



**EUROPEAN TECHNOLOGY  
PLATFORM FOR HIGH  
PERFORMANCE COMPUTING**

# **WORKSHOP ON ENERGY EFFICIENCY**

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30/05/2018, Ljubljana**

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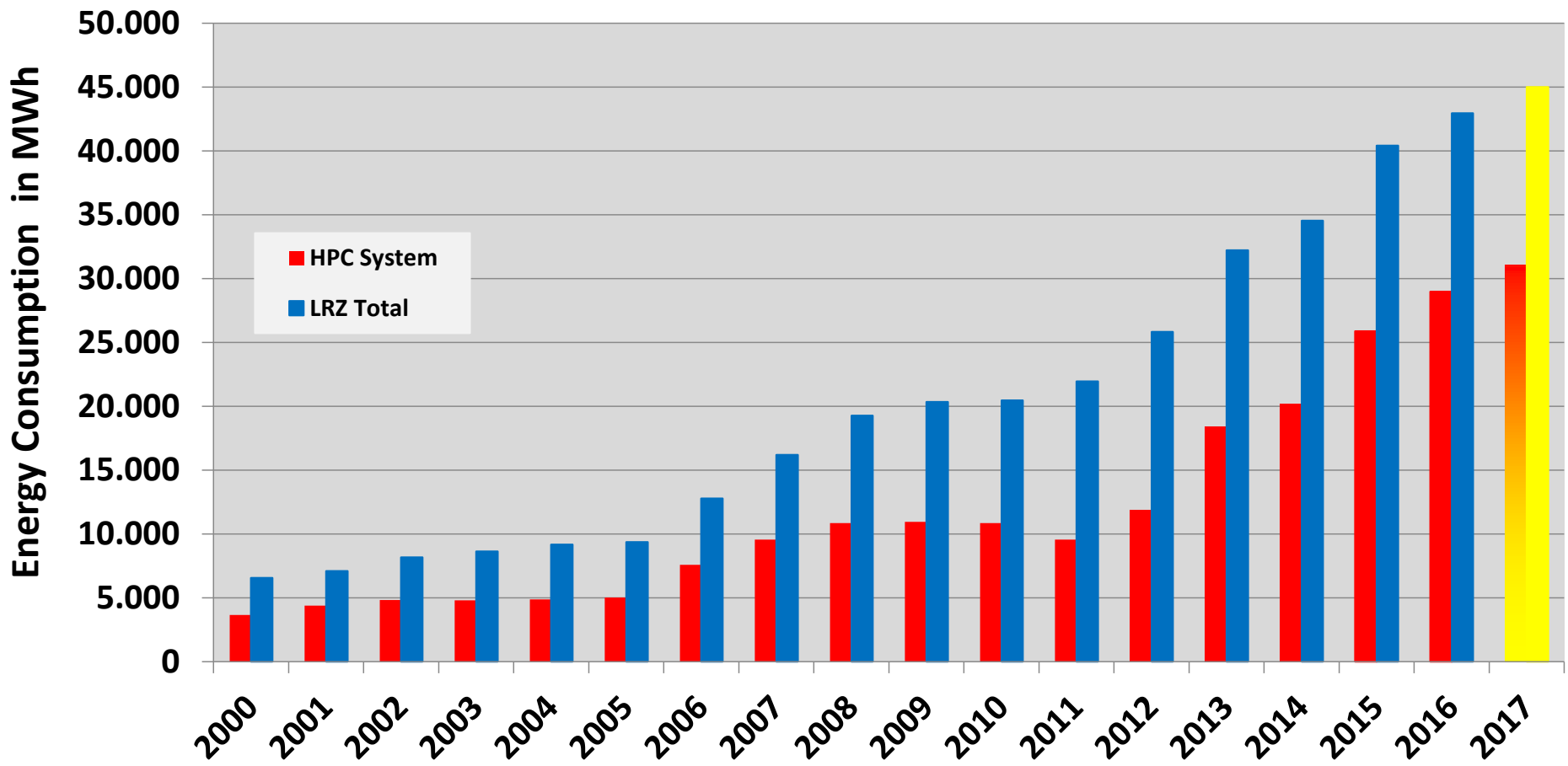
# AGENDA

