FP7 Support Action - European Exascale Software Initiative

DG Information Society and the unit e-Infrastructures

European Exascale Software Initiative
From EESI to EESI2

IESP workshop

Kobe – Avril 2012

Jean-Yves Berthou & **Philippe Ricoux**

ANR **Total**

Agenda

- **EESI objectives and agenda**
- EESI vision and recommendations
- From EESI to EESI2

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Characteristics of the EESI project

Coordination and support action – FP7/Infrastructures

www.eesi-project.eu

Coordinator: EDF R&D, Jean-Yves Berthou

Starting date : 1st of June 2010, for 18 months

Requested EC contribution : 640 000 €

Consortium : 8 contractual partners:

17 associated participants

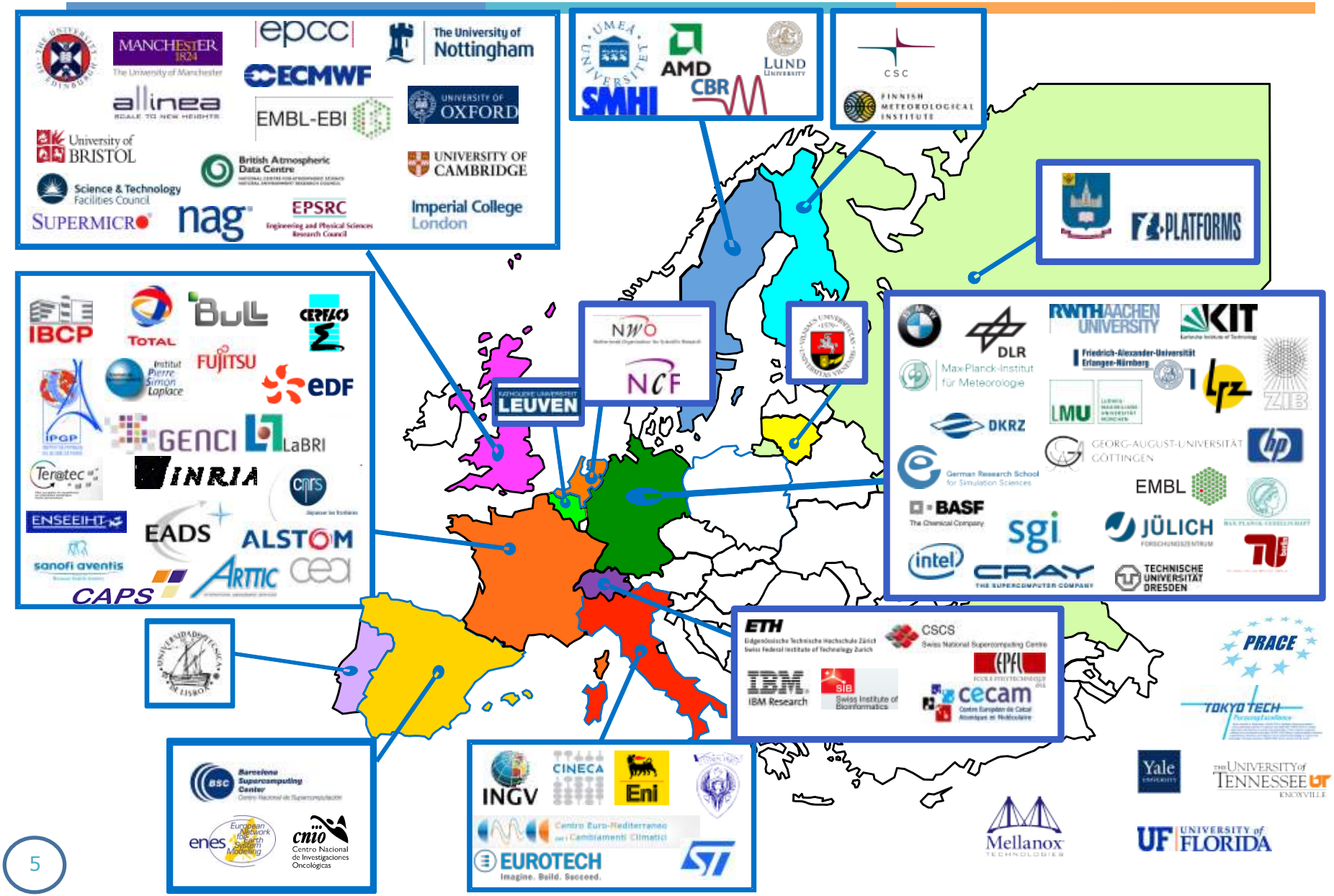
About 120 contributing participants

EESI main goals

Build a European **vision and roadmap** to address the challenge of performing scientific computing on the new generation of computers which will provide **multi-Petaflop** performances in 2010 and **Exaflop** performances in 2020

- investigate how Europe is located, its strengths and weaknesses, in the overall international HPC landscape and competition
- identify priority actions
- identify the sources of competitiveness for Europe induced by the development of Peta/Exascale solutions and usages
- Are European stakeholders willing/able to build an exa-scale prototype/by when?
- investigate and propose programs in education and training for the next generation of computational scientists
- identify and stimulate opportunities of worldwide collaborations

