Future and Emerging Technologies (FET) Work Programme 2014-2015 in H2020

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Future and Emerging Technologies

DG CONNECT

European Commission

Overview

- FET in Horizon 2020

- FET-Open – *fostering novel ideas*

- FET-Proactive - *nurturing emerging themes and communities*

- FET-Proactive - *High-Performance Computing*

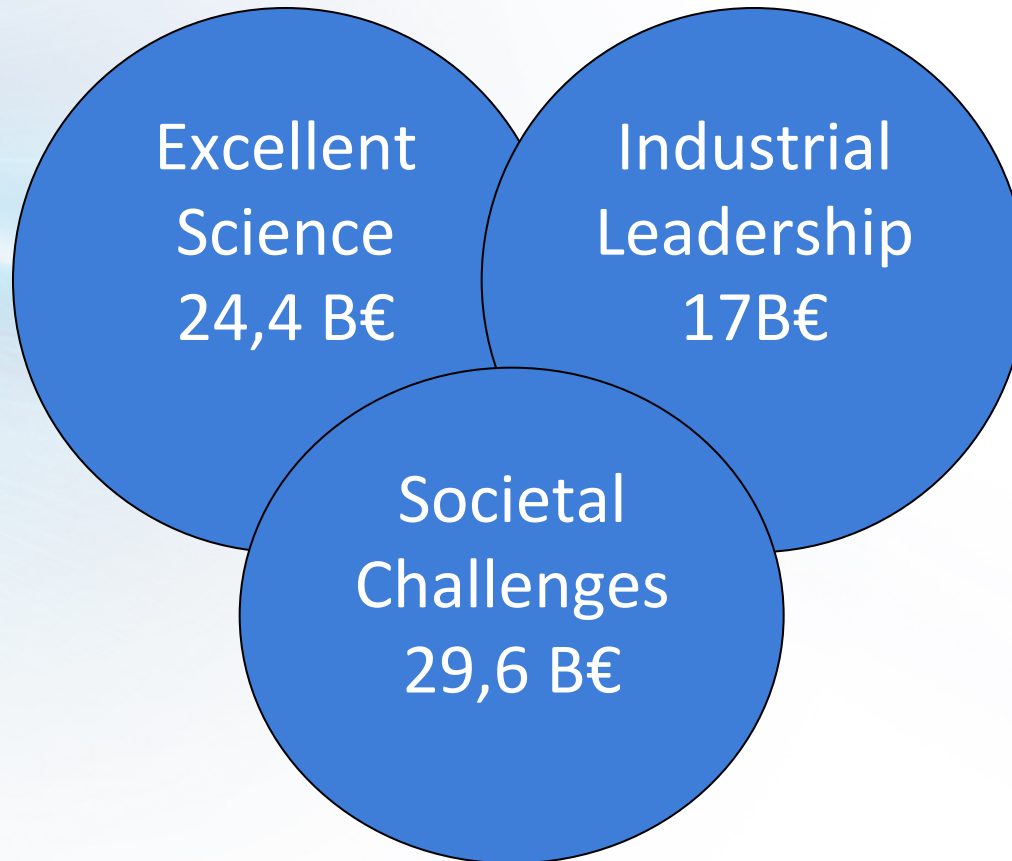- FET Flagships - *tackling grand interdisciplinary science and technology challenges*

European Commission

HORIZON 2020

the EU framework programme for research and innovation

2014-2020

APPROVED

A stronger, clearer focus

H2020 Budget: 77B€ (current prices)

Excellent Science
24,4 B€

Industrial Leadership
17B€

Societal Challenges
29,6 B€

OTHERS: 5,8B€ (Spreading excellence & widening participation, Science & Society, JRC, EIT)

FET in Horizon 2020

Excellent Science pillar in H2020

- European Research Council (13B€)
- Marie Skłodowska-Curie actions (6,1B€)
- **Future and Emerging Technologies**   FET: 2,7 B€
- Research infrastructures programme (2,4B€)

*"**Future and emerging technologies** shall support collaborative research in order to extend Europe's capacity for advanced and paradigm-changing innovation. It shall foster scientific collaboration across disciplines on radically new, high-risk ideas and accelerate development of the most promising emerging areas of science and technology as well as the Union wide structuring of the corresponding scientific communities."*

HORIZON 2020 - THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION (2014-2020)

Pathfinding Europe's technological future

FET's missions

- *To promote and support the emergence of radically new technology areas that will renew the basis for future European competitiveness and growth and will make a difference for society in the decades to come.*

- *To initiate and shape the development of European research and innovation eco-systems around such future and emerging technologies, as seeds of future industrial leadership and potential solutions for societal challenges.*

- *To turn Europe into the best environment for responsible and dynamic multi-disciplinary collaborations on such future and emerging technologies, including facilitating the wider training of researchers in new areas.*