14:30	Welcome & Report on EE HPC WG	Michael Ott, LRZ
14:50	100% Warm-water Cooling with CoolMUC-3	Axel Auweter, Megware
15:15	The Mont-Blanc 3 Project	Etienne Walter, Atos
15:40	Coffee Break	
16:00	The Global Extensible Open Power Manager - GeoPM	Matthias Maiterth, LMU&Intel
16:25	MULTITHERMAN: Out-of-band High-Resolution Power and Performance Monitoring Support for Big-Data Analysis	Antonio Libri, ETH
16:50	Q&A and Wrap-Up	

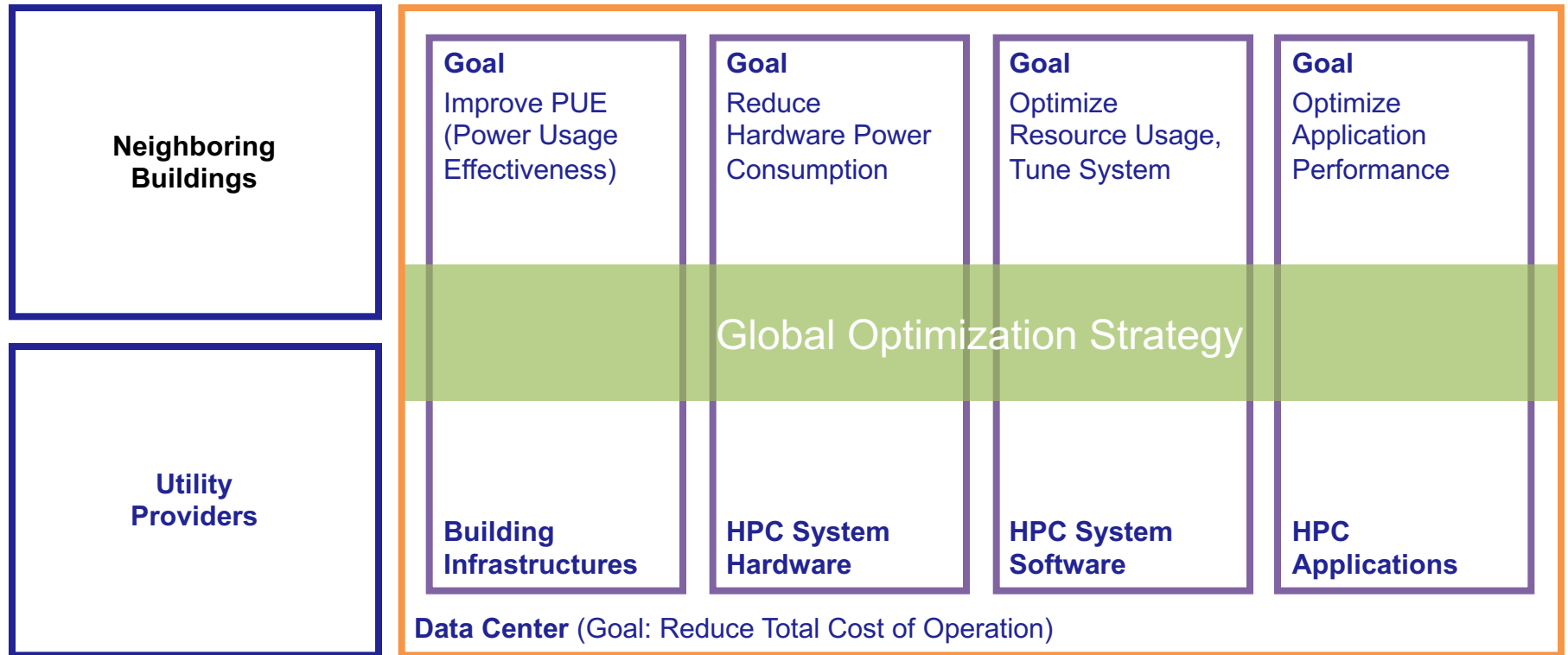
# ENERGY EFFICIENCY IN HPC

- Moore's law is coming to an end
- Supercomputers are not becoming faster anymore, just wider
- Power envelope is increasing:
  - #1 Top500 11/2007: 2.3 MW
  - #1 Top500 11/2012: 8.2 MW
  - #1 Top500 11/2017: 15.4 MW
  - First Exascale systems will be ~30MW
- Every % increase in efficiency counts!

