ETP 4 HPC

THE EUROPEAN TECHNOLOGY PLATFORM FOR HIGH PERFORMANCE COMPUTING

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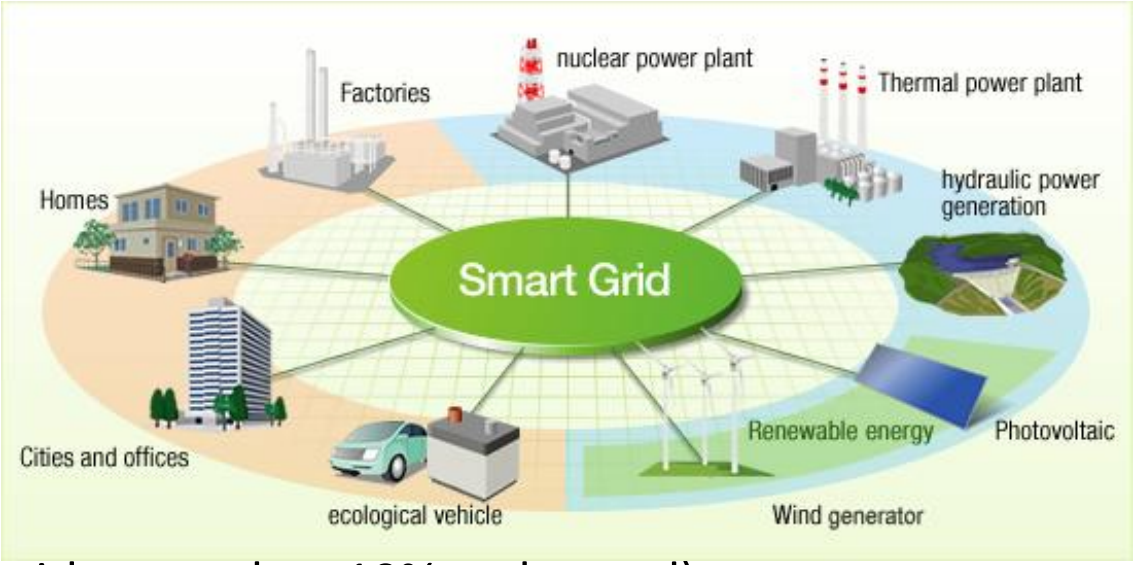
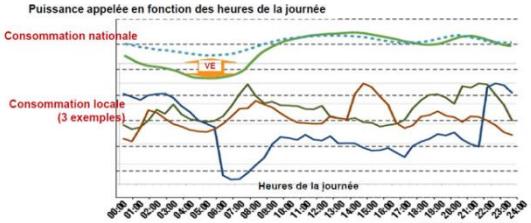
Challenges, R&D priorities and European actions

JF Lavignon, Bull
ETP4HPC Chairman

HPC in the loop : smart grid



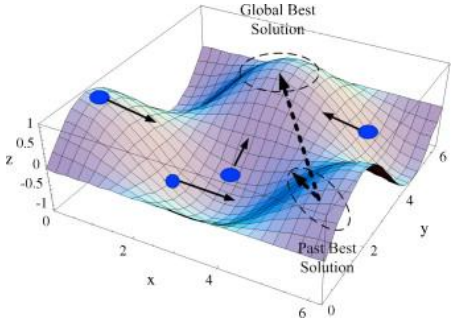
- Huge system
  - 34 interconnected countries in Europe
  - 530 M inhabitants
  - 300,000 km network
  - 880 GW production
  - 3,200 TWh consumed (with more than 10% exchanged)
- Complex optimization and control problem
  - More and more data available
  - Complex models and interactions