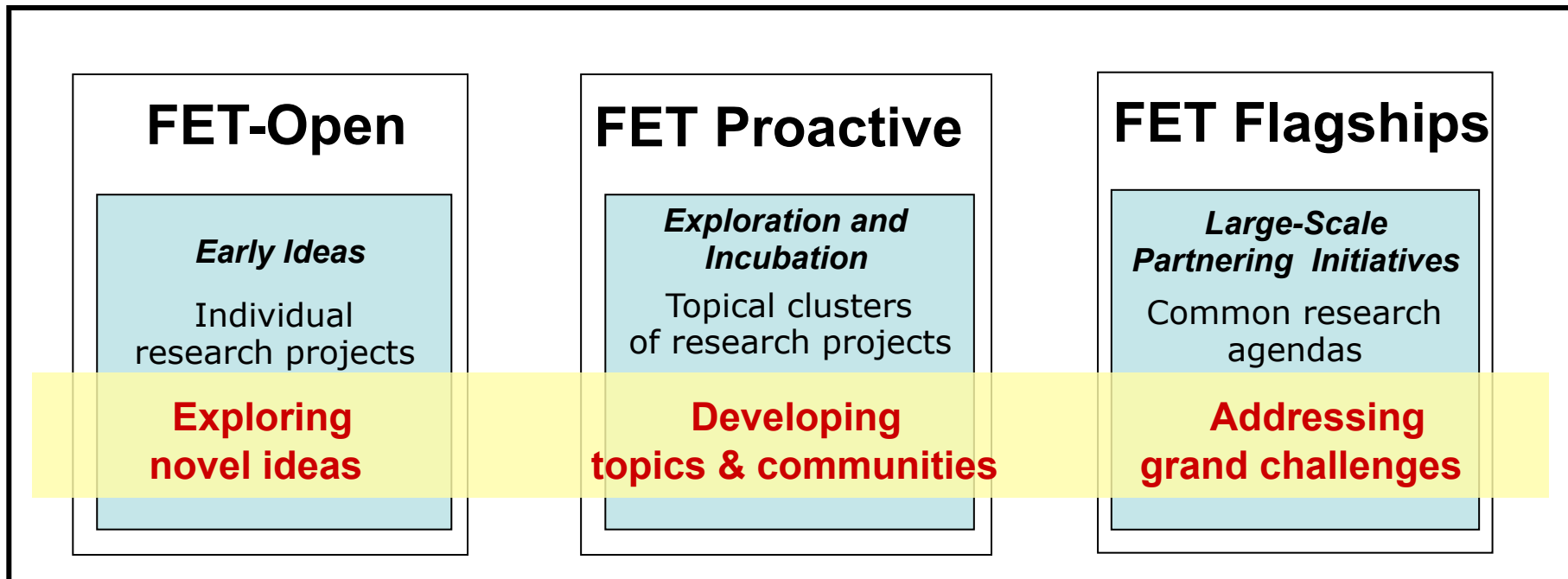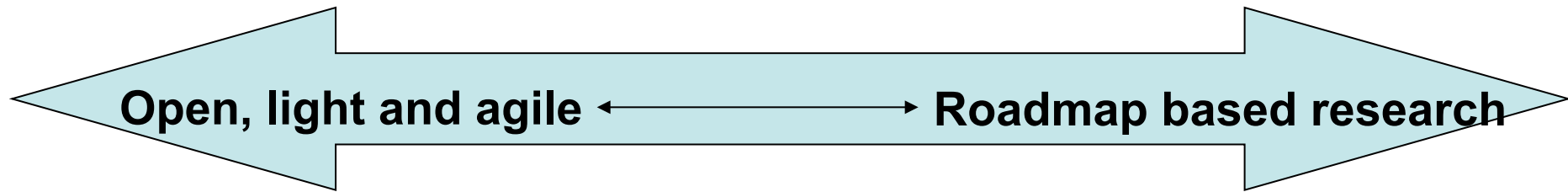# A new level of ambition

- *New mandate, going beyond ICT*
    - **Pathfinding Europe's technological future**
    - **Bootstrapping new R&I eco-systems**

- *New large-scale partnering initiatives complementing small and medium scale activities*
    - **FET Flagships**
    - **High-Performance Computing (PPP)**
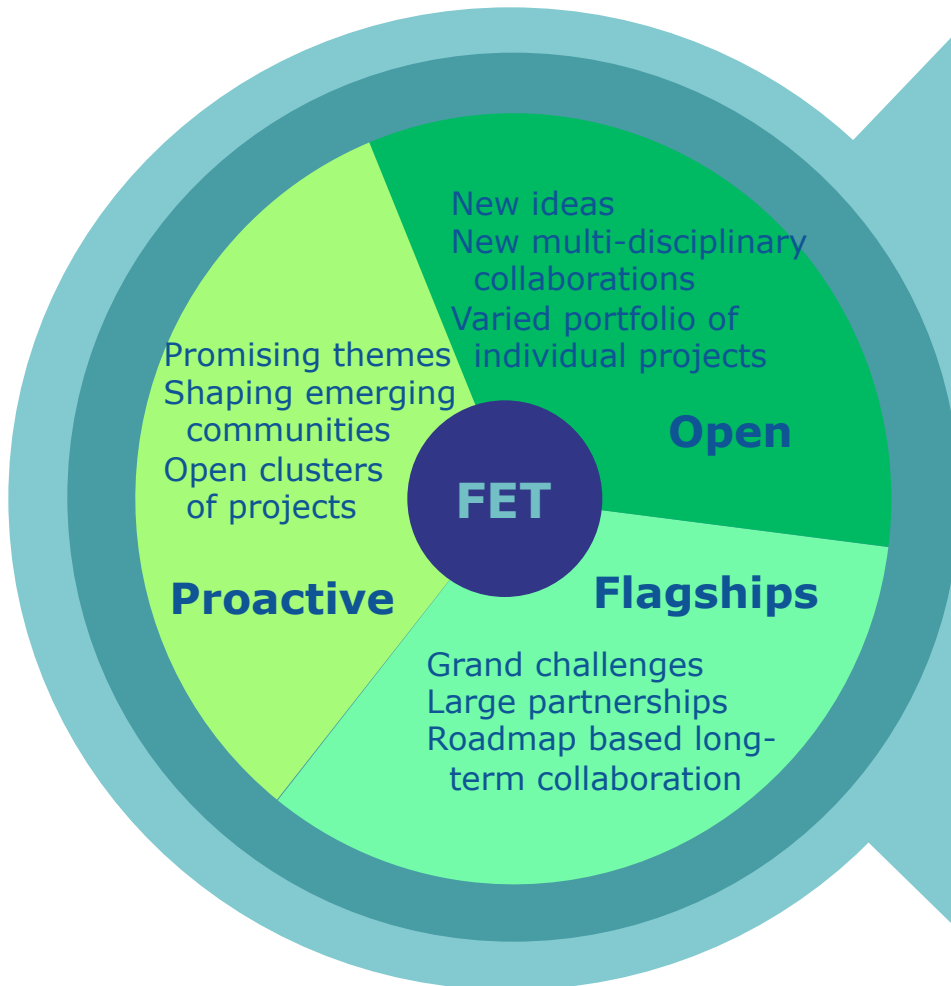
A new actor in the S&T funding landscape

