

## Engineering Tripos Part IB, Sustainable Engineering, 2020-21

### Lecturers

[Dr Claire Barlow and others](#) [1]

### 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. Professor Julian Allwood. Absolute Zero: a pragmatic view of how the UK can deliver on its zero-emissions legal commitment within 29 years**

For the past twenty years, we have recognised that climate change is a pressing threat, discussed it endlessly, but every year emissions have risen. One of the key reasons for this lack of urgency is the hope that new technologies will take the problem away, or at least make it easier to deal with, than if we act now. Obviously, it suits politicians and incumbent businesses to delay acting, in the hope that future action will require less change. However, we now have just 29 years left to reach zero emissions, and it is relatively unlikely that any new large-scale technologies will have much effect, because it takes a long time to introduce and deploy them. In this talk, we'll therefore look in detail at what it would take to reach zero emissions with today's technologies, and explore the commercial and political context in which decisions about climate mitigation are being played out.

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#### **2. 5 November. Dr André Cabrera Serrenho. Are electric cars really zero-emissions? — key principles of technology implementation to step up climate change mitigation**

Despite decades of efficiency improvements in energy devices and industrial processes, global greenhouse gas emissions keep growing. Reducing emissions to zero is thus a huge challenge — and we are running out of time! This will require a combination of both technology innovation and change in consumer behaviour. However, we are often missing out on key aspects of technology innovation: the need to understand the impacts across the life cycle of products and the time it takes for new technologies to produce their benefits. In this lecture, we will explore how these aspects can be used to step up climate change mitigation. We will explore various examples of technology implementation, starting with electric cars.

**3. 12 November. Dr Claire Barlow. Plastics: a wicked problem**

Lightweight, versatile, cheap and hygienic: plastics have transformed our world in the last half century, pervading all aspects of our lives and bringing countless benefits. But their durability, which can be such a valuable attribute, is also their downfall. David Attenborough's Blue Planet documentaries have highlighted the devastating effect that waste plastic is having on our environment, particularly focusing on the marine environment. Plastic packaging is seen as iconic of our wasteful throwaway society: should it just be banned? A more thoughtful approach to the problem requires us to see packaging as part of a complex system, and to consider resource usage across the whole lifecycle of materials and products: used and disposed of wisely, packaging can save huge amounts of resources. In this lecture we will explore wider sustainability aspects of the use of plastics for packaging and examine the alternatives.

**4. 19 November. Dr Shaun Fitzgerald. Sustainable buildings**

In this session we will first quickly look at the forecast for CO<sub>2</sub> emissions under different scenarios, and then delve into the demand which is driving these. Energy use associated with the operation of buildings accounts for the highest forecast growth of any sector, and we will therefore examine some opportunities to reduce this. The session will highlight how we can apply engineering principles and help transform the energy consumption of buildings. We will discuss not just how improvements in our understanding of buildings physics can lead to potential improvements, but use examples from industry and explore some of the barriers which engineers have to overcome in practice. These include working with complete supply chains, understanding the pressures involved, the practical issues of building regulations/guidelines and how these have been changed and can be developed further by you.

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**5. 26 November. Dr Kristen McAskill. United Nations sustainability goals**

This session will provide an overview of the Sustainable Development Goals and the significance of these goals in coalescing an international agenda for sustainable development. To put these goals into context, it will include a short historic review of international coordination and policy. It will consider responsibilities for achieving these goals and implications for the engineering profession. The session will briefly explore examples of how engineering practices have evolved in response to the sustainability agenda and take a brief look at how some professional engineering institutions are now responding.

**Coursework**

Coursework, in the form of a small independent research project, 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 12-15 hours.

You will present your poster to a small group of students in a timetabled lab session in the Lent Term.

Deadline for poster submission (in electronic format as PDF): Friday January 15th 2021, 4pm (via Moodle: details to follow).

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

**Booklists**

I have listed here some books, e-resources and documents that you may find interesting. All the books are readable rather than being textbooks!

- *Sustainable Materials: with both eyes open*, Julian Allwood and Jonathan Cullen ([www.withbotheyesopen.com](http://www.withbotheyesopen.com) [2])
- *Sustainable Energy: without the hot air*, David Mackay ([www.withouthotair.com](http://www.withouthotair.com) [3])

- *Materials and the Environment*, Michael Ashby, Butterworth-Heinemann, 2012 (e-book available)
- Paul Hawken, Amory B Lovins, L. Hunter Lovins. *Natural Capitalism: The Next Industrial Revolution* (2010).
- Michael Braungart, William McDonough. *Cradle to Cradle. Remaking the Way We Make Things* (2009)
- Mike Berners-Lee. *How Bad are Bananas?: The Carbon Footprint of Everything* (2010)
  
- Rethinking Single-use plastics. Report from Citi GPS, download from <https://www.citivelocity.com/citigps/rethinking-plastics/> [4]
- You may like to look at the latest report from the Intergovernmental Panel on Climate Change, <http://www.ipcc.ch/> [5]

Please refer to the Booklist for Part IB Courses for references to this module, this can be found on the associated Moodle course.

## Examination Guidelines

Please refer to [Form & conduct of the examinations](#) [6].

Last modified: 07/11/2020 17:21

**Source URL (modified on 07-11-20):** <https://teaching.eng.cam.ac.uk/content/engineering-tripos-part-ib-sustainable-engineering-2020-21>

## Links

[1] <mailto:cyb1@cam.ac.uk>

[2] <http://www.withbotheyesopen.com>

[3] <http://www.withouthotair.com>

[4] <https://www.citivelocity.com/citigps/rethinking-plastics/>

[5] <http://www.ipcc.ch/>

[6] <https://teaching.eng.cam.ac.uk/content/form-conduct-examinations>