



**EN**

## **Horizon 2020**

### **Work Programme 2016 - 2017**

#### *2. Future and Emerging Technologies*

**Important notice on the second Horizon 2020 Work Programme**

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

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



## **Table of contents**

<b>Introduction .....</b>	<b>4</b>
<b>Call - FET-Open – Novel ideas for radically new technologies .....</b>	<b>6</b>
FETOPEN-01-2016-2017: FET-Open research and innovation actions.....	6
FETOPEN-02-2016: FET-Open Coordination and Support Actions .....	7
FETOPEN-03-2017: FET-Open Coordination and Support Actions .....	9
FETOPEN-04-2016-2017: FET Innovation Launchpad .....	10
<b>Conditions for the Call - FET-Open – Novel ideas for radically new technologies .....</b>	<b>12</b>
<b>Call - FET Proactive – Boosting emerging technologies .....</b>	<b>17</b>
FETPROACT-01-2016: FET Proactive: emerging themes and communities .....	17
FETPROACT-02-2017: FET ERANET Cofund .....	20
FETPROACT-03-2016: FET ERANET Cofund in Quantum Technologies.....	21
<b>Conditions for the Call - FET Proactive – Boosting emerging technologies.....</b>	<b>23</b>
<b>Call - FET Proactive – High Performance Computing .....</b>	<b>26</b>
FETHPC-01-2016: Co-design of HPC systems and applications .....	26
FETHPC-02-2017: Transition to Exascale Computing .....	27
FETHPC-03-2017: Exascale HPC ecosystem development .....	30
<b>Conditions for the Call - FET Proactive – High Performance Computing .....</b>	<b>32</b>
<b>Call - FET FLAGSHIPS – Tackling grand interdisciplinary science and technology challenges .....</b>	<b>34</b>
FETFLAG-01-2016: Partnering environment for FET flagships .....	34
<b>Conditions for the Call - FET FLAGSHIPS – Tackling grand interdisciplinary science and technology challenges .....</b>	<b>36</b>
<b>Other actions .....</b>	<b>38</b>
1. External expertise .....	38
2. Graphene FET Flagship core project .....	38
3. HBP FET Flagship core project .....	39

**Budget..... 41**

## **Introduction**

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

FET focuses on research beyond what is known, accepted or widely adopted and supports novel and visionary thinking to open promising paths towards **radically new technological possibilities**. In particular, FET funds **interdisciplinary collaborations** that seek genuine cross-fertilisation and deep synergies between the broadest range of advanced sciences (including the life sciences, social sciences and humanities) and cutting-edge engineering disciplines.

FET has three main lines of activity:

- **FET Open** supports the early-stages of the science and technology research and innovation around new ideas towards radically new future technologies. It also funds coordination and support activities for such high-risk forward looking research to prosper in Europe.<sup>1</sup>
- **FET Proactive** addresses promising directions for research on future technologies in order to build up a European critical mass of knowledge and excellence around them.
- **FET Flagships** are science-driven, large-scale, multidisciplinary research initiatives oriented towards a unifying goal, aiming at transformational impacts with substantial benefits for European competitiveness and for society.

In this workprogramme, particular attention is paid to tapping into the **innovation** potential from the respective FET action lines. For example, actions to stimulate the exploitation of early results from FET research are foreseen. In order to create a wider and more diverse support base from which to take these innovations forward, the participation of new actors and of young and high-potential researchers and high-tech innovators is encouraged.

The approach of FET is in line with the Horizon 2020 Responsible Research and Innovation (RRI) cross-cutting issue, engaging society, integrating the gender and ethical dimensions, ensuring the access to research outcomes and encouraging formal and informal science education. Accordingly, FET encourages wide non-discriminatory participation and outreach and calls for its participants to pay attention to diversity issues such as gender, age and culture, being convinced that this can offer new perspectives, pose new questions and open new areas of investigations.

---

<sup>1</sup> Note that 40% of the H2020 budget for FET is earmarked for FET Open.

Silo-breaking research collaborations are a hallmark of most FET actions. They improve readiness across Europe to take up **new research and innovation practices** that make leading-edge research more open, creative and closer to society, for example through 'open science', the use of advanced modelling, simulation and open collaboration platforms. Moreover, a variety of creativity-enhancing and artistic practices can be used within research and innovation approaches, for instance for exploring technological visions, for testing unexpected technical solutions, developing novel uses of technology or for exploring their social acceptance. More generally, **public engagement** aims to bring on board a wide diversity of actors (researchers, industry, policy makers, civil society organisations, teachers, artists, citizens etc.) to participate in and/or deliberate on the directions taken by science, research, technology and innovation. Whenever such approaches are used this should be clearly reflected in the methodology description of the proposal: the actors/stakeholders to be engaged, the type of engagement process sought, the objective(s) of the engagement process (as related to the overall project objectives).

The **ethical dimension** of the activities undertaken through FET should be analysed and taken into account. This implies respect of ethical principles and related legislation during the implementation of the action (data protection and privacy, consent and protection of participants, potential misuse of the research results, fair benefit sharing, environment protection, etc.). Beyond this, the ethical considerations should also address the desirability of the action's potential long term implications (i.e., socioeconomic, climate, sustainability).

FET research is well placed for **global collaborations** that can raise the level of excellence and accelerate the impact from global alliances. Thus, participation of excellent non EU partners in FET activities, whenever necessary, is welcome.

A novelty in Horizon 2020 is the Pilot on Open Research Data which aims to improve and maximise access to and re-use of research data generated by projects. Projects funded under the Future and Emerging Technologies (FET) part of Work Programme 2016-2017 will by default participate in the Pilot on Open Research Data in Horizon 2020. Projects have the possibility to opt out of the Pilot, provided a justification is given for doing so. Participation in the Pilot is not taken into account during the evaluation procedure. In other words, proposals will not be evaluated favourably because they are part of the Pilot and will not be penalised for opting out of the Pilot. A further new element in Horizon 2020 is the use of Data Management Plans (DMPs), detailing what data the project will generate, whether and how it will be exploited or made accessible for verification and re-use, and how it will be curated and preserved. The use of a DMP is required for projects participating in the Open Research Data Pilot. Other projects are invited to submit a DMP if relevant for their planned research. Only funded projects are required to submit a DMP. Further guidance on the Pilot on Open Research Data and Data Management is available on the Participant Portal.

## **Call - FET-Open – Novel ideas for radically new technologies**

*H2020-FETOPEN-2016-2017*

This call aims to support the early stages of joint science and technology research for radically new future technological possibilities. The call is entirely non-prescriptive with regards to the nature or purpose of the technologies that are envisaged and thus targets mainly the unexpected. A bottom-up selection process will build up a diverse portfolio of projects. In order to identify and seize opportunities of long-term benefit for citizens, the economy and society, the early detection of promising new areas, developments and trends, wherever they come from, will be essential. The FET-Open call also seeks for coordination and support activities to turn Europe into the best place in the world for responsible collaborative research and innovation on future and emerging technologies that will make a difference for society in the decades to come. Finally, a specific topic under this call aims to stimulate innovation by initiating entrepreneurial activities around results from FET research projects.