A much larger intervention budget

FET funding schemes

Open, light and agile ⟷ **Roadmap based research**

FET-Open

Early Ideas

Individual research projects

Exploring novel ideas

FET Proactive

Exploration and Incubation

Topical clusters of research projects

Developing topics & communities

FET Flagships

Large-Scale Partnering Initiatives

Common research agendas

Addressing grand challenges

FET cross-cutting issues

FET

Open
New ideas
New multi-disciplinary collaborations
Varied portfolio of individual projects

Proactive
Promising themes
Shaping emerging communities
Open clusters of projects

Flagships
Grand challenges
Large partnerships
Roadmap based long-term collaboration

New synergies and collaborations
- New interdisciplinary synergies linking sciences, technologies and the humanities
- Attracting new high-potential actors, e.g., high-tech SMEs and young researchers
- Programme synergies at European level
- International (global) cooperation

Promoting new approaches and tools for doing science
- Exploring creative R&I methodologies
- Future generation computing to enable advanced simulation, data capture,…
- Digital Science and e-infrastructures

Innovation
- European leadership for FETs
- Encouraging new ideas and actors
- Kick-starting new innovation eco-systems (small and large) around new technologies
- Delivery of new technology options and baselines to industry and spin-offs
- Digital science, open data for wider and faster transfer, spin-off and education

Responsible research and innovation
- Social Sciences and Humanities are relevant
- Promoting societal debate and exchange
- FET Advisory Board and FET Observatory to capture views and needs widely
- Open access, open data policies
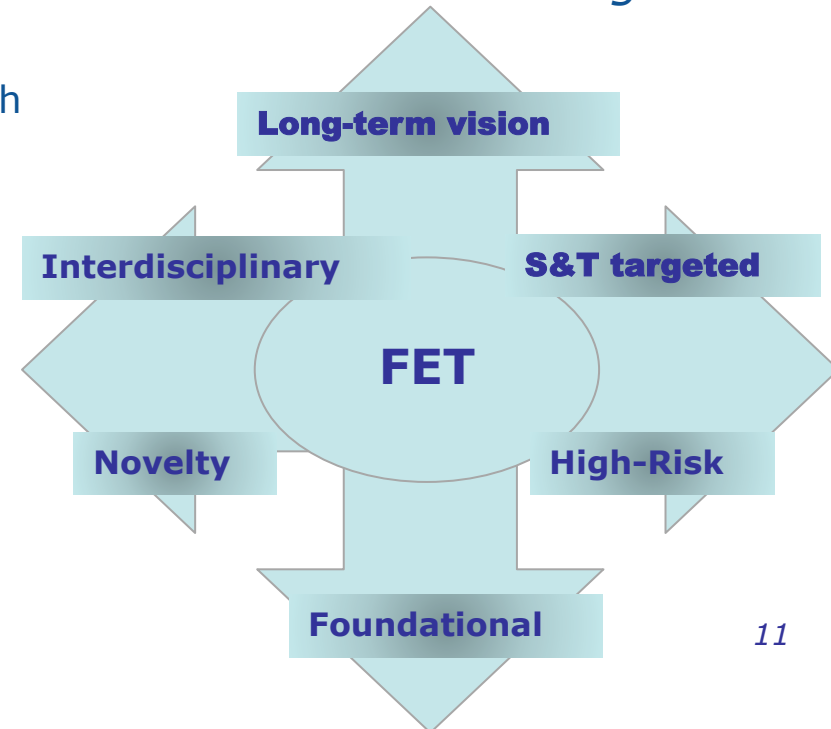- Ethics of methods as well as of results

