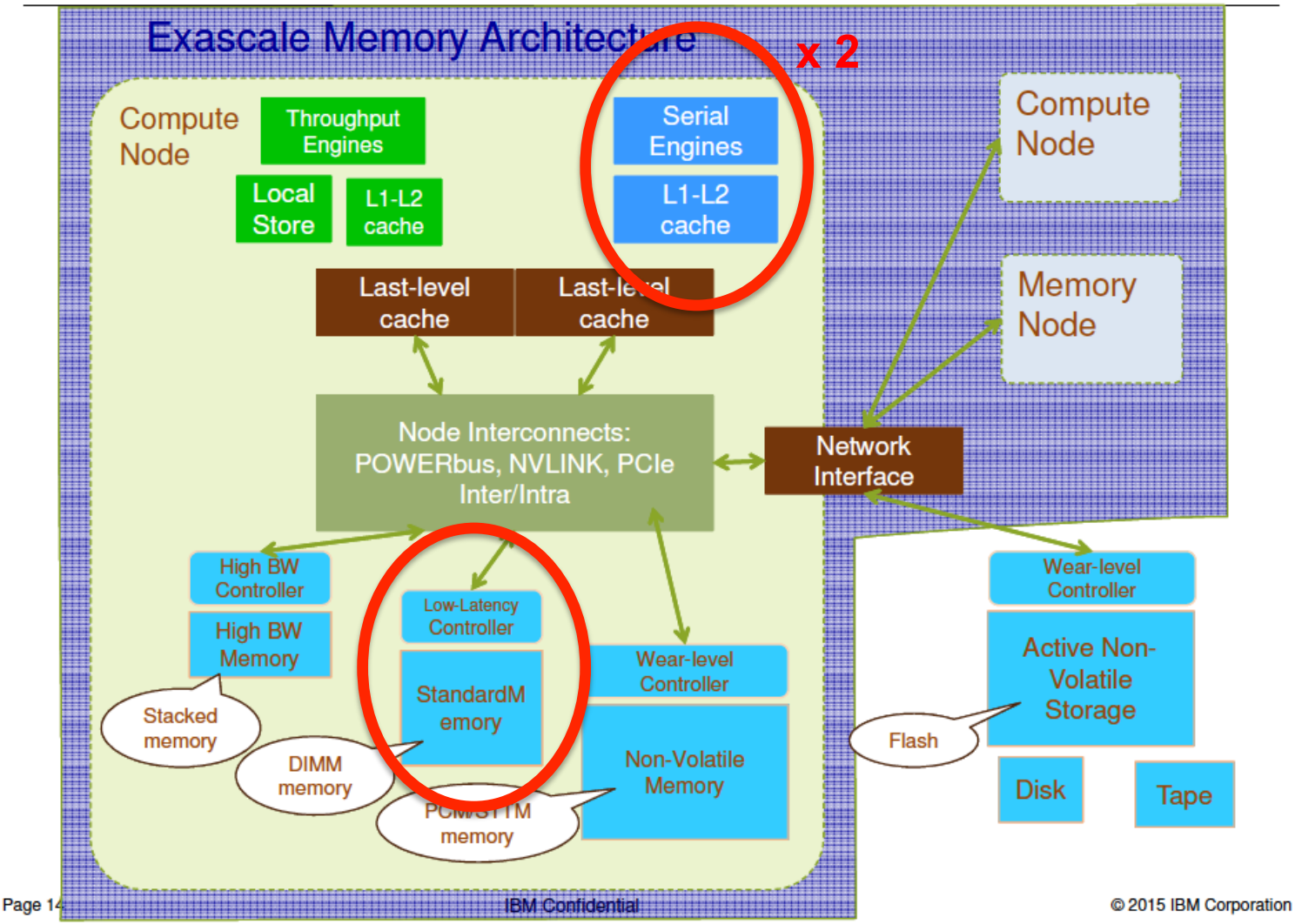
Edouard Audit, EoCoE Project Coordinator

