovation** to the level of market uptake. |
| The underlying, jointly developed business innovation concept of the proposed innovation is sound, and has already been tested in an operational/production environment. It has a potential to **bring important progress to or** **revolutionise an existing industrial sector, business practice and/or societal challenge.** |
| The proposed innovation isambitious and is set to **add substantial value to Europe (e.g. considerably contribute to Europe's industrial leadership or the solution of Horizon 2020 societal challenges)**, and this is well identified and elaborated in the proposal. Game-changing ideas or breakthrough innovations are particularly sought after.**A high degree of novelty comes with a high chance of either success or failure.** |
| The proposed innovation has successfully been tested in an operational or production environment (stage of development at TRL 6 or similar for non-technological innovations) and **can move to market take-up (B2B or B2C) within maximum 36 months.** |
| The proposal demonstrates that **the intrinsic quality of the innovation will be significantly higher than current state-of-the-art solutions**, in terms of value for money, problems solved, new applications, sustainability, etc. |
| ***Quality and efficiency of implementation*** |
| ***25% WEIGHTING*** |
| The **work plan is coherent and effective**. It takes into account the project's ambition and objectives, includes a realistic and relevant time-frame, and refers to a sound and comprehensive implementation plan, in particular in relation to major deliverables. Tasks and resources are allocated in an appropriate and cost-effective way. |
| The proposal demonstrates that the **partners** of the consortium are **complementary**, and **together have what it takes** (personnel, facilities, skills, networks, access to markets…) **to deliver on groundbreaking innovation and fast, wide market uptake**. Implementation risks and threats are well identified; the proposal contains a **risk mitigation plan**, with detailed actions. |
| Both the **organisational framework/governance structure** underpinning the action and the **decision-making processes** are established in a **clear and efficient** way. |

**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](http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-h-esacrit_en.pdf). The full evaluation procedure is described in the relevant [guide](http://ec.europa.eu/research/participants/docs/h2020-funding-guide/grants/from-evaluation-to-grant-signature_en.htm) published on the Participant Portal.

**Consortium agreement**

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

**Indicative timetable for evaluation and grant agreement signature**

* Information about the outcome of the evaluation: maximum 3 months after the corresponding cut-off date set out above.
* Indicative date for the signing of grant agreements: maximum 6 months from the final date for submission.

### FET-Open Novel ideas for radically new technologies

H2020-FETOPEN-2018-2020

**Principles and characteristics of FET-Open and who should apply**

*FET-Open aims to establish European leadership in the early exploration of future technologies. It looks for opportunities of long-term benefit for citizens, the economy and society. It aims to mobilise Europe's most creative and forward thinking researchers from all disciplines to work together and explore what may become the leading technology paradigms of the future.*

FET Open supports early stage science and technology research exploring new foundations for radically new future technologies by challenging current paradigms and venturing into unknown areas. A bottom-up selection process widely open to any research idea builds up a diverse portfolio of new research directions. Early detection of promising new areas, developments and trends, along with attracting new and high-potential research and innovation players, are key factors.

**FET Open** combines high scientific ambition with concrete technological implications. It aims to attract interdisciplinary consortia that do not shy away from exploring connections between remote disciplines in order to open-up new and potentially game changing technological directions that FET as a whole aims to develop into the leading technology paradigms of the future, including through FET-Proactive projects and FET-Flagship initiatives. In spite of the high initial risk, the long-term impact can be enormous: these new technologies can become the core for new high-growth companies, for new industries or for radically new ways of tackling societal challenges.

**The FET-Open** **call** is a part of the European Innovation Council (EIC) pilot. It provides the EIC with a bold exploratory engine that shatters the frontiers of current thinking. All FET-Open projects, even if far from today's markets, are full of great ideas to inspire the entrepreneurial minds that the EIC attracts. While keeping its own identity of excellence in science and technology research, the exposure of FET-Open within the EIC allows new and sometimes unexpected opportunities to be detected and picked up early on. For those cases, the FET Innovation Launchpad is designed to assist in the first steps to accelerate the real-world impact of a result from FET research – a win-win for both research and for innovation. Other parts of the EIC provide further tools for achieving high-impact on society and/or the economy. Furthermore, by being part of the EIC pilot, FET-Open participants have access to the assistance, networking and financing possibilities offered by the EIC thus further increasing the leverage and increased impact from the initial high-risk investment in FET projects.

