

EN

Annex 2

Horizon 2020

2. Future and Emerging Technologies

DISCLAIMER

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DRAFT

Introduction

Future and Emerging Technologies (FET) activities aim to create in Europe a fertile ground for responsible and dynamic multi-disciplinary collaborations on future technologies and for kick-starting new European research and innovation eco-systems around them. These will be seeds for future industrial leadership and for tackling society's grand challenges in new ways.

In this work programme FET continues its three lines of activity:

1. FET Open¹: the call text for FET-Open in this work programme has been simplified for a clearer scope. FET-Open is part of the European Innovation Council preparatory phase. FET-Open also calls for coordination and support for communication, innovation and horizon scanning. The FET-Open Innovation Launchpad, which was started in the previous work programme, has been refined to take into account experience from the first call.

2. FET Proactive: this work programme features a selection of ambitious emerging technology topics derived from an extensive consultation and advice from the FET Advisory Group. Topics include: living technologies, socially interactive technologies, technologies related to time, artificial organs, micro-energy technologies, and topological matter. Community building and innovation eco-system development are key elements in FET proactive and a specific action on neuromorphic computing is foreseen.

The FET Proactive initiative in HPC is designed in synergy with the LEIT-ICT and e-Research Infrastructures WPs. It covers the co-design of the exascale machines integrating the European microprocessor part and addresses the development of scientific and engineering applications that will run on extreme scale HPC machines.

3. FET Flagships: the work programme supports the continuation of the Graphene and HBP flagships, with a clear shift to innovation and impact. The work programme also features the ramp-up of a new flagship on Quantum Technologies, and preparatory actions for preparing new Flagships.

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

¹ Note that 40% of the Horizon 2020 budget for FET is earmarked for FET Open.

Call - FET-Open – Novel ideas for radically new technologies²

H2020-FETOPEN-2018-2020

Mission Statement: 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) preparatory phase. 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 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 preparatory phase, 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 topic(s):

² It is expected that this call will continue in 2020.

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 must 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 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:

- 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 2020³.

Type of Action: Research and Innovation action

³ First time participation here refers to the individuals involved, not their institution or organisation.

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 Actions⁴

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 subtopics:

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). A clear focus on the specific nature of FET is a must.

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. Specificity to the nature of FET is a must.

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 and long-term impacts on society and humankind.

For a. and c. at most one proposal will be funded.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 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:

⁴ This activity directly aimed at supporting the development and implementation of evidence base for R&I policies and supporting various groups of stakeholders is excluded from the delegation to the Research Executive Agency (REA) and will be implemented by the Commission services.

- 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 and more open research and innovation practices.

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 2020⁵] 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 EUR 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.

⁵ The following topics are intended: [add a list of all eligible WP topic identifiers

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

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

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2018	2019	
Opening: 03 Oct 2017			
FETOPEN-01-2018-2019-2020 (RIA)	184.50	162.00	15 May 2018 23 Jan 2019 18 Sep 2019 13 May 2020
Opening: 31 Oct 2017			
FETOPEN-02-2018 (CSA)	2.00		06 Mar 2018
FETOPEN-03-2018-2019-2020 (CSA)	2.50	2.70	16 Oct 2018 09 Oct 2019 14 Oct 2020
Overall indicative budget	189.00	164.70	

The total available budget for the FET-Open topic FETOPEN-01-2018-2019-2020 is EUR 650,00 million. The budgets available per cut-off date for this topic are as follows:

1. Cut-off date 15/05/2018: EUR 127,00 M€
2. Cut-off date 23/01/2019: EUR 160,00 M€
3. Cut-off date 18/09/2019: EUR 160,00 M€
4. Cut-off date 13/05/2020: EUR 203,00 M€ (indicative)

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EUR 57,50 million from the 2018 budget will be used to fund the last cut-off of the Horizon 2020 FETOPEN-2016-2017 call under the FET workprogramme 2016-2017.

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

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

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

FETOPEN-03-2018-2019-2020	<p>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.</p> <p>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.</p>
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Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in General Annex H of the work programme. The following exceptions apply:

FETOPEN-01-2018-2019-2020	<p>Excellence</p> <p>Adherence to the "FET gatekeepers" as described in the call text:</p> <ul style="list-style-type: none">• 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.
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	<ul style="list-style-type: none"> • 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. <p>Threshold: 4/5, Weight: 60%</p> <p>Impact</p> <ul style="list-style-type: none"> • The extent to which the outputs of the project would contribute to the expected impacts listed in the work programme under the relevant FET topic. • Effectiveness of measures and plan to disseminate and use the results (including management of IPR) and to communicate about the project to different target audiences. <p>Threshold: 3.5/5, Weight: 20%</p> <p>Quality and efficiency of the implementation</p> <p>The following aspects are taken into account:</p> <ul style="list-style-type: none"> • 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. <p>Threshold: 3/5, Weight: 20%</p>
<p>FETOPEN-03-2018-2019-2020</p>	<p>Excellence</p> <p>The following aspects are taken into account:</p> <ul style="list-style-type: none"> • Clarity and quality of the innovation idea and its link with the previous or ongoing FET project indicated in the proposal. • 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. • Suitability and necessity of the proposed activities to reach the stated objectives, including their complementarity to

