

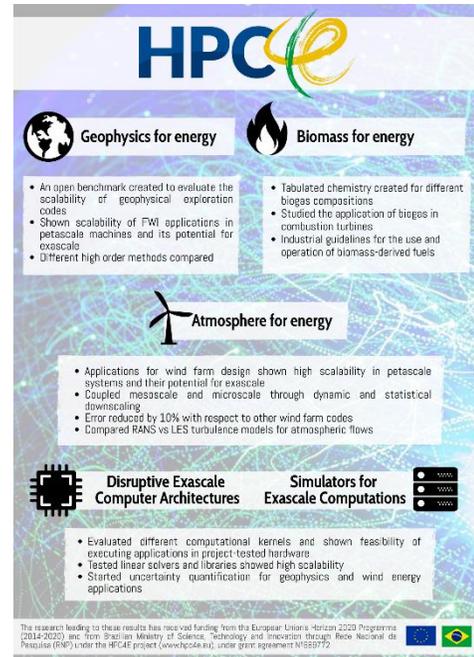
## Exascale architectures lead to greener and more advanced combustion systems

- *The European funded project HPC4E presents its whitepaper with incisive insights for the energy sector*

Two years ago, experts in the HPC4E consortium aimed to move beyond the state of the art in HPC simulations required for different sources of energy: Oil & Gas, Wind and Biogas combustion. After two years of joint European and Brazilian research, HPC4E has published a detailed summary with conclusions in the position paper titled “Whitepaper about the use of Exascale computers in Oil & Gas, Wind Energy and Biogas Combustion industries”. The use of new Exascale architectures and the corresponding advances in codes to fully exploit new chip capabilities will help address challenges for combustion technologies, wind power generation and hydrocarbon exploration, allowing a transition to greener and more advanced energy systems based on alternative fuels combined with renewable energy technologies.

“This project has revealed the synergies between European and Brazilian researchers, and has strengthened the bilateral relationships. From the point of view of the technical results, the project has been a success, having achieved all the planned objectives”, comments José M. Cela, BSC CASE Department Director and the European HPC4E project coordinator.

All the project’s results have been summarised in a single [factsheet](#). The complete outcome of the project will also explained in the workshop “[HPC Roadmap for Energy Industry](#)” taking place on Wednesday, 24 January at Barcelona Supercomputing Center (BSC). The aim of this event is to explain the scientific results by each partner as well as to find new synergies for future collaborations related to high-performance computing (HPC) for energy.



The factsheet is a vertical document with a blue and green background. At the top is the HPC4E logo. Below it are four main sections, each with a representative icon and a list of bullet points:

- Geophysics for energy** (Globe icon):
  - An open benchmark created to evaluate the scalability of geophysical exploration codes
  - Shown scalability of FWI applications in petascale machines and its potential for exascale
  - Different high order methods compared
- Biomass for energy** (Flame icon):
  - Tabulated chemistry created for different biogas compositions
  - Studied the application of biogas in combustion turbines
  - Industrial guidelines for the use and operation of biomass-derived fuels
- Atmosphere for energy** (Wind turbine icon):
  - Applications for wind farm design shown high scalability in petascale systems and their potential for exascale
  - Coupled mesoscale and microscale through dynamic and statistical downscaling
  - Error reduced by 10% with respect to other wind farm codes
  - Compared RANS vs LES turbulence models for atmospheric flows
- Disruptive Exascale Computer Architectures** (Chip icon) and **Simulators for Exascale Computations** (Server rack icon):
  - Evaluated different computational kernels and shown feasibility of executing applications in project tested hardware
  - Tested linear solvers and libraries showed high scalability
  - Started uncertainty quantification for geophysics and wind energy applications

At the bottom, there is a small text block: "The research leading to these results has received funding from the European Union's Horizon 2020 Programme (2014-2020) and from Brazilian Ministry of Science, Technology and Innovation through Rede Nacional de Pesquisa (RNP) under the HPC4E project (www.hpc4e.eu), under grant agreement N°589772." followed by the logos of the European Union and Brazil.

Promotional video: <https://www.youtube.com/watch?v=S5idvEUhY0E>



## About HPC4E

The HPC for Energy project (HPC4E), coordinated by Barcelona Supercomputing Center (EU) and COPPE (Brazil), brings together European and Brazilian partners that include both companies within the energy sector, such as REPSOL, TOTAL, Iberdrola and PETROBRAS, as well as the following research centres: Barcelona Supercomputing Center, CIEMAT, Inria, University of Lancaster (ULANC), Queen Mary University of London, COPPE, LNNC, ITA, Universidade Federal do Rio Grande do Sul and Universidade Federal de Pernambuco. More information: [www.hpc4e.eu](http://www.hpc4e.eu)

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