A one-year taught Master's programme

MPhil in Engineering for Sustainable Development

For details see: www-esdmphil.eng.cam.ac.uk

UNIVERSITY OF CAMBRIDGE
Department of Engineering

Department of Engineering
Centre for Sustainable Development


Global challenges
"This is not an engineering degree but a course for engineers which fills in all the missing pieces."
Former MPhil student
Environmental limits
People
Change
Complex systems

Engineering for Sustainable Development is about recognising that engineers have to operate within an increasingly complex set of constraints, and therefore must be capable of dealing with a range of challenges. The subject is based on some very straightforward principles.

It is about living within Earth's finite limits and resources, helping everyone on the planet to achieve an acceptable quality of life, acting as stewards of the environment for future generations, and dealing with complexity and handling the many trade-offs that have to be made.

Our students are drawn from all over the world and bring with them a wealth of experiences and ideas. A key benefit of joining the course is the opportunity to collaborate, now and in the future, with this group and to gain insights into a number of different perspectives.

Those who join us will benefit not just from the MPhil and the modules offered in the Engineering Department, but also from the wide range of enriching activities and events that are available across the University. We look forward to working with you to make the most of your time at Cambridge.

Dr Dai Morgan
Course Director

The Course Team

Dr Dai Morgan
Course Director

Dr Morgan is Course Director for the MPhil in Engineering for Sustainable Development. His general research interests include:

- Design, manufacturing and sustainable development
- Systems perspectives on sustainability.

Dr Kristen MacAskill
Assistant Professor

Dr MacAskill is an Assistant Professor in Engineering, Environment and Sustainable Development. Her general research interests include:

- Infrastructure resilience
- Disaster risk management and governance.

Dr André Cabrera Serrenho
Assistant Professor

Dr Cabrera Serrenho is an Assistant Professor in Engineering, Environment and Sustainable Development. His general research interests include:

- Energy and material systems
- Climate change mitigation.

What is Engineering for Sustainable Development?

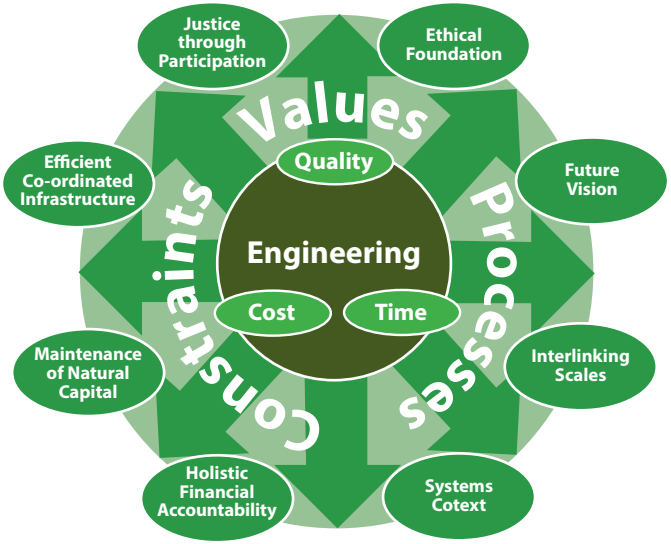
Engineering for sustainable development means:

- *Dealing with **complexity** ... through adopting a systems approach;*
- *Dealing with **uncertainty** ... when decision-making in the absence of complete information or evidence;*
- *Dealing with **change** ... by challenging orthodoxy and envisioning the future;*
- *Dealing with **other disciplines** ... through building multidisciplinary teams;*
- *Dealing with **people** ... through consultation processes and negotiation to meet society's and individuals' needs;*
- *Dealing with **environmental limits** ... through seeking efficient resource use, ensuring pollution control and maintaining ecosystem services;*
- *Dealing with **whole-life costs** ... by considering environmental and social externalities and embracing life-cycle management; and*
- *Dealing with **trade-offs** ... by avoiding optimisation around a single variable or viewpoint to create solutions acceptable for all.*

The MPhil at Cambridge University embodies these themes and adds the following as essential to engineers' ability to tackle the issues facing the modern world:

- *Understanding **mechanisms for managing change** … so future engineers are equipped to play a leadership role; and*
- *Acquiring **innovation and business skills** … as precursors to successful implementation of solutions.*

A Sustainable Framework for Engineers



Engineering for Sustainable Development broadens the 'design space' for engineering decision-making beyond the traditional drivers of *cost*, *quality*, and *time* to incorporate:

- Consideration of the economic and social factors that apply in the prevailing circumstances;
- Careful balancing of costs and benefits; and
- Equity and ethical questions about the distribution of these costs and benefits, now and in the future.