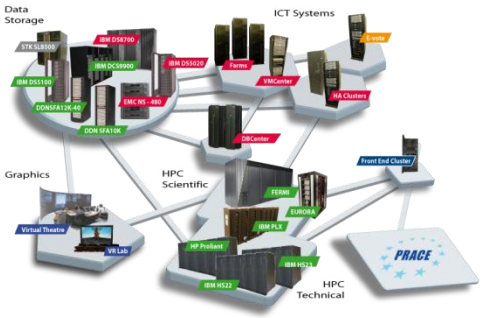


- Big stakes
  - In the US, 67% of the electricity is wasted in production, transport and distribution

HPC technologies for system control

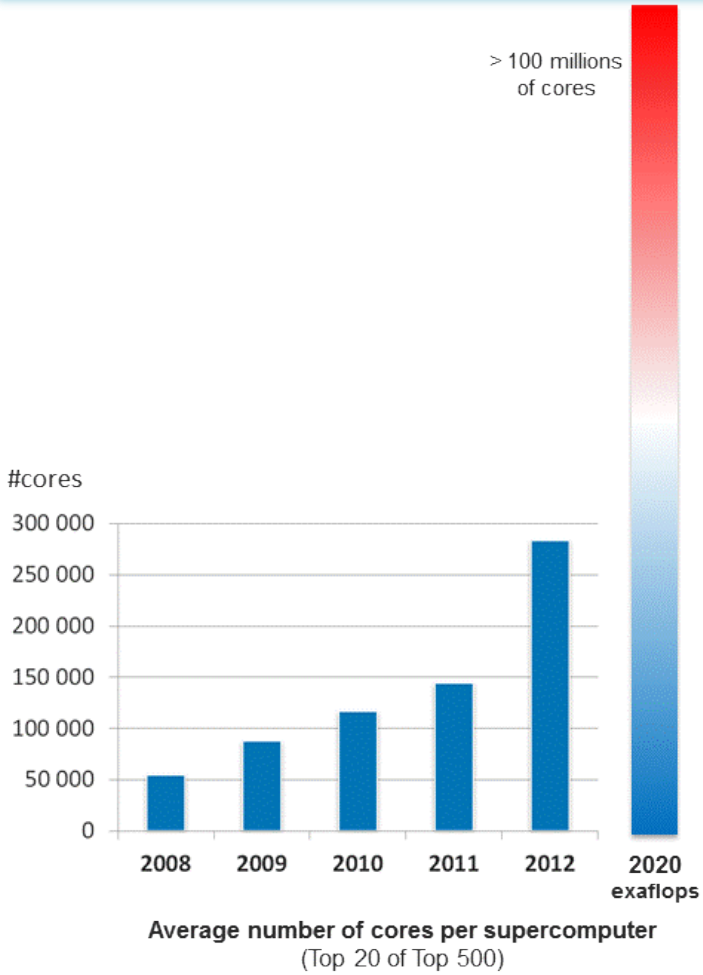
- New algorithms
  - Time constraint optimization
  - Data integration
- New architectures
  - Integration of data streams
  - Connection to real time control system
- New system software
  - Time control
  - Interaction with operator
- Application to other fields : fire, flooding … management, smart cities…





Meeting the Application challenges with parallelism

EXAFLOP: Number of cores increases exponentially



Average number of cores per supercomputer
(Top 20 of Top 500)

The Current Situation:

- Only 1% of SW are capable to exploit 10 000 processors
- It takes 5 to 10 years in average to rewrite an application
- 50% of IT managers said that their applications scaled at a maximum of 120 cores (2011 survey, Addison Snell)

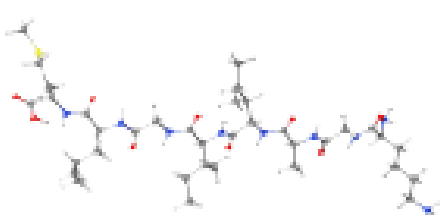
The two-fold Challenge:

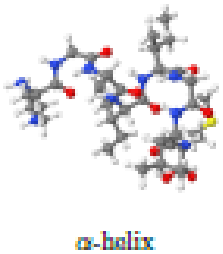
1. Keep the early adopters on path
   (capture the full benefits of the performance from thousands of processors to millions of cores)

