



Network for Sustainable Ultrascale Computing (NESUS)

www.nesus.eu

Objectives of the Action

□ Aim of the Action:

- ❖ To coordinate European efforts for proposing realistic solutions addressing major challenges of **building sustainable Ultrascale Computing Systems (UCS)** with a collaborative approach.

□ Objectives:

1. To increase EU research in the field of sustainable UCS by fostering original high quality initiatives and to create a critical mass of researchers.
2. To give coherence to the European ICT research related to sustainability in areas with traditionally different, but complementary research communities (HPC, Cloud, Big Data, ..).
3. To build a multi-disciplinary forum for cross-fertilization of ideas aiming to become a reference point in Europe for sustainable ultrascale computing.

Scientific context and objectives (1/2)

- Ultrascale computing systems (UCS)
 - ❖ Large-scale complex system integrating parallel and distributed computing systems, that cooperate to provide solutions to the users at unprecedented scale.
- As the scale and complexity increase in UCS, **sustainability is becoming a major challenge**
- Sustainability in UCS should be the result of leveraging several aspects to face complexity:
 - ❖ Programmability, Data management, Resilience, Energy efficiency, Scalability.

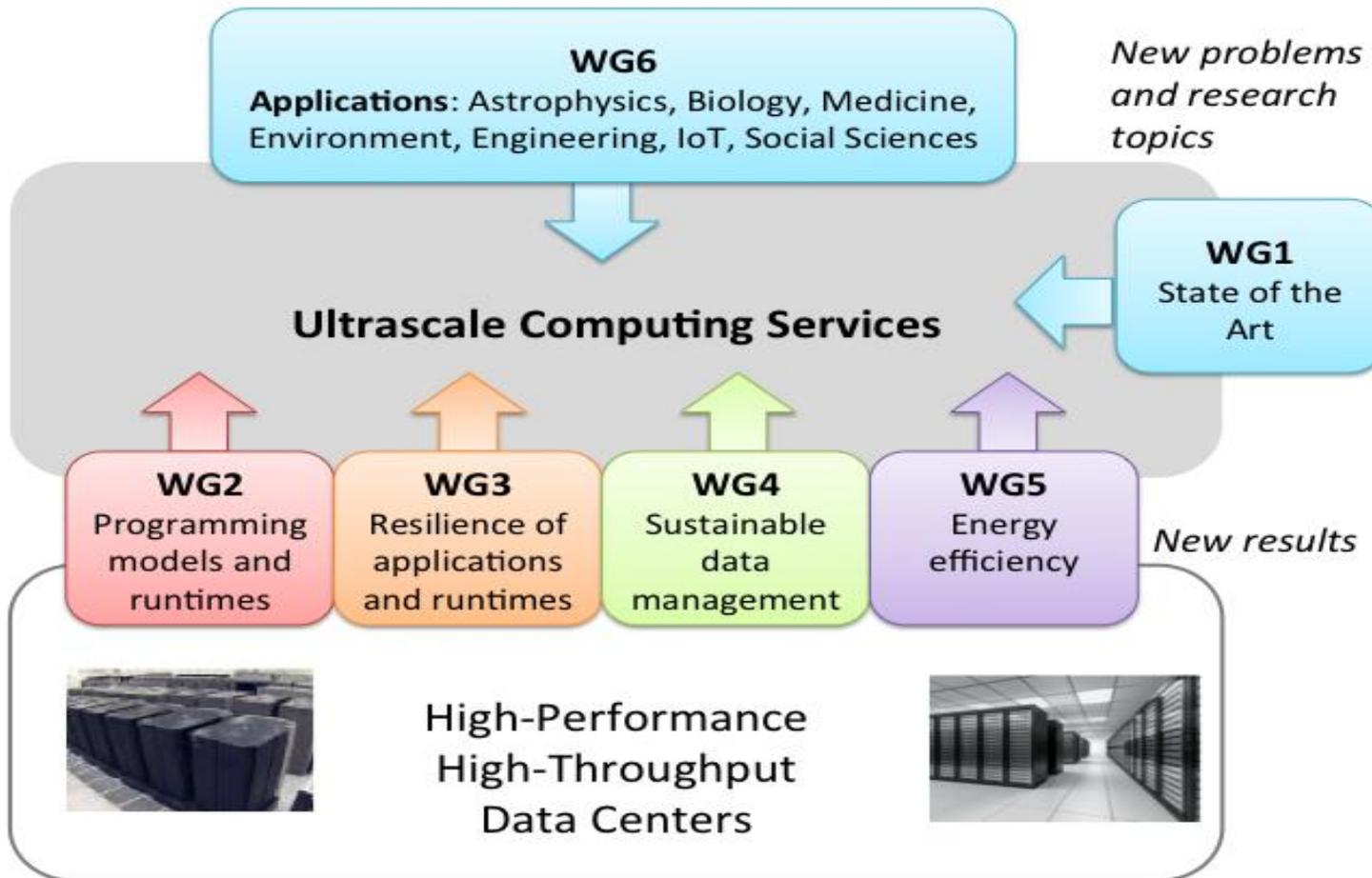
Scientific context and objectives (2/2)