5th ENES HPC Workshop, May 17, 2018

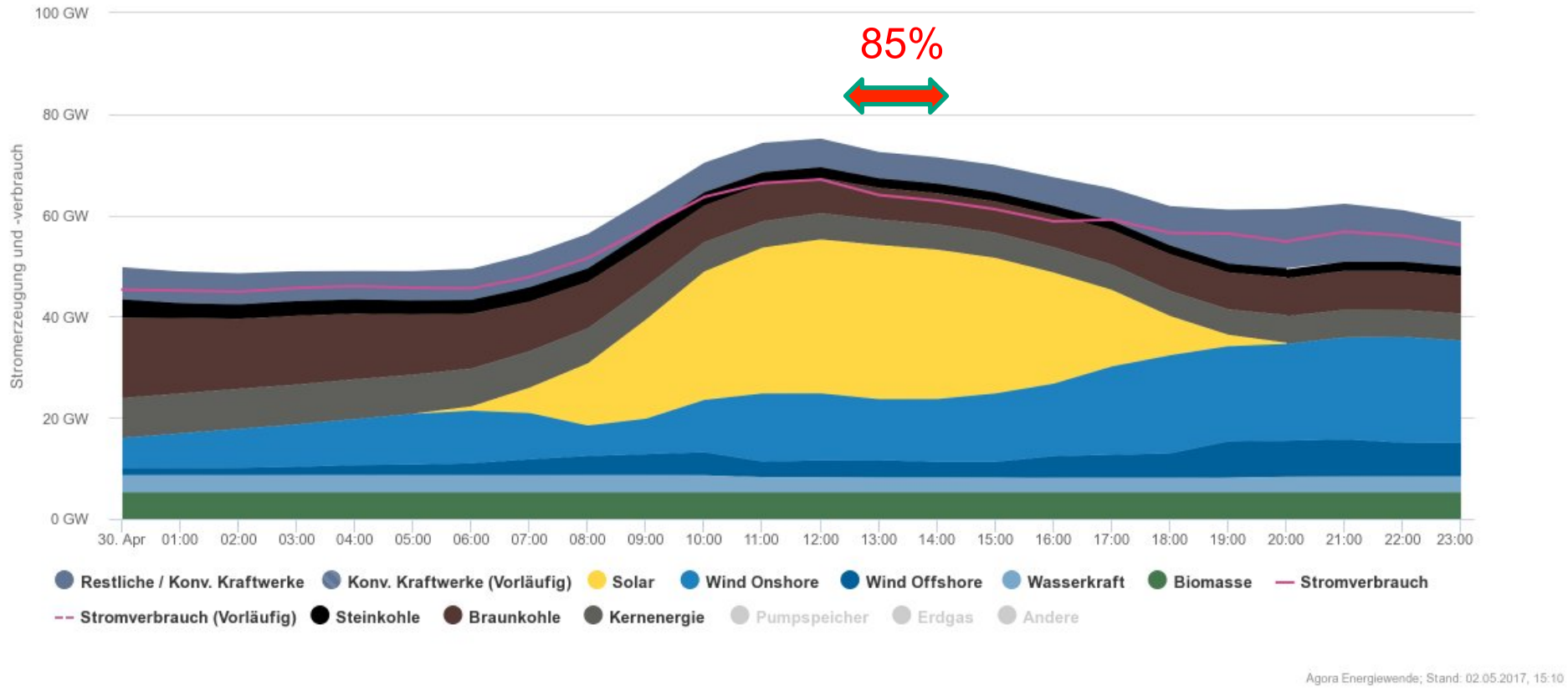
HPC is undergoing a major technological breakthrough



Business as usual

RWE Weisweiler lignite power station (near Aachen)
Power output: 2 GW
18 Megatonnes CO2/year
5th largest emitter in Europe
Planned lifetime: ~2045