EESI: 150 participants, 100 entities



European Exascale Software Initiative AGENDA

NWO Netherlands Organisation for Scientific Research

JÜLICH FORSCHUNGSZENTRUM

Enabling technologies for Exaflop computing

- Hardware roadmap, links with vendors
- Software eco-systems
- Numerical libraries, solvers and algorithms
- Scientific software engineering

Tera@tec

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

Initial International workshop

Internal workshop: presentation of each working group results and roadmaps

Final conference : public presentation of project result

EDF

GENCI

Application Grand Challenges

- Industrial and Engineering Applications (Transport, Energy)
- Weather, Climatology and Earth Sciences
- Fundamental Sciences (Chemistry, Physics)
- Life science, Health, BPM

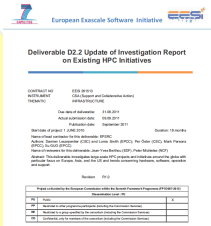
Constitution of WG, Setup of guidelines, organisation modes

Initial cartography of existing HPC projects, initiatives in Europe, US and ASIA

Synthesis of all contributions and production of a set of recommendations

Presentation of EESI results to the EC

Updated cartography of existing HPC projects, initiatives in Europe, US and ASIA



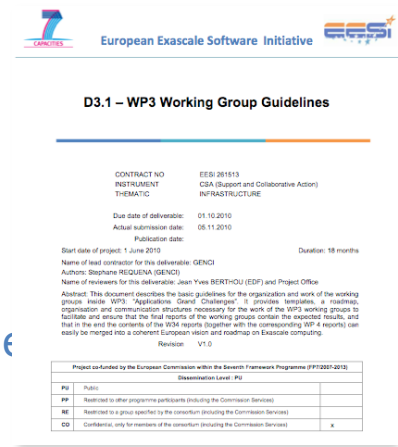
CSC epcc

T0	T0+5	T0+12	T0+13	T0+16	T0+17	T0+18
5 months	8 months	1 month	3 months	1 month	1 month	
June 1, 2010	October 2010	June 2011		November 2011		

Common Guidelines for Group Activity

- Common templates in order to
  - Facilitate exchanges between WP3 and WP4
  - Identify and classify key issues (**What-Who-Where-When-How much**)
    - Description of the scientific and technical perimeter of the WG (*)
    - Social benefits, societal, environmental and economical impact (*)
    - Scientific and technical hurdles
    - Address cross cutting issues : Resilience, Power Mngt, Programmability, Performance and Reproducibility of the results, …
    - European strengths and weaknesses in the worldwide competition
    - Sources of competitiveness for Europe
    - Needs of education and training
    - Potential collaborations outside Europe
    - Existing funded projects and funding agencies
    - Timeline, needs of HR, provisional costs, ...
    - Building an (or several) exa-scale prototype in Europe? By whe
  - Facilitate elaboration of intermediate and final reports

(*) for Application WGs, description in terms of Application Grand Challenges


European Exascale Software Initiative

D3.1 – WP3 Working Group Guidelines

CONTRACT NO EESI 261513
INSTRUMENT CSA (Support and Collaborative Action)
THEMATIC INFRASTRUCTURE

Due date of deliverable: 01.10.2010
Actual submission date: 05.11.2010
Publication date:

Start date of project: 1 June 2010 Duration: 18 months

Name of lead contractor for this deliverable: GENCI
Authors: Stephane REQUENA (GENCI)
Name of reviewers for this deliverable: Jean Yves BERTHOU (EDF) and Project Office

Abstract: This document describes the basic guidelines for the organization and work of the working groups inside WP3 "Applications Grand Challenges". It provides templates, a roadmap, organisation and communication structures necessary for the work of the WP3 working groups to facilitate and ensure that the final reports of the working groups contain the expected results, and that in the end the contents of the WG4 reports (together with the corresponding WP 4 reports) can easily be merged into a coherent European vision and roadmap on Exascale computing.

Revision: V1.0

Project co-funded by the European Commission within the Seventh Framework Programme (FP7/2007-2013)

Dissemination Level : PU		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	x

EESI reports, eesi-project.eu

JÜLICH FORSCHUNGSZENTRUM

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GENCI

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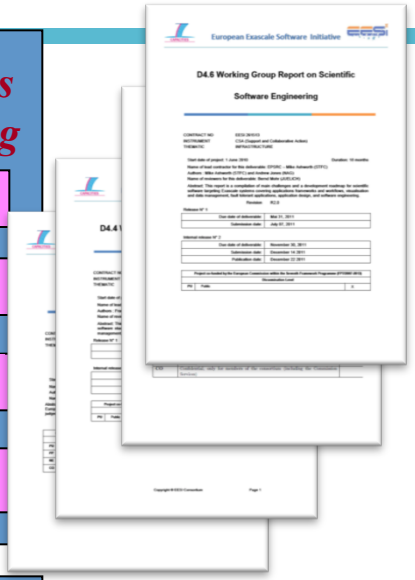

