HPC/Exascale state of play

IESP 8th workshop

Kobe 11-13 April 2012

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e-infrastructures
European Commission - DG INFSO

- *Ongoing activities*
- *HPC Communication*
- *Horizon 2020*
- *WP2013 Exascale Objective*

Ongoing activities

- Communication to Parliament and Council on HPC
- Current efforts in HPC/Exascale
  - PRACE in European HPC infrastructures
  - TEXT, Mont-Blanc, CRESTA, DEEP projects
  - Other objectives related to HPC (FET, Advanced Computing…)
  - EESI vision and roadmap (Oct 2011)
  - Support to collaboration: EESI2 (IESP) *(in negotiation)*
  - ICT WP 2013 objective on Exascale computing
- Horizon 2020

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Communication on HPC

Europe's place in a global Race

COM(2012) 45 adopted on 15.2.2012

HPC: What for?

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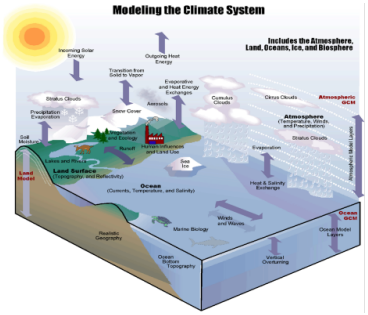
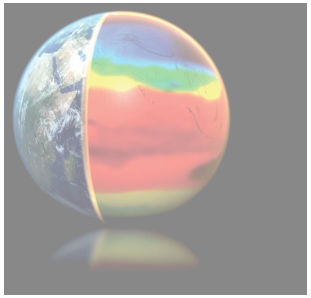
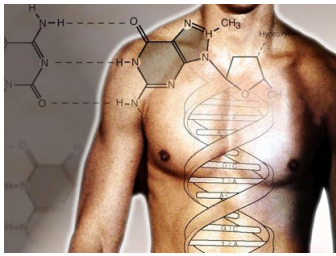
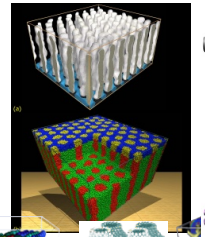


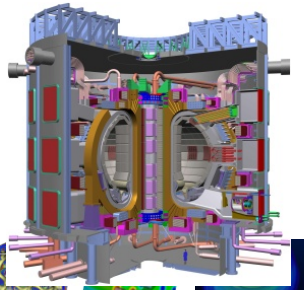


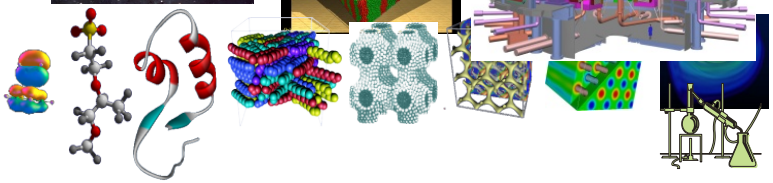
Weather, Climate & Earth Sciences



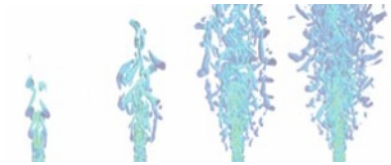
Life Sciences and Health

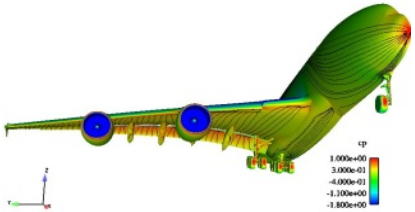


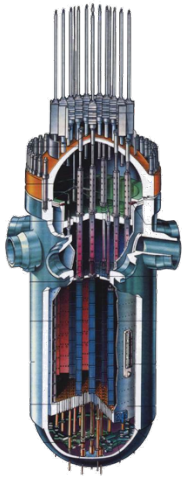


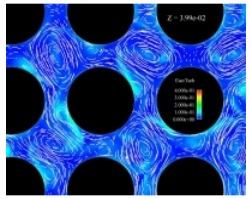


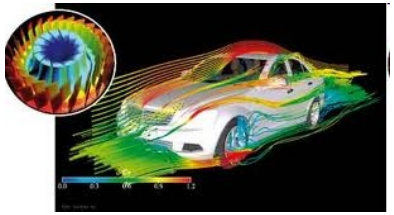
Fundamental sciences: Physics, Chemistry, Material Sciences, Astrophysics Applications.











