



ELEC9714 Electricity Industry Planning and Economics

Course Staff

The primary course coordinator and lecturer is:

Dr Iain MacGill

Joint Director (Engineering), Collaboration on Energy and Environmental Markets (CEEM)

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Also, providing some key coordination support will be **Dr Navid Haghdad**

Consultations: You are, of course, encouraged to ask questions on the course material during the lectures. Iain will be available for additional consultation on the lectures, assignments and projects before, during and after lectures, or by appointment (arranged at lectures or by email). There will also be a number of discussion forums on the course Moodle for questions regarding logistics, lecture materials and assessment tasks. Please always check here first to see if your question has already been asked and answered, and to post your question if you think it is relevant to other students. Scheduled consultation times for the assignments and projects will be advised during lectures, and on the course *Moodle*. Note that ALL email enquiries must be made from your student email address with ELEC9715 mentioned in the subject line. I am unlikely to reply to emails that do not meet these requirements. Please note that Iain is not available for consultations without an appointment.

Keeping informed: Announcements may be made during classes, via email (to your student email address) and/or via online learning and teaching platforms – in this course, we will use Moodle <https://moodle.telt.unsw.edu.au/login/index.php> and MS Teams. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

Course Summary

Contact Hours

As a post-graduate offering, the course consists of 4 hours of lectures each week from weeks 1 to 9. The last week of term will involve student seminar presentations. There are no formal tutorials or laboratories. However, there may be tutorial like sessions within some of the lecture slots. Consultation periods prior to the submission of assignments will be offered – further details will be provided over the term. The provisional syllabus of these weekly lectures is outlined below. Lectures will be via MS Teams running over two hours on Monday and Wednesday. Note that there will be several occasions where the lectures will be run at different times to these due to several schedule clashes. These changed times will be advised via Moodle. All the lectures will be recorded.

Lectures	Day	Time	Location
	Monday	2-4pm	Online via MS Teams
	Wednesday	2-4pm	Online via MS Teams and/or in-person

Context and Aims

The purpose of this course is to introduce students to the main issues involved in electricity industry planning and economics – that is, decision making approaches and methods to meet longer-term industry objectives. This will be considered in the context of both traditional monopoly utility run power systems, and the restructured market-based industries now becoming more common worldwide. Furthermore, it will also explore the challenges and opportunities that renewables and distributed energy resources bring to these issues.

Indicative Lecture Schedule

WEEK	ON-LINE LECTURES	Class tasks
1	Introduction to the electricity industry and electricity industry restructuring. Introduction to key data sources, data tools, modelling and analysis tools	Student surveys and quiz tasks.
2	Decision making in planning and investment Centralised and decentralized decision making frameworks – techniques for integrated resource planning and price setting	Quiz tasks [out] Information on group projects and possible topics
3	Market prices and financial instruments – their role in the electricity industry for investment.	Quiz tasks [out] Assignment 1
4	Australia’s restructured electricity industry, National Electricity Market design, performance	Quiz tasks Group project topics finalized
5	Network economics, planning and investment	Quiz tasks [in] Assignment 1
6	Flexibility week	Project Consultations and revision [out] Assignment 2
7	Renewable energy economics and investment	Quiz tasks
8	Retail Market design and end-user decision making the electricity industry	[in] Assignment 2
9	Sustainable energy futures – future challenges and options for the NEM and electricity industries around the world	Quiz tasks
10	<i>Student group project presentations – presented in MS Teams</i>	Presentation into Moodle before seminars [out] Exam prep. guidance
11		Project group wikis finalized and reports due week 11

Assessment

Assessment activity	Assessment (%)
Group project reports on an agreed topic	15
Group student wikis and seminars	5
Individual student participation in surveys, forums, wikis, quizzes	10
Individual student assignments during the term	20
Final exam (2 hours)	50

COVID19 - Important Health Related Notice

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by [NSW health](#) or government authorities. Current alerts and a list of hotspots can be found [here](#). **You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate.** We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed.

If you are required to self-isolate and/or need emotional or financial support, please contact the [Nucleus: Student Hub](#). If you are unable to complete an assessment, or attend a class with an attendance or participation requirement, please let your teacher know and apply for [special consideration](#) through the [Special Consideration portal](#). To advise the University of a positive COVID-19 test result or if you suspect you have COVID-19 and are being tested, please fill in this [form](#).

UNSW requires all staff and students to follow NSW Health advice. Any failure to act in accordance with that advice may amount to a breach of the Student Code of Conduct. Please refer to the [Safe Return to Campus](#) guide for students for more information on safe practices.

