

Engineering in a changing climate

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Editorial

The earth's climate is changing and in broad terms we know to what degree, though in many respects uncertainties are large. In one way or another engineering responds; incrementally through the evolution of more efficient systems and processes, radically through innovation, or simply in response to the demands of a new operating environment. This special issue illustrates this activity and makes it abundantly clear that the engineering community is active, indeed pro-active, in facing the challenges. Both the range of current activity and the direction in which it is heading are illustrated.

As described in the Stern review commissioned by the UK government¹ it is accepted that atmospheric carbon dioxide (CO₂) is a key factor in climate change that is influenced by human activity. The first paper in this edition addresses this point directly for electrical power generation, considering carbon capture and storage (CCS). Ms Chalmers and Dr Gibbins from the Energy Technology for Sustainable Development Group at Imperial College discuss some critical challenges in this area and propose urgent action to implement and develop the associated technology. Fossil fuel power plants with CSS and/or low carbon power generation, such as renewable and nuclear energy, could radically reduce future CO₂ emissions.

Transport is a further key area for reduction of CO₂ emissions and the King report on low carbon cars is a response from one sector². There are two papers dealing directly with issues from other sectors. Professor Baker and co-authors from the University of Birmingham Centre for Rail Research and Education note that railways offer a relatively efficient means of transport and that increasing capacity of the UK rail network could help reduce overall CO₂ emissions. The effects of climate change on the operation of railways are also considered. Professor Parker and Mr Lathoud of Rolls-Royce discuss the impact of aviation on climate and describe technological developments linked to the mitigation of environmental impact. A concern for aviation is that if passenger traffic continues to grow and CO₂ emissions from other sectors (currently responsible for much larger total emissions) are reduced, then aviation will come under increasing pressure to reduce emissions. Industry is addressing this challenge through engineering development and innovation.

Implementation of a hydrogen economy to replace areas of the present carbon economy is a radical change that can play a part in reducing CO₂ emissions. Hydrogen could be used with fuel cells to generate power for stationary and transport applications. This is discussed by Dr Mandal and Professor Gregory from the University of Glasgow. Several challenges in developing this technology are described, and the paper focuses on aspects of fuel cell technology and materials research for solid state hydrogen storage.

¹ Stern, N.: The Economics of Climate Change, HM Stationary Office, 2006

² King, J, 2007. The King review of low carbon cars; Part I: the potential for CO₂ reduction, HM Treasury

Consideration of climate change is evident in many areas of engineering in addition to those of power generation and transport mentioned above. Substantial efforts are underway in manufacturing, urban engineering and agriculture. Sustainability and product life cycle analysis are increasingly used in product design and included in engineering training. The paper by Professor Griffiths and colleagues from the Centre of Research in Energy, Waste and the Environment at the University of Cardiff analyses strategies for managing municipal solid waste. The role of materials recovery is seen as crucial, the benefits being illustrated by a detailed case study.

Direct intervention in the processes affecting climate, geo-engineering, is gaining recognition and the final paper in this edition, by Professor McInnes of the University of Strathclyde, takes the leap in imagination required to consider large scale space-based geo-engineering. He argues that natural and human-driven climate variation will require long term climate manipulation, and that developments for the Earth could pave the way for engineering the climate of other planets.

We would like to thank the authors for their contributions and the editors of the Journal for the opportunity to present this edition. Of course, these few papers hardly begin to cover the wide range of engineering activities associated with climate change. However, we hope that these contributions will encourage further awareness and engagement of Mechanical Engineers with climate change technology and policy, and that the Journal is able to publish further stimulating papers in this area in the future.

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