The MPhil in Engineering for Sustainable Development at Cambridge explores the context in which engineering activity must take place.

At its simplest, the course aims to encourage you to **ask better questions when formulating problems** and to have the confidence to critically examine conventional solutions and formulate new approaches within the increasing number of constraints that engineering activity has to satisfy. Our overall objective is to **challenge some of your thinking**, which may be uncomfortable at times, but in doing so we intend to provide you with the additional breadth to your education you will need to deliver engineering products and services in a more effective and sensitive way.

We do not attempt to teach 'technical solutions' to a narrowly defined set of current sustainability issues. We believe it is vital that engineers be encouraged to focus attention on the outcomes of their work, and how it meets clearly defined needs, rather than simply on delivering outputs.

Figure source: Fenner R and Ainger C (2020) A review of sustainability in civil engineering: why much more commitment is needed. Proceedings of the Institution of Civil Engineers – Civil Engineering 173(2): 69–77, https://doi.org/10.1680/jcien.19.00036

About the Programme

The MPhil in Engineering for Sustainable Development at Cambridge is a one-year, full-time professional practice programme designed for students from an engineering background. Launched in 2002, the course recruits around 30 to 40 students annually.

The MPhil programme is structured in a way that allows individual students to tailor their studies to suit their own interests and experience. Much of the material studied is selected by students from elective topics ranging from key technologies to policy and management issues. Students can also tailor their individual research dissertations to suit their own interests and experience.

Dissertation projects can involve working with companies, government agencies and other organisations and often produce work that is subsequently published in peer-reviewed technical journals.

Who should apply?

The course is a professional practice programme designed for students from an engineering background.

Applicants are required to have a first or good upper-second class UK honours degree in an engineering, science or related quantitative discipline, or an equivalent standard from an overseas university, and preferably some postgraduate work experience in the engineering industry.

What do graduates go on to do?

ESD alumni go on to a range of roles in the majority world and beyond. Some enter engineering roles in industry whilst others join non-governmental organisations or consultancies or take on government roles. Whilst we do not directly feed into a specific PhD programme, a number of students go on to further study in academia.

How to apply

Details of how to apply can be found at:
www-esdmphil.eng.cam.ac.uk/prospective-students/how-to-apply

MPhil Programme Structure

For details see: www-esdmphil.eng.cam.ac.uk/about-the-programme/prog-structure

Please note that the programme structure is subject to annual review and amendment.

Core Modules

All students study four core modules. These focus on developing a breadth of skills and understanding that complements the technical background of the participants.

Two of the core modules deal respectively with qualitative and quantitative aspects of engineering sustainability.

Driving Change Towards Sustainability investigates the ideas behind sustainable development that are relevant to engineers, including ethical issues, managing change within industry and dealing with multiple stakeholders.

Sustainability Methods and Metrics introduces such tools as life cycle analysis, systems dynamics, multi-criteria analysis, ecosystem service valuation, environmental economics, agent-based modelling and social science research methods.

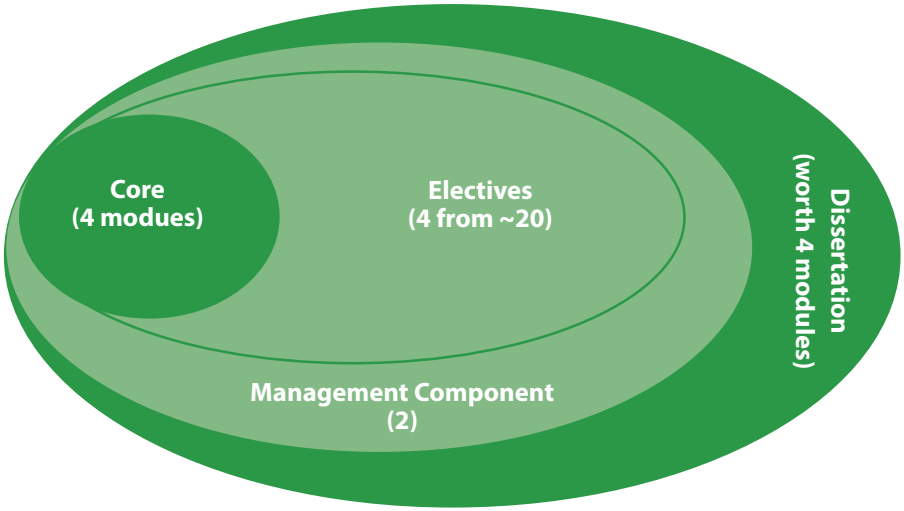
The remaining core modules go deeper into specific aspects of the sustainability agenda.