	<p>actions already foreseen or expected from the previous or ongoing FET project.</p> <p>Threshold: 3/5, Weight: 40%</p> <p>Impact</p> <p>Contributions to the impacts listed under this topic in the work programme:</p> <ul style="list-style-type: none"> • Added innovation potential with respect to the FET project from which this innovation originates. • Extent of economic and/or societal benefits resulting from this innovation as identified in the proposal. • Suitability of measures for taking the innovation beyond the research world, including through engagement with prospective exploitation partners, other stakeholders, users or society. <p>Threshold: 3.5/5, Weight: 40%</p> <p>Quality and efficiency of the implementation</p> <p>The following aspects are taken into account:</p> <ul style="list-style-type: none"> • Quality of workplan and management. • Relevance of expertise in the consortium. • Appropriate allocation of resources (person-months). <p>Threshold: 3/5, Weight: 20%</p>
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Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme. The following exceptions apply:

<p>FETOPEN-01-2018-2019-2020</p>	<p>The following specific page limits apply. Part B of the proposal should consist of a maximum of 16 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.</p> <p>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.</p>
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	<p>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.</p>
<p>FETOPEN-03-2018-2019-2020</p>	<p>The following specific page limits apply. Part B of the proposal should consist of a maximum of 8 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.</p> <p>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.</p> <p>For deciding the priority order for proposals with the same score, the procedure for Innovation actions will apply.</p>

The full evaluation procedure is described in the relevant [guide](#) published on the Participant Portal.

Consortium agreement:

<p>FETOPEN-01-2018-2019-2020</p>	<p>Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.</p>
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Call - FET Proactive – Boosting emerging technologies⁶

H2020-FETPROACT-2018-2020

Mission Statement: FET Proactive aims to identify the future and emerging technological paradigms with highest potential for Europe's economy and society. For each of them, it looks to establish a broad and solid European basis in terms of knowledge, key technological building blocks and interdisciplinary communities. By reaching out well beyond the research world, it ensures that Europe has the best 'first mover' position to capitalise rapidly and effectively on emerging societal and industrial opportunities.

Proposals are invited against the following topic(s):

FETPROACT-01-2018: FET Proactive: emerging paradigms and communities⁷

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 ecosystem around a new technological paradigm, well beyond the world of research alone.

Scope: proposals should address research and innovation activities in line with one of the following emerging paradigms:

1. **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. (15MEuro)
2. **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

⁶ It is expected that this call will continue in 2020.

⁷ A second series of topics under FET Proactive will be called for in 2020

from biological or computational evolution, for instance); or modelling to understand and better anticipate non-linear temporality in complex systems (economies, societies,...). Technologies in e.g., high-speed electronics, 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. (13MEuro)

3. **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 must be included. (20MEuro)
4. **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. 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 must be included (15MEuro)
5. **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 integration within hybrid/distributed energy systems. Proposals should also address aspects of sustainability and environmental impact. (15MEuro)
6. **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. (10MEuro)

Proposals are sought for cutting-edge **high-risk / high-reward research and innovation projects** addressing the above initiatives that aim to demonstrate a new technological paradigm. 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 '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.

This topic allows for proposals to provide financial support to European third parties in line with the conditions set out in Part K of the General Annexes, in order to enhance impacts through punctual small scale experimentation and use of project results by third parties, or to award an inducement prize following a contest organised by the beneficiaries.

Expected Impact:

- Scientific and technological to the foundation and consolidation of a radically new future technology
- Potential for future returns in terms of societal or economic innovation or market creation.
- Spreading excellence and building leading innovation capacity across Europe by involvement of key actors that can make a difference in the future, including excellent young, researchers, ambitious high-tech SMEs or first-time participants to FET under Horizon 2020⁸.
- Build-up of a goal oriented interdisciplinary community (within and beyond the consortium).
- 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.

⁸ First time participation here refers to the individuals involved, not to their institution or organisation.

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.

FETPROACT-02-2018: Community building in Neuromorphic Computing Technologies

Specific Challenge: To network and coordinate the efforts of the European academic and industrial research and innovation communities in neuromorphic computing (NMC) technologies. To promote the application of these technologies in cognitive computing, capitalising on their key benefits such as greater flexibility, efficiency and their adaptive and permanent learning capacities, to generate large industrial interest and stimulate further investments and innovations in the field.

Scope: Proposals should aim at networking and coordinating the efforts of the relevant NMC stakeholders, notably academia, RTOs and industry by addressing the following: constituency/eco-system building, through dedicated events, and the fostering of collaboration among related research and innovation projects in Europe to facilitate the matching of NMC technologies with industrial needs; joint research and innovation road mapping of NMC technologies and solutions in different application domains; pre-normative and education activities and; pre-normative and education activities and harmonised benchmarking of NMC solutions in the different application domains; and wide diffusion of NMC technologies, including by supporting the promotion of technology cases and eye-opening demonstrators in promising industry sectors such as automotive, robotics, manufacturing and more generally for big data analysis, learning and adaptation to evolving contexts of operation.

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

- Increased synergies and collaboration between research and innovation projects in Europe;
- Increased synergies across national and European Programmes supporting NMC technologies;
- Increased industrial support and engagement in jointly developing NMC solutions in key applications domains backed up by a high-quality research and innovation roadmap in the related areas;
- Availability of NMC technologies demonstrating their applicability and innovation potential in relevant industry sectors;
- Development of NMC innovation programmes and communities in Europe including dissemination and education aspects.

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.