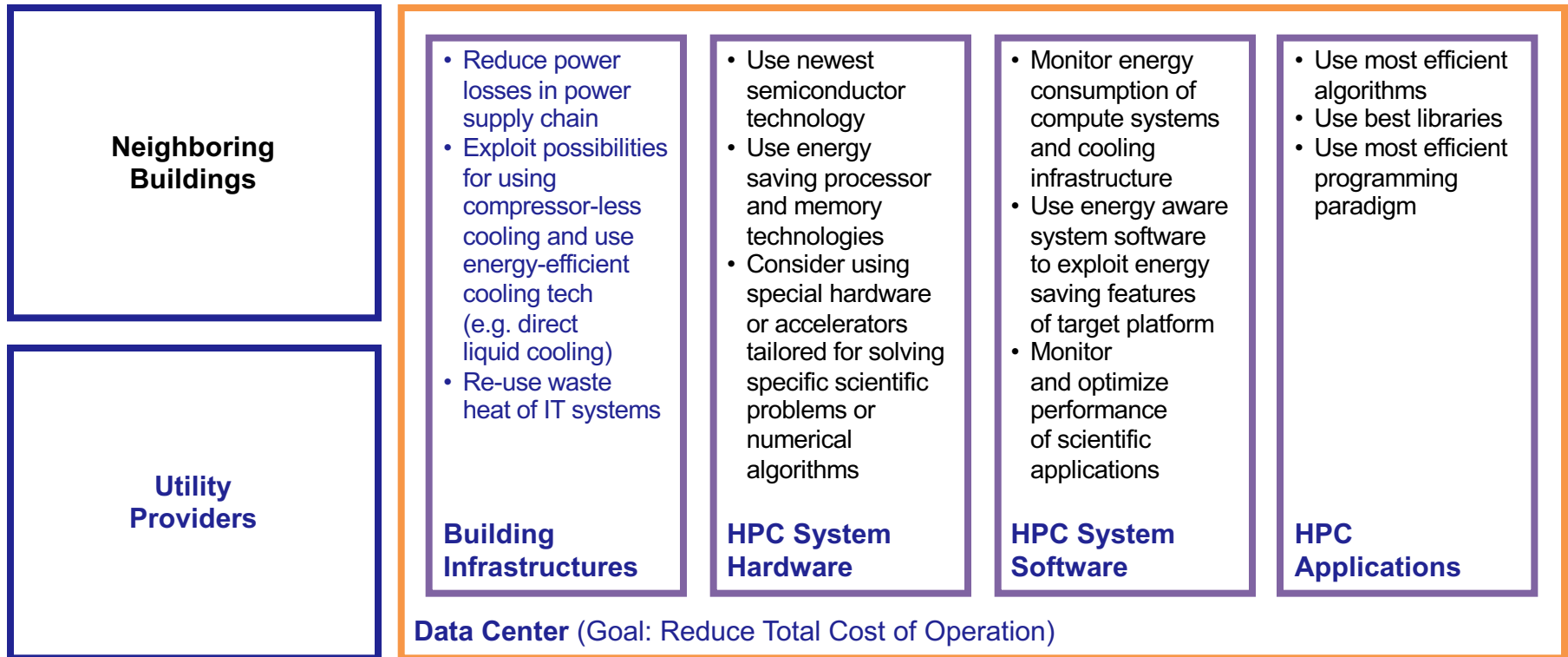
# ENERGY CONSUMPTION AT LRZ



# THE FOUR PILLAR MODEL



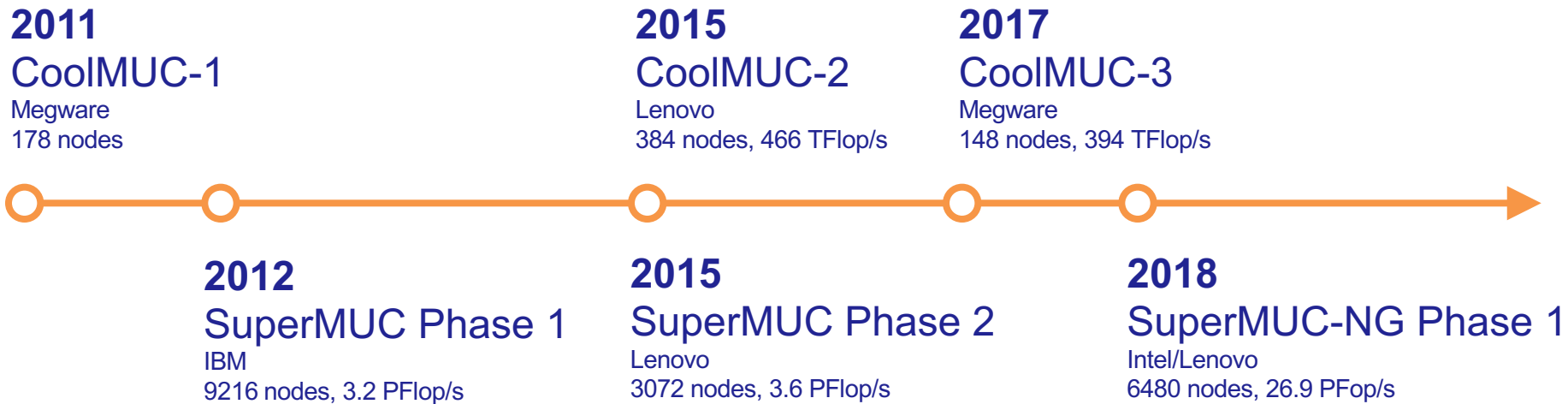
# THE FOUR PILLAR MODEL



# ENERGY EFFICIENCY AT LRZ

- Pioneer in direct-liquid hot-water cooling
- Heat re-use (heating, adsorption chillers)
- Energy-aware scheduling
- Broad instrumentation of all infrastructure
- DCDB: High frequency, high resolution monitoring and analysis

# PIONEER IN HOT WATER COOLING





# ETP4HPC WORKING GROUP ON ENERGY EFFICIENCY

- Why
  - Many ETP4HPC members are active in the field of energy efficiency
  - Energy efficiency is a very European topic
  - Focus in Europe is different than in the US and EE HPC WG
- What
  - Bringing together like minded people
  - Fostering a pan-European network for collaboration
  - Sharing experience and lessons learned
- How
  - Workshops
  - Mailing list
  - Teleconferences

# EE HPC WG: IN A NUTSHELL

## Mobilize community to accelerate energy efficient HPC

- Explore innovative approaches
- Peer to peer exchange
- Share best practices
- Take collective action

