



Energy in the 21st Century

Module Coordinator

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What will you learn from this Elective?

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. About ½ of energy use is based on electricity, but this share must grow if energy supply is to be decarbonized. It is not clear that the trend towards low carbon electrical power generation is inexorable. There are many questions which are hotly contested. What are the practical limits of specific low carbon technologies? How much energy do we need? How expensive is low carbon 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. We will discuss the possibilities of power generation technologies that will be available in your lifetime, from a practical engineering view point considering the social, economic and environmental constraints. We will explore how wind, solar, nuclear, tidal and even fossil fuel power sources work. This course is about the performance of machines and technology in the energy sector.

Student Workload

114 hours student effort:

- Lectures: 24 hours
- Assignments: 40 hours
- Reading & study: 50 hours

Assessment Components

- 1) A 2 hour exam during the end of semester session. This exam is 25 short questions drawn from a pool of approximately 150, the style and content of which you will be familiar with from the online self assessment MCQ. (50%)
- 2) There are 3 computer based assignments (50%).

Indicative Reading List

- David J.C. MacKay, Sustainable Energy – without the hot air. ISBN 978-0-9544529-3-3.
- Online tool to make a plan to decarbonize Ireland's energy supply.
- Clack, C.T.M., et al., Evaluation of a proposal for reliable low-cost grid power with 100% wind, water, and solar. Proceedings of the National Academy of Sciences of the United States of America, 2017. **114**(26): p. 6722-6727.
- Jacobson, M.Z., et al., Low-cost solution to the grid reliability problem with 100% penetration of intermittent wind, water, and solar for all purposes. Proceedings of the National Academy of Sciences of the United States of America, 2015. **112**(49): p. 15060-15065.

Learning Outcomes

At the end of this module you will be able:

1. to quantify the scale of the energy supply and demand task in Ireland and globally;
2. to state the conflicting drivers of energy policy (i.e. the energy trilemma);
3. to appreciate the significance of energy and power units;
4. to describe and compare various electrical power generation technologies;
5. to estimate the potential contribution of a particular technology.
6. to think critically about the necessary trade-offs when choosing one technology or another.