FETPROACT-03-2018: FET ERA-NET Cofund

Specific Challenge: to advance the construction of the European Research Area in the FET domain by sharing a common vision of the various relevant efforts in Europe and fostering cooperation towards the coordinated development of radically new future technologies.

Scope: Proposals should coordinate national and regional programmes in the FET domain by implementing a call for proposals jointly funded by the participating countries with EU co-funding in accordance with the provisions of the General Annexes, possibly followed by further calls for proposals without EU co-funding. The action may also organise additional joint activities in the FET domain between the participating funding agencies. Two activities are mandatory:

1. Identifying future and emerging technologies where transnational cooperation and community structuration is needed, in complementarity and synergy with FET;
2. Developing strategic agendas for these topics and accompanying the structuration of the related communities through workshops and transversal activities.

Expected Impact: Closer coordination and greater mobilisation and pooling of resources between regional, national and EU research programmes in the FET domain.

Type of Action: ERA-NET Cofund

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

Conditions for the Call - FET Proactive – Boosting emerging technologies

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

Topics (Type of Action)	Budgets (EUR million)	Deadlines
	2018	
Opening: 16 Oct 2017		
FETPROACT-02-2018 (CSA)	0.50	22 Mar 2018
FETPROACT-03-2018 (ERA-NET-Cofund)	6.00	18 Dec 2018
Opening: 17 Apr 2018		
FETPROACT-01-2018 (RIA)	88.00	18 Sep 2018
Overall indicative budget	94.50	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

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

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

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

FETPROACT-01-2018	<p>Excellence</p> <p>The following aspects are taken into account:</p> <ul style="list-style-type: none"> • Clarity of long-term vision of a science-enabled technology. • Concreteness and ambition of the proposed science-to-technology breakthrough that addresses this vision. • Range and added value from interdisciplinarity, novelty and non-incrementality of the research proposed. • High-risk of the research proposed and plausibility and flexibility of the approach. <p>Threshold: 4/5, Weight: 60%</p> <p>Impact</p> <ul style="list-style-type: none"> • The extent to which the outputs of the project would contribute to the expected impacts mentioned in the work programme under the relevant FET topic. • Effectiveness of measures and plan to disseminate and use the results (including management of IPR) and to communicate the project to different target audiences. <p>Threshold: 3.5/5, Weight: 20%</p> <p>Quality and efficiency of the implementation</p> <p>The following aspects are taken into account:</p> <ul style="list-style-type: none"> • Coherence and effectiveness of the work plan to achieve project objectives and impacts, including adequate allocation of resources to tasks and partners.
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	<ul style="list-style-type: none"> • Appropriateness of the research and innovation management structures and procedures. • Role and complementarity of the participants and extent to which the consortium as a whole brings together the necessary expertise. <p>Threshold: 3/5, Weight: 20%</p>
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Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme. The following exceptions apply:

FETPROACT-01-2018	<p>Proposals submitted under each initiative will be evaluated by separate independent panels.</p> <p>The following specific page limits apply. Part B of the proposal should consist of a maximum of 31 A4 pages. The limits will be clearly shown in the ‘proposal templates’ in the Participant Portal electronic submission system. Sections which are not subject to limits will be indicated.</p>
FETPROACT-03-2018	<p>Given the specific nature and strategic objective of the ERA-NET Cofund instrument, at most one ERA-NET Cofund action will be funded under this topic.</p>

The full evaluation procedure is described in the relevant [guide](#) published on the Participant Portal.

Grant Conditions:

FETPROACT-01-2018	<p>For grants awarded under this topic beneficiaries may provide support to European third parties as described in part K of the General Annexes of the Work Programme either in form of grants or prizes and within the limitations as described in the call text of this topic. The respective options of Article 15 of the Model Grant Agreement will be applied.</p>
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Consortium agreement:

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FETPROACT-01-2018	Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.
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DRAFT

Call - FET Proactive – High Performance Computing⁹

H2020-FETHPC-2018-2020

Mission Statement: The HPC FET Proactive aims to create a world-class European HPC ecosystem, by developing leading-class technology and solutions towards exascale performance for ambitious scientific/engineering applications and services. By benefiting from the convergence of HPC, Big Data and Cloud Computing technologies, the HPC ecosystem will provide innovative, usable and competitive solutions that will upraise Europe's scientific capabilities and industrial competitiveness.

In April 2016, as part of its Digitising European Industry¹⁰ strategy, the Commission adopted the communication *European Cloud Initiative - Building a competitive data and knowledge economy in Europe*¹¹, which was endorsed by the European Council in June 2016. The initiative aims to create, a **leading European High Performance Computing and Big Data (HPC/BD) research and industrial ecosystem by 2023** underpinned by a world-class European Data Infrastructure offering high performance computing and data capabilities, fast connectivity and high-capacity cloud solutions.

A synergetic approach for HPC technologies is promoted, which is complementary to relevant activities covered in the LEIT and eINFRA work programmes 2018-2020 and are called in the framework of the Public Private Partnership (PPP) on HPC with the ETP4HPC Association (European Technology Platform in HPC).

Proposals are invited against the following topic(s):

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

Specific Challenge: In the frame of the Bilateral Agreement on Science and Technology between the European Union and the United States of Mexico¹², the aim is to develop strategic partnership in HPC with Mexico that enables advancing the work on HPC applications in domains of common interest. Mexican partners will not be funded by the EU and they are expected to participate in the project with their own funding.

Scope: 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.

The Commission considers that 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.