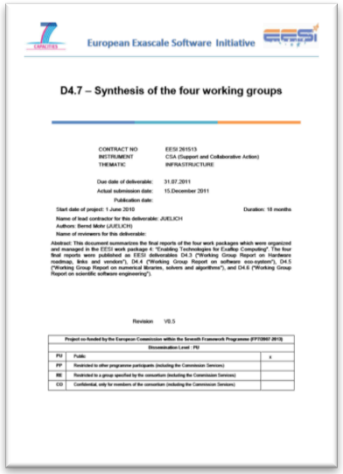

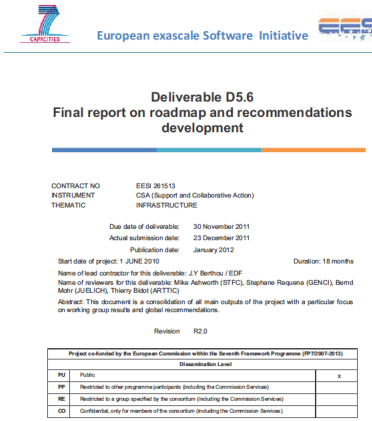

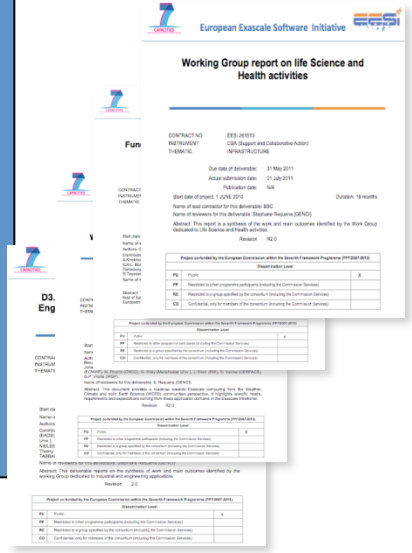

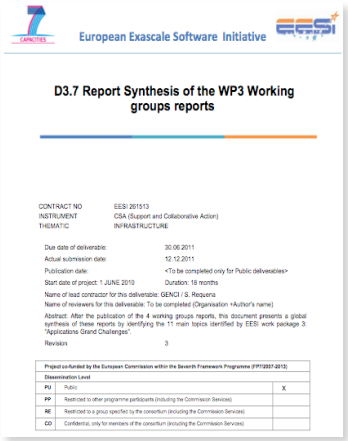

Agenda

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- **EESI vision and recommendations**
- From EESI to EESI2

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EESI Conclusions

- Europe need for a **sustainable, long term and coordinated** effort
- Europe is still well positioned to be part of the few player worldwide deploying and exploiting Exascale technology but action is needed now
- A 2,5 to 3,5 billions euros total budget over 10 years, supported by EC, National European funding agencies, industry, … **a several decades** engagement
- Scientific Computing at Exascale, from a computing and data intensive point of view are **strategic** for maintaining and developing both **European Scientific Excellence and Industry Competitiveness**
- **International** collaboration is required
- Beside legacy codes, Europe should encourage the development of **Open Source solutions** to foster international collaborations and the emergence of international *de facto* standards, enabling commercial exploitation

EESI as a support action

- EESI has created a momentum, a dynamic, between HPC end users from academia and industry, computer scientists and techno/ service providers
- 150 experts have shared common issues and built a vision, produced recommendations
- … and it was fun!

WORKSHOP

EESI-Internal Workshop
29-30 June 2011, Domaine du Tremblay, France

The workshop took place near Paris in Domaine de Tremblay and was associated to the Teratec Forum organised at l'Ecole Polytechnique on 28-29 June 2011.

