



Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin



MSc in Energy Science

Learning Affiliate of the Energy Institute



90 Credits

Full time over 12 months

Part time over 24 months



Energy science is a broad, modern, inter-discipline essential to the global way of life in the 21st century and beyond. Energy science encompasses the essential aspects of physics, chemistry, geology, engineering and business that pertain to the generation and utilisation of energy.



About the Degree

The connection between physics, chemistry, earth science, engineering and economics determines how energy is utilised, the environmental consequences of its use, and in turn determines many government policies across the globe.

A working understanding of each of these areas is necessary for students inspired to pursue a career in the energy sector, or for those interested in communicating or managing the environmental impact of the world's energy use, such as climate change.

The syllabus covers Energy Economics and Policy, Natural Resource Management, Fossil & Nuclear Energy, Conventional Energy Conversion Devices, Sustainable Energy Technologies, Electricity & Power Electronics, and Mitigation of the Environmental Impact of Energy Utilisation. Each topic starts from the fundamental scientific principles and develops to the actual engineering implementations.

Course Structure

The curriculum is designed to allow students from science, engineering, and related disciplines with relevant experience, to gain the scientific knowledge needed to contribute to the energy sector. This can be through industry, business, academia, government policy or media communication.

Students will examine the fundamental and applied science of how energy resources could be diversified from conventional polluting sources (e.g. CO₂, NO_x, SMOG) to renewable sources, where the sustainability of both the energy source and the conversion technology is presently unknown.

Introduction to Energy Science	Lecture Hours
Context and Philosophy of Energy Science	2
Environmental Impact of Energy Utilisation	12
Economics of Energy & Energy Regulation & Policy	15
Thermodynamics, Reaction Kinetics and Heat Transfer	12
Energy Storage Electromagnetism	12
Materials for Energy Applications	7
Total	60



Core 1: Conventional Energy Sources & Technologies	Lecture Hours
Fossil fuels, Combustion, Engines & Emissions	25
Nuclear Reactions, Materials & Reactor Technology	15
Total	40