Resilience of Infrastructure Systems looks at engineering development with an understanding that infrastructure developed today needs to be able to deliver services for an uncertain future.

Innovations in Sustainable Design and Manufacturing considers how to guide innovation towards more sustainable outcomes. It explores manufacturing, design and business model perspectives and identifies contemporary issues in the field.

Management Component

The Management component comprises a taught module and a team-based client consultancy project (CCP). The taught module covers a range of Stakeholder Engagement activities. The CCP, which takes place in Lent term, provides the opportunity to engage with external organisations.



Elective Modules

Students choose four elective modules from among those offered by the MPhil. Examples of available modules are listed below.

Please note that the elective modules offered will change from year to year.

From the Centre for Sustainable Development

- International Development
- Policy, Legislation and Government

From the Engineering Department

- Accounting and Finance
- Architectural Engineering
- Biomimetics
- Business Innovation in a Digital Age
- Climate Change Mitigation
- Construction Engineering
- Contaminated Land and Waste Containment
- Electricity and the Environment
- Energy Systems and Efficiency
- Innovation and Strategic Management of IP
- International Business
- Management of Technology
- Renewable Electric Power
- Renewable Energy: Solar and Biofuels
- Renewable Energy: Wind, Wave, Tidal and Hydro
- Strategic Management

From the Judge Business School

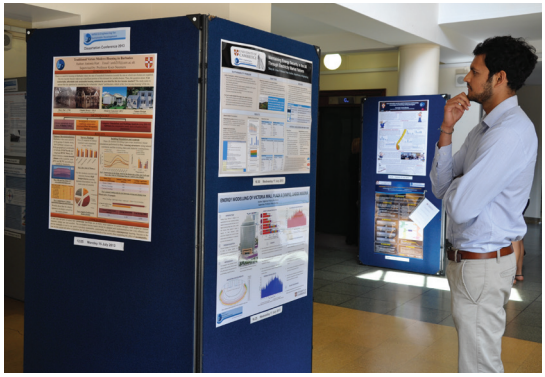
- Business, Government and Technology in Emerging Markets
- Managing the Innovation Process
- Negotiation Skills
- Technology Policy: Concepts and Frameworks
- Uncertainty and Real Options in System Design

From other University Departments

- Sustainable Architecture and Urban Design

Individual Research Dissertation

For abstracts of previous dissertations see:
www-esdmphil.eng.cam.ac.uk/about-the-programme/dissertations



The MPhil Dissertation takes place between May and August and provides an opportunity for in-depth study of a topic of individual interest to each student.

A progress report on each student's research is presented at the Dissertation Conference in mid-July. This is followed by the Annual Course Dinner, a formal College event, which also welcomes alumni of the programme back to Cambridge.

Examples of topics completed recently include:

- A systems analysis of the sustainable development goals: Risk, tipping points, and critical dependencies
- Guiding sustainable medical device design for low-resource settings
- Sustainability assessment of a single-use plastics ban
- Solid waste pollution in Lagos, Nigeria: An analysis of the social, technical and economic barriers to market-driven solutions
- The effect of racially segregated urban form on social equality: A spatial study of Cape Town, South Africa
- London's future drainage and wastewater: Valuing wider benefits of adaptation options
- Urban resilience in post-disaster recovery: A case study on the 2015 Nepal earthquake
- Holistic mapping of the New Zealand energy and emissions systems to assess mitigation opportunities

Other Features of the MPhil

Role Plays and Simulation Games

Residential Field Courses

Site Visits

Change Challenges

Weekly Seminar Discussions

Practitioner Viewpoint Series and Guest Lectures

How to Apply

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