2. Bring all the others in the game

New methods : chemistry example

- Scientific problem
  - Prediction of chemical properties
    - Drug design, electronics industry, material, biochemistry…

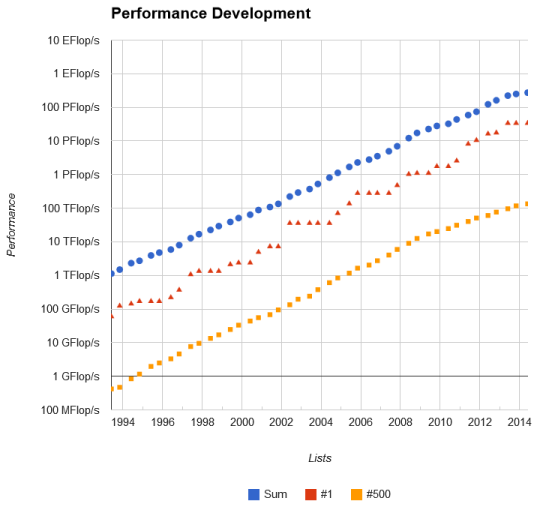




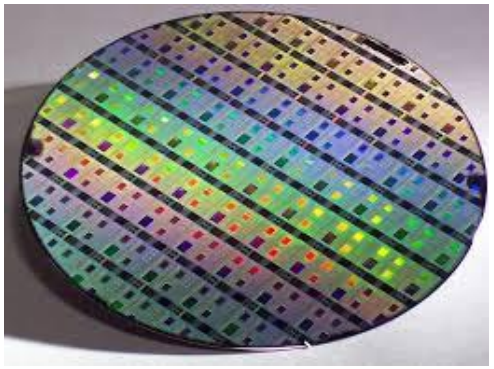
- Standard methods
  - Density Functional Theory, post Hartree-Fock
  - Solving the Partial Differential Equation for the unkown wave function
  - Introduction of approximation to reduce dimension problem
  - CPU intensive with communication
- New approach
  - Quantum Monte Carlo stochastic method
  - Exploration of configuration space using Markov chain to visit only the most probable states
  - Still some investigation at theoretical level
  - Able to use parallelism, non blocking communication
  - Resilient system

The power challenges

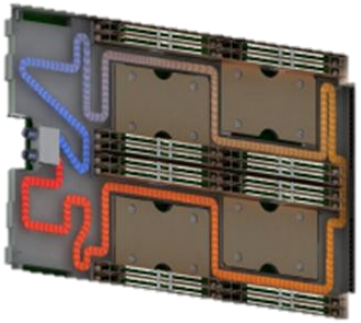
- HPC power trends over 20 years
  - Performance : #1 x by 560,000
    54 times more than Moore Laws
  - Power : 18 MW
    110 times the power



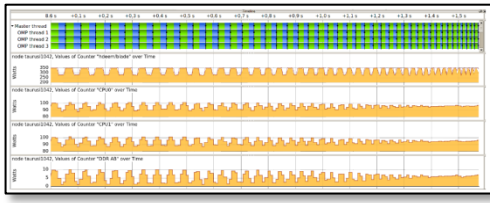
- Silicon process
  - Power density increase
  - Low frequency can reduce power
    but increase the concurrency