⁹ It is expected that this call will continue in 2020.

¹⁰ COM(2016) 180 final

¹¹ COM(2016) 178 final

¹² Communiqué of the 8th Joint Steering Committee of 27th May 2016 in Brussels

Expected Impact:

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

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.

FETHPC-02-2019: HPC PPP - 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.

All grants under this topic will be subject to Article 30.3 of the Model Grant Agreement, relative to the right of the Commission to object to transfers or licensing of results.

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 must 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 topics:

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 requesting a contribution from the EU of between EUR 4 and 8 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.

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:

- coordinate the European HPC strategy, and monitor and measure its implementation,
- produce roadmaps for HPC technology and applications, covering also the post-exascale, and evaluate them through impact monitoring
- 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
- build and maintain relations with other relevant international HPC activities
- 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 requesting a contribution from the EU of between EUR 3,5 and 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

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

b) Coordination and Support Actions

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

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

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

Conditions for the Call - FET Proactive – High Performance Computing

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

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2018	2019	
Opening: 31 Oct 2017			
FETHPC-01-2018 (RIA)	2.00		22 Mar 2018

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Opening: 31 Oct 2018			
FETHPC-02-2019 (CSA)		4.00	24 Sep 2019
FETHPC-02-2019 (RIA)		64.00	
Overall indicative budget	2.00	68.00	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

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

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

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

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

The full evaluation procedure is described in the relevant [guide](#) published on the Participant Portal.

Grant Conditions:

FETHPC-02-2019	For grants awarded under this topic for Research and Innovation Actions the Commission or Agency may object to a transfer of ownership or the licensing of results to a third party established in a third country not associated to Horizon 2020. The respective option of Article 30.3 of the Model Grant Agreement will be applied.
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Consortium agreement:

FETHPC-01-2018, FETHPC-02-2019	Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.
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Call - FET FLAGSHIPS – Tackling grand interdisciplinary science and technology challenges¹³

H2020-FETFLAG-2018-2020

Mission statement: FET Flagships tackle grand Science and Technology challenges expected to result in 'game changing' impacts on economy and society, benefitting European citizens and paving the way for global technological and industrial leadership. Because of their ambition, their scale and their interdisciplinary nature, FET Flagships can only be realised through a long-term and sustained effort at European level, by building on large scale research cooperation across academia and industry and across national research programmes, and by mobilising Europe's best researchers around an ambitious R&D roadmap.

Under the first work programme of Horizon 2020, a Framework Partnership Agreement (FPA) has been established for each of the two running Flagships, Graphene and the Human Brain Project (HBP).

Activities in this work programme will: (i) further support the two running Flagships on the basis of their FPAs, following Specific Grant Agreements (SGAs) and other actions launched under previous work programmes; (ii) kick-start the support to the new Flagship on Quantum Technologies (QT); (iii) further support the FLAGERA and QUANTERA ERA-NETs that bring together national and regional funding agencies from the Member States and Associated Countries in support respectively of the two running Flagships and the QT one; and (iv) include preparatory actions to prepare the ground for new candidate FET Flagship initiatives.

Proposals are invited against the following topic(s):

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

Objective: This topic aims at launching Coordination and Support Actions (CSA) to prepare new candidate 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 and sustained effort.

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.

¹³ It is expected that this call will continue in 2020.

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:

- **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.
- **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.
- **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:

- **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.
- **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.

- **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.
- **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, with the Commission and with the relevant funding agencies and national research initiatives.
- **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.
- **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 Flagship must address one of the following three main areas: **ICT and Connected Society, Health and Life Sciences, or Energy, Environment and Climate change**. Proposals should clearly specify which one of these 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

Proposals should address any of the following topics in part or in whole:

- **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.
- **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.
- **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

Proposals should address any of the following topics in part or in whole:

- **Disruptive technologies to Revolutionise Healthcare:** New technologies and approaches aiming at a paradigm shift in the field of prevention, prediction and treatment of diseases. This includes in particular bioinformatics and modelling approaches to use patients' genetic expression patterns and metabolism and derived systems to provide individualised prevention, prediction and treatment; novel and innovative nano-medicine approaches including for example bio-sensors, organ-on-a-chip technologies, network medicine, technologies for drug delivery; and regenerative medicine and biofabrication techniques to replace human cells, tissues and whole organs and to integrate these in functioning body systems.
- **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, including structure and dynamics, and the full multi-omics (genome/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 pathological mechanism.

(3) Energy, Environment and Climate change

Proposals should address any of the following topics in part or in whole:

- **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 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.
- **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.

Expected Impact: For the CSA:

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

For the proposed Flagships:

- 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.
- 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

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

FETFLAG-02-2018: ERA-NET Cofund for FET Flagships

Specific Challenge: To fund partnering projects (PPs) and coordinate the national activities and support of Member States and Associated Countries (MS/AC) to the Graphene and HBP Flagships. PPs are projects funded from other sources (e.g. by national/regional funding) which address areas relevant for the Flagships and contribute to their objectives.¹⁴

Scope: One follow-up action to the FLAG-ERA II ERA-NET Cofund action (<http://www.flagera.eu/>) aiming to coordinate national and regional research programmes to fund PPs of the two Flagships by implementing a call jointly funded by the participating countries with EU co-funding in accordance with the provisions of the General Annexes, possibly followed by further calls for proposals without EU co-funding. The action may also organise additional joint activities between the participating funding agencies in support of the two Flagships.