Proposals are invited against the following topic(s):

### **FETOPEN-01-2016-2017: FET-Open research and innovation actions**

Specific Challenge: The successful exploration of new foundations for radically new future technologies requires supporting a large set of early stage, high risk visionary science and technology projects to investigate new ideas. Here agile, risk-friendly and highly interdisciplinary research approaches are needed with collaborations that are open to all sciences and disciplines and that dissolve the traditional boundaries between them. The renewal of ideas is complemented by the renewal of actors taking these new ideas forward. Therefore, this topic encourages the driving role of new high-potential actors in research and innovation, such as excellent young, both female and male, researchers and high-tech SMEs that may become the scientific and industrial leaders of the future.

Scope: This topic supports the early stages of research to establish a new technological possibility. Proposals are sought for **collaborative research with all of the following characteristics** ('FET gatekeepers'):

- **Long-term vision**: the research proposed must address a new and radical long-term vision of a science- and technology-enabled future that is far beyond the state of the art and not currently foreseen by technology roadmaps.
- **Breakthrough scientific and technological target**: research must target a scientifically ambitious and technologically concrete breakthrough, argued to be a crucial step towards achieving the long-term vision. The plausibility of the proposed breakthrough(s) to be attained within the life-time of the project must be argued in the proposal.
- **Novelty**: the research proposed for achieving the breakthrough must be based on cutting-edge knowledge, new ideas and concepts, rather than in the mere application or incremental refinement of existing ones.

- **Foundational:** the breakthroughs that are envisaged must be foundational in the sense that, if achieved, they would establish an essential basis for a new kind of technology and its future uses, not currently anticipated.
- **High-risk:** the inherently high risk of the research proposed will be reflected in a flexible but effective methodology for exploring alternative directions and options, supported by open and agile research and innovation practices.
- **Interdisciplinary:** the proposed collaborations are expected to go beyond 'waterfall' configurations in multi-disciplinary science- and technology research. Instead they should seek new solutions through genuine exchanges, mutual learning, cross-fertilisation and synergistic advances among distant disciplines in order to open unexplored areas of investigation and new directions for joint research.

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

Expected Impact:

- Initiating or consolidating a baseline of feasibility or a radically new line of technology and its future uses by establishing the essential proofs-of-principle and their foundational scientific underpinnings.
- Strengthening European leadership in the early exploration of visionary, new and emerging technologies, beyond academic excellence and with global recognition. This impact can be reinforced by involving also new high-potential actors such as young, both female and male, researchers and high-tech SMEs that may become the European scientific and technological leaders and innovators of the future.
- Impact is also sought in terms of the take up of new research and innovation practices for making leading-edge science and technology research more open, collaborative, creative and closer to society.<sup>2</sup>

Type of Action: Research and Innovation action

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

**FETOPEN-02-2016: FET-Open Coordination and Support Actions**

Specific Challenge: The challenge is to make Europe the best place in the world for collaborative research and innovation on future and emerging technologies that will secure and renew the basis for future European competitiveness and growth, and that will make a difference for society in the decades to come.

---

<sup>2</sup> See also the discussion on public engagement in the introduction to this FET workprogramme.

Scope: Proposals should address only one of the following subtopics:

- a. FET Communication [2016]: raising the visibility and impact of FET through novel and creative approaches for reaching out to various stakeholders and well beyond the research communities. This may include, for example, collecting, aggregating and disseminating information from the entire range of FET projects and activities, and using an appropriate mix of channels and formats to engage with the target audiences, including scientists, students, media, policy makers, the business community and the general public. This subtopic should include public engagement processes as discussed in the introduction of this FET Work Programme.
- b. FET Exchange [2016]: actions for structuring and strengthening an emerging FET-relevant science and technology research and innovation topic and the interdisciplinary communities involved in this topic. This may include, for example, research roadmapping, stimulating (formal and informal) learning and exchange, expanding the range of disciplines (including the life sciences and humanities where relevant), involving new actors such as young researchers, entrepreneurs and high-tech SMEs, and broadening stakeholder engagement (multi-actor or citizen). One specific theme that may be addressed is the area of alternative metrics (so-called "altmetrics") to assess research outputs and researchers.
- c. FET Conference [2016]: supporting the organisation of the fourth European Future and Emerging Technologies Conference and Exhibition (see for example <http://www.fet11.eu/> ). The conference shall showcase progress and results from FET research, attract high-tech SMEs, investors and entrepreneurs that might take FET results forward, seed new ideas across disciplines, foster a dialogue between science, policy and society on future and emerging technologies (through public engagement), explore new ways of combining research and innovation and involve high-potential actors that will make the difference. Proposals will address pre-conference communication activities, the local organisation, participant assistance and post-conference follow-up. The event shall take place in early 2018.
- d. FET Innovation Greenhouse [2016]: actions for establishing a Europe-wide capacity for innovation, exploitation and entrepreneurship stemming from the visionary, high-risk interdisciplinary science and technology research supported by FET. Greenhouse provides innovation support services to help bridging the gap between FET research and its application in industry and for society. The focus should be on enabling the earlier creative and learning stages of innovation from FET research, for which the classical path of business plans and investors is still premature, many options are still open and a more exploratory, risk-friendly and tailored support is needed. A wide technological scope, a strong specificity to FET and complementarity with existing greenhouse initiatives and innovation services are of prime importance. This subtopic also welcomes support to the actions funded under the FET Innovation Launchpad (FETOPEN-04-2016-2017) and for networking and exchange among them.

For each of the scope items a) and c) at most one action will be funded.



The Commission considers that proposals requesting a contribution from the EU of between EUR 0.3 and 0.5 million for scope items a), b) and d), and up to EUR 1 million for the scope item c), would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Strengthening globally recognised European leadership in the early exploration of visionary, new and emerging technologies, beyond academic excellence 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 understanding of the range of possible impact mechanisms for long-term science and technology research.
- Improved readiness across Europe to engage in silo-breaking research collaboration and to take up new 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-03-2017: FET-Open Coordination and Support Actions**

Specific Challenge: The challenge is to make Europe the best place in the world for collaborative research and innovation on future and emerging technologies that will renew the basis for future European competitiveness and growth, and that will make a difference for society in the decades to come.

Scope: Proposals should address one of the following topics:

- a. FET Futures [2017]<sup>3</sup>: identifying strategy options, challenges and opportunities to stimulate and organise interdisciplinary research and innovation towards new and visionary technologies of any kind. Actions should rely on evidence from FET activities (e.g., portfolio, constituency, results) and from other sources (including other funding bodies or private initiatives worldwide, like those using prize schemes or challenges). They should aim at open and dynamic stakeholder participation using creative methods and on-line tools/social networks. This topic should include public engagement processes as discussed in the introduction of this FET Work Programme.
- b. FET Exchange [2017]: actions for structuring and strengthening an emerging FET-relevant science and technology research and innovation topic and the interdisciplinary

---

<sup>3</sup> *This activity directly aimed at supporting the development and implementation of evidence base for R&I policies is excluded from the delegation to REA and will be implemented by the Commission services.*

communities involved in this topic. This may include, for example, research roadmapping, stimulating (formal and informal) learning and exchange, expanding the range of disciplines (including the life sciences and humanities where relevant), involving new actors such as young researchers, entrepreneurs and high-tech SMEs, and broadening stakeholder engagement (multi-actor or citizen).

For scope item a) at most one action will be funded.

