Energy2050 HPC highlights

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Energy 2050

The University of Sheffield Strategic Energy Research Initiative

- Vision: To deliver the **innovative** and **transformative** scientific and technological solutions to the energy, security, and economic challenges facing UK in the 21st century

- Strategic Objectives:
  - Deliver the scientific discoveries and major scientific tools that transform our understanding of nature and strengthen the connection between advances in fundamental science and technology innovation
  - Develop and Support a more competitive, resilient UoS energy infrastructure
  - Support RD&D for a transition to a low-carbon energy system
  - Encourage Energy innovation, Contribute to national policy: Create new jobs, enable economic growth and Contribute to increased net exports.
Modelling activities

Developing advanced models for future power generation technologies

- Novel operating conditions
- Improved modelling approaches
Small/medium wind turbine < 300 kW, low wind and turbulent

Vertical axis wind turbine, design & modelling

Flow measurement, PIV
Wind Resource Assessment for Demo-Locations using Large Eddy Simulation (LES):
Large eddy simulation of the urban wind flow
Animation of the Pathlines
Flow pathline at the tip of the blade
Pilot Plant facilities including PACT

- 250kW pulverised biomass, coal combustor
- 300kW Micro Gas Turbine
- 200kW Fluidised bed combustor
- 1 tonne per day CO₂ capture plant
Flame stability

Transient intensity of the flame

Frequency spectrum

\[ F = \frac{\sum_{n=1}^{N} P_{xx}(f_n) \cdot (f_n)}{\sum_{n=1}^{N} P_{xx}(f_n)} \]

Gas combustor CFD

- Commercial micro-gas turbine
- Stability under novel conditions
- Pollutant predictions
Industrial scale CFD

• Large scale utility boiler geometry
• Steady state simulations
CFD/process integration

Fei, Y.; Black, S.; Szuhánszki, J.; Ma, L.; Ingham, D.; Stanger, P. & Pourkashanian, M.
Evaluation of the potential of retrofitting a coal power plant to oxy-firing using CFD and process co-simulation
*Fuel Processing Technology*, 2015, 131, 45 - 58
Future developments

• Improved fidelity of models
• Larger industrial cases
• New fuels and novel conditions
• Virtual reality power systems
Thank you
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