German power balance 30/4/2017



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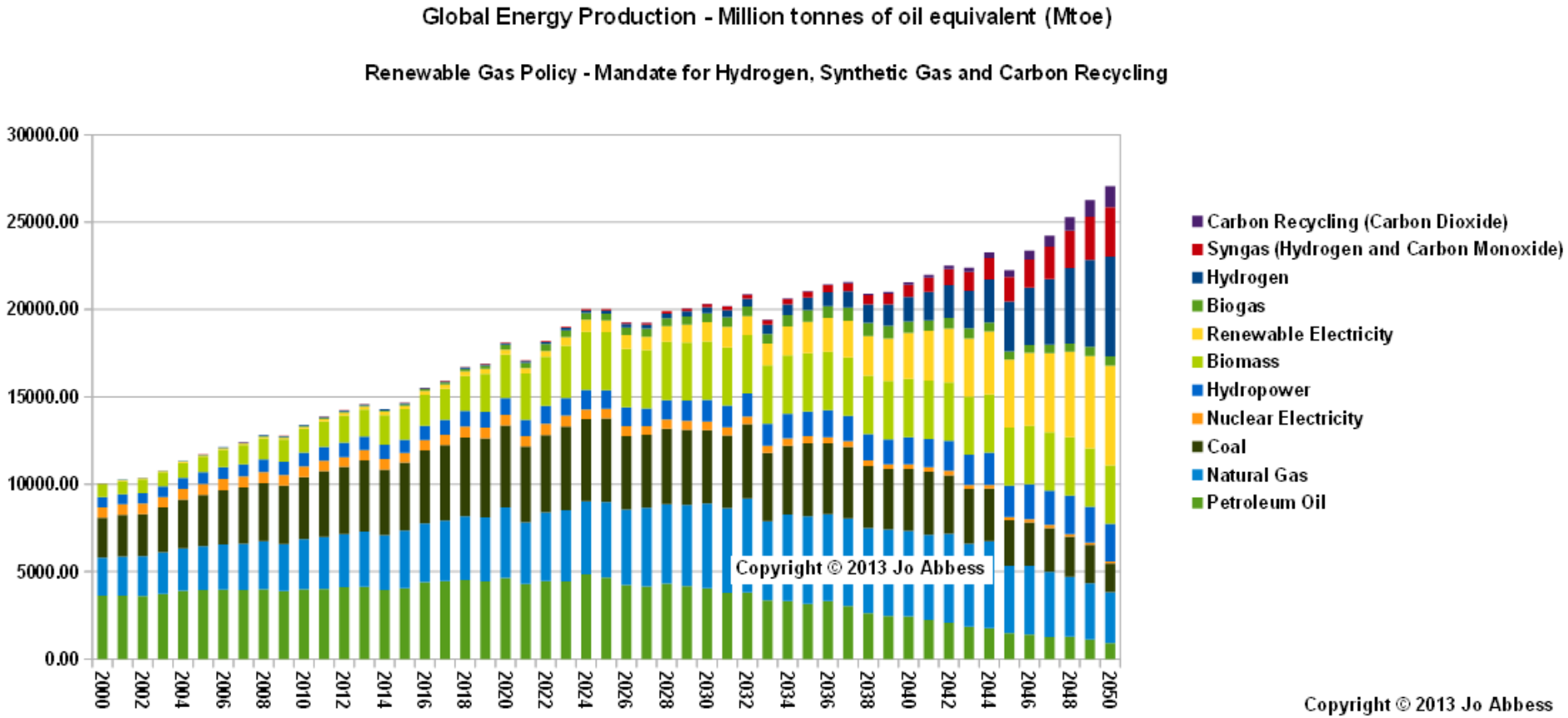
Energy production is undergoing a major breakthrough



EoCoE

<u>Main objective :</u> Using the prodigious potential offered by the ever-growing computing infrastructure to foster and accelerate the European transition to a reliable and low carbon energy supply.

EoCoE is at the crossroad of the numerical and energy revolution

The present revolution in hardware technology calls for a similar paradigm change in the way application codes are designed.

