

High Performance Computing: implementing the strategy

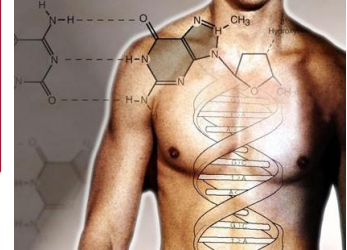
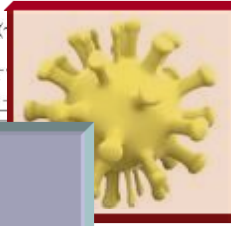
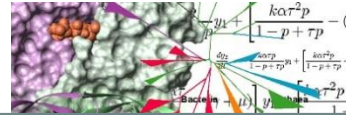
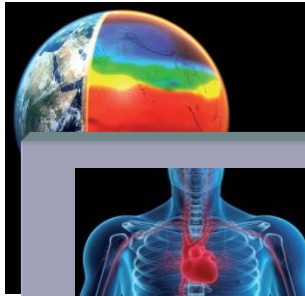
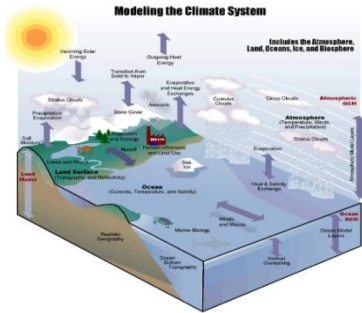
**PRACE Scientific Conference
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European Commission - DG CONNECT**

HPC: What for?



European
Commission



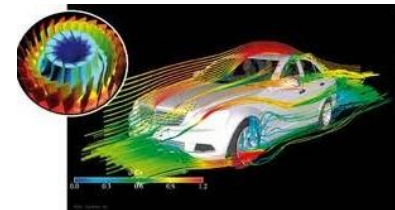
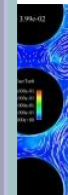
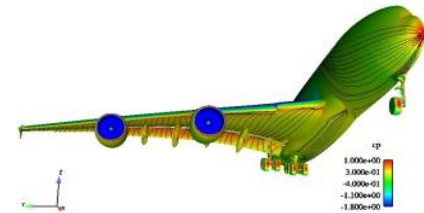
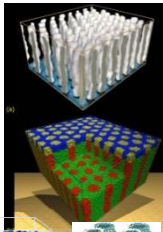
Weather, Climate & ...



New applications
e.g. Health, Big data



/Life
ences



Fundamental sciences: Physics,
Chemistry, Material Sciences,
Astrophysics

Industrial & Engineering





- HPC has a fundamental role in driving innovation leading to societal impact through **better solutions for societal challenges** and **increased industrial competitiveness**
- Proposing a renewed European strategy in HPC and an action plan to position the EU as a centre of innovation, a hub of scientific excellence and a global partner
- Ensure European leadership in the supply and use of HPC systems and services by 2020

HPC drivers :

- Addressing Societal/Scientific/Industrial challenges more effectively
- Industry is increasingly depending on HPC to fulfil the need to innovate in products and services (better jobs)
- Transition from petascale to exascale computing creates new opportunities for both science applications and computing technologies
- Gaining independent access to HPC systems and services for Europe supports growth and competitiveness in industry and the economy