The Commission considers that proposals requesting a contribution from the EU of between EUR 0.3 and 0.5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Strengthening globally recognised European leadership in the early exploration of visionary, new and emerging technologies, beyond academic excellence 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 understanding of the range of possible impact mechanisms for long-term science and technology research.
- Improved readiness across Europe to engage in silo-breaking research collaboration and to take up new 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-04-2016-2017: FET Innovation Launchpad**

Specific Challenge: FET projects often generate new and sometimes unexpected opportunities for commercial or societal application. This topic aims at funding further innovation related work (i.e. activities which were not scheduled to be funded by the original project) to verify and substantiate the innovation potential of ideas arising from FET funded projects and to support the next steps in turning them into a genuine social or economic innovation.

Scope: Short and focused individual or collaborative actions to take out of the lab a promising result or proof-of-concept that originated from a FET-funded project and to get it on the way to social or economic innovation through new entrepreneurship or otherwise. The action will support the transformation of that specific research result into a credible offering for economic or social impact, by exploring the feasibility of an exploitation path and by coordinating and supporting the assembling of the right knowledge, skills and resources and thus serves as a launch pad for exploitation.

This call topic is focused on the early innovation stages from results of an ongoing or recently finished project<sup>4</sup> funded through FET under FP7 or H2020. The complementarity and precise link with the relevant FET project is to be explicitly addressed in the proposal by clearly stating the nature and origin of the results to be taken up, and by adding a confirmation of any necessary agreements with owners or right holders of those results to move towards their exploitation. This call topic does not fund additional research, nor does it fund activities that are/were already foreseen in the relevant FET project. Activities to be funded should be fit-for-purpose (e.g., tailored to the level of maturity of the result to be taken up) and can include, among others, the definition of a commercialisation process to be followed, market and competitiveness analysis, technology assessment, consolidation of intellectual property rights and strategy, scenario and business case development, developing contacts and support relevant activities with for instance, industrial transfer partners, potential licence-takers, investors, societal organisations or potential end users.

By focusing on the very early stage of the innovation path, the scope of this call includes situations where an SME or other suitable entrepreneurial context may not yet exist.

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. Nonetheless, this does not preclude submission and selection of proposals of different duration.

Expected Impact:

- Increased innovation potential from FET projects by picking up expected as well as non-anticipated innovation opportunities.
- Creation of concrete and closer-to-market high-potential innovations from FET projects.
- Stimulating, supporting and rewarding an open and proactive mind-set towards exploitation beyond the European research world.
- 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.***

---

<sup>4</sup> For a project to be considered 'ongoing or recently finished' in the context of this call topic its end date must be at most one year before the deadline for proposal submission to this topic.

**Conditions for the Call - FET-Open – Novel ideas for radically new technologies**

Opening date(s), deadline(s), indicative budget(s):<sup>5</sup>

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2016	2017	
Opening: 08 Dec 2015			
FETOPEN-02-2016 (CSA)	3.00		11 May 2016
FETOPEN-01-2016-2017 (RIA)	84.00	110.50	11 May 2016 17 Jan 2017 27 Sep 2017
Opening: 01 Mar 2016			
FETOPEN-04-2016-2017 (CSA)	1.20	1.80	29 Sep 2016 27 Sep 2017
Opening: 20 Sep 2016			
FETOPEN-03-2017 (CSA)		1.50	17 Jan 2017
Overall indicative budget	88.20	113.80	

For FETOPEN-01-2016-2017, an amount of EUR 84.00 million will be equally allocated to each of the three cut-off dates. The budget for the third cut-off date will be provided in part from the 2017 budget (EUR 26.50 million) and from the 2018 budget (EUR 57.50 million).

<sup>5</sup> The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

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

The deadline(s) in 2017 are indicative and subject to a separate financing decision for 2017.

The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

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

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

FETOPEN-04-2016-2017	<p>Proposals must build on results from an ongoing or recently finished project, funded by FET under FP7 or H2020 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. For applicants that are not the owner of the result to be taken up in the proposal: 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>
----------------------	--

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

FETOPEN-01-2016-2017	<p><b>Excellence</b></p> <p>Compliance with the FET-gatekeepers as described in the call:</p> <ul style="list-style-type: none"> <li>• Clarity and novelty of long-term vision, and ambition and concreteness of the targeted breakthrough towards that vision.</li> <li>• Novelty, non-incrementality and plausibility of the proposed research for achieving the targeted breakthrough and its</li> </ul>
----------------------	---

	<p>foundational character.</p> <ul style="list-style-type: none"> <li>• Appropriateness of the research methodology and its suitability to address high scientific and technological risks.</li> <li>• Range and added value from interdisciplinarity, including measures for exchange, cross-fertilisation and synergy.</li> </ul> <p><b>Threshold: 4/5, Weight: 60%</b></p> <p><b>Impact</b></p> <p>Contributions to the impacts listed under this topic in the workprogramme:</p> <ul style="list-style-type: none"> <li>• Importance of the new technological outcome with regards to its transformational impact on technology and/or society.</li> <li>• Impact on future European scientific and industrial leadership, notably from involvement of new and high potential actors.</li> <li>• Quality of methods and measures for achieving impact beyond the research world and for establishing European though leadership, as perceived by industry and society.</li> </ul> <p><b>Threshold: 3.5/5, Weight: 20%</b></p> <p><b>Quality and efficiency of the implementation</b></p> <p>The following aspects are taken into account:</p> <ul style="list-style-type: none"> <li>• Soundness of the workplan and clarity of intermediate targets.</li> <li>• Relevance of expertise in the consortium.</li> <li>• Appropriate allocation and justification of resources (person-months, equipment).</li> </ul> <p><b>Threshold: 3/5, Weight: 20%</b></p>
<p>FETOPEN-04-2016-2017</p>	<p><b>Excellence</b></p> <p>The following aspects are taken into account:</p> <ul style="list-style-type: none"> <li>• Clarity and quality of the innovation idea and its link with the previous or ongoing FET project indicated in the proposal.</li> <li>• 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.</li> </ul>

	<ul style="list-style-type: none"> <li>• Suitability and necessity of the proposed activities to reach the stated objectives, including their complementarity to actions already foreseen or expected from the previous or ongoing FET project.</li> </ul> <p><b>Threshold: 3/5, Weight: 40%</b></p> <p><b>Impact</b></p> <p>Contributions to the impacts listed under this topic in the workprogramme:</p> <ul style="list-style-type: none"> <li>• Added innovation potential with respect to the FET project from which this innovation originates.</li> <li>• Extent of economic and/or societal benefits resulting from this innovation as identified in the proposal.</li> <li>• Suitability of measures for taking the innovation beyond the research world, including through engagement with prospective exploitation partners, other stakeholders, users or society.</li> </ul> <p><b>Threshold: 3.5/5, Weight: 40%</b></p> <p><b>Quality and efficiency of the implementation</b></p> <p>The following aspects are taken into account:</p> <ul style="list-style-type: none"> <li>• Quality of workplan and management.</li> <li>• Relevance of expertise in the consortium.</li> <li>• Appropriate allocation and justification of resources (person-months).</li> </ul> <p><b>Threshold: 3/5, Weight: 20%</b></p>
--	--

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

FETOPEN-01-2016-2017	Due to the nature of the FETOPEN-01-2016-2017 call, specific page limits apply. Part B of the proposal should consist of a title page plus up to a maximum of 15 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.
FETOPEN-04-2016-2017	Due to the nature of the FETOPEN-04-2016-2017 call, specific page limits apply. Part B of the proposal should consist of a title page plus up to a maximum of 7 A4 pages. The limits will be

*HORIZON 2020 - Work Programme 2016 - 2017  
Future and Emerging Technologies*

	clearly shown in the ‘proposal templates’ in the Participant Portal electronic submission system. Sections which are not subject to limits will be indicated.
FETOPEN-01-2016-2017, FETOPEN-02-2016, FETOPEN-03-2017, FETOPEN-04-2016-2017	At consensus stage, the consensus score for each evaluation criteria will be the median of the corresponding scores attributed by the individual evaluators and consensus report will comprise a collation of the comments from individual reports, or extracts from them. Final scores and any additional comments are decided by the final panel review.
FETOPEN-02-2016	For each of the subtopics a) and c) at most one action will be funded.
FETOPEN-03-2017	For subtopic a) at most one action will be funded.