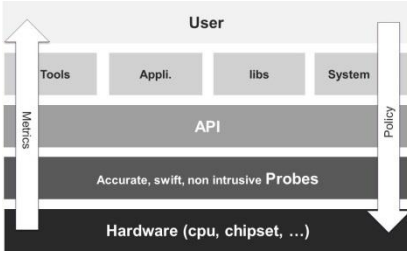
Energy efficiency R&D



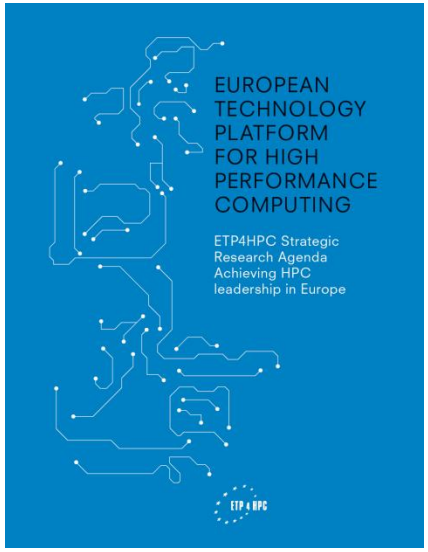
- Over a short period PUE from 1.7 to 1.1
- Power monitoring
  - Getting the understanding of performance and energy consumption



- Power management at hardware level
  - Dark silicon
  - Optimal settings
- Optimization at HPC system level