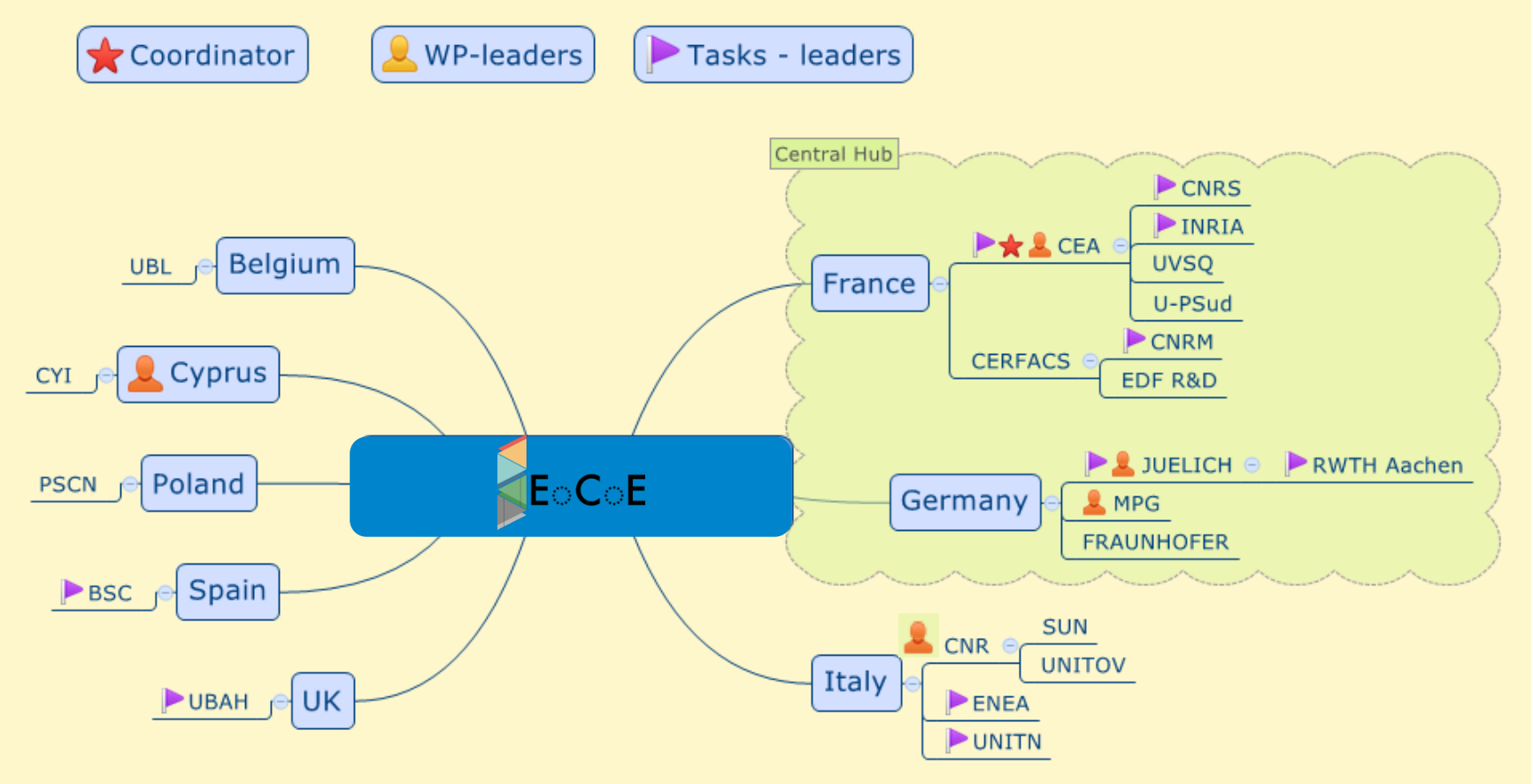
EoCoE assists the energy transition via targeted support to four renewable energy pillars: Meteo, Materials, Water and Fusion.

These four pillars are anchored within a strong transversal multidisciplinary basis providing high-end expertise in applied mathematics and HPC.