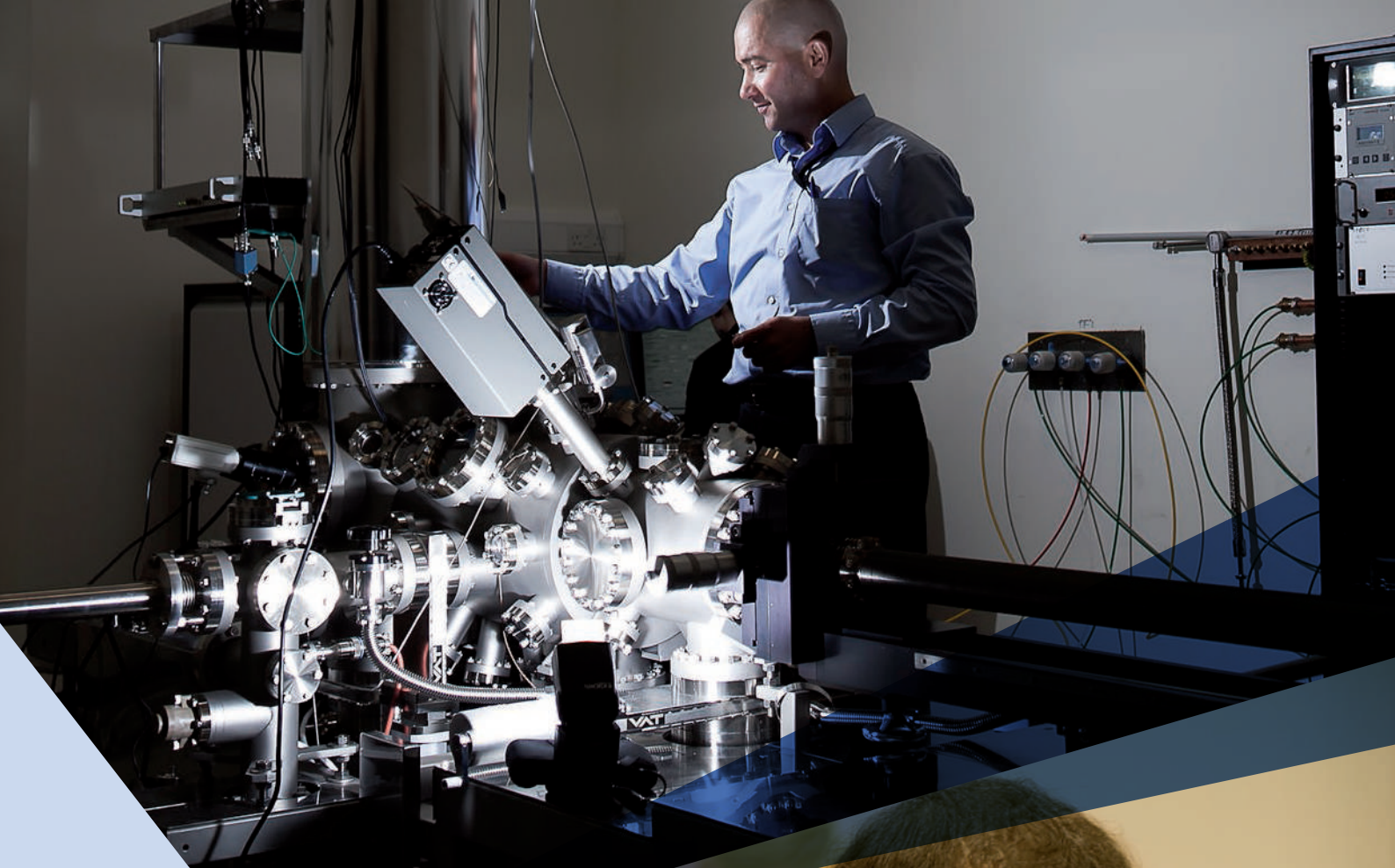
Core 2: Sustainable Energy Sources & TechnologiesI	Lecture Hours
Electrochemical Cell Technology	14
Photovoltaics	13
Carbon Dioxide Capture & Storage	13
Total	40

Core 3: Electric Power Generation & Distribution	Lecture Hours
Power Systems, Analysis & Smart Grids	20
Electric Machines & Power Electronics	20
Total	40

Core 4: Sustainable Energy Sources & Technologies II	Lecture Hours
Biofuels, Biomass & Hydrogen	18
Wind Energy Generation & Storage	22
Total	40

Core 5: Managing the Impact of Energy Utilisation	Lecture Hours
Raw Materials & Natural Resource Management	15
Techniques for Quantitative Analysis & Characterisation of Energy Critical Raw Materials	15
Nuclear Safety & Environmental Impact	10
Total	40

Research Project in Academia or Industry
15 Weeks Full-Time







Syllabus Summary

Introduction to Energy Science: Essential Science and Economics for Energy

A cross-cutting introductory module is designed to furnish students with all of the basic physics, chemistry and engineering concepts that are required to become an “Energy Scientist”. These basics complement an introduction to the essential “**Economics of Energy**” and “**principles of Energy Policy**” which will allow students to understand the compatibility of energy technologies with market uptake arguments.

Syllabus: Economics of energy, energy policy & regulation, essential thermodynamics, reaction kinetics and heat transfer, fundamentals of electromagnetism, materials for energy applications, greenhouse gases and the carbon cycle.