  - Workload control and optimization
- APIs between application level information and system level features



Strategic Research Agenda: a multi-dimensional vision



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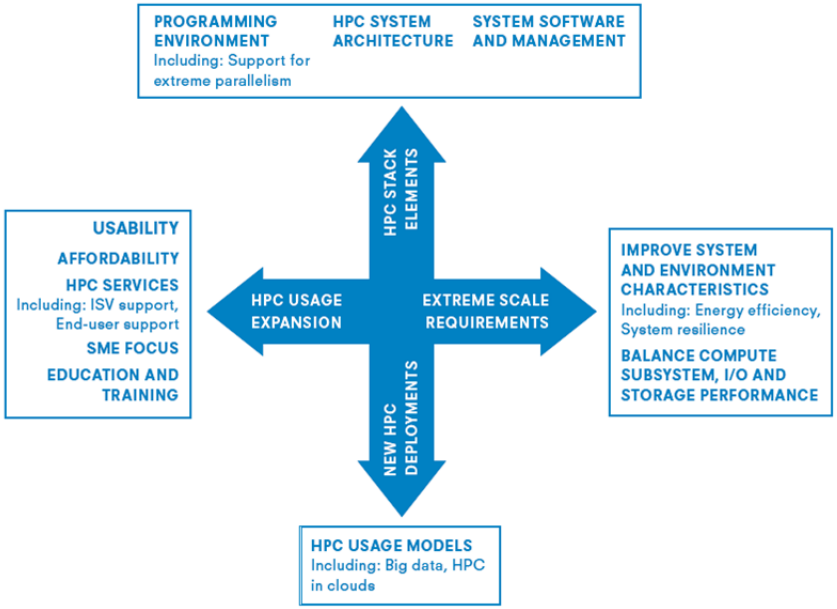
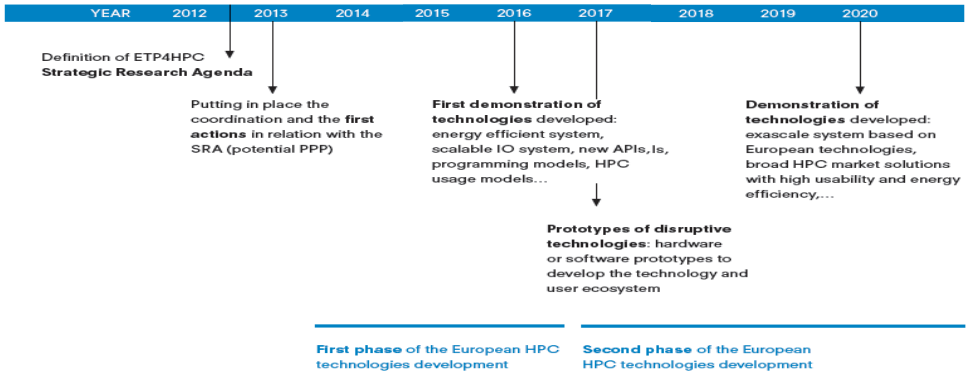
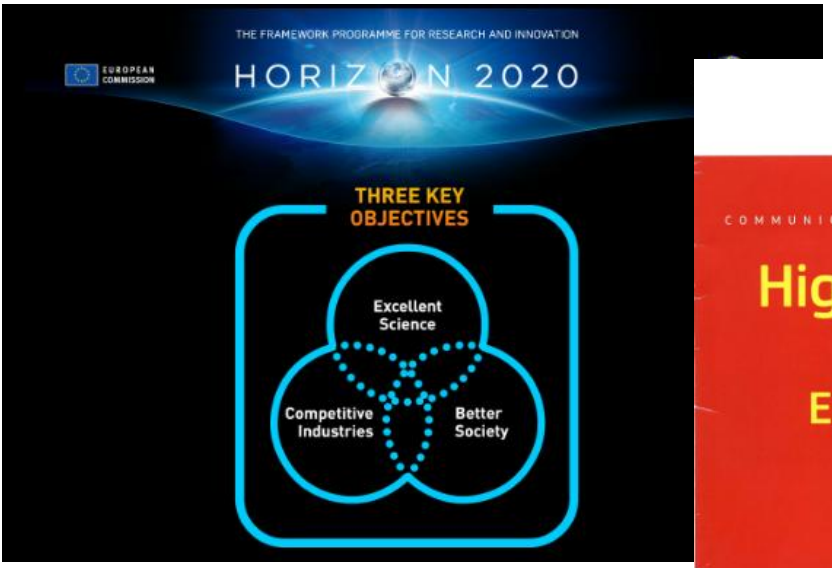




