

Engineering Tripos Part IB, Sustainable Engineering, 2015-16

Lecturers

Dr Claire Barlow and others

Timing and Structure

5 lectures in Michaelmas Term.

Objectives

As specific objectives, by the end of the course students should be able to:

- Appreciate the scale of the global challenges in energy production and control of climate change, and the importance of identifying, quantifying and pursuing the developments which will have significant impact.
- Understand a range of opportunities to reduce energy consumption and to implement lower carbon technologies, in different sectors of engineering, in both developed and developing economies.
- Complete a technical investigation into an aspect of Sustainable Engineering of their own choice.

Content

The need to move rapidly toward a lower carbon economy is widely accepted in the Engineering community, to mitigate against climate change, to improve future energy security, and to assist the developing economies of the world. This course will illustrate some of the current issues and applied developments relating to sustainability, in all areas of Engineering. Students follow up the lecture course with their own short research project over the Christmas vacation, submitted as a poster.

1. 29 October. Dr Claire Barlow. Critical materials and sustainability: are we running out of resources?

Are we in danger of running out of some materials? It is generally accepted that the way we currently use materials cannot be sustained indefinitely, but opinions vary on what the real 'crunch points' are. In this lecture we will explore some of the issues, concentrating on materials which are extracted from the ground. We will look at the basis on which decisions are made about the resources that should be regarded as critical. This is a difficult area: different assumptions and priorities lead to big discrepancies in the materials appearing on the resulting lists. We will then turn to ways in which the problems of materials scarcity can be mitigated. Solutions include substitution of other materials, minimisation of materials usage, and increasing the reclamation of materials and products at end-of-life.

2. 5 November. Professor Julian Allwood. Use less.

In this talk, we'll take a look at how humans are getting on in managing (or not) their impacts on the natural environment, and focus particularly on climate change. The sad reality is that while we talk more and more about global warming, the rate at which our emissions are increasing is itself increasing, and this comes down to the fact that rich countries want to keep continuing getting richer. As a result, while we're happy to talk about relative reductions in environmental impact, our absolute impacts are still rising. The solution is pretty straightforward - we have to use less; less energy, water, material and meat. Doing so wouldn't be that painful if we made the choice to do so, so we'll look at how it might happen, how engineers can contribute, and how we can be part of the very broad public debate that's required to imagine a future in which we aim to grow our well-being more than our incomes.

3. 12 November. Dr Mike Sheppard. Climate change and world economy.

In 2014, emissions of carbon dioxide grew by half a percent relative to the previous year. Many had expected emissions to grow by around two percent, the typical growth rate seen in previous years. Some hailed this reduction in growth rate as an indication that measures to limit carbon emissions were finally working. The real cause of the lower emissions growth was the softening of China's economy which is undergoing a shift from industrial to service activities. How will the world's future economic growth, and that of Asia in particular, affect future carbon emissions and what will be the consequences for climate?

4. 19 November. Professor David Cebon. Towards sustainable road freight.

Every single thing that you have bought in a shop (or online) has been transported by road at some stage in its life – both as a finished product and at various stages of its creation. The package that it came in was transported by road, the label on the package was transported by road, the ink on the label on the package was transported by road, the machine that printed the ink on the label on the package was transported by road, as were all the printing machine's components, the raw materials they were made from, etc. If road freight stopped tomorrow, our urban society would cope for 4 or 5 days before mayhem broke out. ... Like running fresh water and electricity, road freight is something that we simply can't manage without.

The amount of freight being transported by road is growing rapidly – to serve increasing consumer demands for goods. This activity currently generates about 7-8% of the UK's CO₂ emissions. This talk will discuss the ways in which the road freight system can be made more sustainable – by improving the engineering systems that move the freight and the logistics systems that organize the movement of freight.

5. 27 November. Dr Michael Ramage. Natural Structure: materials, form and force

The relationship between structural form and natural force allowed medieval master builders to construct spaces that still inspire awe today, many of which would be difficult to recreate. But with an understanding of antique knowledge, traditional construction, and contemporary computation we can once again explore the form and structure of centuries ago in contemporary architecture and engineering. Combining historic wisdom with the latest natural material technology offers the promise of novel and sustainable building solutions. Michael Ramage will discuss new developments from his research at Cambridge that draws on learning from ancient traditions for contemporary sustainable architecture and engineering.

Coursework

Coursework instructions will be issued with suggested issues and questions to follow up on each lecture. Students will identify and select a technical topic of their own choice and interest in the broad area of Sustainable Engineering, either motivated by the lectures and suggested topics, or from their own reading. Independent research into this topic will be conducted over the Christmas vacation, leading to preparation of a poster summarising the key findings. The expected time to be spent on the research project and poster is 10-15 hours.

Deadline for poster submission (in electronic format as PDF): Friday January 15th 2016, 4pm (via Moodle: details to follow).

Standard credit: 10 marks (from maximum of 14); penalty of 1 mark per day poster is late.

Booklists

Recommended books for the research project and for general interest are:

- David Mackay, *Sustainable Energy - without the hot air* (available online)
- Michael Ashby, *Materials and the Environment*
- Julian Allwood and Jonathan Cullen, *Sustainable Materials - with both eyes open* (available online)

See [Part IB Booklist](#) [1]

Examination Guidelines

Please refer to [Form & conduct of the examinations](#) [2].

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