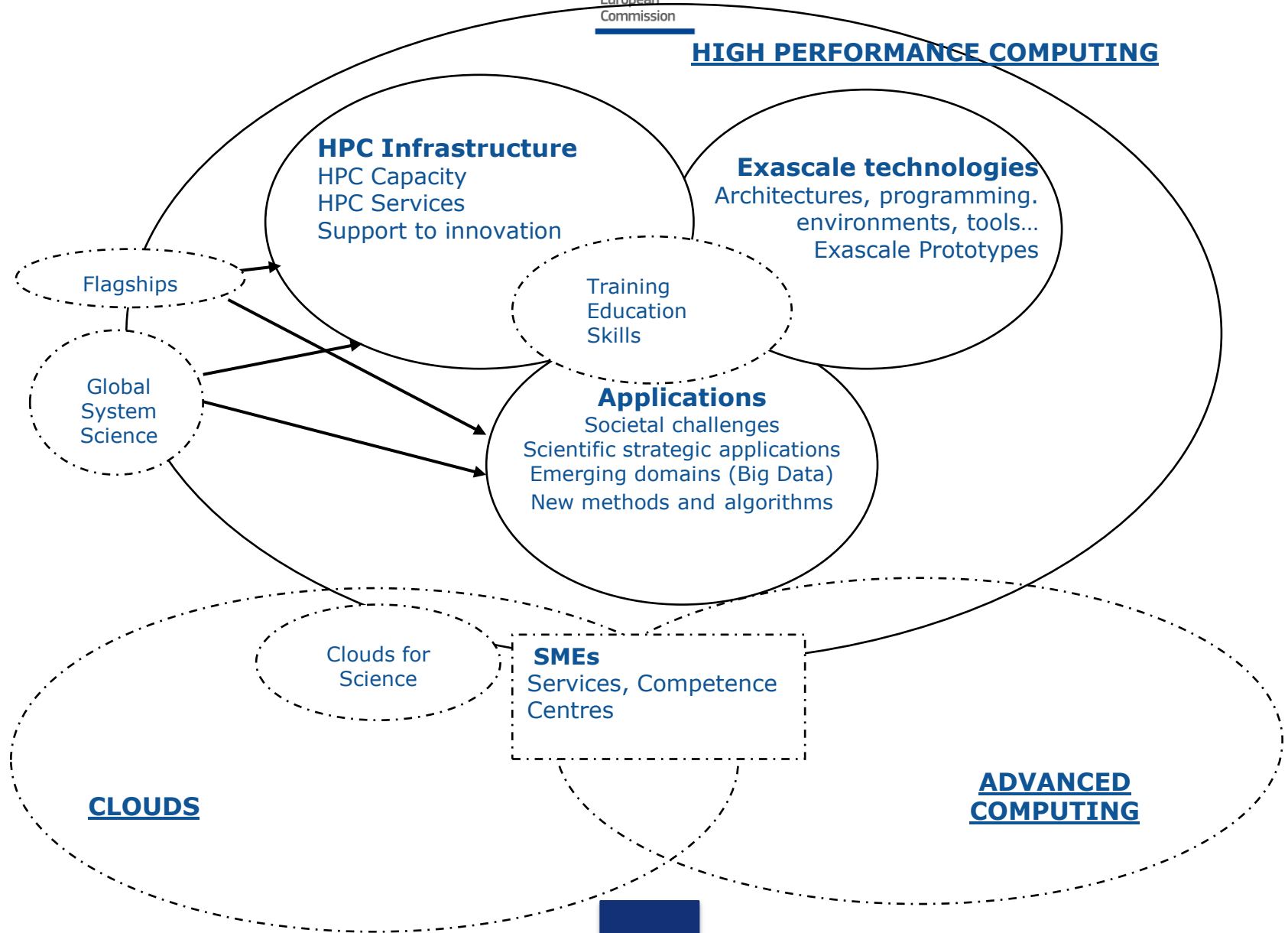


- HPC is an important asset for the EU's innovation capacity of strategic importance to the EU's industrial and scientific capabilities as well as its citizens
- There is a need for an EU-level policy in HPC addressing the entire HPC ecosystem:
 - deploying and maintaining a world-class and sustainable European HPC infrastructure (PRACE – very good achievement in FP7)
 - developing state-of-the-art HPC technologies, systems, software, applications and services in Europe
 - supporting and strengthening the role of academic HPC users
- All relevant actors, public and private, need to work in partnership
- MS, EC and industry to ensure appropriate investments in HPC
- MS and EC to exchange and to share priorities and plans for HPC