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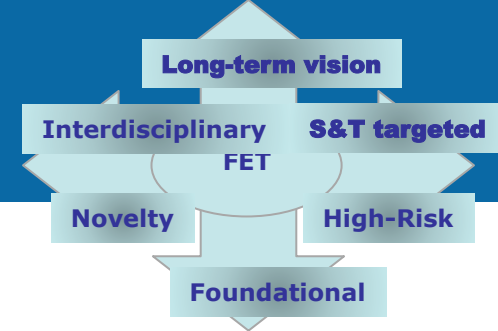
DRAFT

Call FET-Open : novel ideas for radically new technologies

- **'Open is open'**
- All technologies, no thematic restriction
- *FET gatekeepers define the kind of research that FET is looking for*
- Scope defined by the 6 gatekeepers
- Bottom-up, but targeted - not blue sky research
- Collaborative research

- *Total budget: 160M€ in 2014-15*

- *Instrument*
- Research and Innovation Action - 154M€
- Coordination and Support actions (CSA) – 6M€

Long-term vision

Interdisciplinary

S&T targeted

FET

Novelty

High-Risk

Foundational

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FET Gatekeepers

Long-term vision

Interdisciplinary **S&T targeted**

FET

Novelty **High-Risk**

Foundational

Long-term vision: a new, original or radical long-term vision of technology-enabled possibilities going far beyond the state of the art

Breakthrough S&T target: scientifically ambitious and technologically concrete breakthroughs plausibly attainable within the life-time of the project.

Foundational: the breakthroughs must be foundational in the sense that they can establish a basis for a new line of technology not currently anticipated.

Novelty: new ideas and concepts, rather than the application or incremental refinement of existing ones.

High-risk: the potential of a new technological direction depends on a whole range of factors that cannot be apprehended from a single disciplinary viewpoint.

> ➢ This inherent high-risk has to be countered by a strongly interdisciplinary research approach, where needed expanding well beyond the strictly technological realm.

Interdisciplinary: the proposed collaborations must go beyond current mainstream collaboration configurations in joint S&T research, and must aim to advance different scientific and technological disciplines together and in synergy towards a breakthrough.

European Commission

FETOPEN 1: FET-Open research projects

Specific challenge

Supporting a large set of early stage, high risk visionary science and technology collaborative research projects *is necessary for the successful exploration of new foundations for radically new future technologies. Nurturing fragile ideas requires an agile, risk-friendly and highly interdisciplinary research approach, expanding well beyond the strictly technological disciplines. Recognising and stimulating the driving role of new high-potential actors in research and innovation, such as women, young researchers and high-tech SMEs, is also important for nurturing the scientific and industrial leaders of the future.*

Project size: 2 to 4M€

- **1 step submission and evaluation of a 16 pages proposal**
- **Proposals are not anonymous**

Budget: 154M€

Deadlines	30/09/2014	31/03/2015	29/09/2015
Budget	77 M€	38,5 M€	38,5M€

DRAFT

FETOPEN 2: Coordination and Support Activities 2014

Specific challenge: The challenge is to make Europe the best place in the world for collaborative research 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 shall address one of the following topics:

FET Observatory*: identifying new opportunities and directions for FET research*

FET Communication*: communicating on FET projects and activities*

FET Exchange*: structuring an emerging FET-relevant topic and communities*

FET Conference*: supporting the organisation of the third FET Conference*

FET Prizes*: identifying suitable areas for prizes and competitions in FET*

FET Impact*: Assessing the impacts of the FET programme*

Project size: 0,3 to 0,5M€ per topic, up to 1M€ for FET Conference

Budget & deadline:
- *3M€ -> Deadline: 30/9/2014*

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FETOPEN 3 : Coordination and Support Activities 2015

Specific challenge: The challenge is to make Europe the best place in the world for collaborative research 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 shall address one of the following topics:

FET Exchange: structuring an emerging FET-relevant topic and communities

FET Take-Up: actions for stimulating take-up of FET research results towards impact and innovation

Project size: 0,3 to 0,5M€ per topic

Budget & Deadline:
- 1,5M€ -> Deadline: 31/3/2015
- 1,5M€ -> Deadline: 29/9/2015

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Call FET Proactive –emerging themes and communities

Three topics :

- **Global Systems Science (GSS)**

- **Knowing, doing and being: cognition beyond problem solving**

- **Quantum simulation**

- *Total budget: 35M€ in WP 2014-15*

DRAFT

FETPROACT 1 : Global Systems Science (GSS) - 2014

Specific challenge: **The ambition is to improve the way scientific knowledge can help inform and evaluate policy and societal responses to global challenges** *like climate change, global financial crises, global pandemics, and growth of cities – urbanisation and migration patterns. These challenges entangle actions across different sectors of policy and society and must be addressed by radically novel ideas and thinking for producing, delivering, and embedding scientific evidence into the policy and societal processes.*

GSS will put to full use the abundance of data on social, economic, financial, technological, and ecological systems available today. GSS emphasises systems thinking and the need to integrate/link data, models, and policies across all policy sectors with all societal actors. GSS will build on results from, among others, Complex Systems Science, Network Science, Mathematics of Big Data, the life sciences, social sciences and humanities, behavioural sciences, statistics, econophysics, etc.