Industrial & Engineering Application for transport and energy

International competition

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US

- Out-compute = out-compete
- 126 m$ for exascale in 2012 alone; 5-6 systems in Top 10

Japan

- Biggest HPC system world-wide (K-computer in Kobe)

Russia

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

China

- Multi-billion investments, 2nd and 4th biggest systems

India

- $1 billion programme for Indian machine announced March 2012

EU

- Dec 2009 Comp Council: "further development of computing infrastructures such as PRACE" and pool "investments in HPC… in order to strengthen the position of European industry and academia in the use, development and manufacturing of advanced computing…"
- 1-2 systems in Top 10

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Europe's investments

TABLE 2

GDP and Supercomputer Spending by Country (GDP: €000,000; Sales €000)

	GDP (1)	Average Supercomputer Sales Over Last Five Years (2)	Supercomputers as a Percentage of GDP	Compared to the U.S. = 100%
U.S.	10,949,000	979,126	0.0089%	100%
Europe	10,201,000	502,074	0.0049%	55%
Japan	3,874,000	212,070	0.0055%	62%
China	3,651,000	52,050	0.0014%	16%
Korea	614,070	51,569	0.0083%	93%
Hong Kong	160,200	11,886	0.0074%	83%
Singapore	140,500	12,525	0.0100%	112%