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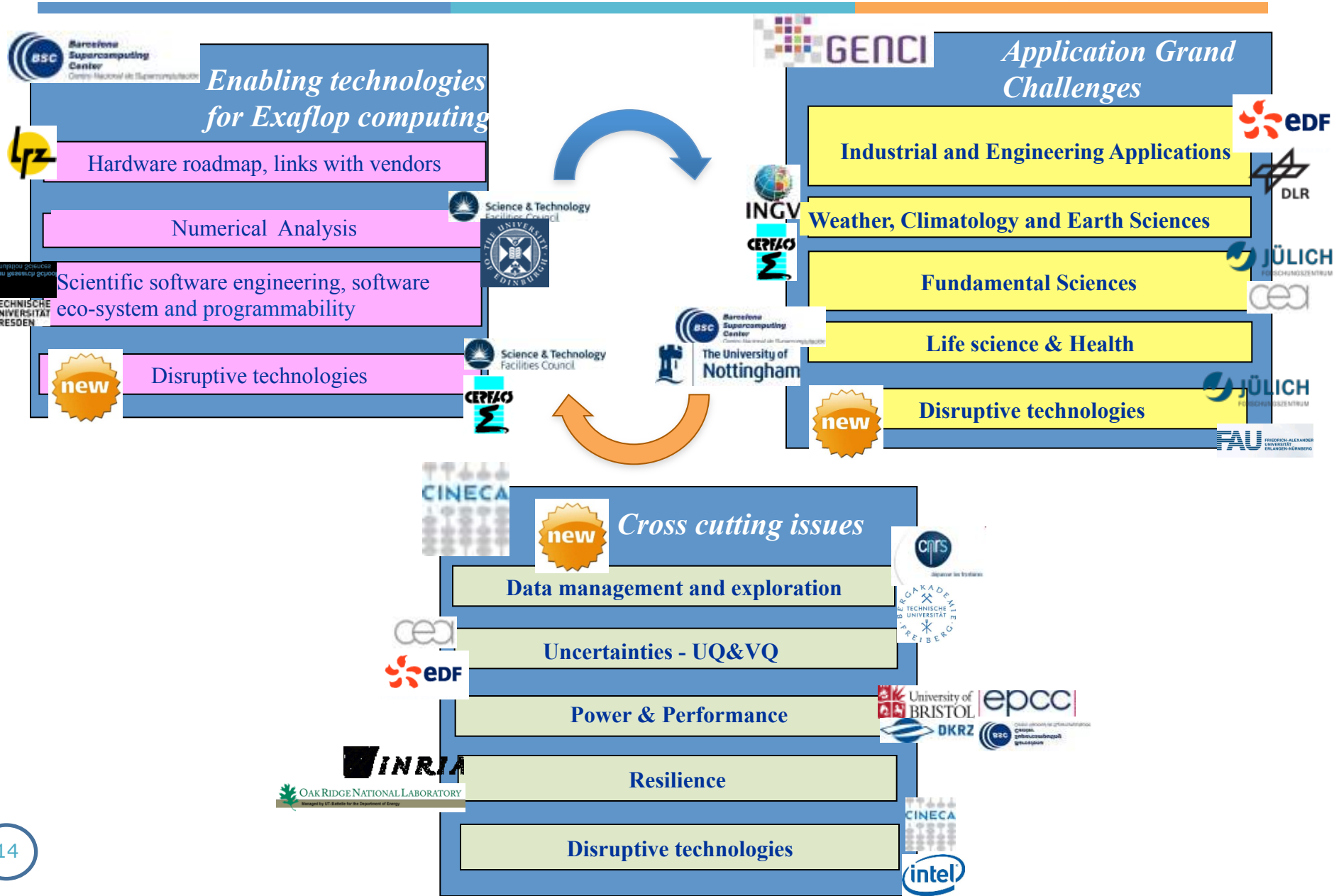
From EESI to EESI2

EESI roadmaps, vision and recommendations need to be monitored, updated, on a dynamical way ... AND new issues to be addressed:

- **Extend, refine, and update** Exascale cartography (**directly in the dedicated WG for better analysis of each WG**) and **roadmaps** from HPC community, on software, tools, methods, R&D and industrial applications, **...** *With a Gap Analysis.*
  - Including WG on ***disruptive technologies***
- **Address "Cross Cutting issues":** Data management and exploration, Uncertainties - UQ&VQ, Power & Performance, Resilience, Disruptive technologies
- **Investigation on** funding scheme and opportunities, education, co-design centres, international coordination
- Operational **Software maturity** level methodology, evaluation

EESI2 Working Groups



Agenda

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- **EESI2 workplan and outputs**