Proposals are invited against the following topics:

**FETOPEN-01-2018-2019-2020**

**FET-Open Challenging Current Thinking**

***Specific Challenge***

To lay the foundations for **radically new future technologies** of any kind from visionary interdisciplinary collaborations that dissolve the traditional boundaries between sciences and disciplines, including the social sciences and humanities. This topic also encourages the driving role of new actors in research and innovation, including excellent young researchers, ambitious high-tech SMEs and first-time participants to FET under Horizon 2020 from across Europe.

***Scope***

Proposals are sought for cutting-edge **high-risk / high-impact interdisciplinary research with all of the following essential characteristics** ("FET gatekeepers"):

* **Radical vision**: the project must address a clear and radical vision, enabled by a new technology concept that challenges current paradigms. In particular, research to advance on the roadmap of a well-established technological paradigm, even if high-risk, will not be funded.
* **Breakthrough technological target**: the project must target a novel and ambitious science-to-technology breakthrough as a first proof of concept for its vision. In particular, blue-sky exploratory research without a clear technological objective will not be funded.
* **Ambitious interdisciplinary research** for achieving the technological breakthrough and that opens up new areas of investigation. In particular, projects with only low-risk incremental research, even if interdisciplinary, will not be funded.

The inherently high risks of the research proposed shall be mitigated by a flexible methodology to deal with the considerable science-and-technology uncertainties and for choosing alternative directions and options.

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

***Expected impact***

* Scientific and technological contributions to the foundation of a new future technology.
* Potential for future social or economic impact or market creation.
* Building leading research and innovation capacity across Europe by involvement of key actors that can make a difference in the future, for example excellent young researchers, ambitious high-tech SMEs or first-time participants to FET under Horizon 2020[[74]](#footnote-74).

***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.***

**FETOPEN-02-2018**

**FET-Open Coordination and Support Actions**

***Specific Challenge***

To promote excellent collaborative research and innovation on future and emerging technologies to secure and renew the basis for future European competitiveness and growth, and that will make a difference for society in the decades to come.

***Scope***

Proposals for Coordination and Support Actions (CSA) should be driven by relevant actors in the research field and address only one of the following sub-topics:

**a) FET Communication and Outreach**

Support communication activities on the FET programme and its achievements and outreach actions targeting a wide range of audiences including the general public, and going well beyond the world of academia and research. This shall stimulate the emergence of a FET community and its connection to relevant multipliers and other stakeholder networks. The activities shall use a diversity of channels and interventions (for example news items, social media, interviews, workshops, exhibitions, competitions, code camps and participatory actions for wider engagement).

**b) FET Innovation**

Stimulate the impact on innovation from FET-funded research and improving the innovation readiness levels of FET results, for example by providing a kind of “market place” for FET technologies, by connecting the world of research with that of, potential users, technology leaders, technology transfer organisations, entrepreneurs, investors or alternative financing channels.

**c) FET Observatory**

Ongoing and systematic identification of new and emerging technologies from FET portfolio analysis, trends analysis (using for instance bibliometric tools, media watch, consultations and workshops) and broader horizon scanning (beyond research), including also consideration of ethical implications, gender differences and long-term impacts on society and humankind.

Specificity to the nature of FET is a must (e.g., upstream positioning, interdisciplinarity, high-risk, novelty, long-term impact,…).

The Commission considers that proposals requesting a contribution from the EU of up to € 0.5 million (and up to 0.7 million for a.) would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

***Expected impact***

* Strengthening globally recognised European leadership in the early exploration of visionary, new and emerging technologies and with a strong engagement of scientists, citizens, innovators and policy makers.
* Improved long-term innovation potential in Europe both from the abundance of novel ideas and the range of actors ready to take them forward.
* Improved readiness across Europe to engage in inter-disciplinary research collaboration and to take up new, open and responsible research and innovation practices, with due attention to aspects such as education, gender differences and long-term societal, ethical and legal implications.