Project size: 2 to 3M€

Budget & Deadline: 10M€ -> Deadline: 1/4/2014

FETPROACT 2 : Knowing, doing, being: cognition beyond problem solving - 2014

Specific challenge: ***This initiative addresses the interdisciplinary fundamentals of knowing, thinking, doing and being, in close synergy with foundational research on future artificial cognitive systems, robots, smart artefacts and large scale cyber-physical systems.*** *It aims at renewing ties between the different disciplines studying knowledge (especially beyond the 'declarative' and static action oriented kind of knowledge), cognition (e.g., perception, understanding, learning, action) and related issues (e.g., embodiment, thinking, development, insight, knowledge as a social construct, identity, responsibility, culture…) from various perspectives (e.g., physical, biological, neuronal, behavioural, social, epistemological, ecological). The aim is to enable new synergies with engineering disciplines on smart and self-organising materials, embedded systems, robotics, hybrid systems or smart infrastructures and cities to take artificial cognitive systems beyond the level of dull task execution or repetitive problem solving.*

Project size: 2 to 4M€

Budget & Deadline: 15M€ -> Deadline: 1/4/2014

FETPROACT 3 : Quantum simulation - 2014

Specific challenge: Devices that exploit quantum phenomena such as superposition and entanglement have the potential to enable radically new technologies. Several promising directions are now well known, for instance in quantum computation and simulation, quantum communication, quantum metrology and sensing. However, overcoming basic scientific challenges as well as bridging from the scientific results to concrete engineering technologies has proved difficult. This objective challenges the research community to develop solutions using quantum technologies that will ultimately address real world problem, with a potential for disruptive change.

*Scope: **Proposals shall address research and development for quantum simulation to address a class of problems that is beyond the reach of classical computing, and that can contribute to answering questions in fundamental or applied sciences, e.g. in quantum materials science or the life sciences.***

Project size: 2 to 4M€

Budget & Deadline: 10M€ -> Deadline: 1/4/2014

One step submission and evaluation

Part A: Administrative part of the proposal

Part B : Scientific part of the proposal

- **16 pages – core proposal**
  - ➤ Cover page (1 page)
  - ➤ Section 1: S&T Excellence
  - ➤ Section 2: Impact
  - ➤ Section 3: Implementation
- **Additional information**
  - ➤ Operational capacity
    - – E.g. legal entity, CV, subcontract, third party
  - ➤ Ethics section

Evaluation criteria (Research project)

| Excellence	Impact	Implementation
☑ Clarity of targeted breakthrough and its specific science and technology contributions towards a long-term vision. ☑ Novelty, level of ambition and foundational character. ☑ Range and added value from interdisciplinarity. ☑ Appropriateness of the research methods.	☑ Importance of the new technological outcome with regards to its transformational impact on technology and/or society. ☑ Quality of measures for achieving impact on science, technology and/or society. ☑ Impact from empowerment of new and high potential actors towards future technological leadership.	☑ Quality of the workplan and clarity of intermediate targets. ☑ Relevant expertise in the consortium. ☑ Appropriate allocation and justification of resources (person-months, equipment, budget).
Threshold: 4/5 **Weight: 60%**	**Threshold: 3,5/5** **Weight: 20%**	**Threshold: 3/5** **Weight: 20%**

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High Performance Computing

European Commission

Key EU developments in 2012-2013

- *Communication from the EC: "High-Performance Computing: Europe's place in a global race" (2012)*
  - ➢ **Council Conclusions on High-Performance Computing (Competitiveness Council – 2013)**

- *Establishment of the European Technology Platform on High-Performance Computing (ETP4HPC - 2013)*
  - ➢ **ETP4HPC - Strategic Research Agenda**
  - ➢ **Public-Private Partnership with ETP4HPC***

EUROPEAN TECHNOLOGY PLATFORM FOR HIGH PERFORMANCE COMPUTING

ETP4HPC Strategic Research Agenda Achieving HPC leadership in Europe
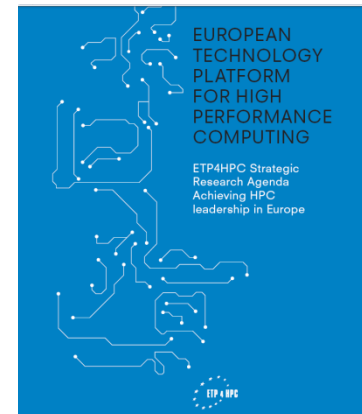
www.etp4hpc.eu

*expected Dec-2013

- HPC is an important asset for the EU's innovation capacity of strategic importance to the EU's industrial and scientific capabilities as well as its citizens:

  - developing innovative industrial products and services,

  - increasing competitiveness,

  - addressing societal and scientific grand challenges more effectively.

- Europe has the technology, knowledge and human skills to develop capabilities covering the whole technological spectrum of the next HPC generation (exascale computing)

- Importance of developing state-of-the-art HPC technologies, systems, software, applications and services in Europe

- All relevant actors, public and private, need to work in partnership

- Invites the EC to elaborate its plans for HPC to support academic and industrial research and innovation under H2020
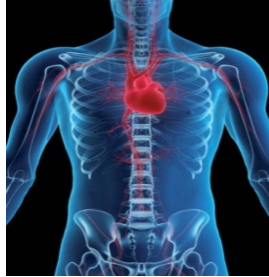
HPC in FET: Critical technologies
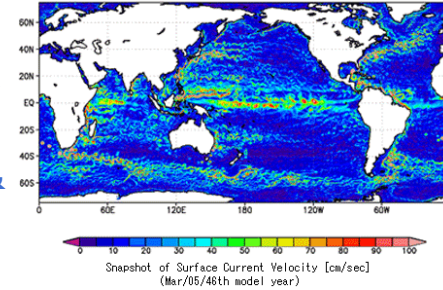
Addressing Societal Challenges