What action in Europe ?

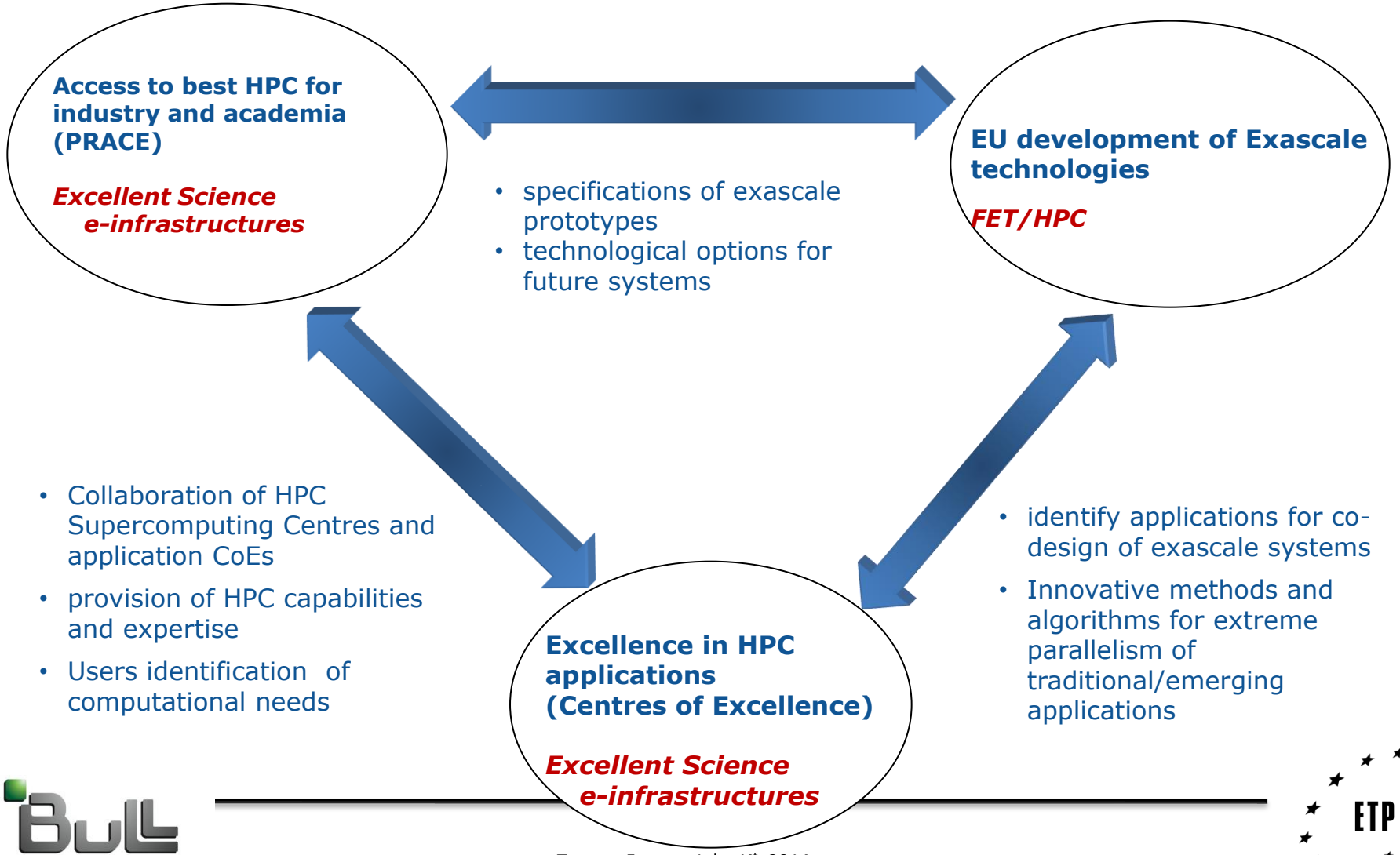
European policy vision



February 2012

May 2013

Interrelation between three elements



PRACE → *the* European HPC Research Infrastructure

- Enabling **world-class science** through large scale simulations
- Providing **HPC services** on **leading edge capability** systems
- Operating as a **single entity** to give access to **world-class supercomputers**
- **Attract**, **train** and **retain** competences
- **Lead** the **integration** of a highly effective **HPC ecosystem**
- Offering its resources through a **single** and **fair** pan-European **peer review process to academia and** industry

- **25** members, since 2010
- **6** supercomputers in **4** hosting countries, nearly **15 Pflop/s**
- Common operation procedure between **35** centers in Europe
- **22** prototypes evaluated
- **169** white papers produced
- **1500** communications from our users
- **166** Thesis
- HPC Community building: **183** events

PRACE

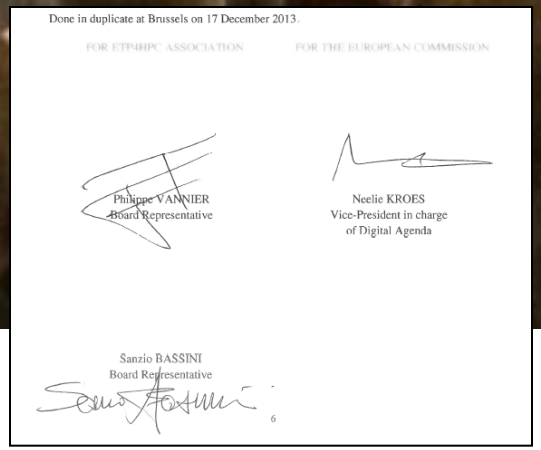
ESFRI

- **8 billion** hours granted since 2010 (a system with 900k cores for 1 year)
- **303** scientific projects enabled from **38** countries
- More than **20 SME** and **industries** access in first year
- **360** PATC Training days
- **2734** Trained people
- **170** applications enabled

Partnership for European leardership in HPC

cPPP

Contractual Public-Private Partnership



Done in duplicate at Brussels on 17 December 2013.