Expected Impact: Closer coordination and greater mobilisation and pooling of resources between regional, national and EU research programmes for realising the research goals of the FET Flagships.

Type of Action: ERA-NET Cofund

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

¹⁴ See SWD(2014) 283 final of 16.9.2014

FETFLAG-03-2018: FET Flagship on Quantum Technologies

Specific Challenge: To build a strongly networked European Quantum Technologies (QT) community around the common goals defined in the Strategic Research Agenda¹⁵, creating the European ecosystem that will deliver the knowledge, technologies and open research infrastructures and testbeds necessary for the development of a world-leading knowledge-based industry in Europe, leading to long-term economic, scientific and societal benefits, and to move advanced quantum technologies from the laboratory to industry with concrete prototype applications and marketable products while advancing at the same time the fundamental science basis, in order to continuously identify new applications and find better solutions for solving outstanding scientific or technology challenges.

Scope: a) Research and Innovation Actions

Proposals are expected to address a mix of quantum technology challenges addressing one or more of the following areas, integrating different aspects like physics, engineering, computer science, theory, algorithms, software, manufacturing, control, infrastructures, etc. Each activity should clearly move the technology up the TRL scale¹⁶.

a. Quantum Communication¹⁷: Development of state-of-the art network devices, applications and systems (memories, quantum repeaters, network equipment, high throughput miniaturised quantum random number generators, etc.) for quantum communication mesh-networks. Proposals should target lower-cost solutions, devices and systems compatible with existing communication networks and standard cryptography systems, as well as device-independent protocols. Each proposal should address aspects like engineering, protocols, certification, software, algorithms. Actions should include validation of the proposed solution and proof of its suitability for the targeted application.

b. Quantum Computing Systems: The development of open quantum computer experimental systems and platforms¹⁸, integrating the key building blocks such as quantum processors (>10qubits) with limited qubit overhead, software stack, algorithms, applications, etc. Work should address the scalability towards large systems (>100 qubits), the verification and validation of the quantum computation, fault-tolerance and solving a concrete computational problem to demonstrate the quantum advantage. Projects should foresee benchmarking activities. Benchmarks will be identified by the CSA¹⁹ for all the platforms selected in this area.

¹⁵ building on the Quantum Manifesto (<http://europa.eu/manifesto>), the Commission Expert Group on Quantum Technologies – High Level Steering Committee has delivered on 17 February 2017 a first version of the Strategic Research Agenda in its intermediate report (http://ec.europa.eu/newsroom/document.cfm?doc_id=42721)

¹⁶ See the definition of Technology Readiness Levels (TRLs) in the General Annexes to the work programme.

¹⁷ This area will be complemented by a dedicated topic on quantum communication testbeds in the LEIT ICT work programme (see topic SU-ICT-04-[2019]).

¹⁸ Including, if relevant, hybrid approaches linking quantum and classical systems or linking different quantum platforms.

¹⁹ See item b) under this topic.

c. Quantum Simulation: Proposals should aim at delivering operational demonstrators, based on existing physical platforms that have shown a clear perspective to achieve more than 50 interacting quantum units and / or full local control. They should work towards demonstrating a certified quantum advantage for solving difficult scientific or industrial problems (e.g. material design, logistics, scheduling, machine learning, optimisation, artificial intelligence, drug discovery, etc.). The proposed solutions need to include the development of protocols, validation schemes and control, simulation software, system configuration and optimisation. Work should address the scalability towards larger systems with more qubits. Projects should foresee benchmarking activities related to real life applications. Benchmarks will be identified by the CSA²⁰ for all the platforms selected in this area. Hybrid architectures are also to be considered under this topic when relevant.

d. Quantum Metrology and Sensing: Quantum sensors for specific application areas such as imaging, healthcare, geo-sciences, outdoor and indoor navigation, time or frequency, magnetic or electrical measurements, etc. ... as well as novel measurement standards²¹, making use of the advances in controlling the fundamental quantum properties. It is expected that the work will lead to practical sensing devices, imaging systems and quantum standards that employ quantum coherence and outperform classical counterparts (resolution, stability) targeting TRL 3 and 4 and showing potential for further miniaturisation/integration into industrial systems.

e. Fundamental science: Research and development of basic theories and components, addressing a foundational challenge of relevance for the development of quantum technologies in at least one of the four areas a.-d. described above, to improve the performance of the components or subsystems targeted in those areas. Proposals must clearly indicate how they support a challenge for one or more of these areas.

For areas a. to d., proposals should be based on a close cooperation between academia and industry, define output and impact KPIs²², include technology benchmarking against other approaches, and include user requirements.

For areas a. to c. above, proposals should seek synergies with relevant national / regional research and innovation programmes running in these areas. They shall clearly specify how they are connected to the programmes and / or how they will incorporate the platforms, testbeds and infrastructures existing in Europe, how they will attract and build communities around them for openly promoting further technology developments as well as testing and benchmarking in the field and how they build on top of these to create European added value. Proposals can integrate various activities covering the whole value chain, from fundamental to applied research, and with other types of activity, including demonstrators, etc., as appropriate. Proposals combining different sources of financing should include a concrete financial plan detailing the use of these funding sources for the different parts of their activities.

²⁰ See item b) under this topic.

²¹ Measurement standards used in metrology for electrical quantities, mass, length, time, frequency, etc...

²² KPI = Key Performance Indicator.