EoCoE consortium

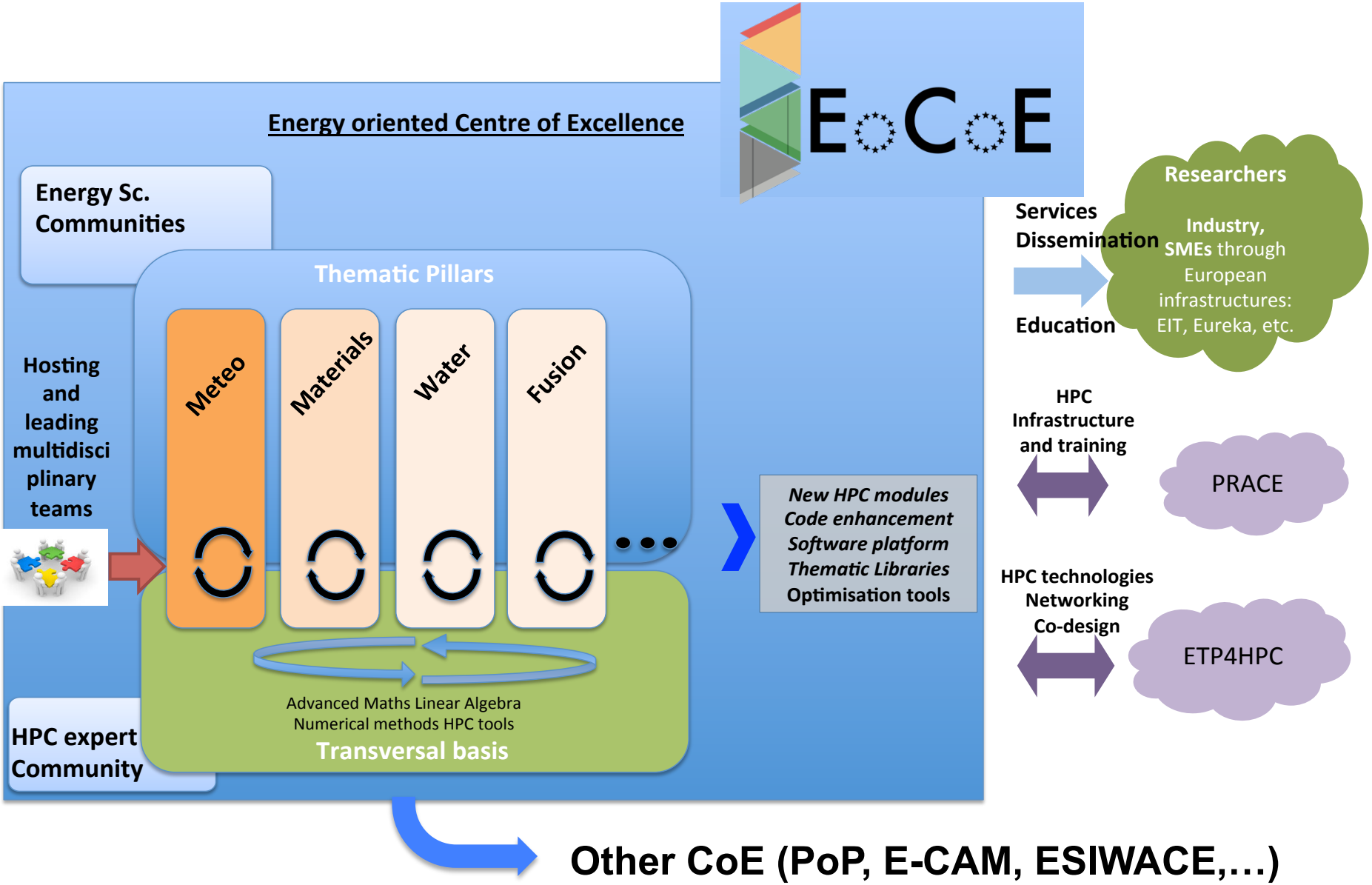
Foster the European transition to a reliable low carbon energy supply using HPC

8 countries, 22 partners, 5.5 M€, lead by MdlS
3 years project, started in October 2015, ends in September 2018

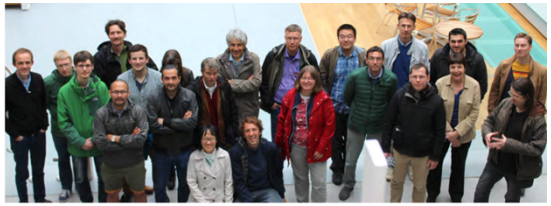


EoCoE : A European project

EoCoE overview



EoCoE is creating a new community that did not exist before.
Without EoCoE, the partners would not be working together.