Armed with all of the essential science, engineering and economics pertinent to the energy discipline, the students proceed to **five specialised modules**;

1. **Conventional Energy Sources & Technologies:** Fossil fuels, Combustion, Engines & Emissions and Nuclear reactions, Nuclear materials & Reactor Technologies
2. **Sustainable Energy Sources & Technologies I:** Electrochemical Cell technology, Photovoltaics and Carbon Capture & Storage
3. **Electric Power Generation & Distribution:** Power Systems, Analysis & Smart Grids and Electric Machines & Power Electronics
4. **Sustainable Energy Sources & Technologies II:** Biofuels, Biomass & Hydrogen and Wind Energy Generation & Storage
5. **Managing the Impact of Energy Utilisation:** Raw Materials & Natural Resource Management, Nuclear Safety & Environmental Impact
6. **15-week research project** in industry or academia on energy-relevant topic

Career Opportunities

The cost of energy is a dominant factor in determining the profitability of any manufacturing business. Large multi-national companies are therefore very concerned by the efficiency and sustainability of their energy usage, as are government organisations.

Ireland and the other European Union member states are the international leaders in energy efficiency and energy sustainability. EU’s Green Deal aims to make EU carbon-neutral by 2050. The energy innovations that will deliver this target will be underpinned by graduates strong in the discipline of energy science.

Because of this, graduates who understand the scientific factors that determine these “Energy Bottom Lines” are in high demand. In addition to environmental and energy regulating authorities, graduates of the MSc in Energy Science have knowledge and skills directly applicable to a host of energy orientated industries, including; power generation and distribution; electronics, automotive, aviation, construction and oil & gas. For graduates interested in academic research, the societal pursuit of clean and secure Energy is at the heart of the research agenda of every major country.

Irish Visa – Third Level Graduate Programme

Under the Third Level Graduate Scheme the Irish Government allows both EU and non-EU/EEA students obtaining a MSc in Energy Science 24 months to seek employment in Ireland.

Top-10 reasons to study an MSc in Energy Science at Trinity College Dublin...

1. Dating back to 1592, Trinity College Dublin is one of the world's leading universities, and is recognised internationally as Ireland's premier university. (QS University Rankings).
2. Trinity is also recognised as one of the world's leading research – intensive universities, many of our MSc Energy Science teaching staff are world leaders in their fields.
3. Dublin has a strong energy relevant industry with many energy intensive multinational companies located close by including; 24 of the world top 25 world pharmaceutical and biotechnology companies and 9 of the world top 10 ICT companies. All of these businesses are energy intensive and have an economic necessity to manage their energy utilisation effectively.
4. The MSc is hosted across the Schools of Physics, Chemistry, Geology and Engineering. This gives our students an unmatched **interdisciplinary ability** to understand all of the scientific and technological issues related to energy science.
5. Dissertations from our postgraduate courses are showcased every year and students discuss their research results with guests from the public sector, business, and industry offering opportunities for recruitment, networking and further collaborations.
6. Graduates of Trinity are highly sought after. Our direct links with industry and research sponsors facilitate the employment and career development of our graduates.
7. Trinity is one of the most successful colleges in Europe for fostering entrepreneurship. Trinity is also the top University in Europe for entrepreneurial graduates who have raised venture capital.
8. Trinity contains large international scale research centres co-funded by Irish and European governments in addition to Industry.
9. Dublin is a **global capital of culture**, Trinity is located in the very centre of this vibrant, multi-cultural city and is a very attractive location for student life, scholarship and for learning and practicing the English language.
10. Dublin is a **gateway to all European cities**.



Comments from Energy Science Alumni

"I've been able to study under some world-renowned professors in lecture theatres which once hosted famous scientists such as Ernest Walton and Erwin Schrodinger. I've used some of the most advanced microscope imaging equipment in the country."

Robert now works for ElectroRoute, providing access to the live Irish power market where he trades on the behalf of power generation companies.

Robert Smyth
Energy Science Alumni



"In short, I just enjoyed every bit of Ireland and Trinity. I have felt always at ease here at Trinity. The professors were understanding, motivating, humble and importantly profound and exceptional in their respective fields. The campus of Trinity with its own unique beautiful charm and grandeur, made my study-life just so relaxing and enjoyable. The city of Dublin just multiplies these positives with the welcoming, courteous, helpful and cheerful people all around."

Vishnu now works at the Secretariat of the United Nations Framework Convention for Climate Change (UNFCCC), based in Bonn, Germany.