FOR ETP4HPC ASSOCIATION

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Board Representative

FOR THE EUROPEAN COMMISSION

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Sanzio BASSINI
Board Representative

EUROPEAN COMMISSION

PRESS RELEASE

Brussels, 17 December 2013

EU industrial leadership gets boost through eight new research partnerships

The European Commission today launched eight contractual Public Private Partnerships (cPPPs) of strategic importance for European industry. The partnerships will leverage more than €5 billion of investments to be allocated through calls for proposals under Horizon 2020, the new EU programme for research and innovation. Each euro of public funding is expected to trigger additional investments of between three and 10 euro to develop new technologies, products and services which will give European industry a leading position on world markets (MEMO/13/1159).

European Commissioner for Research, Innovation and Science Máire Geoghegan-Quinn said: *"Europe needs industry to innovate to create income and jobs. New technologies and products, such as green cars, energy efficient buildings and cleaner manufacturing processes, are essential to address societal challenges such as climate change, energy and resource efficiency. We want these contractual PPPs to have a substantial impact on the competitiveness of the EU industry, on sustainable economic growth and the creation of new high-skilled jobs in Europe."*

Vice President Neelie Kroes, Commissioner responsible for the Digital Agenda, said: *"This is a great opportunity for Europe. These PPPs will maintain our global lead in robotics, photonics, high performance computing, telecoms and give us a head start in smart cities, intelligent transport, education, entertainment, media and other promising markets. Combined with a comprehensive industrial strategy, the PPPs will ensure vigorous European leadership and a better future for all."*

The eight contractual Public-Private Partnerships are:

- **Factories of the Future (FoF)**, to support the manufacturing industry through the development of sustainable production technologies and systems (Link to factsheet)
- **Energy-efficient Buildings (EeB)**, to increase the competitiveness and energy efficiency of the construction industry (Link to factsheet)
- **European Green Vehicles Initiative (EGVI)**, to develop a competitive and resource efficient transport system with significantly less CO2 emissions (Link to factsheet)
- **Sustainable Process Industry (SPIRE)**, to make the process industry more resource- and energy-efficient (Link to factsheet)
- **Photonics**, one of the key enabling technologies for our future prosperity and an essential element of many sectors, from energy and health, to everyday products like DVD players and mobile phones (Link to factsheet)
- **Robotics**, a key driver of industrial competitiveness and essential to address key societal challenges in areas such as demographic change, health and well-being, food production, transport and security (Link to factsheet)
- **High Performance Computing (HPC)**, which plays a pivotal role in stimulating Europe's economic growth and advancing European science (Link to factsheet)
- **Advanced 5G networks for the Future Internet (5G)**, to stimulate the development of network internet infrastructure to ensure advanced ICT services for all sectors and users (Link to factsheet)

The contracts setting up the PPPs were signed today by the Commission and chairpersons of specially-created industrial research and innovation associations, representing more than 1,000 large and small enterprises across Europe.

cPPP in a nutshell

- Mutual commitments
  - EC : continuous support of HPC in Horizon 2020 : 700 M€
  - HPC community : R&D investment matching EC effort + industrial development

- Coordination of the action
  - Advices from stakeholders to EC
  - Management of the work programmes by the EC
  - Preparation of roadmaps proposing the vision
  - Common monitoring of Key Progress Indicators

FETHPC Call

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

- Proposals shall target one of the following subtopics:
  a) HPC core technologies and architectures
  b) Programming methodologies, environments, languages and tools
  c) APIs and system software for future extreme scale systems
  d) New mathematical and algorithmic approaches