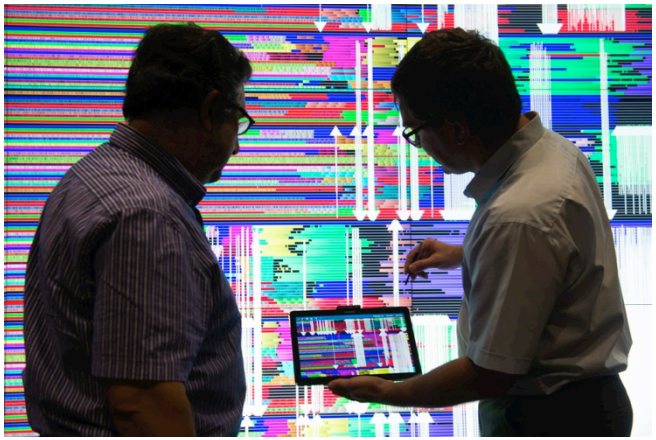


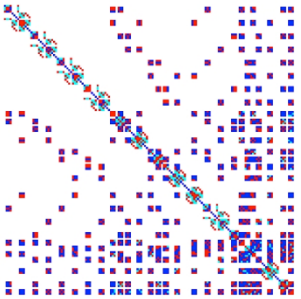
- **High added value of the project**
- **Work needed for the integration of the different communities.**

Objectives - I

Develop or optimise high end tools and software for all the communities. Get ready for exascale computers

- Applied math and numerical methods
- Linear algebra
- System tools for HPC
- New programing models



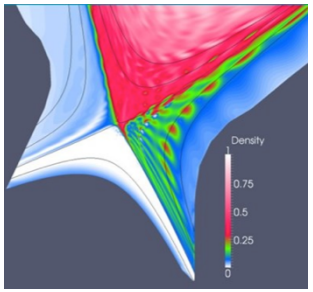


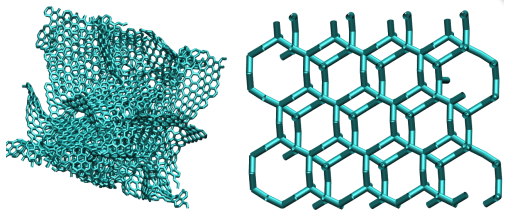
Objectives - II

*Improve means of **production**, **storage** and **distribution** of clean electricity with **short**, **middle** and **long** term goals*

Meteorology for energy : Very short term forecast to predict the production of solar and wind farm – Efficient coupling to the grid, energy trading.

Fusion for energy : Coupling kinetic and fluid codes, mesh aligned with equilibrium configurations.