Vishnu Nair
Energy Science Alumni



"I really liked the wide range of topics on the Energy Science course – it gave me a great understanding of the industry as a whole. I now work in electricity trading for a company which builds grid-scale lithium-ion batteries."

Selina Paxton
Energy Science Alumni



"Energy Science is an interdisciplinary project involving chemistry, physics, economics, etc. The students in the class all have different backgrounds, so we were able to share our ideas on an eco-future from multiple viewpoints and cultures."

Weiming Liu
Energy Science Alumni



"I enjoyed the fact that other subjects besides physics were included in the course such as geology and chemistry. Covering a broad range of aspects about the different technologies and sciences associated with the energy sector has helped me to have a non-biased opinion for the future energy market."

Sarah O'Halloran
Energy Science Alumni



Entry requirements

This MSc is suitable for graduates who have achieved an upper second class honours degree or the international equivalent in either physical sciences or engineering. However, applications from similarly qualified candidates from other disciplines are welcome if they can demonstrate a sufficient level of knowledge or interest in the Energy sector.

Application Procedure

Applications will be accepted until June 30th. Final decisions on all applications will be made by the July 31st. However as entry to the MSc in Energy Science is highly competitive, early application is advised and opens in early November.

Your application should consist of the following documents

- ▶ Cover letter outlining your interest in the degree.
- ▶ Curriculum Vitae.
- ▶ Transcript of academic results.
- ▶ Copies of degree certificates.
- ▶ Contact details of two academic references.

If English is not your first language, you should also include documentation showing reasonable competency in the English language. Applicants whose first language is not English or who have not completed their undergraduate degree through the medium of English are welcome but may be required to demonstrate their English through an assessment or interview with the Course Director prior to a final decision on admission. Trinity's English language requirements are available at www.tcd.ie/study/apply/admission-requirements/postgraduate/



The University may request additional documents. Guidelines on how to complete the application form as well as the additional documents that must accompany an application are available from the www.tcd.ie/courses/postgraduate/how-to-apply/. Please note that in some cases where there are pending documents, excellent candidates may be made a Conditional Offer.

Most candidates are typically informed of the decision on their application within three weeks following the receipt of the complete application.

Prospective students should contact the course director at the details below.

Contact us:

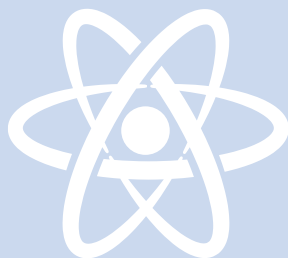
Email: energyscience@tcd.ie

Website: www.tcd.ie/courses/energyscience/

Telephone: +353 1 896 2019

Course Fees

The fee levels for the current academic year are available at www.tcd.ie/academicregistry/fees-and-payments/



International Accreditation

The MSc in Energy Science expects to be accredited by the Energy Institute in 2019. While the accreditation assessors are performing their examination, the MSc Energy Science enjoys full member benefits as a Learning Affiliate of the Energy Institute.

The Energy Institute

The Energy Institute (EI) is the international professional body for the energy industry, developing and sharing knowledge, skills and good practice towards a safe, secure and sustainable energy system. The EI supports over 23,000 individuals working in or studying energy and 250 companies worldwide, providing learning and networking opportunities to support professional development, as well as professional recognition and technical and scientific knowledge resources on energy in all its forms and applications. The EI is licensed by the Engineering Council (UK) to offer Chartered, Incorporated and Engineering Technician status to engineers, the Science Council to award Chartered Scientist status, and also licensed by the Society for the Environment to award Chartered Environmentalist status. These opportunities will be available to student of the MSc Energy Science

Learned Lecturers

The lecturers of the MSc Energy are all either members of the Energy Institute and/or members of other international organisations in their discipline such as the Royal Society of Chemistry, America Chemical Society, Institute of Physics, The Combustion Institute, American Society of Mechanical Engineers and others.



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