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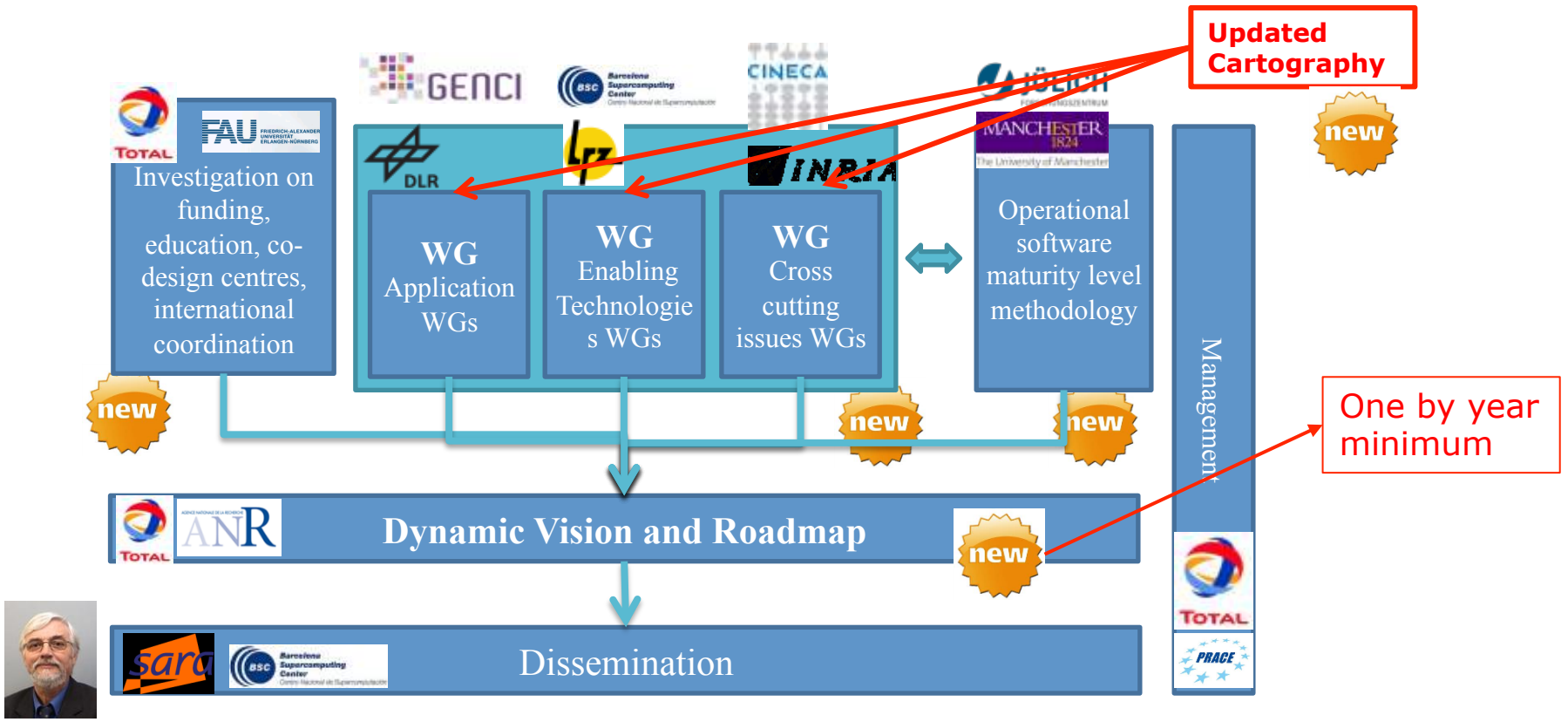
EESI2 general picture



Contractual partners: TOTAL (coordinator), PRACE AISBL (acting for third parties LZR, GENCI, BSC, CINECA, EPCC, SARA…)

Contributing partners, involved in the management of EESI2 tasks but not associated to PRACE AISBL: INTEL, DLR, EDF, ANR, CERFACS, …

Supporting partners : more than 50 letters of Support

EESI2 proposal submitted in November to INFRA-2012-3.3: *Coordination actions, conferences and studies supporting policy development, including international cooperation, for e-Infrastructures*.

Requested funding: 1.5 M€ → 1.36 M€ accepted by EC

Duration: 30 months, kick off planned in September/October 2012, end în April 2015)

EESI2 Main Focus

Main focus of EESI2 are the key issues identified by EESI1 experts' panel :

Cross Cutting issues

- Power management: A power supply reduction (a factor of 50 must be achieved)
- Performance optimization, programmability, load balancing
- Fault tolerance, resilience: developing software or API (fault tolerance independently of users)
- Reproducibility, ***Uncertainties***: many phenomena studied can exhibit chaotic behaviours.
- ***Data management***: Big data, Data placement and memory access , I/O parallel, Storage ...

Software technologies issues for strong and weak scalability:

- Numerical analysis: new efficient solvers/algebra libraries, automatic massively parallel mesh-generation tool, meshless methods and particle simulation,
- Scientific software engineering: platform, standard coupling interfaces and software tools mixing legacy and new generation codes for Multi-physics, multi scale simulation,
- Coupling between stochastic and deterministic methods, UQ approach

Based on the recognized EESI1 network expertises, the **EESI2 objectives** will be to go a step forward

- in the **Exascale dynamic vision and roadmap, recommendations** for Europe
- in the proposition of **benchmarks** and **methodologies** to validate the incremental progress and **breakthrough,**
- in the **gap analysis** to reach the targeted objectives, to periodically estimate maturity, innovation

EESI2 WP objectives (1/2)

Education, strategic scientific coordination:

- Investigate and describe state-of-the-art, trends, and future needs in HPC training and education.
- Establish and maintain a global network of expertise and funding bodies in the area of Exascale computing.
- Investigate and describe the establishment and landscape of co-design centers in the area of HPC and specifically Exascale computing.
- Monitor functioning of international existing centers.

Application Work Groups:

- Investigating on key application breakthroughs, quantifying their societal, environmental and economical impacts and performing a gap analysis between current situation and Exascale targets and integrating international cartography
- Evaluating the R&D activity performed by scientific and industrial communities, especially in applications redesigning and development of multiscale/multiphysics frameworks;
- Assessing the feasibility of setting up Applications Co Design Centers in Europe;
- Fostering the structuration of scientific communities at the European level.