Budget : 93.4 M€

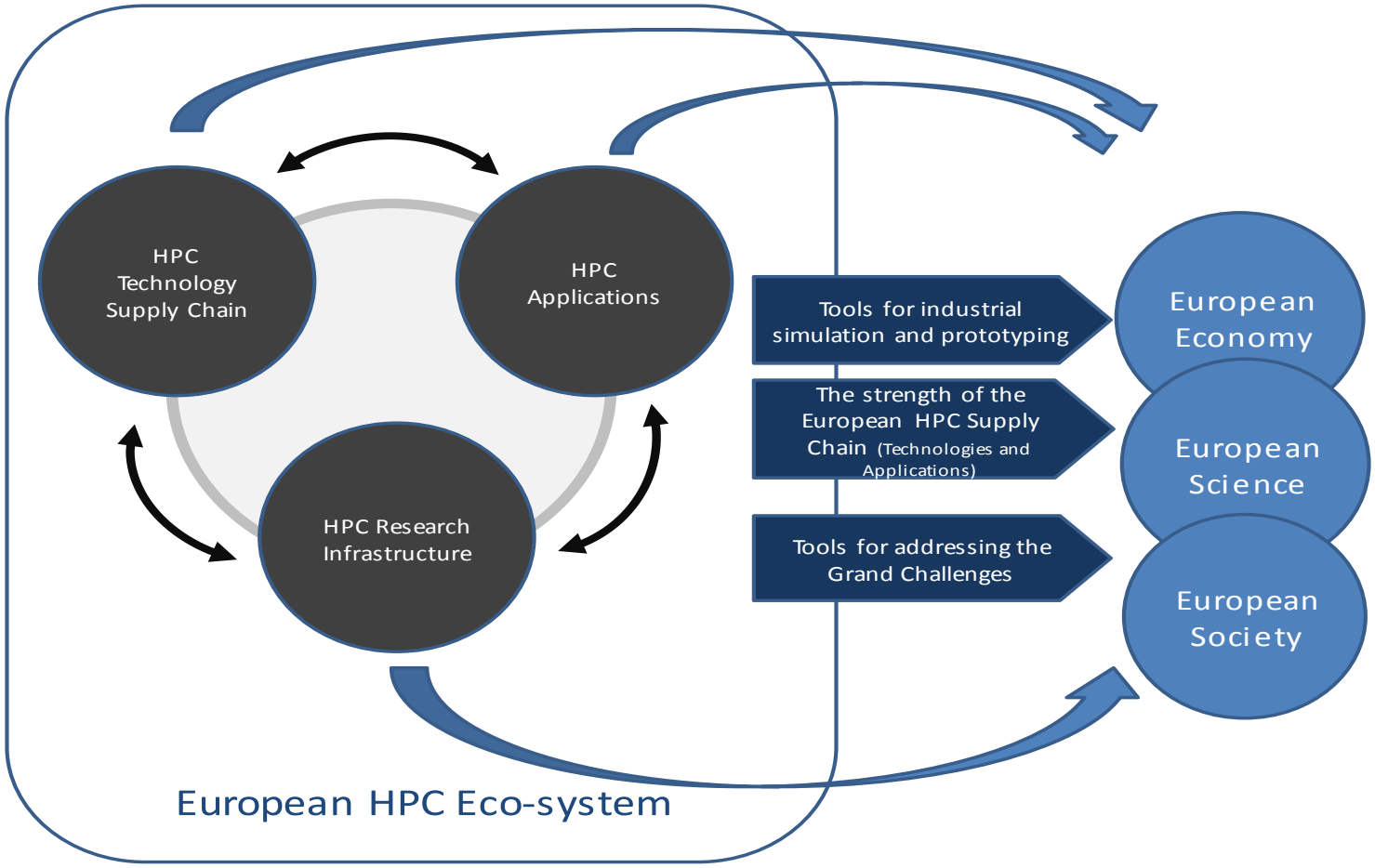
Deadline : 25/11/2014

HPC Centres of Excellence (HPC CoE)

Specific challenge:

- **Establish a limited number of user-centred Centres of Excellence (CoE) in the application of HPC for addressing scientific, industrial or societal challenges**
  - **CoEs may be**
    - **'thematic':**
      - **addressing specific application domains such as medicine, life science or energy**
    - **'transversal':**
      - **on computational science (e.g. algorithms, analytics, numerical methods etc.)**
    - **'challenge-driven':**
      - **addressing societal or industrial challenges (e.g. ageing, climate change, clean transport etc.); or a combination of these types.**

HPC cPPP – Building a European HPC Ecosystem



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