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

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



## **Call - FET Proactive – Boosting emerging technologies**

***H2020-FETPROACT-2016-2017***

Proposals are invited against the following topic(s):

### **FETPROACT-01-2016: FET Proactive: emerging themes and communities**

Specific Challenge: To mature a number of novel areas and themes by working towards structuring emerging communities and supporting the design and development of transformative research themes. The main benefits of this structuring yet explorative approach are emerging novel areas that are not yet ready for inclusion in industry research roadmaps, and building up and structuring of new interdisciplinary research communities around them. It makes the step from collaborations between a small number of researchers, to larger collaborations addressing various aspects of a novel research theme to jointly explore possibilities for, and long-term implications of future technologies that matter.

Scope: Proposals should address research and innovation activities, aimed at jointly exploring directions and options to establish a solid baseline of knowledge and skills, and to foster the emergence of a broader innovation ecosystem for a new technology as well as a fertile ground for its future take-up (e.g., through public engagement processes when relevant, or through formal and informal education). Proposals should address a single of the specific subtopics within one of the following areas:

#### **Area 1: Future technologies for societal change**

- a. Being human in a technological world: critical interdisciplinary explorations of potentially game-changing impacts of future technologies on humanity, in plausible as well as in extreme scenarios. This can include individual, gender, organisational, economic, cultural and societal impacts, for instance from changes to self- or social perception, to our narratives, or to human development (e.g., cognitive, physical) or evolution. Visions being addressed should be radically forward looking and relatively unexplored, such as hyperconnectivity, human augmentation, hybridisation of nature, life extension, extra-sensorial perception or real/virtual blending. The work should provide fresh perspectives that challenge current thinking, include ethical and social aspects, reflecting on the purposes, impacts and motivations for the research and innovation activity, the associated uncertainties, areas of ignorance, assumptions, questions and dilemmas; and by this crystalize through active stakeholder engagement concrete options for shaping a worthwhile and responsible future.
- b. New science for a globalised world : tools and methods (mathematical, technological, social/organisational,...) for the collaborative study, projection and engineering of large scale open socio-technological and –ecological systems characterised by complexity and inherent uncertainty due to, among others, partial knowledge, ignorance and conflicting world-views by different actors. These tools and methods should include the study of

informal opinion groups emerging on the Internet at a global level, and focusing on global topics such as Global Systems Science as a new integrative science approach, the emergence of global solutions as patchworks of local ones, non-rationality, the impact of open-data, the dynamics of social and cultural divides, of peace and conflict, and various incentives, drivers and enablers of change and innovation, including the arts.

## **Area 2: Biotech for better life**

- a. Intra- and inter-cell bio-technologies: new technologies to enable the study and engineering of processes within and between biological cells, and their exploitation for purposes such as sensing, signalling, imaging, regulating, curing or for mimicking or re-engineering the intra- and inter-cell physics and dynamics. This can include the use of natural cells, optimised, therapeutic and compound, synthetic ones or combinations of these, as well as cell-free techniques. Where needed, multiscale mathematical modelling and computational simulation can be included. Proposals under this subtopic should also explore the paradigm-changing potential of these technologies, for instance in the bio-medical field.
- b. Bio-electronic medicines and therapies: using adaptive nerve or brain stimulation for precise regulatory control of organs or other biological processes inside the human body, in order to restore or maintain healthy conditions. This includes technologies for bio-electronic medicines, drug-free therapies, adaptive drug release, closed-loop BNCI, more invasive stimulation, or development of neurotransmitter sensor/actuator systems, all within a setting of personalised and adaptive medicine and the tight integration of diagnostic and therapeutic capabilities (theranostics). A Responsible Research and Innovation approach, including aspects of ethics, as well as social science and humanities should be taken into account.
- c. Cognitive neuro-technologies: integrated interdisciplinary approaches combining theory and novel technology-based experiments for understanding the circuits and pathways of higher-level cognitive functions (such as navigation, goal-oriented behaviour, motivation and reward, memory, knowledge and belief formation, reasoning and decision making, emotion, interaction, communication), the related principles of neural coding and operation within and between brain regions and the role of the physical and social/cultural environment in bringing them about. Proposals should focus on non-validated, leading-edge methodologies and technologies specifically relevant to cognitive neuroscience. Target applications could include, for example, adaptive human interfaces, specific brain interfaces and neuro-prosthetics to restore or support cognitive functions or to address unmet therapeutic needs.

## **Area 3: Disruptive information technologies**

- a. New computing paradigms and their technologies: new foundations for computing, including bio-, nature- and socio-inspired ones that can encompass also aspects of communication, interaction, mimicry or differentiation (adaptation, learning, evolution), as well as non-technological aspects like organisational or physical/virtual

architectural ones, and tailored to future and emerging challenges and requirements in highly interdisciplinary settings and for new kinds of mathematical and computational approaches in science.

- b. Quantum engineering: reproducible, economical and scaleable approaches, architectures and techniques for designing and realising devices and systems that exploit quantum phenomena, such as superposition and entanglement, for achieving new or radically improved functionalities (for instance in sensing, precision measurement, transduction, secure communication, control, simulation and computation) and demonstrated in the context and boundary conditions of a specific application area (for example in the biological, medical, materials, process, energy or standards domain).
- c. Hybrid opto-electro-mechanical devices at the nano-scale: new working principles and their first-time validation in nano-, molecular- or atomic-scale devices based on the interaction and mutual control of multiple physical degrees of freedom to achieve new or radically improved functionalities and application scenarios under plausible operating conditions. The interacting degrees of freedom are those involved in e.g. nano-optics, nano-scale electromagnetism, nano-mechanics and phonons and fluctuations.

#### **Area 4: New technologies for energy and functional materials**

- a. Ecosystem engineering:<sup>6</sup> new models, materials, processes, devices and systems going beyond a single dimension for extreme energy and resource efficiency and recovery, and footprint management into circular ecosystems (energy, raw materials, waste, water,...). New approaches and technologies for extremely efficient energy generation (e.g., artificial photosynthesis or microfluidic conversion), transfer, conversion, high-density storage and consumption. The targeted improvements with respect to the state of the art are to be stated in quantitative terms. Genuine cross-fertilisation and deep synergies between the broadest range of advanced sciences and cutting-edge engineering disciplines for emerging ecological technologies seeking holistic paradigms, striving to reduce or eliminate the environmental impact, and the replacement of toxic/pollutant substances by ecofriendly materials should be considered. First time validation and assessment of these results in the context of integrated synergetic circular economy solutions or other quasi self-sufficient environments.
- b. Complex bottom-up construction: new technologies and methods for self-organisation, assembly and adaptation of materials and physical devices/systems with complex functionality (including for instance energy storage, conversion or recovery), complex composition and/or spanning a range of scales (nano, meso) and with superior properties on each of them. Energy and resource/material availability, ecofriendliness and efficiency are to be taken into account). Where needed, multiscale mathematical modelling and computational simulation of materials and related production or self-organisation processes can be included.