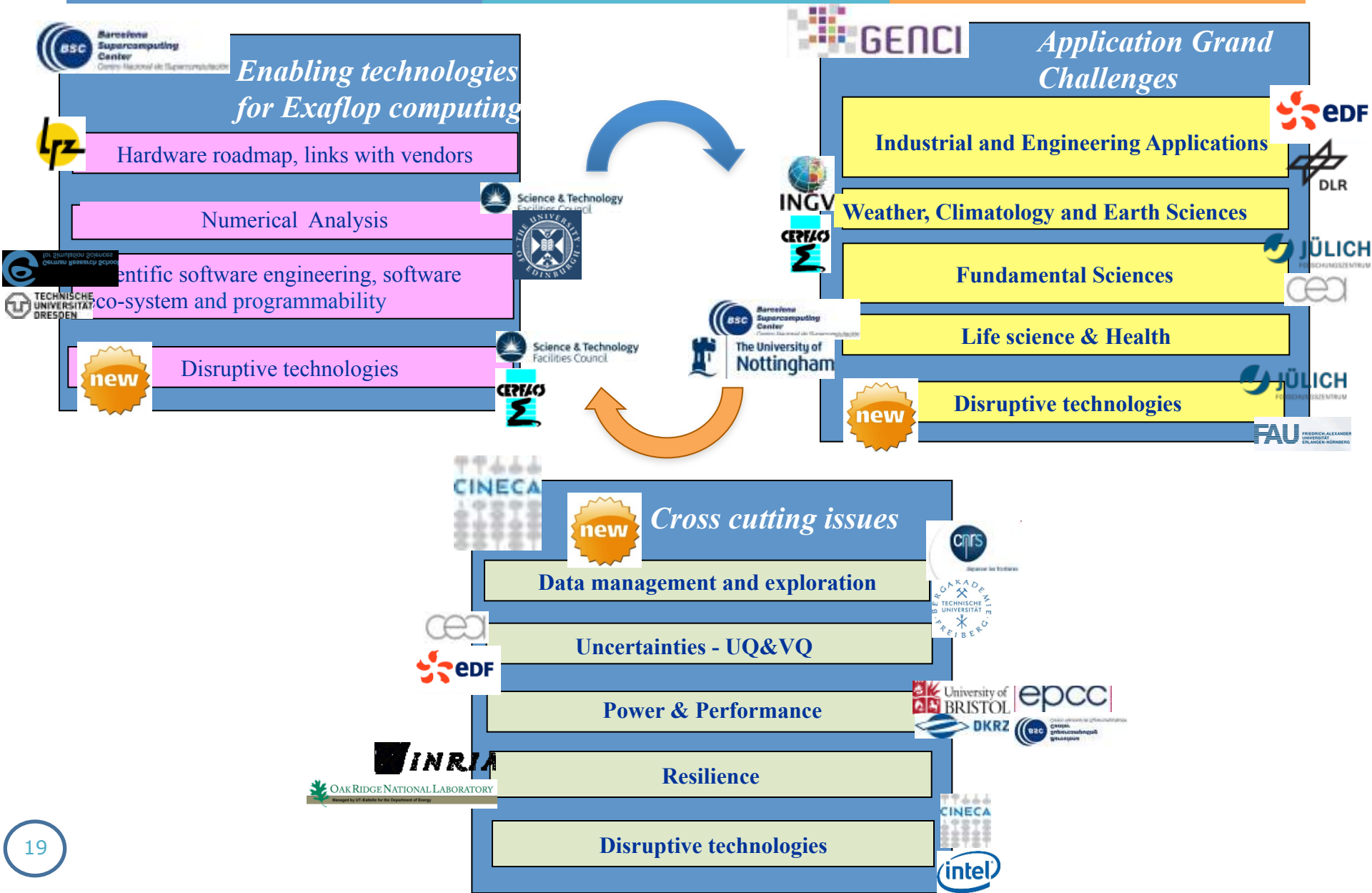
Enabling technologies Work Groups:

- Numerical analysis, with aspects such as dense linear algebra, graph and hypergraph partitioning, sparse direct methods, Iterative methods
- Disruptive technologies and Integration of international cartography

Cross cutting issues Work Groups:

- Define Data management and exploration specific issues roadmap
- Define actions and follow up of projects on uncertainties
- Identify power management impact on the system design and on programmability
- Define concrete actions to achieve the best coupling Architecture-Algorithm-Application
- Define concrete objectives in terms of fault tolerance at system and application level
- Survey new hardware and software technologies in order to monitor technologies that could influence the design of Exascale systems

EESI2 Working Groups



EESI2 WP objectives (2/2)

Operational software maturity level methodology, WP6 :

