

BCME01: Energy in the 21st century (powering the Anthropocene).

Co-ordinator: Assoc. Prof. Craig Meskell (cmeskell@tcd.ie)

Semester 2

Maximum Capacity: 30 students

Module Learning Aim:

This module will critically assess the options for producing energy in the context of climate change.

Module scope:

Human activity fundamentally changes the characteristics of the planet on which we live in a way that until recently could only happen through cataclysmic natural events. Our individual and collective preferences, aspirations and past decisions change large scale land use from forest to barren concrete; flatten mountains; flood valleys; divert rivers and wind patterns; consume aquifers; acidify the ocean; and ultimately we change the climate. This era has been called the Anthropocene. Energy use is a key enabler of civilization, so it acts as a driver for these changes indirectly (for example, ready availability of cars encourages urban sprawl) and directly through greenhouse gas (GHG) emissions, for example.

Many believe that the risks of climate change are so significant that it is imperative that GHG emissions are dramatically reduced. About 2/3 of emissions are due to energy generation and conversion. In 2014 over half of all global electricity generation was based on fossil fuel. Less than 5% used wind and solar. But that's up from less than 1% in 2004. It is not clear that the trend towards low carbon power generation is inexorable. There are many questions which are hotly contested. What are the practical limits of particular low carbon technologies? How much energy do we need? Is there enough oil/gas left? Can electricity replace oil/gas for transport and heating? How expensive is renewable power and is it a price that people can afford? What happens when the wind doesn't blow, or at night when solar cells don't work? The question of how the global community, and we in Ireland, should generate power for our sophisticated, comfortable, liberal civilization is a cross-disciplinary question, touching on economics, earth science, physics, sociology, even morality. But converting an energy source into a useable power supply at a large enough scale to transform a society is an engineering task.

This course is not about the geology of resource depletion, although that is a constraint on energy supply. This course is not about socio-economics, although this represents the competing objectives of energy availability. This course is not about climate change or policy, although this is the context and driver for the changing energy mix. We will discuss the possibilities of power generation technologies that will be available in your lifetime, from a practical engineering view point with regard to those other considerations. We will explore how wind, solar, nuclear, tidal, wave and even fossil fuel power sources work. This course is about the performance of machines and technology. We will use engineering ideas and analysis, but it will not be very mathematical – there will be a few equations and physics ideas, but not many. Junior Cert level maths and science is all we need.

Learning outcomes: At the end of this module you will be able: to quantify the scale of the energy supply and demand task; to describe and compare various power generation technologies; to estimate the potential contribution of a particular technology.

Assessment: This module will be delivered in Semester 2 and will be assessed with a combination of assignments (50%) and a final exam (50%).