---

<sup>6</sup> This topic is aligned with the Commission communication SWD(2014) 211 'Towards a circular economy: a zero waste programme for Europe' and its annex, which describes specific contributions expected from FET.

The Commission considers that proposals requesting a contribution from the EU of between EUR 4 and 10 million would allow this specific challenge to be addressed appropriately. When appropriate, this allows for proposals to provide financial support to third parties in line with the conditions set out in Part K of the General Annexes, for example to access specific expertise, to enhance impacts or to award an inducement prize following a contest organised by the beneficiaries.

The Commission further considers that proposals with a duration 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 duration.

The funding budget per area is with a maximum of EUR 20 million for each of the areas 1 and 4, and a maximum of EUR 30 million for each of the areas 2 and 3.

Expected Impact:

- Establish a solid baseline of knowledge and skills for a future technology in the theme addressed.
- Goal oriented community structuring and true interdisciplinary collaboration.
- 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.

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-02-2017: FET ERANET Cofund**

Specific Challenge: To support the maturation of novel research topics and structuration of the corresponding communities in the FET domain, in complementarity and synergy with the FET actions directly funded by the Commission, and while fostering cross-fertilisation and synergies between the supported topics and communities. This reflects that the participating funding organisations share the objectives of the FET programme and would amplify its funding and activities through this ERA-NET. The overarching goal is to enhance the construction of the European Research Area in the FET domain, by sharing a common vision of the various efforts in Europe in this domain and fostering cooperation towards the coordinated development of these technologies.

Scope: Proposals should coordinate national and regional programmes for research in the FET domain by implementing a joint transnational call for proposals (resulting in grants to third parties) with EU cofunding. Proposers are encouraged to implement other joint activities related to the coordination of public research and innovation programmes, such as transnational networking, meetings and technology transfer activities, as well as additional

joint calls without EU cofunding. These activities should in particular cover the following areas:

- Share information on existing research programmes, strategic research agendas and technological roadmaps, among research funding organisations and with the relevant other stakeholders;
- Jointly identify emerging topics where transnational cooperation and support to community structuration is most needed, in complementarity with the FET programme;
- Develop strategic agendas for these topics and accompany the structuration of the related communities through workshops and support to transversal activities.

Expected Impact:

- Amplification of the support to FET topics at the national level;
- Faster emergence of technologies through enhanced coordination;
- Identification and emergence of candidate FET Proactive and FET Flagship topics and communities;
- Enhanced complementarities and synergies in Europe 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.*

**FETPROACT-03-2016: FET ERANET Cofund in Quantum Technologies**

Specific Challenge: Research on quantum technologies in Europe is currently funded through several targeted initiatives at European, national and regional level. The aim is to foster synergy between these initiatives in the area of quantum technologies in order to create collaborations among the best groups in Europe and fostering broader partnerships around them to spread excellence and to broaden the European footprint of this emerging technology area.

Scope: Proposals should coordinate national and regional programmes for research in the area of quantum technologies by implementing a call jointly funded by the participating states with EU cofunding resulting in grants to third parties. This call shall address the following topics:

- New principles, experiments, technologies, devices and systems that exploit quantum phenomena like entanglement and superposition to achieve new or radically enhanced functionalities.
- Demonstration and critical assessment of these advancements in comparison to classical or other quantum-based technological options.

- Exploration of advanced quantum enabled applications in areas of scientific, industrial or societal interest, linked to a critical assessment of feasibility beyond the technical (e.g., in terms of innovation potential, acceptability and industrial/societal take-up).

Proposers are encouraged to implement other joint activities related to the coordination of public research and innovation programmes in quantum technologies, such as transnational networking, training, technology transfer and additional joint calls without EU co-funding.

Expected Impact:

- Closer coordination and greater mobilisation and pooling of resources between regional, national and EU research programmes in the area of quantum technologies.
- Increased transnational collaboration on quantum technologies, especially on topics that are complementary to the EU workprogrammes in this area.
- Spreading of excellence on quantum technologies across Europe.
- Establishment and alignment of national and regional research and innovation plans and initiatives in the area of quantum technologies.
- Identification of promising directions for future research programming through a comprehensive overview on multiple lines of development across Europe.
- Increased awareness of national and regional research and innovation interests, synergies and complementarities in the area of quantum technologies and their applications.

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):<sup>7</sup>

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2016	2017	
Opening: 08 Dec 2015			
FETPROACT-01-2016 (RIA)	80.00		12 Apr 2016
FETPROACT-03-2016 (ERA-NET-Cofund)	10.00		
Opening: 20 Sep 2016			
FETPROACT-02-2017 (ERA-NET-Cofund)		5.00	24 Jan 2017
Overall indicative budget	90.00	5.00	

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 parts B and C of the General Annexes to the work programme.

<sup>7</sup> The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

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

The deadline(s) in 2017 are indicative and subject to a separate financing decision for 2017.

The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

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

FETPROACT-01-2016	<p><b>Excellence</b></p> <p>The following aspects are taken into account:</p> <ul style="list-style-type: none"><li>• Clarity of targeted breakthroughs and of the science and technology contributions towards establishing a solid baseline of knowledge and skills for the specific theme being addressed.</li><li>• Novelty, level of ambition and foundational character.</li><li>• Appropriateness of the methodology to narrow down multiple options and to address high scientific and technological risks.</li><li>• Range and added value from interdisciplinarity, including measures for exchange, cross-fertilisation and synergy.</li></ul> <p><b>Threshold: 4/5, Weight: 60%</b></p> <p><b>Impact</b></p> <p>The extent to which the outputs of the project contribute at the European or International level to:</p> <ul style="list-style-type: none"><li>• the expected impacts listed under this topic in the workprogramme.</li><li>• the transformation of technology and/or society.</li><li>• structuring effects on multidisciplinary communities of researchers and stakeholders.</li><li>• innovation potential and leadership from the emergence of a new innovation ecosystem, the empowerment of new and high potential actors and from public engagement.</li></ul> <p><b>Threshold: 3.5/5, Weight: 20%</b></p> <p><b>Quality and efficiency of the implementation</b></p> <p>The following aspects are taken into account:</p> <ul style="list-style-type: none"><li>• Quality of the workplan and clarity of intermediate targets.</li><li>• Relevant expertise in the consortium.</li><li>• Appropriate allocation and justification of resources (person-months, equipment).</li></ul>
-------------------	--



	<b>Threshold: 3/5, Weight: 20%</b>
--	------------------------------------

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

FETPROACT-01-2016	<p>At consensus stage, the consensus score for each evaluation criteria will be the median of the corresponding scores attributed by the individual evaluators and consensus report will comprise a collation of the comments from individual reports, or extracts from them. Final scores and any additional comments are decided by the final panel review.</p> <p>Due to the nature of the FETPROACT-01-2016 call, specific page limits apply. Part B of the proposal should consist of a title page plus up to a maximum of 30 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> <p>When selecting projects for funding, from the budget available for this topic a maximum of EUR 20 million will be allocated for each of the areas 1 and 4, and a maximum of EUR 30 million for each of the areas 2 and 3.</p>
FETPROACT-02-2017, FETPROACT-03-2016	<p>Given the specific nature and strategic objective of the ERANET Cofund instrument, at most one ERANET Cofund will be funded under each of these topics.</p>

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

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

## **Call - FET Proactive – High Performance Computing**

***H2020-FETHPC-2016-2017***

The FET-Proactive call on HPC aims at the next steps for leveraging the existing European strengths for building the next generation of extreme performance computing and taking advantage of the new opportunities created from the transition from peta to exascale computing. The ultimate goal is to achieve world-class extreme scale computing capabilities in platforms, technologies and applications.