***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.***

**FETOPEN-03-2018-2019-2020**

**FET Innovation Launchpad**

***Specific Challenge***

This topic aims at turning results from FET-funded projects into genuine societal or economic innovations.

***Scope***

Short individual or collaborative actions focused on the non-scientific aspects and the early stages of turning a result of an ongoing or recently finished project funded through FET under FP7 or Horizon 2020[[75]](#footnote-75) into a genuine innovation with socio-economic impacts. The precise link with the relevant FET project and the specific result for which a FET Innovation Launchpad proposal is intended, are to be explicitly described in the proposal. This topic does not fund research or activities that are/were already foreseen in the original FET project. Activities proposed should reflect the level of maturity of the result to be taken up. They can include the definition of a commercialisation process, market and competitiveness analysis, technology assessment, verification of innovation potential, consolidation of intellectual property rights, business case development. Proposals can include activities with, for instance, partners for technology transfer, licence-takers, investors and other sources of financing, societal organisations or potential end-users. Limited low-risk technology development (for instance for demonstration, testing or minor adjustment to specific requirements) can be supported as long as it has a clear and necessary role in the broader proposed innovation strategy and plan.

The Commission considers that proposals for actions no longer than 18 months and requesting a contribution from the EU of up to € 0.1 million would allow this specific challenge to be addressed appropriately.

***Expected impact***

* Increased value creation from FET projects by picking up innovation opportunities.
* Improved societal and market acceptance of concrete high-potential innovations from FET projects.
* Stimulating, supporting and rewarding an open and proactive mind-set towards exploitation beyond the research world.
* Contributing to the competitiveness of European industry/economy by seeding future growth and the creation of jobs from FET research.

***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.***

**Conditions for the call**

EIC - FET-Open – Novel ideas for radically new technologies

**Opening dates, deadlines, indicative budgets** [[76]](#footnote-76)

|  |  |
| --- | --- |
| **Opening date:**7 November 2017 | **Deadline of cut-offs*****All deadlines are at 17.00.00Brussels local time*** |
| FETOPEN-01-2018-2019-2020 (RIA) | **16 May 2018****24 January 2019****18 September 2019****13 May 2020** |
| ***Budget of FETOPEN-01-2018-2019-2020 (RIA)*** | *€ millions* |
| **2018** | **2019** | **2020** |
| **Overall indicative budget** | 181.20 | 162.80 | 361.00 |

|  |  |
| --- | --- |
| **Opening date:**7 November 2017 | **Deadline of cut-offs*****All deadlines are at 17.00.00 Brussels local time*** |
| FETOPEN-02-2018 (CSA) | **11 April 2018** |
| FETOPEN-03-2018-2019-2020 (CSA) | **16 October 2018****08 October 2019****14 October 2020** |
| ***Budget of FETOPEN (CSA)*** | *€ millions* |
| **2018** | **2019** | **2020** |
| **Overall indicative budget FETOPEN-02-2018 (CSA)** | 2.00 |  |  |
| **Overall indicative budget FETOPEN-03-2018-2019-2020 (CSA)** | 2.50 | 2.70 | 3.00 |

The call opens at 17.00.00 Brussels local time on the opening date.

The total indicative budget for the FET-Open topic FETOPEN-01-2018-2019-2020 is EUR 647,50 million. The indicative funding budgets available per cut-off date for this topic are as follows:

1. Cut-off date 16/05/2018: €123,70 million
2. Cut-off date 24/01/2019: €160,40 million
3. Cut-off date 18/09/2019: €160,40 million
4. Cut-off date 13/05/2020: €203 million

€57.50 million from the 2018 budget will be used to fund in part the last cut-off of the Horizon 2020 FETOPEN-2016-2017 call under the FET work-programme 2016-2017.