<http://eehpcwg.llnl.gov>

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### EE HPC WG

~700

Members

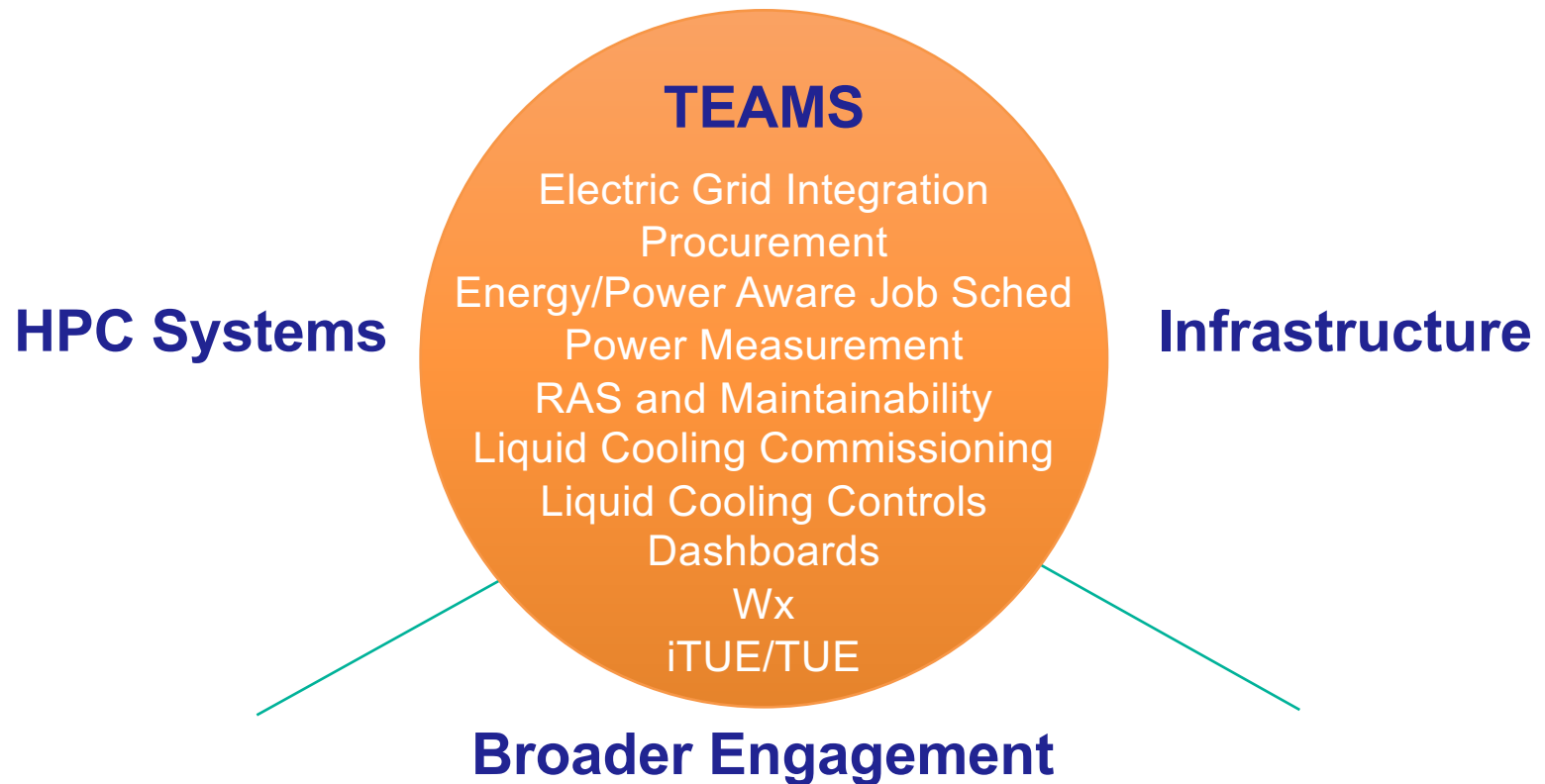
25+ countries

50% GOV

30% COM

20% EDU

# EE HPC WG: INTER-DISCIPLINARY BLEND



# EE HPC WG: INFRASTRUCTURE

- Controls
- Energy Reuse Effectiveness
- High Voltage Direct Current
- Liquid Cooling (Wx)
- Liquid Cooling Commissioning
- Maintainability
- TUE and iTUE

# EE HPC WG: HPC SYSTEMS

- Energy and Power Aware Job Scheduling and Resource Management
- HPC and Grid Integration
- Procurement Considerations Documents
- System Workload Power Measure Methodology

# EE HPC WG: BROADER ENGAGEMENT

- Conferences
- Workshops
- Papers
- Website
- Webinars
- Press



**EWHPC**

European Workshops on HPC Infrastructures



hppac18



# EE HPC WG @ ISC18

- 24/06 09:00 Tutorial: *Boosting Power Efficiency of HPC Applications with GEOPM*
- 25/06 13:00 BoF: *Preparing to Liquid Cool Your Next HPC Deployment*
- 25/06 16:00 Focus session: *What's new with Cloud Computing for HPC*
- 25/06 17:30 Award-winning paper: *On the Accuracy and Usefulness of Analytic Energy Models for Contemporary Multicore Processors*
- 26/06 09:30 BoF: *The Green500: Trends in Energy Efficient Supercomputing*
- 26/06 10:30 BoF: *Energy and Power Aware: Job Scheduling and Resource Management*
- 27/07 14:45 Special event: *An Analysis of Contracts and Relationships between Supercomputing Centers and Electricity Service Providers*
- 28/06 14:00 Workshop: *Energy Efficiency Tools for High Performance Computing – EETHPC*