The call complements the other building blocks under the e-Infrastructures and LEIT-ICT parts of Horizon 2020 of the European HPC strategy. The implementation of this HPC strategy in Horizon 2020 combines three elements: (a) developing the next generation of HPC towards exascale; (b) providing access to the best supercomputing facilities and services; and (c) achieving excellence in HPC applications. The Public Private Partnership (PPP) with the European Technology Platform in HPC (ETP4HPC), which started on 1 January 2014, provides the framework for the implementation of elements (a) and (c) of the HPC strategy, based on the Strategy Research Agenda (SRA) of the ETP4HPC.<sup>8</sup>

Proposals are invited against the following topic(s):

### **FETHPC-01-2016: Co-design of HPC systems and applications**

Specific Challenge: Achieve world-class extreme scale, power-efficient and highly resilient HPC platforms through a strong co-design approach driven by ambitious applications and in close cooperation with the scientific disciplines and stakeholders concerned; achieve the full range of technological capabilities needed for delivering a broad spectrum of extreme scale HPC systems. The designs of these systems must respond to critical demands of energy efficiency, scale, resilience, programmability and support for various classes of applications including extreme-data applications.

Scope: Proposals with innovative and ground-breaking approaches to system architectures targeting extreme scale, power-efficient and highly resilient platforms with emphasis on balanced compute and data access characteristics. Special attention should be given to extreme data processing requirements. Proposals should have a strong co-design approach driven by a mix of ambitious applications and in close cooperation with the various scientific disciplines and stakeholders concerned. Proposals should show how their proposed solution improves energy efficiency and demonstrate the reduced energy-to-solution for the selected applications. Possible strategies for improving energy efficiency may include: reducing PUE (Power Usage Effectiveness), designing of cost-efficient approaches to the reuse of thermal energy, reducing the amount of energy spent for communication and data movement. Proposals should address the problem of maintaining reliability, coping with run-time errors and enabling stable operation of an HPC system that is able of extreme scaling; this issue may

---

<sup>8</sup> See <http://www.etp4hpc.eu/strategy/strategic-research-agenda/>

be addressed through holistic detection/recover approaches covering and orchestrating all layers of the HPC stack as well as significant advancements in fault prediction algorithms and smarter tools to prevent faults. Proposals should provide analytical or simulation models that allow to extrapolate the sustained performance on the given architecture for HPC systems. The target system architectures must scale to at least 100 PFlops and, for compute-centric workloads, a target of 15MW for 250 PFlops peak performance in 2019 is suggested. Proposals should explain how these scalability and energy-efficiency targets are achieved for the considered applications. APIs and interfaces between applications and underlying middleware, run-time and operating systems, i.e. all application-aspects impacting the underlying system design are included in this topic. Proposals should be able to demonstrate their achievements in integrated pre-exascale prototypes.

The Commission considers that proposals requesting a contribution between EUR 10 and 20 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:

- Contribution to the realisation of the ETP4HPC Strategic Research Agenda, thus strengthened European research and industrial leadership in HPC technologies.
- Proof-of-concept through integrated pre-exascale prototypes for future energy-efficient exascale-class HPC systems and optimal co-design driven by ambitious applications.
- Covering important segments of the broader and/or emerging HPC markets, especially extreme-scale HPC systems.
- Impact on standards bodies and other relevant international research programmes and frameworks.

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-02-2017: Transition to Exascale Computing**

Specific Challenge: Take advantage of the full capabilities of exascale computing, in particular through high-productivity programming environments, system software and management, exascale I/O and storage in the presence of multiple tiers of data storage, supercomputing for extreme data and emerging HPC use modes, mathematics and algorithms for extreme scale HPC systems for existing or visionary applications, including data-intensive and extreme data applications in scientific areas such as physics, chemistry, biology, life sciences, materials, climate, geosciences, etc.

Scope: Proposals should address one or more of the following subtopics:

a) **High productivity programming environments for exascale:** Proposals should have as target to simplify application software development for large- and extreme-scale systems. This can include the development of more productive programming models and environments, the easier combination of different programming models, and using increased intelligence throughout the programming environment. Key aspects include managing data transfers, data locality and memory management, including support for heterogeneous and reconfigurable systems as well as dealing with inter-application dynamic load balancing and malleability, adapting to changes in the number of processors. Unified performance tools are required supporting HPC, embedded and extreme data workloads, on diverse target systems. APIs, runtime systems and the underlying libraries should support auto-tuning for performance and energy optimisation. Automated support for debugging and anomaly detection is also included under this subtopic. To provide simplified development and to ensure the maintainability of domain-specific languages (DSLs), DSL frameworks are required which target a general-purpose stable programming model and runtime. Since large future systems will require the use of multiple programming models or APIs, an important aspect is interoperability and standardisation of programming model, API and runtime as well as the composability of programming models (the capability of building new programming models out of existing programming model elements)

b) **Exascale system software and management:** Proposals should advance the state of the art in system software and management for node architectures that will be drastically more complex and their resource topology and heterogeneity will require OS and runtime enhancement, such as data aware scheduling. In the area of hardware abstraction, proposals should address run time handling of all types of resources (cores, bandwidth, logical and physical memory or storage) and controls, e.g. for optimised data coherency, consistency and data flow. For applications, proposals should address new multi-criteria resource allocation capabilities and interaction during task execution, with the aim to improve resilience, interactivity, power and efficiency. To cope with the exploding amount of data, the sequential analysis process (capture, store, analyse) is not sufficient; proposals should explore on-the-fly analysis methods offering reactivity, compute efficiency and availability. Graphical simulation interaction will require new real-time features; configuration and deployment tools will have to evolve to take into account the composability of software execution environments.

c) **Exascale I/O and storage in the presence of multiple tiers of data storage:** proposals should address exascale I/O systems expected to have multiple tiers of data storage technologies, including non-volatile memory. Fine grain data access prioritisation of processes and applications sharing data in these tiers is one of the goals as well as prioritisation applied to file/object creates/deletes. Runtime layers should combine data replication with data layout transformations relevant for HPC, in order to meet the needs for improved performance and resiliency. It is also desirable for the I/O subsystem to adaptively provide optimal performance or reliability especially in the presence of millions of processes simultaneously doing I/O. It is critical that programming system interoperability and standardised APIs are achieved. On the fly data management supporting data processing,

taking into account multi-tiered storage and involving real time in situ/in transit processing should be addressed.