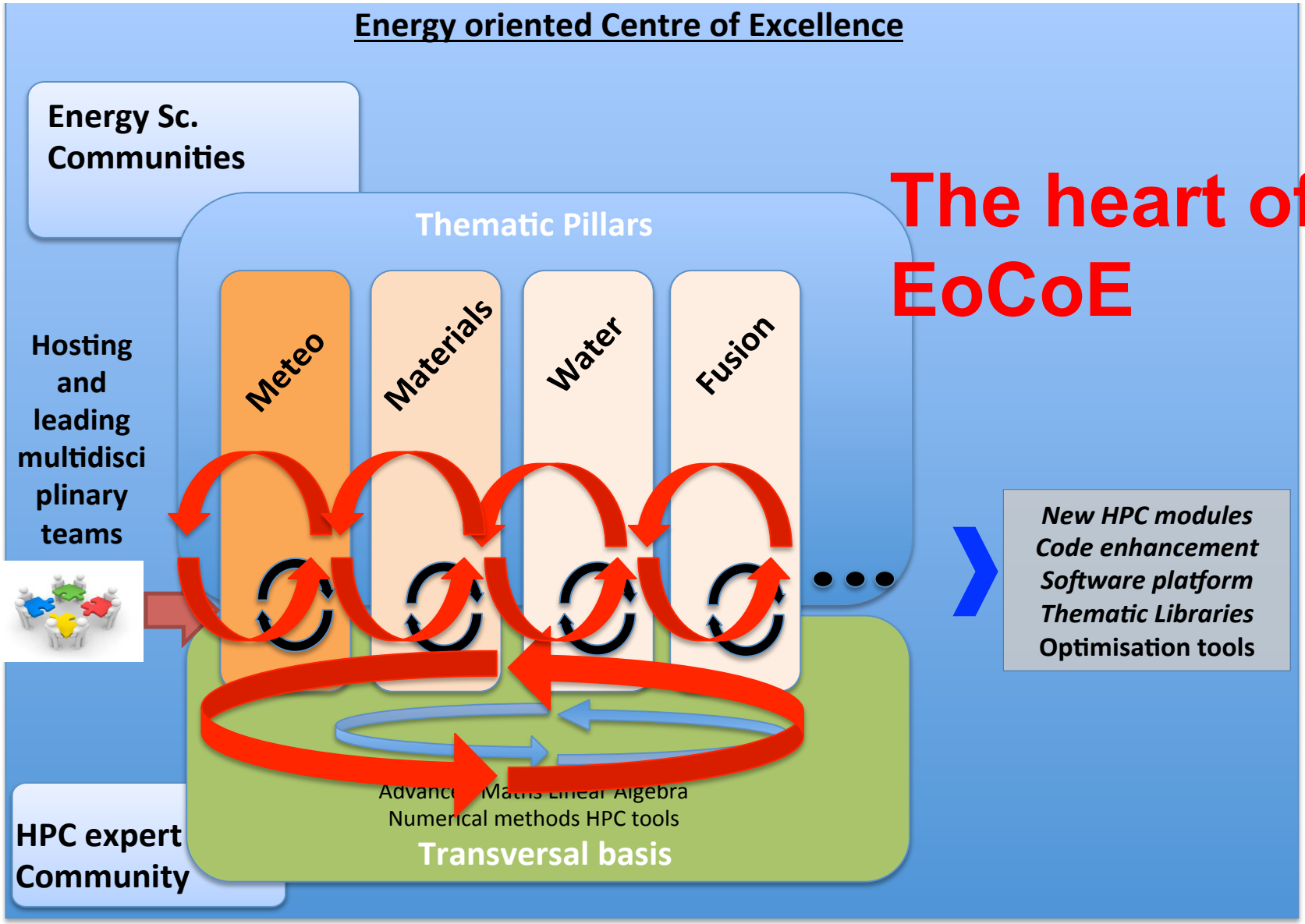




Material for energy : Photovoltaic cells, batteries and super-capacitors

Water for energy : Geothermal and hydro-power – management of resources, strategy of usage - influence of climate change.

The heart of EoCoE



HPC/Exascale approach - I

A systematic approach for code monitoring and performance analysis

Code Diaries

- Development of a complete metric sheet and associated tools to evaluate codes in a systematic way.
- Fully automated evaluation workflow
- Code diaries and follow-up

Detailed Performance metrics

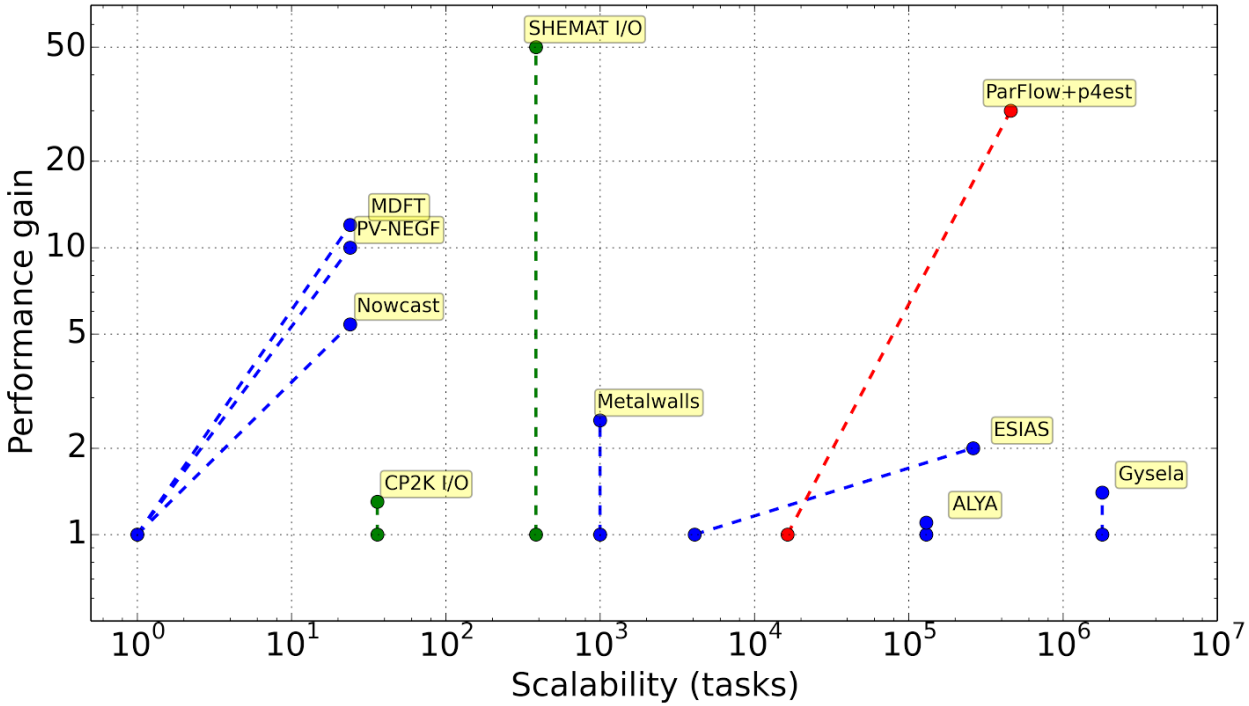
- Compute
- Memory
- I/O
- Communications
- …..