- Important to understand how all these factors affect sustainability:
 - ❖ Need of managing a whole ecosystem, not separate components
- EU and US are intensively researching on:
 - ❖ Exascale (PRACE, EESI, HP-SEE, IESP)
 - ❖ Large scale virtual systems (XSEDE, FutureGrid, Grid5000).
 - ❖ Big data (BIG, EIOW, BDEC)
- Current efforts on sustainability research in these areas are mostly related to energy efficiency.
 - ❖ Need of managing the whole ecosystem, holistic approach

Scientific focus

- Cross-community approach of exploring system software and applications for enabling a sustainable development of future ultrascale computing platforms.
- Focus:
 - ❖ Exploring new solutions for the **system software stack** (programming paradigms, runtimes, middlewares, resilience, data management, and energy models) and their application to enhance sustainability in UCS.
 - Understanding trade-offs and synergies to leverage all factors.
 - Considering new hardware and architectural solutions.
 - ❖ Exploring **redesign and reprogramming** efforts for applications to efficiently exploit ultrascale platforms, while providing sustainability.
 - Middleware for large scale federated (HPC) clouds

Scientific plan



Strong WG cooperation to find synergies among solutions and provide horizontal solutions, breaking current verticality.

WG 1. State of the art and continuous learning in UCS

□ Focus

- ❖ Hardware platforms and software stack of very large scale systems
- ❖ New techniques to enhance sustainability holistically.

□ Key objectives

- ❖ Gather the participants experiences and knowledge
- ❖ Looking for innovative external solutions
- ❖ Generating new research lines

WG 2. Programming models and runtimes

□ Focus

- ❖ Promoting new sustainable programming and execution models in the context of rapidly changing underlying computing architecture.

□ Key objectives

- ❖ Scale handling (optimal usage of resources, faults)
- ❖ Improving programmability.
- ❖ Adaptation to rapidly changing underlying computing architecture
- ❖ Adaptations for data-centric programming models, resilience, and energy-efficiency

WG 3. Resilience of applications and runtime environments

□ Focus

- ❖ Innovative techniques to deal with hardware and system software failures or intentional changes within the complex system environment

□ Key objectives

- ❖ Monitoring and assessment of failures in Ultra-large-scale systems
- ❖ Going beyond fail-stop errors to manage hard, transient, and failures in the SW stack
- ❖ Understanding HW & SW dependencies and monitoring changes and their impact within complex systems.

WG 4. Sustainable data management

□ Focus

- ❖ Study data management lifecycle on scalable architectures in a synergistic approach to pave the way towards sustainable UCS.

□ Key objectives

- ❖ Evolution of the storage I/O stack towards higher-levels of scalability and sustainability to cope with globalization of data
- ❖ Improving the programmability of data management and analysis and enhancing data workload predictability.

WG 5. Energy efficiency

□ Focus

- ❖ Energy efficiency of ultrascale systems in front of other quality metrics
- ❖ To explore the design of metrics, analysis, frameworks and tools for putting energy awareness and energy efficiency at the next stage.

□ Key objectives

- ❖ Exploring energy sustainability in UCS and proposing new holistic models of energy consumption for UCS
- ❖ Designing and studying energy aware components and applications

WG 6. Applications

□ Focus

- ❖ Identify algorithms, applications, and services amenable to ultrascale systems
- ❖ Study the impact of application requirements on the sustainable ultrascale system design

