

# **Research Challenges in Combustion and Production of Sustainable Fuels for ‘Green’ Energy Futures**

**Y. Hardalupas**

Imperial College London, Mechanical Engineering Department,  
London SW7 2AZ, UK

Climate change is the biggest challenge that our society faces. To deliver the required reduction of carbon emissions, a smooth transition is required from the existing infrastructure to a new approach that is yet to be agreed at an international level. A scenario could involve renewable energy from wind and solar sources delivering some of the societal electricity needs and the rest stored into new decarbonized / sustainable fuels, i.e. Hydrogen, Ammonia, e-fuels.

The new fuels require improved combustion technologies, which are expected to be crucial for a sustainable future society. However, combustion technologies must be able to deliver zero emissions, which include carbon dioxide, unburned hydrocarbons, NO<sub>x</sub> and particulates and other substances, depending on the application. The talk will review different combustion technologies that can deliver net zero carbon emissions, which include:

1. Hydrogen and its vectors (e.g. Ammonia)
2. Solar or e-fuels
3. Metal nanoparticle fuels
4. Supercritical CO<sub>2</sub>

The relevance of these approaches to aviation, land and marine transport, power generation and industrial heat will be considered, and the combustion research challenges will be explained.

The talk will also address some research challenges related to the generation and storage of energy from renewable sources, which must be addressed for sustainable production of new fuels. These will include:

- need for increased lifetime of wind turbine blades, currently limited by material erosion due to rain / ice droplet impact
- efficient production of hydrogen and e-fuels in scaled-up electrolyzers