- **Vision:** to ensure European leadership in the supply and use of HPC systems and services by 2020 in a strategy combining:
 - (a) developing the next generation of HPC towards exascale;
 - (b) providing access to the best HPC infrastructure for both industry and academia;
 - (c) achieving excellence in HPC applications; (*Centres of Excellence in scientific/industrial HPC applications in (new) domains that are most important for Europe*)
- **linking demand and supply** – *in the spirit of Horizon 2020*
- A proposal for a contractual Public-Private Partnership (cPPP) has been submitted by the European Technology Platform ETP4HPC covering (a) and (c)

Overall strategy



(a) HPC towards exascale



Developing the next generation of HPC systems towards exascale

- engaging a European-wide effort to develop autonomous technology to build exascale systems within ~10 years.
- transition to exascale computing requires fundamental science and technology developments (window of opportunity)
- leading-edge HPC find their way to consumer products within ~5 years
- **Content:** R&D covering the whole spectrum from processors and system architectures to high-level software and tools and novel applications (encompassing system software, file systems, compilers, programming environments and tools, algorithms etc.)- delivering prototype systems according to specifications.

(a) HPC towards exascale



▪ **Current thinking for Horizon2020:**

- ETP4HPC (first version of the Strategic Research Agenda in February 2013)
- Leveraging European strengths for the development of hw/sw technology, prototype(s) and novel applications
- coordinated with work in LEIT/Advanced Computing, Micro/nano-electronics (ENIAC) and Photonics for basic component technology

▪ **Some important clarifications ...**

- **It's not just about exascale hw/systems**, but about the Computer Science needed to have a new generation of ICT (e.g. data-intensive and data-driven applications, low power, algorithmic, multi-many core programming...)
- Scientific applications have a lot to gain... (co-design can give an advantage to both technology providers and scientists)

(b) access to best HPC infrastructure for industry and academia



Provide a world-class HPC capability and services to increase competitiveness in science and industry (including SMEs)

- ever growing computational and simulation requirements to stay at the forefront of scientific breakthroughs and to boost innovation capabilities of industry
- access for the best researchers in Europe, independently of the location of either the infrastructure or the user
- **Content:**
 - support to actions of demonstrated *European added value*

(b) access to best HPC for industry and academia



- **Current thinking for Horizon2020:**
 - Build on PRACE achievements to advance further integration and sustainability
 - network of national/regional competence centres to promote HPC services and the dissemination of best practices specifically to SMEs (*specifically foreseen in the HPC Communication*)
- **Some important clarifications ...**
 - **Public procurement of commercial systems open to all suppliers**

(c) Achieving excellence in HPC applications



Development, optimization and provisioning of a whole range of strategic applications addressing societal, scientific and industrial challenges to fully exploit the computational infrastructure

- only very few applications using HPC really take advantage of current petaflop systems; new computational methods and algorithms must be developed, and (new) applications must be (re-)programmed in radically new ways
- codes are developed and maintained on "best effort" approach by individuals for specific communities (and often unclear license terms)
- computational expertise needs to be made more widely available
- **Content:**
 - establishment of an e-Infrastructure of Centres of Excellence (CoEs) in HPC applications; CoEs focus on scientific or industrial domains that are most important for Europe (multidisciplinary approach) and on co-design

(c) Achieving excellence in HPC applications



- **Current thinking for Horizon2020 :**
 - support to a limited number of Centres of Excellence
 - topics – broadly defined - to be chosen following an open call for proposals
 - CoEs to establish governance led by the application owners/users
 - coordinated with work in the "Societal Challenges" pillar for areas with HPC-intensive applications
- **Some important clarifications ...**
 - **CoEs will be user-driven**, reflecting the importance of users in the HPC ecosystem
 - “topics” may relate to scientific or industrial domains, societal challenges, or be “horizontal”