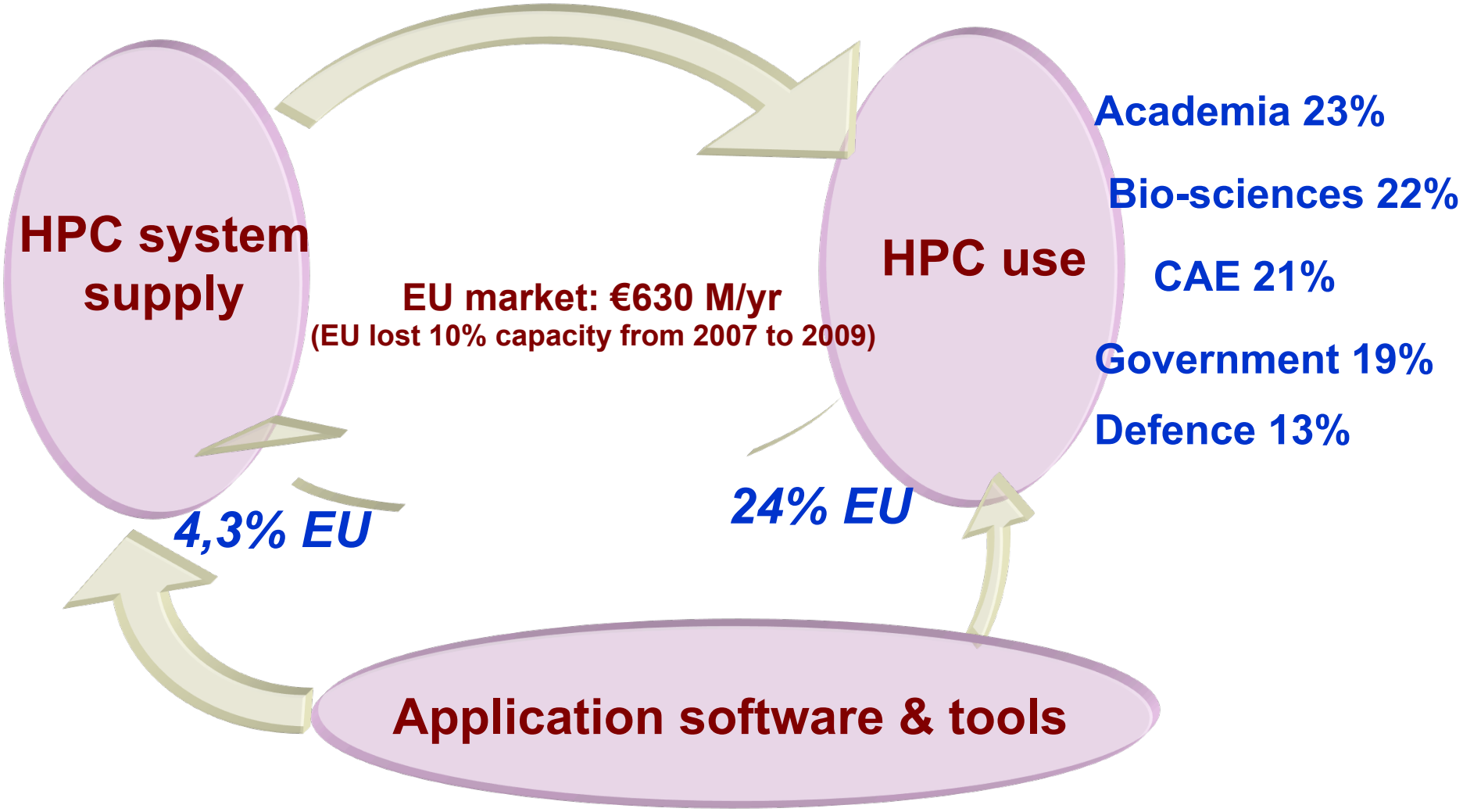
Only half of US GDP spending

Notes: (1) source: CIA World Factbook, 2009, (2) five-year average yearly spending. Supercomputing data includes server spending only

Source: IDC, 2010

HPC state of play

HPC Ecosystem



Towards a renewal of HPC in Europe

Europe can do it

- EU has expertise across the full supply chain
- The exa-scale challenge provides a window of opportunity *now*
- A joint effort is needed – and PRACE shows the way

Europe should run the HPC race - Objectives

- Provide a world-class HPC infrastructure & service
- Ensure independent access to HPC
- Establish pan-EU governance
- Ensure EU's position a global actor

Key policy actions

- Governance at EU level (industry - science)
  - industry-led European Technology Platform for HPC
  - PRACE and centres of excellence – HPC software and services
- Must double spending (MS, EU, industry) to 1.2b€/year
- Development of EU native capability via pre-commercial procurement (PCP) and pooling of resources
  - ~10% /year of HPC acquisition budget
  - Joint PCP actions involving several Member States
  - PCP by large users or Member States individually *(under certain conditions)*

Key policy actions 2/2

- Develop further the HPC ecosystem
  - PRACE governance and 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
  - Strengthening efforts to ensure 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)
  - Additional exploitation obligations in Horizon 2020 for HPC

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The EU Framework Programme for Research and Innovation

2014-2020

HORIZON 2020

www.ec.europa.eu/research/horizon2020

Research and Innovation

What is Horizon 2020

- **Commission proposal for a 80 billion euro research and innovation funding programme (2014-2020)**
- **A core part of Europe 2020, Innovation Union & European Research Area:**
  - **Responding to the economic crisis** to invest in future jobs and growth
  - **Addressing people's concerns** about their livelihoods, safety and environment
  - **Strengthening the EU's global position** in research, innovation and technology

What's new

- **A single programme** bringing together three separate programmes/initiatives*
- **Coupling research to innovation** – from research to retail, all forms of innovation
- **Focus on societal challenges** facing EU society, e.g. health, clean energy and transport
- **Simplified access**, for all companies, universities, institutes in all EU countries and beyond.

*The 7th Research Framework Programme (FP7), innovation aspects of Competitiveness and Innovation Framework Programme (CIP), EU contribution to the European Institute of Innovation and Technology (EIT)

Three priorities:

1. Excellent science
2. Industrial leadership
3. Societal challenges

Priority 1. Excellent science

Why:

- World class science is the foundation of tomorrow's technologies, jobs and wellbeing
- Europe needs to develop, attract and retain research talent
- Researchers need access to the best infrastructures

Proposed funding (million euro, 2014-2020)

European Research Council Frontier research by the best individual teams	*13 268*
Future and Emerging Technologies Collaborative research to open new fields of innovation	*3 100*
Marie Curie actions Opportunities for training and career development	*5 572*
Research infrastructures *(including e-infrastructure)* Ensuring access to world-class facilities	*2 478*

Priority 2. Industrial leadership

Why:

- Strategic investments in key technologies (e.g. advanced manufacturing, micro-electronics) underpin innovation across existing and emerging sectors
- Europe needs to attract more private investment in research and innovation
- Europe needs more innovative SMEs to create growth and jobs

Proposed funding (million euro, 2014-20)