- ❑ **Make the communities performance aware**
- ❑ **Establish a clear road-map for optimisation**
- ❑ **Monitor the progress**
- ❑ **Identify the main bottleneck for porting to exascale architecture**

HPC/Exascale approach - II

Close collaborations between WP1 and WP2-5

→ Very significant results on real **production** applications

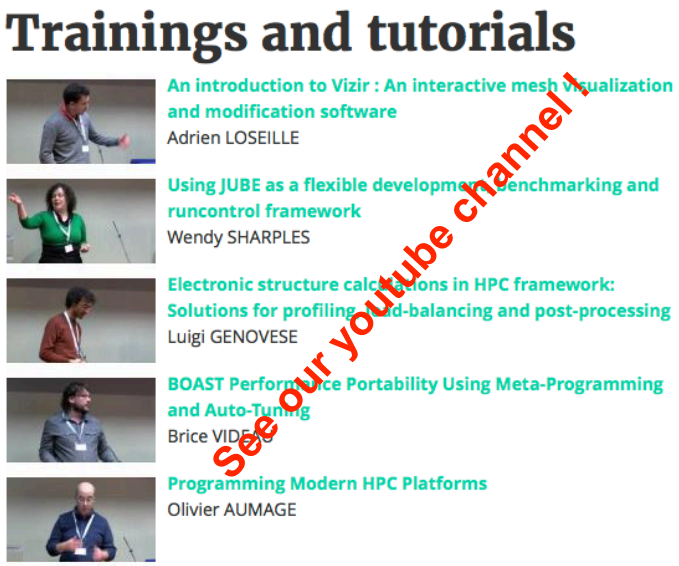


- **Turning Exascale into benefit**

- Pushing relevant application toward exascale…
- … and bridging the skill gap for less advanced users.

Making the community HPC aware

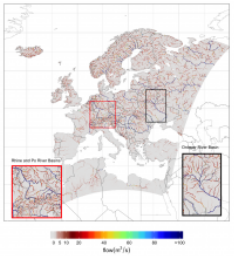
- Workshops
- Tutorial
- Face-to-face meetings
- Joint daily work between HPC and application experts

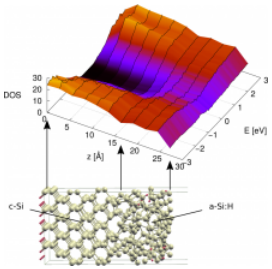


We should take every one on the road to exascale even if at different pace

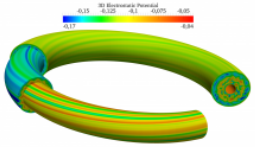
EoCoE thematic pillars

- Ensuring the the CoE is user driven
- Clear scientific case requiring HPC/exascale
- Strong links, co-working with WP1
- Flagship codes
- General improvement of numerical tools





- Significant scientific achievement enabled
  - **improving efficiency of photovoltaic cells and batteries**
  - **probabilistic short term weather forecasting**
  - **continental scale river discharge modelling at 3km resolution**
  - **Edge simulations with self-consistent energy balance and ITER relevant geometry**



Build a European hub where the HPC and energy communities can meet and work for the energy transition

- *What are the needs in terms of HPC-related computational expertise in the energy sector at present and in the near future?*
- *What are the use-cases of HPC applications and what is their potential energy industrial impact?*
- *Which aspects of such needs would require access to the next generation of HPC systems (exascale) in terms of computation and/or data storage?*