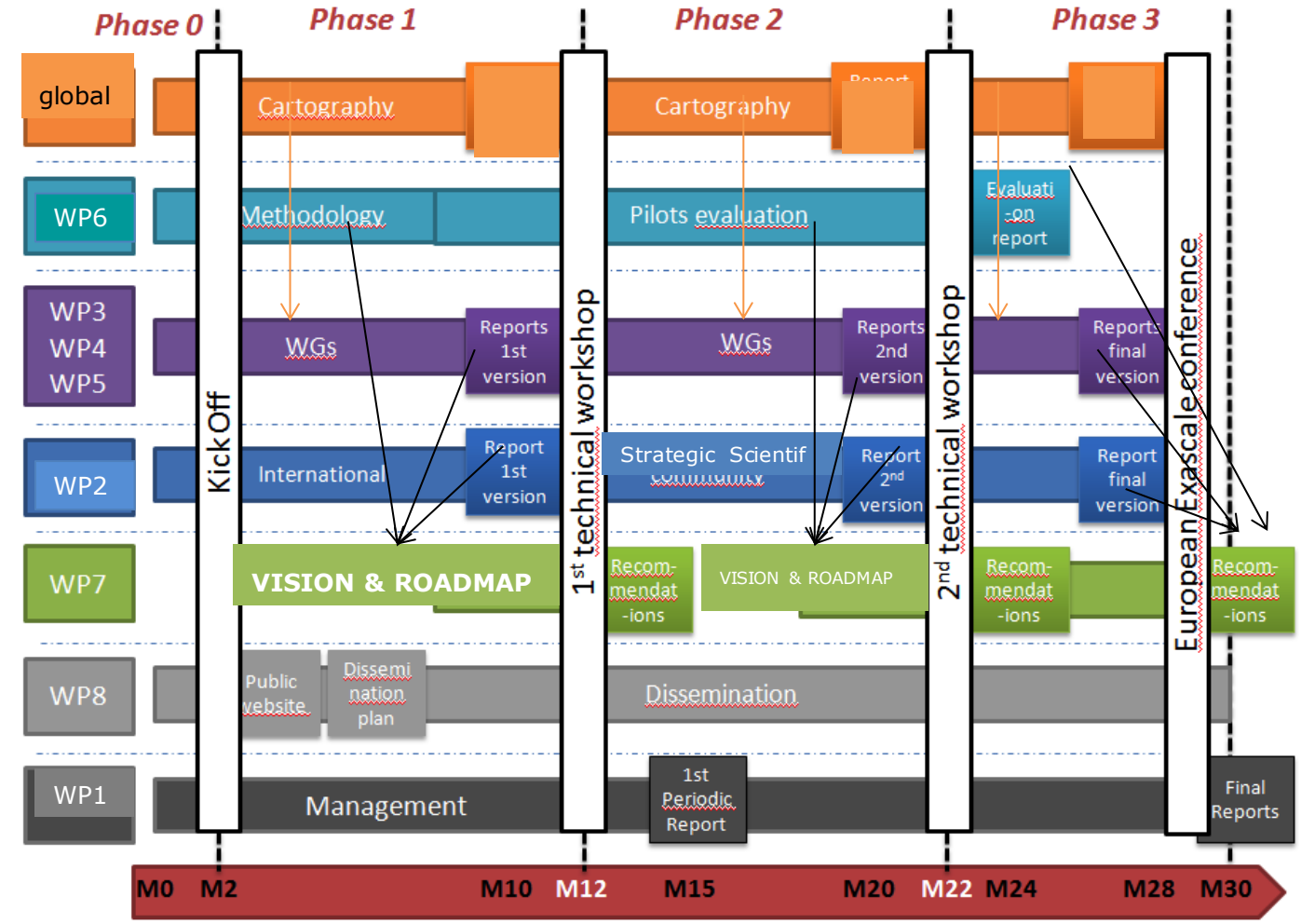
- Develop and document a methodology for estimating the level of maturity of Exascale software components
- Identify 3 software stack components from existing and near future European Exascale projects and apply the defined methodology

ALL previous WP will converge in the key WP of EESI2

- **EESI2 vision and roadmap, WP7 :** periodic recommendations synchronized with EC R&D projects decision agenda (M14 and M24).

- **Dissemination, WP8**

EESI2 Work Plan



EESI2 Main Agenda

EESI2 Work Breakdown Structure	2012							2013												2014											Start Month	End Month
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24	M25	M26	M27	M28	M29	M30		
WP1 Management																															**M1**	**M30**
T1.1 Project global management																															M1	M30
T1.2 Project administrative management																															M1	M30
WP2 Education, Strategic Scientific coordination																															**M1**	**M30**
T2.1 Investigation on Funding agencies																															M1	M30
T2.2 Investigation of existing education courses and training needs																															M1	M30
T2.3 Investigation on co-design centers																															M1	M30
T2.4 Towards an International collaboration																															M1	M30
WP3 Application Work Groups																															**M1**	**M30**
T3.1. WG3.1 Industrial and engineering applications																															M1	M28
T3.2 WG3.2 Weather, Climatology and earth sciences																															M1	M28
T3.3 WG3.3 Fundamental sciences																															M1	M28
T3.4 WG3.4 Life science & Health																															M1	M28
T3.5 WG3.5 Disruptive technologies																															M1	M28
T3.6 Coordination International Cartography																															M1	M30
WP4 Enabling technologies Work Groups																															**M1**	**M30**
T4.1 WG4.1 Numerical analysis																															M1	M28
T4.2 WG4.2 Scientific software engineering, software eco-system																															M1	M28
T4.3 WG4.3 Disruptive technologies																															M1	M28
T4.4 Coordination International Cartography																															M1	M30
WP5 Cross cutting issues																															**M1**	**M30**
T5.1 WG5.1 Data management and exploration																															M1	M28
T5.2 WG5.2 Uncertainties (UQ/V&V)																															M1	M28
T5.3 WG5.3 Power & Performance																															M1	M28
T5.4 WG5.4 Resilience																															M1	M28
T5.5 Disruptive technologies																															M1	M28
T5.6 Coordination International Cartography																															M1	M30
WP6 Operational maturity level methodology of the software produc																															**M1**	**M24**
T6.1: Evaluation methodology set up																															M1	M6
T6.2: Perform evaluation on 3 components																															M7	M24
WP7 EESI vision and Roadmaps																															**M10**	**M30**
T7.1 Overall synthesis of EESI2 activities. Elaborate European visions, build																															M6	M30
T7.2 Provide recommendations to EC to improve its strength in Exascale																															M1	M30
WP8 Dissemination																															**M1**	**M30**
T8.1: Organization of technical workshops																															M10	M26
T8.2 Organisation of European Exascale conference																															M24	M30
T8.3 EESI in Europe and world-wide																															M1	M30
T8.4 Information Dissemination																															M1	M30