Interrelation between the three pillars



PRACE

Access to best HPC for industry and academia

- specifications of exascale prototypes for Tier-0
- technological options for future procurements

ETP4HPC

Development of Exascale technologies and applications

- CoEs may be associated to HPC Centres
- provision of HPC capabilities and expertise

- identify applications for co-design of exascale systems

Centres of Excellence

Excellence in HPC applications

Next steps



- On-going work in the preparation of the WP2014-2015 to implement the HPC strategy
- Presentation of the EC plans on the implementation of the HPC strategy - as requested in the Council Conclusions (*Nov-Dec*)
- Adoption of first Horizon 2020 Workprogramme adoption (*expected in December*)
- HPC cPPP proposal (in parallel):
 - Assessment of the cPPP proposals by external experts (early July)
 - Discussions with stakeholders and contractual arrangements finalisation (Sept-November)
 - Commission decision on the launch of cPPPs (November)
 - Signature of contractual arrangements (after November 2013)
- EC to report on progress in the HPC strategy to Council by 2015



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Connecting
the finest
minds

... Linking ideas at
the speed of light

Sharing the
best scientific
resources

... Harnessing
the unlimited power
of computers,
instruments and data

Building virtual
global research
communities

... Innovating the
scientific process



e-infrastructure

**Thanks for your
attention!**



géant | grids | scientific data | supercomputing



European Commission
Information Society and Media



US

- Out-compute = out-compete (leading consumer of HPC systems)
- Top computer (Nov 2012) Titan (Oak Ridge) + 4 systems in Top 10
- 126 m\$ for exascale in 2012 alone; Two 100+ PF systems by 2016

China

- Multi-billion investments development of indigenous HPC supply chain
- **Next #1 system (~50 pF Tianhe-2)** - Plans for two 100 PF systems by 2015

Japan

- 3rd Top HPC system, exascale plans expected by end of 2013

Russia

- Announcement of HPC programme by D. Medvedev (2009)

India

- \$1 billion programme for Indian machine announced March 2012

EU

- 3 systems in Top 10 (2 Germany, 1 Italy)
- PRACE: European high-end HPC Research Infrastructure
- EC Communication: A strategic plan towards European leadership (Feb 2012) – Horizon 2020 (2014-2020)