Health, demographic change and well-being
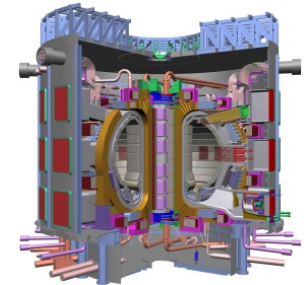(Personalised medicine, pharma/bio-medical simulations, Virtual Physiological Human, Human Brain Project)

Climate action, resource efficiency and raw materials
(Simulators for Climate & Earth Sciences, Gas&Oil)

Smart, green and integrated transport Engineering
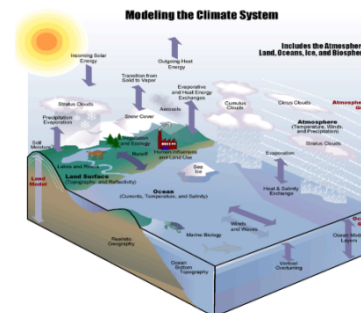(performance, sustainability, energy efficiency)

Secure, clean and efficient energy
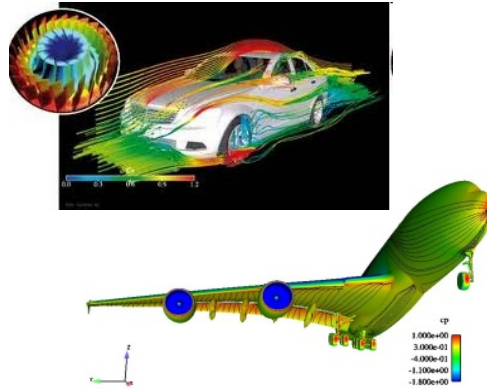(Fusion, nuclear plant simulations)

Food security, sustainable agriculture, marine research and the bio-economy
(simulation of sustainability factors (e.g. weather forecast, stock plagues and diseases control, etc))

Inclusive, innovative and secure societies
(Smart Cities, multivariable decision/analytics support)

An integrated HPC approach in H2020

- HPC strategy combining three elements:

(a) Computer Science: towards **exascale** HPC; *A special FET initiative focussing on the next generations of exascale computing as a key horizontal enabler for advanced modelling, simulation and big-data applications* [HPC in FET]

(b) achieving excellence in HPC **applications**; *Centres of Excellence for scientific/industrial HPC applications in (new) domains that are most important for Europe* [e-infrastructures]

(c) providing **access** to the best supercomputing facilities and services for both industry and academia; *PRACE - world-class HPC infrastructure for the best research* [e-infrastructures]

- complemented with training, education and skills development in HPC

HPC- Exascale Challenges in FET

- **Energy**: Extrapolation of current power consumption (e.g. Top system Tianhe-2) would need ~1 GW for sustained exaflops: breakthroughs and advances in circuits, architecture and software are needed to achieve the ~20 MW exaflop computing

- **Memory and I/O**: Handling of memory, latency and locality at all levels, from processor, to network and storage

- **Programmability and algorithms**: Programmers face the challenge of handling <u>billions</u> of computing threads. Only very few applications using HPC really take advantage of current petaflop system.

- **Resilience:** Innovative ideas are needed to cope with a very unstable and complex environment of millions of cores with frequent fault rates

- **Co-design**: Technology development must be associated to users requirements to get the right systems to satisfy the needs of applications.

  ➤ engaging a European-wide effort to develop technology to build exascale systems within ~10 years

FETHPC 1: HPC core Technologies, Programming Environments and Algorithms for Extreme Parallelism and Extreme Data Applications - 2014

Specific challenge: Addressing the exascale challenges to achieve, by 2020, the full range of technological capabilities for **exascale-class HPC systems** *which are balanced at all levels and validated with significant application drivers*

Scope :

- **a. Core technologies and architectures** *(e.g. processors, memory, interconnect and storage) and their optimal integration into HPC systems, platforms and prototypes*

- **b. Programming methodologies, environments languages and tools***: new programming models for extreme parallelism and extreme data applications*

- **c. APIs and system software** *for future extreme scale systems*

- **d. New mathematical and algorithmic approaches** *(e.g. ultra-scalable algorithms for extreme scale systems with quantifiable performance for existing or visionary applications)*

Project size : 2 to 4M€, up to 8M€ for topic a)

Budget & Deadline :   93,4M€ -> Deadline: 25/11/2014

- with a minimum of 60% to be allocated to research under part a) of the scope

FETHPC 2: HPC Ecosystem Development - 2014

Specific challenge: To develop a sustainable European HPC Ecosystem

Scope:

- **Coordination of the HPC strategy** : coordination of the activities of stakeholders such as ETP4HPC, PRACE, application owners and users (including emerging HPC applications), the European exascale computing research community, the open source HPC community, etc.