**d) Supercomputing for Extreme Data and emerging HPC use modes:** HPC architectures for real-time and in-situ data analytics are required to support the processing of large-scale and high velocity real-time data (e.g. sensor data, Internet of Things) together with large volumes of stored data (e.g. climate simulations, predictive models, etc.). The approaches should include support for real-time in-memory analysis of different data structures, direct processing of compressed data and appropriate benchmarking method for performance analysis. Interactive 3-D visualisation of large-scale data to allow users to explore large information spaces in 3-D and perform on-demand data analysis in real-time (e.g. large scale queries or analytics) should be addressed. Interactive supercomputing is required to execute complex workflows for urgent decision making in the field of critical clinical diagnostics, natural risks or spread of diseases; this implies adapting operational procedures of HPC infrastructures, developing efficient co-scheduling techniques or improving checkpoint/restart and extreme data management

**e) Mathematics and algorithms for extreme scale HPC systems and applications working with extreme data:** Specific issues are quantification of uncertainties and noise, multi-scale, multi-physics and extreme data. Mathematical methods, numerical analysis, algorithms and software engineering for extreme parallelism should be addressed. Novel and disruptive algorithmic strategies should be explored to minimize data movement as well as the number of communication and synchronization instances in extreme computing. Parallel-in-time methods may be investigated to boost parallelism of simulation codes across a wide range of application domains. Taking into account data-related uncertainties is essential for the acceptance of numerical simulation in decision making; a unified European VVUQ (Verification Validation and Uncertainty Quantification) package for Exascale computing should be provided by improving methodologies and solving problems limiting usability for very large computations on many-core configurations; access to the VVUQ techniques for the HPC community should be facilitated by providing software that is ready for deployment on supercomputers.

The Commission considers that proposals requesting a contribution from the EU between EUR 2 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. Proposals should clearly indicate the subtopic which is their main focus. At least one project per subtopic will be funded.

Expected Impact:

- Contribution to the realisation of the ETP4HPC Strategic Research Agenda, thus strengthened European research and industrial leadership in HPC technologies.
- Successful transition to practical exascale computing for the addressed specific element of the HPC stack.

- Covering important segments of the broader and/or emerging HPC markets, especially extreme-computing, emerging use modes and extreme-data HPC systems.
- Impact on standards bodies and other relevant international research programmes and frameworks.
- European excellence in mathematics and algorithms for extreme parallelism and extreme data applications to boost research and innovation in scientific areas such as physics, chemistry, biology, life sciences, materials, climate, geosciences, etc.

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-03-2017: Exascale HPC ecosystem development**

Specific Challenge: To develop a sustainable European exascale HPC Ecosystem.

Scope: Proposals should address a single of the two following subtopics:

a) Coordination of the Exascale HPC strategy and International Collaboration: Proposals must include activities for promoting a joint community structuring and synchronisation; the further development and update of the Strategic Research Agenda for High Performance Computing as well as the application and applied mathematics exascale roadmaps; prepare the ground for targeted international research collaboration on specific aspects of the exascale challenges. Proposed actions should also seek to create synergies with other HPC related activities under H2020, in particular concerning the underlying basic technologies that are required for exascale computing (e.g. *LEIT/Advanced Computing*, *LEIT/Photonics*, and *ECSEL* (Electronic Components and Systems for European Leadership)); and concerning the relevant research in applications, the progress of which critically relies on cutting-edge HPC systems (*LEIT/Big-Data*, *LEIT/Cloud* area as well as relevant research in applications emerging from the *H2020 Societal Challenges* in domains such as health (e.g. VPH initiative), genomics, climate change, energy, mobility and smart cities).

b) Excellence in Exascale Computing Systems: The focus should be in boosting European HPC academic research excellence in future exascale-class computing cutting across all levels – hardware, architectures, programming, applications – and including specific actions to better structure the European academic HPC research, create stronger links with HPC providers and HPC users, attract venture capital, promote entrepreneurship and foster industry take-up.

The Commission considers that proposals requesting a contribution between EUR 1 and 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Strengthened European research and industrial leadership in the supply, operation and use of HPC systems.
- Contribution to the realisation of the ETP4HPC Strategic Research Agenda.
- Development of a competitive European ecosystem for building and exploiting a wide range of next-generation extreme performance computing systems.
- Structuring the efforts of stakeholders for implementing the European HPC strategy.
- Reinforced cooperation in international endeavours on HPC software and systems towards exascale.
- European Excellence in Exascale Computing systems.

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 Proactive – High Performance Computing**

Opening date(s), deadline(s), indicative budget(s):<sup>9</sup>

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2016	2017	
Opening: 14 Apr 2016			
FETHPC-01-2016 (RIA)	41.00		27 Sep 2016
Opening: 12 Apr 2017			
FETHPC-02-2017 (RIA)		40.00	26 Sep 2017
FETHPC-03-2017 (CSA)		4.00	
Overall indicative budget	41.00	44.00	

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 parts B and C of the General Annexes to the work programme.

<sup>9</sup> The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

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

The deadline(s) in 2017 are indicative and subject to a separate financing decision for 2017.

The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.



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

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

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

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

## **Call - FET FLAGSHIPS – Tackling grand interdisciplinary science and technology challenges**

***H2020-FETFLAG-2016***

Flagships are science-driven, large-scale, multidisciplinary research initiatives oriented towards a unifying goal, aiming at transformational impacts on science and technology and substantial benefits for European competitiveness and society. The goals of such initiatives are visionary and highly ambitious in terms of scientific challenges, resources and coordinated efforts. They require cooperation among a range of disciplines, communities and national, regional and European programmes. The implementation model of the Flagships and their governance structure are described in the Commission Staff Working Document on FET Flagships<sup>10</sup>.

Two Flagships, Graphene and the Human Brain Project, have been launched in 2013, as well as an ERANET action bringing together national and regional funding agencies from several Member States and Associate Countries in support of the two Flagships. A Framework Partnership Agreement (FPA) has been established for each of the two Flagships, creating a stable and structured partnership between the Commission and research organisations that are committed to implement the Flagships. This work programme aims to launch actions to advance the two Flagships on the basis of these FPAs, following an initial Specific Grant Agreement (SGA) and other actions launched under previous work programmes.

Proposals are invited against the following topic(s):

### **FETFLAG-01-2016: Partnering environment for FET flagships**

Specific Challenge: To support funding and coordination of partnering projects (PPs) of the two Flagships.

PPs are projects supported by national/regional funding agencies and/or by private funding. They are addressing areas relevant for the Flagships and contribute to their objectives. Their role and activities and their integration into the Flagships were described in the above mentioned Staff Working Document<sup>11</sup>.

The aim is to bring together national funding agencies from Member States and Associated Countries to fund such PPs, as well as supporting these and other PPs in their networking, coordination and participation in Flagship activities.

Scope: Proposals should address a single of the two following subtopics:

**a. ERA-NET Cofund action:** one follow-up action to the FLAG-ERA ERANET (<http://www.flagera.eu/>) aiming to coordinate national and regional research programmes to

---

<sup>10</sup> SWD(2014) 283 final of 16.09.2014

<sup>11</sup> SWD(2014) 283 final of 16.09.2014

fund PPs of the two Flagships through a joint transnational call for proposals (resulting in grants to third parties) between several such programmes complemented by EU co-funding, 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.

**b. Coordination and Support action:** one action will be funded which will support all of the following points, for both Flagships:

- the participation of PPs in meetings, workshops or other relevant activities organised by the Core Project of each Flagship;
- the participation of PPs in the governance activities of each of the Flagships;
- the networking and coordination of the PPs for helping them contribute to the research roadmaps of each Flagship and for disseminating their activities to promote Flagships at the regional/national level.