EESI2 Efforts

LIST OF WORK PACKAGES (WP)						
WP Number [53]	WP Title	Type of activity [54]	Lead beneficiary number [55]	Person-months [56]	Start month [57]	End month [58]
WP 1	Management	MGT	1	2.50	1	30
WP 2	Education, strategic scientific coordination	SUPP	2	8.80	1	30
WP 3	Application Work Groups	SUPP	2	9.80	1	28
WP 4	Enabling technologies Work Groups	SUPP	2	7.60	1	28
WP 5	Cross cutting issues Work Groups	SUPP	2	10.20	1	28
WP 6	Operational software maturity level methodology	SUPP	2	4.40	1	24
WP 7	EESI2 vision and roadmap	SUPP	1	4.40	1	30
WP 8	Dissemination	OTHER	2	6.90	1	30
			Total	54.60		

1 TOTAL
2 PRACE ass.

+ a large amount (200 k€) for specific expertise from non classic partners : individual expertise on a specific item
(within a network of more than 100 Experts already involved in EESI1)

EESI2 Outputs (1/2)

Based on detailed cartographies and roadmaps shared by the EU HPC community on key issues challenges:

- A **detailed evaluation** of how Europe is located, its strengths and weaknesses, in the overall international HPC landscape and competition, including: Identification of main HPC European actors and users, Identification of main European and international HPC existing or planned initiatives and strategies, Links with funding agencies, Links with vendors, ISV and service providers, for leading to

  Periodic Exascale VISION and ROADMAP, RECOMMENDATIONS

- A cartography of existing **education** courses and **training** needs and **proposition for new programs adapted to Exascale**

- **A complete overview of existing worldwide Co-design centres (New from EESI1) and recommendations for Europe on such structures**

- A **methodology to evaluate the maturity of results of projects that implement software components (New from EESI1)**

EESI2 Outputs (2/2)

- Detailed periodic roadmaps on the key challenges identified in EESI1, including:
  - **Gap analysis, Breakthroughs, (New from EESI1)** , Identification of priority actions, Identification of the main sources of competitiveness for Europe
- Dissemination actions, including:
  - Meeting with Funding agencies, A public web site, 2 large public international conference
- Strengthening of worldwide collaborations, including:
  - Representing Europe in the international Exascale community
  - Contribution to the International dialogs between US, Europe and Asia including EU organisations, the European commission and IESP.
  - **Contributing to build an international Exascale software Organization**

EESI2 FOCUS

- **VISION AND ROADMAP for Europe, funding agencies**
  - **One by year update**

- **Contributing to build an international Exascale software Organization**

- **As EESI1,**

  Coordination and support action – FP7/Infrastructures

  www.eesi-project.eu


Thank you

EESI2 WP objectives (1/2)

- **Operational software maturity level methodology, WP6 :** One recommendation of EESI1 is the establishment of a European Exascale Software Centre to coordinate research, development, testing, and validation of HPC Exascale software ecosystem components developed in National and EU projects. To investigate the feasibility and to prepare for the operation of such a centre, WP6 objective is to:
  - Develop and document a methodology for estimating the level of maturity of Exascale software components
  - Identify 3 software stack components from existing and near future European Exascale projects and apply the defined methodology

ALL previous WP will converge in the key WP of EESI2

EESI2 WP objectives (2/2)

- **EESI2 vision and roadmap, WP7 :** One EESI2 main objective is to provide periodic expertises and recommendations to the national and european funding agencies and R&D stakeholders .

  Overall synthesis will be provided on all WP activities with a particular focus on software key issues improvement, cross cutting issues advances, update of roadmap, and gap analysis.

  These periodic recommendations should be synchronized as much as possible with EC R&D projects decision agenda. In a first approach, M14 and M24 are the milestones of these syntheses.

- **Dissemination, WP8** will disseminate all inputs of the project to the community. It aims at:
  - Design and execute a communication strategy;
  - Organising two internal workshops;
  - Organising a European Exascale conference.