The Commission considers that proposals requesting a contribution from the EU up to EUR 10 million would allow the areas a. to c. to be addressed appropriately; proposals requesting a contribution from the EU up to EUR 6 million would allow the area d. to be addressed appropriately; and proposals requesting a contribution from the EU between EUR 2 and 3 million would allow the area e. to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

The expected indicative funding budget is: up to EUR 20 million for area e. At least two proposals for each area a. to d. will be funded.

When appropriate, proposals may provide financial support to European third parties in line with the conditions set out in Part K of the General Annexes, for example to access specific expertise or infrastructure. The consortium will define the selection process of third parties for which financial support will be granted (with a maximum of EUR 100 000²³ per party). A maximum of 10% of the EU funding requested by the proposal should be allocated to this purpose.

All projects shall make provisions to actively participate in the common activities of the Quantum Flagship and in particular: participate in the overall governance of the Flagship; coordinate technical work with the other selected projects of the Flagship; and contribute to the activities of the Coordination and Support Action defined in b) below. All the projects that will be selected under the Quantum Flagship shall have a 3-years duration and shall be implemented as a programme through the use of complementary grants. The respective options of Article 2, Article 31.6 and Article 41.4 of the Model Grant Agreement²⁴ will then be applied.

All the grants of the Quantum Flagship shall be subject to the Article 30.3 of the Model Grant Agreement²⁵, relative to the right to object to transfers or licensing of results.

b) Coordination and Support Action

Proposals should aim at coordinating the relevant stakeholders, notably academia, RTOs and industry participating in the Flagship initiative. In particular, it is expected to establish a communication platform, facilitate dialogue, promote the objectives of the Flagship and monitor the progress, support the governance structure, organize outreach events (including addressing the impact of technology development on economy and society), identify training and education needs and promote European curricula in quantum engineering, identify and coordinate relevant standardisation, IPR actions, and international collaboration and help networking of respective national and international activities in the field. The action will also identify, together with the community, a benchmarking for all

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

²⁴ See http://ec.europa.eu/research/participants/data/ref/h2020/mga/gga/h2020-mga-gga-multi_en.pdf

²⁵ See http://ec.europa.eu/research/participants/data/ref/h2020/mga/gga/h2020-mga-gga-multi_en.pdf

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communication/computing/simulation platforms selected under area a. to c. of the Research and Innovation Actions above.

It is expected that such an activity is driven by the relevant actors of the field including academia, RTOs and industry.

Expected Impact: a) Research and Innovation Actions

- Contribute to the strategic objectives of the Flagship;
- Expand European leadership and excellence in quantum technologies;
- Scientific breakthroughs that form the basis for future technologies;
- Synergetic collaboration with existing European platforms and infrastructures;
- Kick-start a competitive European quantum industry;
- Availability of open platforms and infrastructures accessible to the European Quantum technologies Community.

b) Coordination and Support Action

- A well-coordinated European initiative on Quantum Technologies, involving all relevant stakeholders and linked with relevant international, national and regional programmes, while assuring an efficient support to the governance of the Flagship;
- Spreading of excellence on Quantum Technologies across Europe, increased awareness of European activities and availability of European curricula in the field.

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

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

Conditions for the Call - FET FLAGSHIPS – Tackling grand interdisciplinary science and technology challenges

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

Topics (Type of Action)	Budgets (EUR million)	Deadlines
	2018	
Opening: 31 Oct 2017		
FETFLAG-01-2018 (CSA)	6.00	20 Feb 2018
FETFLAG-02-2018 (ERA-NET-Cofund)	10.00	20 Feb 2018

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FETFLAG-03-2018 (RIA)	130.00	20 Feb 2018
FETFLAG-03-2018 (CSA)	1.50	
Overall indicative budget	147.50	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

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

For two stage procedure:

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

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

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

FETFLAG-01-2018	<p>For the evaluation of the first-stage proposals, only the criteria ‘excellence’ and ‘impact’ will be evaluated and, within these criteria, only the aspects in bold will be considered.</p> <p>Excellence</p> <ul style="list-style-type: none"> • Degree of adherence to the FET Flagship concept as specified in the work programme • Soundness of the proposed Flagship's vision, scientific concept, quality and pertinence of the objectives and of its targeted technologies and progress beyond the state-of-the-art • Existence of excellence and critical mass in Europe to reach the Flagship goals in the long term and extent to which these are considered in the proposed Flagship
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	<p>Threshold: 4/5</p> <p>Impact</p> <ul style="list-style-type: none">• Contribution of the proposed Flagship to the expected impacts, as listed in the work programme• EU added value of the proposed Flagship and extent to which it makes use of complementarities, exploits synergies, and enhances the overall outcome of regional, national, European and international research programmes• Contribution of the proposed CSA to the expected impacts listed in the work programme• Quality of the proposed CSA approach to disseminate the project results, and to attract large public support <p>Threshold: 4/5</p> <p>Quality and efficiency of the implementation</p> <ul style="list-style-type: none">• Quality and effectiveness of the methodology, work plan, and coordination activities of the proposed CSA(including milestones, metrics to monitor progress, and deliverables)• Quality and effectiveness of the approach to engage with relevant research initiatives in the Member States, industry and interdisciplinary research communities, as well as initiatives at European level• Appropriateness of the proposed CSA management structures and procedures, including risk management• Quality of the Consortium as a whole, including complementarity of the participants and extent to which the consortium as whole brings together the necessary expertise to carry out the tasks foreseen in the CSA• Appropriateness of the allocation of tasks and resources, ensuring that all participants have a valid role and adequate resources in the CSA project to fulfil that role <p>Threshold: 3/5</p>
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Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme. The following exceptions apply:

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FETFLAG-01-2018	This evaluation will be done in two stages. The proposal for the first stage is maximum 20 pages and should address the questions what makes this a FET Flagship, what will be the impact on European economy and society, and what is the European added value, following the instructions in the template provided. Only proposals that pass stage 1 will be invited to submit a full proposal.
FETFLAG-02-2018	Given the specific nature and strategic objective of the ERA-NET Cofund instrument, at most one ERA-NET Cofund action will be funded under each topic.
FETFLAG-03-2018	The following specific page limits apply for proposals addressing area " e. fundamental science ". Part B of the proposal should consist of a maximum of 16 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.
FETFLAG-03-2018	At most one CSA proposal will be funded under this topic.

The full evaluation procedure is described in the relevant [guide](#) published on the Participant Portal.

Grant Conditions:

FETFLAG-03-2018	Grants awarded under this topic shall have a 3-years duration and shall be implemented as a programme through the use of complementary grants and the respective options of Article 2, Article 31.6 and Article 41.4 of the Model Grant Agreement will then be applied. In particular the projects are required to conclude a collaboration agreement, in principle prior to the signature of the grant agreement.
FETFLAG-03-2018	For grants awarded under this topic Research and Innovation Actions the Commission or Agency may object to a transfer of ownership or the licensing of results to a third party established in a third country not associated to Horizon 2020. The respective option of Article 30.3 of the Model Grant Agreement will be applied.
FETFLAG-03-2018	For grants awarded under this topic beneficiaries may provide support to European third parties as described in part K of the General Annexes of the Work Programme. The support to third

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	parties can only be provided in the form of grants, within the limitations set out in the call text for this topic. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied.
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Consortium agreement:

FETFLAG-03-2018	Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.
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Other actions

1. External Expertise

This action will support:

1. The use of appointed independent experts for the monitoring of running projects, where appropriate.
2. The use of appointed independent experts to advise on, or support, the design and implementation of EU research and innovation policy or programmes as well as the achievement and functioning of the European Research Area. A special allowance of EUR 450/day will be paid to the experts appointed in their personal capacity who act independently and in the public interest.

Type of Action: Expert Contracts

Indicative timetable: As needed

Indicative budget: EUR 1.00 million from the 2018 budget and EUR 1.50 million from the 2019 budget

2. Graphene FET Flagship core project

The Graphene Framework Partnership Agreement (FPA) consortium will be invited to submit a proposal for a Specific Grant Agreement (SGA) that will implement the next three years (indicative) of the action plan defined in the Graphene FPA.

The proposal should adhere to the FPA programme of activities and address key parts of the S&T roadmap, taking into account the Technology & Innovation roadmap and the state of the art. It should focus on those areas that have the greatest innovation potential and impact on Europe's economy and society. The bulk of the research efforts should address technologies at TRL 4-5 or above, and be reflected by an increased industrial participation in the Consortium, as well as by an intensive cooperation with industry players and increased technology transfer activities.

The proposal should describe the coordination and management activities of the Flagship (including research activities with and services provided to an increasing number of partnering projects); the collaboration with other research initiatives or programmes at regional, national, European or international level; and updating S&T and Technology & Innovation roadmaps. The proposal should also detail activities in areas such as education and training, dissemination and science- and citizens-oriented outreach activities, safety, ethics and societal aspects.

Any modification to the FPA Consortium partners should be sufficiently motivated and based on the highest standards of scientific and technological excellence and on open and transparent criteria.

This action allows for the provision of financial support to third parties in line with the conditions set out in Part K of the General Annexes.

Expected impact: Contribution to the targeted impacts defined in the action plan of the FPA.

Type of Action: Specific Grant Agreement

Indicative timetable: Second quarter of 2019

Indicative budget: EUR 150.00 million from the 2019 budget

3. HBP FET Flagship core project

The Human Brain Project (HBP) Framework Partnership Agreement (FPA) consortium will be invited to submit a proposal for a Specific Grant Agreement (SGA) that will implement the next three years (indicative) of the action plan defined in the HBP FPA.

The proposal should adhere to the FPA programme of activities and ensure that the activities focus on the essential elements for producing impactful results in neuroscience, medicine and computing. It should describe how ongoing HBP activities or other related S&T developments in Europe will be further developed and integrated, while taking into account the state of the art, maintaining a multi-disciplinary approach and involving the relevant scientific communities.

The facilities of the HBP Service Research Infrastructure (SRI) should reach at least TRL 8 ('deployment', as defined in the HBP FPA Action Plan) by the end of this SGA. The proposal should explain how this will be achieved and measured; how it will engage relevant actors from established RI and ICT infrastructures and ensure that a sufficient number of scientists, RTOs, industry or healthcare users actively validate the SRI functionalities and operation modalities for preparing its wide adoption and use by the R&D communities; and how further innovation by relevant industry and other stakeholders will be nurtured from the HBP techniques and technologies.