Proposals under this subtopic need to demonstrate how they add value beyond the activities already foreseen in the Flagships to liaise with PPs.

The action under this subtopic should be driven by (one or more) stakeholders representing relevant scientific communities.

Expected Impact: **a. ERA-NET Cofund action**

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;

**b. Coordination and Support Action**

Creating mutual benefit between the PPs and their Core Project, enhancing the impact of the Flagships on national and regional research programmes and fostering the role of PPs in the governance of the Flagships.

Type of Action: Coordination and support 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 FLAGSHIPS – Tackling grand interdisciplinary science and technology challenges**

Opening date(s), deadline(s), indicative budget(s):<sup>12</sup>

Topics (Type of Action)	Budgets (EUR million)	Deadlines
	2016	
Opening: 10 Nov 2015		
FETFLAG-01-2016 (ERA-NET-Cofund)	8.00	01 Mar 2016
FETFLAG-01-2016 (CSA)	1.00	
Overall indicative budget	9.00	

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 parts B and C of the General Annexes to the work programme.

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

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

---

<sup>12</sup> The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.  
All deadlines are at 17.00.00 Brussels local time.  
The Director-General responsible may delay the deadline(s) by up to two months.  
The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

*HORIZON 2020 - Work Programme 2016 - 2017*  
*Future and Emerging Technologies*

FETFLAG-01-2016	<p>Given the specific nature and strategic objective of the ERANET Cofund instrument, at most one ERANET Cofund will be funded under the relevant subtopic.</p> <p>Given the strategic objective of the Coordination and Support Action called for, at most one Coordination and Support Action will be funded under the relevant subtopic.</p>
-----------------	---

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

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

## **Other actions<sup>13</sup>**

### **1. External expertise**

This action will support:

- The use of appointed independent experts for the monitoring of running projects, where appropriate.
- The use of appointed independent experts to assist with the interim evaluation of the two FET Flagships, including their governance and implementation mechanisms, as defined in the Commission Staff Working Document on FET Flagships<sup>14</sup>. 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.
- 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 budget: EUR 1.00 million from the 2016 budget and EUR 1.98 million from the 2017 budget

### **2. Graphene FET Flagship core project**

Within the Graphene Framework Partnership Agreement (FPA) awarded under topic FETFLAG 1 - 2014 of the Call FET Flagships, the selected consortium will be invited to submit a proposal for a second Specific Grant Agreement (SGA) that will implement the next two years (indicative) of the action plan defined in the FPA.

The proposal should adhere to the programme of activities as envisioned in the FPA. It should address key parts of the FPA research roadmap while taking into account, whenever relevant, the changing state of the art throughout the world.

The proposal should describe how the coordination and management of the overall Flagship initiative as described in the FPA is implemented. The coordinating role must include in particular the concrete actions needed to ensure the overall continuity and coherence in the

---

<sup>13</sup> The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

<sup>14</sup> SWD(2014) 283 final of 16.09.2014

management of the Flagship initiative, such as (i) the governance of the Flagship initiative as a whole, (ii) updating the research roadmap and its innovation branches, and (iii) the collaboration with other research initiatives or programmes at regional, national, European or international level.

The proposal should focus on those areas that have the greatest innovation potential and impact on economy and society. This may require refocusing the Flagship resources accordingly. Any modification to the FPA selected Consortium partners should be sufficiently motivated and based on the highest standards of scientific and technological excellence and on open and transparent criteria.

The proposal should detail activities in areas such as human capital, education and training, dissemination, ethics and societal aspects.

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: Contributions to the targeted impacts defined in the action plan of the FPA.

Type of Action: Specific Grant Agreement

6-years Graphene Framework Partnership Agreement with identified beneficiary and specific grants awarded to identified beneficiary for Research and Innovation Action under the Framework Partnership Agreement.

The standard evaluation criteria, thresholds, weighting for award criteria and the maximum rate of co-financing for this type of action are provided in parts D and H of the General Annexes.

Indicative timetable: Second quarter of 2017

Indicative budget: EUR 88.00 million from the 2017 budget

### **3. HBP FET Flagship core project**

Within the Human Brain Project (HBP) Framework Partnership Agreement (FPA) awarded under topic FETFLAG 1 - 2014 of the call FET Flagships, the selected consortium will be invited to submit a proposal for a second specific Grant Agreement (SGA) that will implement the next two years (indicative) of the action plan defined in the FPA.

The proposal should adhere to the programme of activities as envisioned in the FPA. It should describe how the activities carried out during the first SGA will be built upon, maintaining a multi-disciplinarily approach and involving the relevant scientific communities in neuroscience, medicine and computing. It should take into account, whenever relevant, progress made by other large brain research initiatives.

The proposal should explain how the project will involve the related scientific and medical communities, including a large number of end-users, in the development and validation of the

HBP ICT platforms and ensure their wide adoption and use. It should also explain how the HBP partners will trigger concrete innovation activities by liaising with industry and other relevant stakeholders.

The proposal should describe how the coordination and management of the overall Flagship initiative as described in the FPA is implemented. The coordinating role must include in particular the concrete actions needed to ensure the overall continuity and coherence in the management of the Flagship initiative, such as (i) the governance of the Flagship initiative as a whole, (ii) updating the research roadmap and its innovation branches, and (iii) the collaboration with other research initiatives or programmes at regional, national, European or international level.

The proposal should detail activities in areas such as human capital, education and training, dissemination, ethics and societal aspects.

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: Contributions to the targeted impacts defined in the action plan of the FPA.

Type of Action: Specific Grant Agreement

6-years Human Brain Project Framework Partnership Agreement with identified beneficiary and specific grants awarded to identified beneficiary for Research and Innovation Action under the Framework Partnership Agreement.

The standard evaluation criteria, thresholds, weighting for award criteria and the maximum rate of co-financing for this type of action are provided in parts D and H of the General Annexes.

Indicative timetable: Second quarter of 2017

Indicative budget: EUR 88.00 million from the 2017 budget



*HORIZON 2020 - Work Programme 2016 - 2017  
Future and Emerging Technologies*

**Budget<sup>15</sup>**

	Budget line(s)	2016 Budget (EUR million)	2017 Budget (EUR million)
<b>Calls</b>			
H2020-FETOPEN-2016-2017		88.20	113.80
	<i>from 09.040101</i>	<i>88.20</i>	<i>113.80</i>
H2020-FETPROACT-2016-2017		90.00	5.00
	<i>from 09.040101</i>	<i>90.00</i>	<i>5.00</i>
H2020-FETHPC-2016-2017		41.00	44.00
	<i>from 09.040101</i>	<i>41.00</i>	<i>44.00</i>
H2020-FETFLAG-2016		9.00	
	<i>from 09.040101</i>	<i>9.00</i>	
<b>Other actions</b>			
Expert Contracts		1.00	1.98
	<i>from 09.040101</i>	<i>1.00</i>	<i>1.98</i>
Specific Grant Agreement			176.00
	<i>from 09.040101</i>		<i>176.00</i>
<b>Estimated total budget</b>		<b>229.20</b>	<b>340.78</b>

<sup>15</sup> The budget figures given in this table are rounded to two decimal places.  
The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.  
The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.