- **Excellence in High Performance Computing Systems** : boost European research excellence on the key challenges towards the next generations of high-performance computing systems; cutting across all levels – hardware, architectures, programming, applications; ensure a durable integration of the relevant European research teams; self-sustainability of the research integration on the longer-term

Budget & Deadline: 4M€ -> Deadline: 25/11/2014

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FET Flagships – salient features

FET Flagships are <u>highly ambitious</u>, <u>large-scale</u>, <u>long-term</u>, <u>science-driven</u>, <u>goal-oriented</u>, roadmap-based research initiatives, which will:

- provide strong scientific, technological and IPR basis for establishing areas of European leadership and bringing substantial benefits for society
- help overcome fragmentation and increase the impact of European research and innovation efforts

and which will require:

- cooperation among a range of scientific communities/disciplines, with industries and with the involvement of representatives from the civil society
- a long-term commitment of all key stakeholders sharing a common scientific vision and under a strong leadership
- a joint effort of EU and national programmes to provide a large financial support (~ 100 M€/year) over a long period (~10 years)

Graphene & Human Brain Project selected

FP7 ramp-up phase
10/2013- 03/2016

Flagship
selection
6 → 2
end 2012

Preparatory
Phase Pilots
**05/2011 -
04/2012**

Call for
Preparatory Actions
21 → 6
July 2010

Stimulating ideas &
structuring the
scientific community
2009 - 2010

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Brain Simulation and Graphene Research Receive Billion Euro Each

0 Comments   f Like 7   Tweet 3   in Share   ⌧ E-mail   🖶 Print

Mark Hoffman   First Posted: Jan 28, 2013 09:57 AM EST

The result of the highly anticipated decision of which two research projects will receive a one billion Euro research grant, the largest single research award ever, from the European Commission were announced by the European Commission's Vice-President Neelie Kroes today.
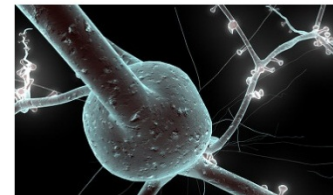
The first project is the Human Brain Project, led by neuroscientist Henry Markram at the Swiss Federal Institute of Technology (EPFL) in Lausanne, which aims to simulate the human brain in a supercomputer, in order to aid medical advancement in brain disorders.

Like Us on Facebook f Like 🔊

The second, called Graphene Project, is led by theoretical physicist Jari Kinaret at Chalmers University of Technology in Gothenburg, Sweden. It's goal is to develop the awesome
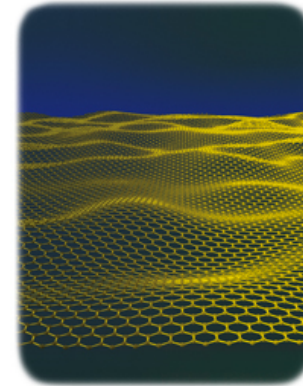
European Commission

GRAPHENE FLAGSHIP

Graphene FET Flagship

Graphene, is a 2D material , a single layer of carbon atoms, stronger than diamond, yet lightweight and flexible
and an exceptional electricity conductor.

The Graphene Flagship will bring graphene, and related 2D materials, **from academic labs to industry, manufacturing and society.**

Artistic impression of a corrugated graphene sheet
Credit: Jannik Meyer

Examples Applications:

- ✓ electronic paper; bendable smartphones; enhanced solar cells and batteries; lighter and more energy efficient airplanes …

- ✓ On the longer term, graphene is expected to give rise to new computers and revolutionary medical applications such as artificial retinas.

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Nokia Morph concept - Credit: Nokia Research Center

The Human Brain Project (HBP)

HBP will create the wold's largest **experimental facility for developing the most detailed models of the brain** (from genes to mind), for studying how the human brain works and ultimately for simulating and developing personalised treatment of brain diseases.

This research lays the scientific and **technical foundation for medical progress**: identifying new drug targets and treatment, in response to the urgent need to combat brain diseases and their associated costs to society.

HBP will also produce brain-inspired '**neuromorphic**' **computing** systems that could drastically reduce power-consumption for super-computers and enhance robots.
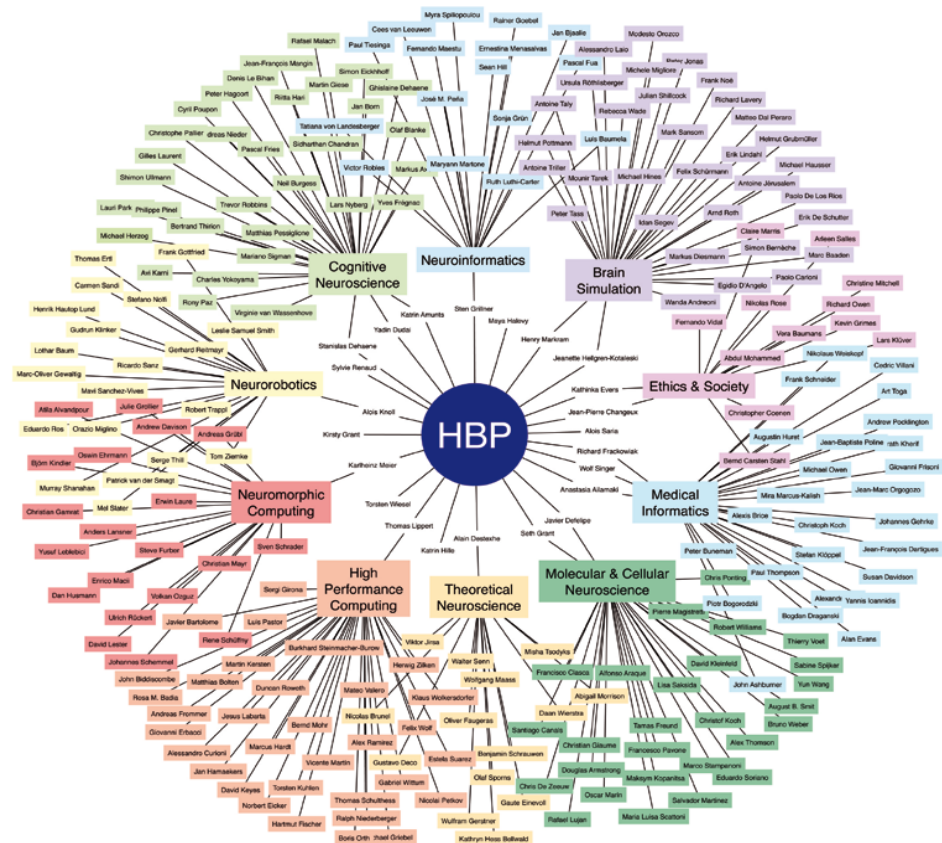
FETFLAG 1: Framework Partnership Agreement (FPA) - 2014