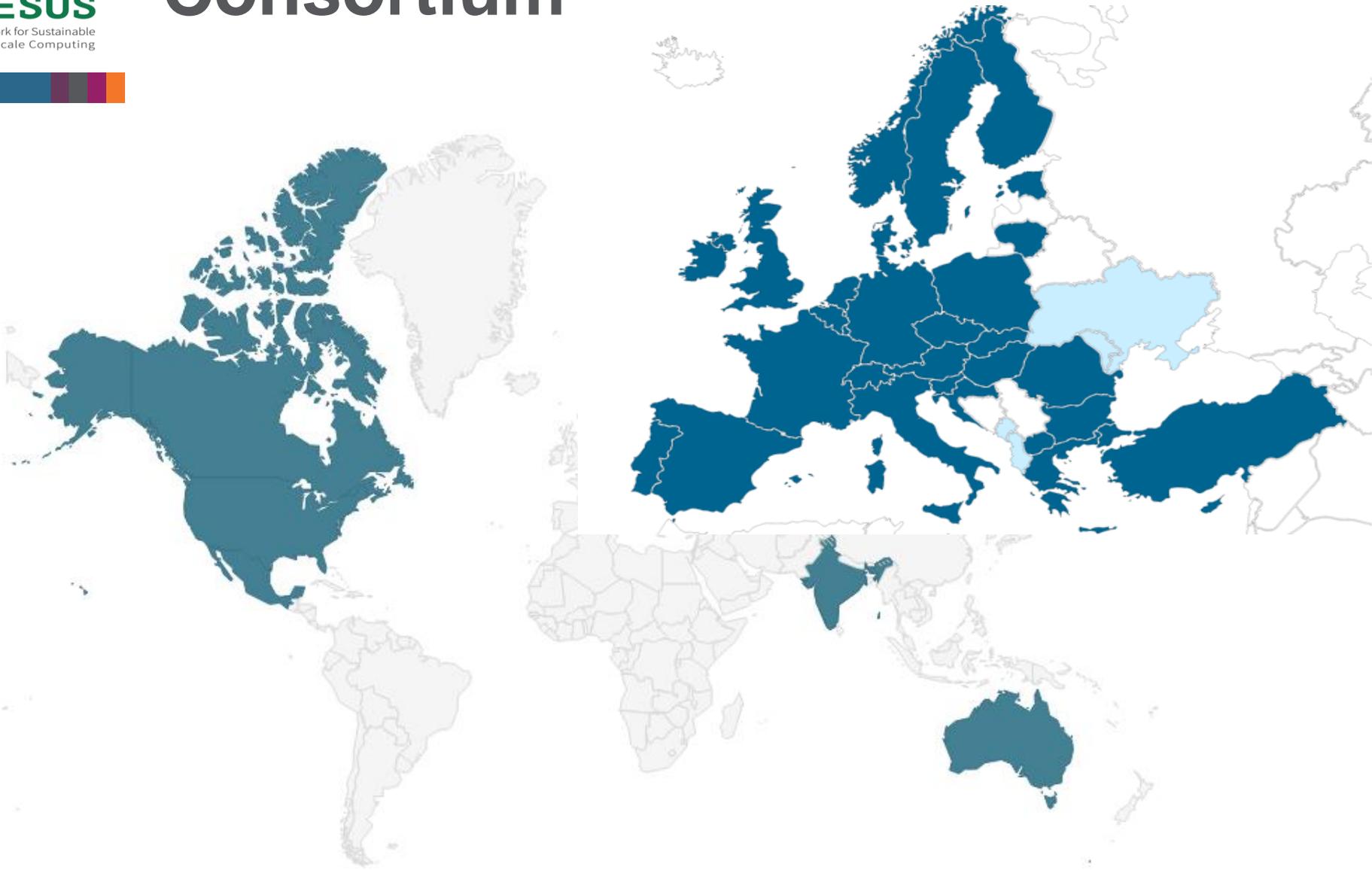
□ Key objectives

- ❖ Categorization and selection a set of key applications with need for ultrascale computing
 - Evaluation of the needs of the selected applications concerning scalability, programmability, portability, resilience
- ❖ Identification of computational patterns for expressing a higher level of abstraction at UCS

Possible Target Applications

- Life Science & Health
- Weather, Climatology and Earth Sciences
- Fundamental Sciences
- Industrial and engineering applications
- Social Computing
- Big-Data Management

Consortium



Industrial Involvement

- Involving industry is part of the Action strategic plan.
 - ❖ Special effort will be made to integrate SMEs
 - ❖ First year: dissemination + contacts

- Possible roles of industrial cooperation:
 - ❖ Helping to bring theoretic research to real world solutions and applications to improve their sustainability.
 - ❖ Participation in the Training School with lectures, industry seminars and Action meetings.
 - ❖ Hosting industrial internships
 - ❖ Exploiting results in cooperation with the Action.

Openness to new partners

- Consortium is open and expertise will be welcomed in every WG.
 - ❖ Always based on mutual benefit.

- Web site tool to submit expressions of interest
 - ❖ <http://www.nesus.eu/new-membership-request>

- **Process** for adding new partners:
 - ❖ COST countries (EU) after second year (first year open):
 - ACG will evaluate and select new membership requests
 - ❖ NNC + IPC countries must be approved by MC and COST Office.



Thank you!

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