**Indicative timetable for evaluation and grant agreement signature**

For single stage procedure:

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

***Eligibility and admissibility conditions***

The conditions are described in General Annexes [B](http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-b-adm_en.pdf) and [C](http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-c-elig_en.pdf) of the work programme. The following exceptions apply:

|  |  |
| --- | --- |
| **FETOPEN-03-2018-2019-2020** | Proposals must build on results from an ongoing or recently finished project, funded as a result of call in any FET topic under FP7 or Horizon 2020 and clearly identified in the proposal. For a project to be considered "recently finished" in the context of this call topic its actual end date must be at most one year before the deadline for proposal submission to this topic. For a project to be considered "ongoing" in the context of this call topic the deadline for proposal submission to this topic must be within the period limited by the contractual start date and end date of the project.Proposals must include a declaration by the coordinator of the necessary rights and ownership of results to be exploited, as described in the proposal. Applicants that are not the owner of the result to be taken up in the proposal must provide a letter from the relevant beneficiary or beneficiaries of the previous FET project that own(s) the result that confirms the existence of the necessary agreements with the coordinator of the current proposal, including on IPR. |

***Evaluation criteria, scoring and threshold***

The criteria, scoring and threshold are described in [General Annex H of the work programme](http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-h-esacrit_en.pdf). The following exceptions apply:

|  |  |
| --- | --- |
| **FETOPEN-01-2018-2019-2020** | **Excellence**Adherence to the "FET gatekeepers" as described in the call text:* Clarity of the radical vision of a science-enabled technology and its differentiation from current paradigms.
* Novelty and ambition of the proposed science-to-technology breakthrough that addresses this vision.
* Range of and added value from interdisciplinarity for opening up new areas of research; non-incrementality of the research proposed.
* High-risk, plausibility and flexibility of the research approach.

**Threshold: 4/5, Weight: 60%** **Impact*** The extent to which the outputs of the project would contribute to the expected impacts listed in the work programme under this topic.
* Effectiveness of measures and plans to disseminate and use the results (including management of IPR) and to communicate about the project to different target audiences.

**Threshold: 3.5/5, Weight: 20%****Quality and efficiency of the implementation**The following aspects are taken into account:* Coherence and effectiveness of the research methodology and work plan to achieve project objectives and impacts, including adequate allocation of resources to tasks and partners.
* Role and complementarity of the participants and extent to which the consortium as a whole brings together the necessary expertise.

**Threshold: 3/5, Weight: 20%** |
| **FETOPEN-03-2018-2019-2020** | **Excellence**The following aspects are taken into account:1. Clarity and quality of the innovation idea and its link with the previous or ongoing FET project indicated in the proposal.
2. Concreteness of objectives and their pertinence for moving the output of FET research through the initial steps of a process leading to a commercial or social innovation.
3. Suitability and necessity of the proposed activities to reach the stated objectives, including their complementarity to actions already foreseen or expected from the previous or ongoing FET project.

**Threshold: 3/5, Weight: 40%** **Impact**Contributions to the impacts listed under this topic in the work programme:1. Added innovation potential with respect to the FET project from which this innovation originates.
2. Extent of economic and/or societal benefits resulting from this innovation as identified in the proposal.
3. Suitability of measures for taking the innovation beyond the research world, including through engagement with prospective exploitation partners, other stakeholders, users or society.

**Threshold: 3.5/5, Weight: 40%****Quality and efficiency of the implementation**The following aspects are taken into account:1. Quality of workplan and management.
2. Relevance of expertise in the consortium.
3. Appropriate allocation of resources (person-months).

**Threshold: 3/5, Weight: 20%** |

***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](http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-h-esacrit_en.pdf). The following exceptions apply:

|  |  |
| --- | --- |
| **FETOPEN-01-2018-2019-2020** | The following specific page limits apply. Sections 1 to 3 of the Part B of the proposal should consist of a maximum of 15 A4 pages. The limits will be clearly shown in the "proposal templates" in the Participant Portal electronic submission system. Sections that are not subject to limits will be indicated.A proposal that, according to the evaluator's assessments, does not convincingly satisfy all FET gatekeepers as described under this topic will be declared out of scope. The communication to the applications will include the evaluators' assessments, or relevant extracts from them.At consensus stage, the consensus score for each evaluation criteria will be the median of the corresponding scores attributed by the individual evaluators. The consensus report will comprise a collation of the comments from individual reports, or extracts from them. The final review panel will decide on the final score based on its consensus discussions. The panel will also decide on any additional comments, possibly including advice not to resubmit the proposal. |
| **FETOPEN-02-2018** | Grants will be awarded to proposals according to the ranking list. However, in order to ensure a balanced portfolio of supported actions, at least the highest-ranked proposal per sub-topic will be funded provided that it attains all thresholds. |
| **FETOPEN-03-2018-2019-2020** | The following specific page limits apply. Sections 1 to 3 of the Part B of the proposal should consist of a maximum of 7 A4 pages. The limits will be clearly shown in the "proposal templates" in the Participant Portal electronic submission system. Sections that are not subject to limits will be indicated.At consensus stage, the consensus score for each evaluation criteria will be the median of the corresponding scores attributed by the individual evaluators. The consensus report will comprise a collation of the comments from individual reports, or extracts from them. The final review panel will decide on the final score based on its consensus discussions. The panel will also decide on any additional comments, possibly including advice not to resubmit the proposal.For deciding the priority order for proposals with the same score, the procedure for Innovation actions will apply. |

The full evaluation procedure is described in the relevant [guide](http://ec.europa.eu/research/participants/docs/h2020-funding-guide/grants/applying-for-funding/submit-proposals_en.htm) published on the Participant Portal.

***Consortium agreement***

|  |  |
| --- | --- |
| FETOPEN-01-2018-2019-2020 | Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement. |

1. A second series of sub-topics under FET Proactive will be called for in 2020 [↑](#footnote-ref-1)
2. First time participation here refers to the individuals involved, not to their institution or organisation. [↑](#footnote-ref-2)
3. Communiqué of the 8th Joint Steering Committee of 27th May 2016 in Brussels [↑](#footnote-ref-3)
4. See the Eligibility and admissibility conditions for this call. [↑](#footnote-ref-4)
5. See part D of the section “Specific features for Research Infrastructures”. [↑](#footnote-ref-5)
6. As framed by the directive 86/609/EEC, and by the Commission proposal for its revision, COM(2008)543 [↑](#footnote-ref-6)
7. When appropriate, proposals addressing areas under this domain are encouraged to develop synergies with [Copernicus](http://www.copernicus.eu/) data and information as well as with GEO/GEOSS. [↑](#footnote-ref-7)
8. For an overview of already existing projects in this initiative see www.smartanythingeverywhere.eu/ [↑](#footnote-ref-8)
9. [www.i4ms.eu](http://www.i4ms.eu/). Technology areas addressed are: Robotics, Analytics, simulation and artificial intelligence, Additive Manufacturing, Laser based manufacturing equipment [↑](#footnote-ref-9)
10. see https://ec.europa.eu/futurium/en/content/digital-innovation-hubs-catalogue-project-0 [↑](#footnote-ref-10)
11. http://dih.i4ms.eu/ [↑](#footnote-ref-11)
12. In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded when this is necessary to achieve the objectives of the action. [↑](#footnote-ref-12)
13. Wherever appropriate, actions should seek synergies from other R&I initiatives like LC-SC3-EE-13-2018-2019-2020, LC-SC3-EC-1-2018-2019-2020, LC-SC3-ES-5-2018-2020. [↑](#footnote-ref-13)
14. http://www.h2020-bridge.eu/ [↑](#footnote-ref-14)
15. http://www.h2020-bridge.eu/ [↑](#footnote-ref-15)
16. It is expected that this topic will continue in 2020. [↑](#footnote-ref-16)
17. It is expected that this topic will continue in 2020. [↑](#footnote-ref-17)
18. As defined under the ETSI Standardisation framework for Network Function Virtualisation initiatives (ETSI-NFV) [↑](#footnote-ref-18)
19. This should be covered as part of an integrated Network management system. [↑](#footnote-ref-19)
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](http://https://setis.ec.europa.eu/system/files/integrated_set-plan/action7_issues_paper.pdf) [↑](#footnote-ref-20)
21. Batteries Directive, EC/2006/66,