- **Two Framework Partnership Agreements between the EC and the Flagship partners** will be established through a call in 2014 in order to formalise in particular:

  - the EC long-term commitment to support the Flagships, and

  - the partners' commitment to establish, maintain and implement the strategic research agenda of each of the Flagships

- At later stages, specific grant agreements will be signed, using the modalities set out in the FPA. Initially this will be the follow-up core projects called for in 2015.

- No budget

- Deadline: 10/4/2014

FET Flagships Core projects -2015

The core project should progress FET Flagship research tasks in accordance with the defined roadmap, and also (amongst others)

- ensuring the overall continuity and coherence

- governance of the initiative

- collaboration with other initiatives or programmes at regional, national, transnational or global level (e.g. related ERANET projects)

Type of action: Research and Innovation Action funded through a specific grant agreement Framework Partnership Agreement.

Budget:

Graphene FPA: EUR 89 million from the 2015 budget
HBP FPA: EUR 89 million from the 2015 budget

Indicative timetable: Second quarter of 2015

FETFLAG 2: Policy environment for FET Flagships - 2014

Specific challenge: The overall challenge is to foster a common European effort by contributing to dissemination efforts, impact assessments and other actions which support and strengthen the FET Flagship initiatives. This also extends to enhancing the interplay between FET Flagships and other Union policies and technology transfer of technologies towards exploitation.

Scope: Supporting the policy environment by addressing aspects such as:
•Supporting collaboration between the FET Flagships and international programmes;
•Assessing the impacts of FET Flagship initiatives, including through metrics and indicators;
•Analysing market potential and supporting technology transfer;
•Collection of information need for policy making, e.g. through consultation actions and surveys.

Budget and deadline: 1,6M€ -> Deadline 10/4/2014

FET WP2014-15   479,2M€

Call FET-Open - fostering novel ideas   **160M€**

- **FETOPEN1: FET-Open research projects**
  - 77M€   30/9/2014
  - 38,5M€   31/3/2015
  - 38,5M€   29/9/2015
- **FETOPEN2: Coordination and Support Activities 2014**
  - 3M€   30/9/2014
- **FETOPEN3: Coordination and Support Activities 2015**
  - 1,5M€   31/3/2015
  - 1,5M€   29/9/2015

Call FET-Proactive - nurturing emerging themes and communities   35M€

- **FETPROACT1: Global Systems Science (GSS)**
  - 10M€   01/4/2014
- **FETPROACT2 : Knowing, doing and being; cognition beyond problem solving**
  - 15M€   01/4/2014
- **FETPROACT3 : Quantum simulation**
  - 10M€   01/4/2014

FET WP2014-15 479,2M€

Call FET Proactive - towards exascale High Performance Computing   97,4M€

- **FET HPC1: HPC Core Technologies, Programming Environments and Algorithms for Extreme Parallelism and Extreme Data Applications**

  ➢ 93,4M€   25/11/2014

- **FET HPC2: HPC Ecosystem Development**

  ➢ 4M€   25/11/2014

Call FET-Flagships - tackling grand interdisciplinary science and technology challenges   179,6M€

- **FETFLAG1: Framework Partnership Agreement (FPA)**

  ➢ na   10/4/2014

- **FETFLAG2: Policy environment for FET Flagships**

  ➢ 1,6M€   10/4/2014

- **Graphene & Human Brain Project FET Flagship Core Projects (under FPA)**

  ➢ 2x89M€   Q2/2015

Other** (study, experts, communication)*   ***7,2M€

FET Information Day in Brussels

What?

- *Overview of the first FET-Proactive objectives*
- *H2020 proposal guidelines and submission procedures*
- *Presentation of ideas for projects and networking*

When?

- *20 January, 2014*

Where?

- *Brussels, location to be confirmed*

Deadline for registration?

- *12 January, 2014*

https://ec.europa.eu/digital-agenda/en/news/horizon-2020-future-emerging-technologies-fet-information-day

Merci de votre attention!

Draft of the FET Work Programme call text :

ec.europa.eu/research/horizon2020/index_en.cfm?pg=h2020-documents

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