The proposal should describe the coordination and management activities of the Flagship including activities, such as: (i) governance, including cooperation with an increasing number of partnering projects; (ii) updating the HBP strategic research roadmap for research, development and innovation in ICT, medicine and neuroscience; (iii) the collaboration with other research initiatives or programmes at regional, national, European or international level; and (iv) the plans and course of action to ensure the sustainability of the HBP SRI and how to start validating it. The proposal should also detail activities in areas such as human capital, education and training, dissemination and attracting large public support, international collaboration, ethics and societal aspects.

Any modification to the FPA Consortium partners should be sufficiently motivated and based on the highest standards of scientific and technological excellence and on open and transparent criteria.

This action allows for the provision of financial support to third parties in line with the conditions set out in Part K of the General Annexes.

Impact: Contribution to the targeted impacts defined in the action plan of the HBP FPA.

Type of Action: Specific Grant Agreement

Indicative timetable: Second quarter of 2019

Indicative budget: EUR 150.00 million from the 2019 budget

4. FET Conference and Events

Procurement of services for the organisation of major public conferences and events in the context of FET, with a strong emphasis on combining aspects of science and technology with outreach to citizens, industry, innovators, entrepreneurs and policy makers from across Europe. This includes a FET Conference in 2019 and one or several events related to specific FET work programme activities and, where relevant, in support of European Presidencies.

Type of Action: Public Procurement - Service contract

Indicative timetable: Early 2019 and 2020

Indicative budget: EUR 0.80 million from the 2019 budget(FET Conference)

CALLS and OTHER ACTIONS for 2020

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Call - FET-Open – Novel ideas for radically new technologies²⁶

H2020-FETOPEN-2018-2020-continued

Topics:

- FET-Open Challenging current thinking [continued]
- FET Innovation Launchpad [continued]

Indicative budget for 2020: EUR 205,50 million out of EUR 364,00 million from the 2020 budget, the rest being transferred to finance to 2019 for the last cut-off of date of FET-Open in 2019.

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²⁶ This is the continuation of a call for which information is provided in the first sections of this work programme part.

Call - FET Proactive – Boosting emerging technologies²⁷

H2020-FETPROACT-2018-2020-continued

Topics:

- FET Proactive: emerging paradigms and communities [continued]

Indicative budget for 2020: EUR 86 Million

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²⁷ This is the continuation of a call for which information is provided in the first sections of this work programme part.

Call - FET Proactive – High Performance Computing²⁸

H2020-FETHPC-2018-2020-continued

Topics:

- HPC PPP - Co-design of extreme scale HPC systems and applications

Indicative budget for 2020: EUR 100,00 million

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²⁸ This is the continuation of a call for which information is provided in the first sections of this work programme part.

Call - FET FLAGSHIPS – Tackling grand interdisciplinary science and technology challenges²⁹

H2020-FETFLAG-2018-2020-continued

Topics:

- Quantum Flagship - ERA-NET Cofund

Indicative budget for 2020: EUR 15,00 million

Other Actions for 2020

1. External Expertise

This action will support:

1. The use of appointed independent experts for the monitoring of running projects, where appropriate.
2. The use of appointed independent experts to advise on, or support, the design and implementation of EU research and innovation policy or programmes as well as the achievement and functioning of the European Research Area. A special allowance of EUR 450/day will be paid to the experts appointed in their personal capacity who act independently and in the public interest.

Type of Action: Expert Contracts

Indicative timetable:

Indicative budget: EUR 1.50 million from the 2020 budget

2. FET conference and events

Procurement of services for the organisation of major public conferences and events in the context of FET, with a strong emphasis on combining aspects of science and technology with outreach to citizens, industry, innovators, entrepreneurs and policy makers from across Europe. This includes one or several events related to specific FET work programme activities and, where relevant, in support of European Presidencies

Type of Action: Public Procurement - null

Indicative timetable:

Indicative budget: EUR 0.50 million from the 2020 budget(FET events)

²⁹ This is the continuation of a call for which information is provided in the first sections of this work programme part.

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Budget³⁰

	Budget line(s)	2018 Budget (EUR million)	2019 Budget (EUR million)	2020 Budget (EUR million)
Calls				
H2020-FETOPEN-2018-2020		189.00	164.70	
	<i>from 09.040101</i>	<i>189.00</i>	<i>164.70</i>	
H2020-FETPROACT-2018-2020		94.50		
	<i>from 09.040101</i>	<i>94.50</i>		
H2020-FETHPC-2018-2020		2.00	68.00	
	<i>from 09.040101</i>	<i>2.00</i>	<i>68.00</i>	
H2020-FETFLAG-2018-2020		147.50		
	<i>from 09.040101</i>	<i>147.50</i>		
H2020-FETOPEN-2018-2020-continued				364.00
	<i>from 09.040101</i>			<i>364.00</i>
H2020-FETPROACT-2018-2020-continued				86.00
	<i>from 09.040101</i>			<i>86.00</i>
H2020-FETHPC-2018-2020-continued				100.00
	<i>from 09.040101</i>			<i>100.00</i>
				15.00

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

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

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

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H2020-FETFLAG-2018-2020-continued	<i>from 09.040101</i>			<i>15.00</i>
Other actions				
Expert Contracts		1.00	1.50	1.50
	<i>from 09.040101</i>	<i>1.00</i>	<i>1.50</i>	<i>1.50</i>
Specific Grant Agreement			300.00	
	<i>from 09.040101</i>		<i>300.00</i>	
Public Procurement			0.80	0.50
	<i>from 09.040101</i>		<i>0.80</i>	<i>0.50</i>
Estimated total budget		434.00	535.00	567.00