<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02006L0066-20131230&qid=1420631813560&from=EN> [↑](#footnote-ref-21)
22. [https://setis.ec.europa.eu/system/files/Towards%20an%20Integrated%20Roadmap\_0.pdf](http://https://setis.ec.europa.eu/system/files/TowardsanIntegratedRoadmap_0.pdf) [↑](#footnote-ref-22)
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](http://https://setis.ec.europa.eu/system/files/integrated_set-plan/action7_issues_paper.pdf) [↑](#footnote-ref-23)
24. For the benefit of users, the Copernicus programme is setting-up several data and information access services (DIAS) to ensure that access and processing of Copernicus Sentinel data and service information are done in a state of the art computing environment. As a principle, the project shall use the DIAS instead of setting-up their own download and processing infrastructure. Where research projects need such services they shall receive access from the DIAS operator (for free or charged, depending on the nature of the service provided). In case the access is charged, the cost to use any DIAS for the purpose of the project shall be eligible. [↑](#footnote-ref-24)
25. http://ec.europa.eu/growth/sectors/space/research/horizon-2020 [↑](#footnote-ref-25)
26. http://www.copernicus.eu/main/data-access [↑](#footnote-ref-26)
27. It is expected that this topic will continue in 2020 [↑](#footnote-ref-27)
28. Forests cover more 40 % of the EU's landmass, represent 70 % of Europe’s freshwater repository, remove the equivalent of 9 % of GHG emitted by other parts of the economy, and provide for a wide range of other social, economic and ecological services. The forest-based sector provides income for 16 million forest owners and 3-4 million workers in rural areas, and represents some 8% of the EU's total manufacturing value. [↑](#footnote-ref-28)
29. e.g., BEST, BOOSTEFF, CUTEWALL, HIFIVENT, OSIRYS, PERFORMWOOD, REACTAFIRE, SUSTAINCOMP, WOOD-FLARETCOAT [↑](#footnote-ref-29)
30. e.g. FP 1004, 1006, 1101, 1105 [↑](#footnote-ref-30)
31. (COM(2012)497) [↑](#footnote-ref-31)
32. (COM (2012) 497) [↑](#footnote-ref-32)
33. i.e. the balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases, as mentioned in the Paris Agreement. [↑](#footnote-ref-33)
34. e.g. see the 2016 USGCRP scientific report for the White House on "Climate Impacts on Human Health", https://health2016.globalchange.gov/ [↑](#footnote-ref-34)
35. For the purposes of this topic, the definition of a 'city' is to be understood according to the harmonised definition of a city established by the OECD and the European Commission, which can be found at: http://ec.europa.eu/regional\_policy/sources/docgener/focus/2012\_01\_city.pdf [↑](#footnote-ref-35)
36. www.covenantofmayors.eu [↑](#footnote-ref-36)
37. part of this topic contributes to the roadmap of the SPIRE cPPP. [↑](#footnote-ref-37)
38. The term "by-products" should be interpreted here as the constituents usually accompanying the major component(s) of a raw material at low concentrations. [↑](#footnote-ref-38)
39. https://ec.europa.eu/jrc/en/scientific-tool/raw-materials-information-system [↑](#footnote-ref-39)
40. It is expected that this topic will continue in 2020. [↑](#footnote-ref-40)
41. https://ec.europa.eu/eip/raw-materials/en/content/strategic-implementation-plan-sip-0#Targets [↑](#footnote-ref-41)
42. https://ec.europa.eu/jrc/en/scientific-tool/raw-materials-information-system [↑](#footnote-ref-42)
43. Capital expenditures (CAPEX), operational expenditure (OPEX), internal rate of return (IRR), and net present value (NPV) [↑](#footnote-ref-43)
44. http://ec.europa.eu/DocsRoom/documents/20509/attachments/1/translations/en/renditions/native [↑](#footnote-ref-44)
45. It is expected that this topic will continue in 2020. [↑](#footnote-ref-45)
46. https://ec.europa.eu/jrc/en/scientific-tool/raw-materials-information-system [↑](#footnote-ref-46)
47. Proposals should pay attention to the specific call conditions for this topic [↑](#footnote-ref-47)
48. For example, country grouping applied by Forest Europe or other equivalent methodology [↑](#footnote-ref-48)
49. Proposals should pay attention to the specific call conditions for this topic [↑](#footnote-ref-49)
50. http://ec.europa.eu/growth/sectors/raw-materials/policy-strategy/index\_en.htm [↑](#footnote-ref-50)
51. COM(2013)659 [↑](#footnote-ref-51)
52. http://ec.europa.eu/growth/sectors/raw-materials/policy-strategy/index\_en.htm [↑](#footnote-ref-52)
53. https://ec.europa.eu/jrc/en/scientific-tool/raw-materials-information-system [↑](#footnote-ref-53)
54. It is expected that this topic will continue in 2020. [↑](#footnote-ref-54)
55. https://ec.europa.eu/eip/raw-materials/en/content/strategic-implementation-plan-sip-0#Targets [↑](#footnote-ref-55)
56. https://ec.europa.eu/jrc/en/scientific-tool/raw-materials-information-system [↑](#footnote-ref-56)
57. Capital expenditures (CAPEX), operational expenditure (OPEX), internal rate of return (IRR), and net present value (NPV) [↑](#footnote-ref-57)
58. SWD(2016) 205 final/2 Action Plan on the Sendai Framework for Disaster Risk Reduction 2015-2030. A disaster risk-informed approach for all EU policies, as well as Directive 2006/21/EC on the management of waste resulting from extractive industries [↑](#footnote-ref-58)
59. https://ec.europa.eu/commission/commissioners/2014-2019/vella/announcements/memorandum-understanding-between-republic-india-and-european-union-water-cooperation\_en [↑](#footnote-ref-59)
60. <http://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020_localsupp_india_en.pdf> [↑](#footnote-ref-60)
61. http://nmcg.nic.in/ [↑](#footnote-ref-61)
62. For the purposes of this topic, the definition of a 'city' is to be understood according to the harmonised definition of a city established by the OECD and the European Commission, which can be found at:

<http://ec.europa.eu/regional_policy/sources/docgener/focus/2012_01_city.pdf> [↑](#footnote-ref-62)
63. EU Covenant of Mayors for Climate and Energy: www.covenantofmayors.eu; Global Covenant of Mayors for Climate and Energy: www.globalcovenantofmayors.org [↑](#footnote-ref-63)
64. It is expected that this topic will continue in 2020. [↑](#footnote-ref-64)
65. http://www.h2020-bridge.eu/ [↑](#footnote-ref-65)
66. For reasons of fostering Europe's competitiveness in the innovative battery sector, participation to this prize contest will be limited to EU Member States and Countries Associated to Horizon 2020. [↑](#footnote-ref-66)
67. of which EUR 5.00 million from the 'Access to Risk Finance' WP part, EUR 5.00 million from the 'Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing' WP part. [↑](#footnote-ref-67)
68. of which EUR 5.00 million from the 'Access to Risk Finance' WP part. [↑](#footnote-ref-68)
69. of which EUR 5.00 million from the 'Access to Risk Finance' WP part. [↑](#footnote-ref-69)
70. Commission Decision C(2013)8198 authorising the reimbursement of cost under the form of a lump sum for SME Instrument Phase 1 actions under Framework Programme Horizon 2020 states that the total eligible cost for a Phase 1 project is €71 249. Applying the co-financing rate of 70%, the amount of the grant is established at €50 000. [↑](#footnote-ref-70)
71. 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. [↑](#footnote-ref-71)
72. ‘For-profit SMEs’ means micro-, small- and medium-sized enterprises, as defined in Commission Recommendation 2003/361/EC, that are not 'non-profit legal entities' as defined in the Horizon 2020 Rules for Participation (Regulation No 1290/2013): i.e., a ‘legal entity which by its legal form is non-profit-making or which has a legal or statutory obligation not to distribute profits to its shareholders or individual members’. [↑](#footnote-ref-72)
73. 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. [↑](#footnote-ref-73)
74. First time participation here refers to the individuals involved, not their institution or organisation. [↑](#footnote-ref-74)
75. Research and Innovation Actions funded under any call in the FET work programmes under Horizon 2020 for 2014-2015, for 2016-2017, and for 2018-2019-2020; projects funded under the FET part of any of the LEIT-ICT work programmes under FP7. See the Call Conditions for specific eligibility conditions. [↑](#footnote-ref-75)
76. 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.

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. [↑](#footnote-ref-76)