Leadership in enabling and industrial technologies *(*ICT, nanotechnologies, materials, biotechnology, manufacturing, space)	*13 781*
Access to risk finance Leveraging private finance and venture capital for research and innovation	*3 538*
Innovation in SMEs Fostering all forms of innovation in all types of SMEs	*619 complemented by 6 829 (expected 15% of societal challenges + LEIT) and 'Access to risk finance' with strong SME focus*

Priority 3. Societal challenges

Why:

- Concerns of citizens and society/EU policy objectives (climate, environment, energy, transport etc) cannot be achieved without innovation
- Breakthrough solutions come from multi-disciplinary collaborations, including social sciences & humanities
- Promising solutions need to be tested, demonstrated and scaled up

Proposed funding (million euro, 2014-2020)

Health, demographic change and wellbeing	*8 033*
Food security, sustainable agriculture, marine and maritime research & the bioeconomy	*4 152*
*Secure, clean and efficient energy**	*5 782*
Smart, green and integrated transport	*6 802*
Climate action, resource efficiency and raw materials	*3 160*
Inclusive, innovative and secure societies	*3 819*

Additional €1 788m for nuclear safety and security from the Euratom Treaty activities (2014-2018). Does not include ITER.

Simplification: a few examples

- **Single set of** simpler and more coherent **participation rules**
- Simpler **evaluation criteria**
- Simplification of **funding rates** and **overhead rates**
- New forms of funding aimed at innovation e.g. PCP, prices, loans…
- Fewer, better targeted **controls and audits**
- Reduction of average **time to grant**
- Improved rules on intellectual property
  - **Tailor-made IPR provisions for new forms of funding**
  - **A new emphasis on open access to research publications**

International cooperation

- **International cooperation is crucial** to address many Horizon 2020 objectives.

- **Principle of general openness**: the programme will remain to be the most open funding programme in the world.

- International participation: facilitated but **better protecting EU interests**

- Horizon 2020 shall be open to the **association** of: acceding countries, candidate countries and potential candidates and selected third countries that fulfil the relevant criteria (capacity, track record, close economic and geographical links to the Union, etc.).

- Targeted actions to be implemented taking a **strategic approach to international cooperation** (dedicated measures in the 'Inclusive, innovative and secure societies' challenge).

Next steps

Ongoing:	Parliament and Council negotiations on the basis of the Commission proposals
Ongoing:	Parliament and Council negotiations on EU budget 2014-2020 (including overall budget for Horizon 2020)
Mid 2012:	Final calls under 7th Framework Programme for research to bridge gap towards Horizon 2020
Mid 2013:	Adoption of legislative acts by Parliament and Council on Horizon 2020
1/1/2014:	**Horizon 2020 starts, launch of first calls**

WP2013 Exascale Objective (Draft)

- Building on the work from the previous Call on exascale
- Two main objectives:

a) Support to the **development** of a very small number of extreme performance **computing platforms** (hw and sw), validated by appropriate application drivers

- Implemented through Integrated Projects (IPs)

b) Innovative solutions for exascale "**technology gaps**"

- Implemented through Specific Targeted Research Projects (STREPs)

Indicative budget : EUR 22 million

of which a minimum of 70% allocated to IPs and 25% to STREPs

a) Support to the **development** of **computing platforms**

- Bringing supercomputing centres, technology and system suppliers, and industrial or academic expertise in grand-challenge application codes
- Synergies with on-going EC-supported efforts in exascale platforms and PRACE

b) To develop innovative solutions and disruptive approaches for key exascale computing challenges for which the evolution of existing technologies is insufficient

(i) new system libraries in the area of I/O, communications and scheduling

(ii) new middleware, programming models and modeling architectures to address the increasing heterogeneity of systems;

(iii) improved modularity, parallelisation and scalability of applications.

Generic topics targeting concrete solutions for important exascale computing challenges can also be covered

Impact

- Clear and highly ambitious scalability targets (e.g. ~ 500 petaflop/s in 2016 - potential for exascale by 2020)
- Strengthened European industry and research in the supply, operation and use of HPC systems, achieving world-leadership; Development of autonomous technology (from processor architectures to applications) for the next generation of extreme performance computing
- Improved European competitiveness in application areas most important for Europe
- European research at the forefront of the development of extreme-performance system software and tools
- Increased return on investments made in PRACE Tier-0 supercomputers and in on-going EC-supported efforts in exascale platforms

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Thank you for your attention!