Some difficulties

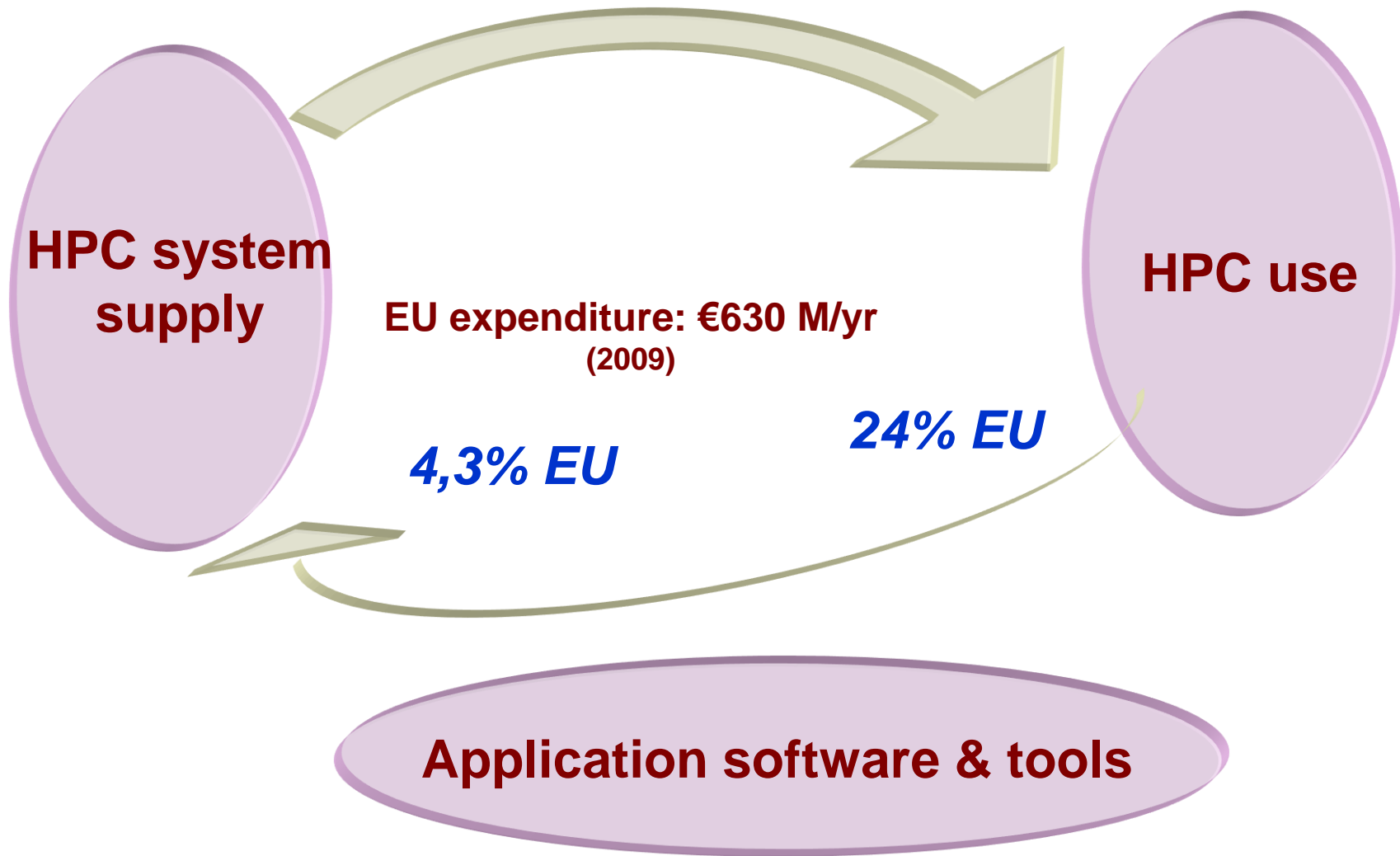
- Europe has lost 10% of its HPC capabilities from 2007 and 2009 while Asia and the US have increased their capabilities
- Europe (all 27 Member States combined) decreasing in terms of HPC capacities available wrt other countries
- Fragmentation of European HPC efforts across many countries (e.g. no single EU country has the capacity to develop exascale technologies)
- Some HPC production capabilities but high reliance on foreign components and (sub) systems
- European IPR benefitting others



European potential

- Applications and codes
- PRACE – world-class Tier 0 European HPC infrastructure
- Deep, diverse HPC user experience and leading capabilities
 - power-efficient microelectronics
 - processor designs
 - interconnects and mass storage systems
 - (sub) system integration software tools

HPC Ecosystem



- Governance at EU level (industry - science)
 - industry-led European Technology Platform for HPC (ETP4HPC)
 - PRACE
 - Centres of excellence – HPC software and services
- Double the investment on HPC (MS, EU, industry)
- Development of EU native capability via pre-commercial procurement (PCP) and pooling of resources

- **Develop further the HPC ecosystem**
 - PRACE services to industry
 - Centres of excellence for HPC applications
 - Hardware and software co-design centres
- **Industrial exploitation of HPC**
 - Competence centres for HPC services to industry/SMEs
 - Workforce well trained in HPC
 - Independent EU supply of HPC components, software and systems
- **Level-playing field for EU supply industry**
 - Raising inequalities in HPC market access (access of EU-based industry to third countries HPC procurements and R&D)
 - Possible additional exploitation obligations in Horizon 2020 for HPC