Course details

Credits

This is a 6 UoC course and the expected workload is around 12-15 hours per week throughout the 10 week term. As noted below, most of this time must be self-directed learning.

Relationship to Other Courses

This is a postgraduate course in the School of Electrical Engineering and Telecommunications. The course is available in the following programs: Master of Engineering Science; Doctor of Philosophy in Engineering, Master of Engineering and Bachelor of Engineering (4th Year Elective substitution). Students undertaking other courses may also be permitted subject to agreement with the School of Electrical Engineering and Telecommunications, and the Course Coordinator.

The companion course, *ELEC9715 Electricity Industry Operation and Control* explores presents decision making approaches and methods to meet shorter-term industry objectives through appropriate operation and control of existing, in place, power system equipment. These courses can be taken separately, or in either sequence. This course replaces the old *ELEC9201 Power System Planning and Economics*.

Pre-requisites and Assumed Knowledge

Although this subject has no formal prerequisites, it is assumed that each student has a basic working knowledge of power systems, and the electricity industry more generally. A number of texts are available for students whose undergraduate training did not include this type of material, or who feel that they require revision. Please contact the lecturer to discuss if you have questions regarding this matter. It is further assumed that students are familiar with Standard Office software tools including Excel, Word and Powerpoint (or equivalents).

Following Courses

The course is not a pre-requisite for other courses at UNSW. However, it does have close links to its companion course, *ELEC9715 Electricity Industry Operation and Control*, as detailed above. There is some cross-over between the two courses but they are also carefully designed to complement each other whilst not requiring that you take them in sequence, or take both of them.

Learning outcomes

After successful completion of this course, you should be able to:

1. Understand the fundamental objectives, constraints and concepts of electricity industry planning, economics and investment.
2. apply basic conventional 'optimal generation mix' planning techniques to simple electricity industry investment problems
3. describe the implementation of electricity industry planning and investment in a restructured industry context including the role of energy spot and derivative markets
4. apply basic models of electricity markets to simple restructured electricity industry problems involving operation and investment.
5. appreciate how electricity industry restructuring, technology development and environmental concerns are changing the way in which electricity industry planning, economics and investment is defined and undertaken
6. describe the opportunities and challenges that emerging distributed energy resources pose for future electricity industry planning, economics and investment.

This course is designed to provide the above learning outcomes which arise from targeted graduate capabilities listed in **Appendix A**. The targeted graduate capabilities broadly support the UNSW and Faculty of Engineering graduate attributes (listed in **Appendix B**). This course also addresses the Engineers Australia (National Accreditation Body) Stage I competency standard as outlined in **Appendix C**.

Syllabus

The nature of the electricity and gas industries; climate change and the electricity industry; objectives & options for restructuring; insights from electricity pricing theory; wholesale electricity market design; Australia's restructured electricity industry; National Electricity Market design & performance; the role of electricity networks in a restructured electricity industry including market representation, network pricing and network regulation; ancillary services; design & implementation of retail electricity markets; electricity industry regulation.

Teaching Strategies

Delivery Mode

The teaching in this course aims at establishing good fundamental understandings of the areas covered via:

- Formal lectures, which provide you with a focus on the core analytical material in the course, together with qualitative, alternative explanations to aid your understanding. These will be online in MS Teams. Some of these lectures will have tutorial style components with the opportunity for either online or in-class participation.
- A number of guest lectures from industry and research experts
- Small periodic Quizzes during the lectures to test your understanding of the material, and explore your views on key issues, challenges and opportunities for electricity industry planning and economics

Learning in this course

You are expected to attend the on-line lectures in order to maximise learning. In addition to the lecture PowerPoints, you should read relevant sections of any recommended texts and other materials. Reading additional texts and reports will further enhance your learning experience. Group learning is also encouraged. UNSW assumes that self-directed study of this kind is undertaken in addition to attending classes throughout the course.

The on-line lectures will make extensive use of PowerPoint slides and a range of activities. Summary PowerPoint printouts will be provided on the course MS Teams / Moodle website. Additional information and reading materials will also be progressively made available on Moodle, but they are no substitute for accurate notes, and active student participation through questions and informal exercises during the on-line. It is also intended that you will be provided with access to a number of on-line data sources for the Australian National Electricity Market.

Indicative Lecture Schedule

Note that the schedule provided above is provisional at this stage and may be updated during the session. You should attend lectures and regularly check the course *Moodle* website for possible updates. Note that there may be tasks (non-assessable) to undertake on *Moodle* each week as well – be sure to keep up to date with developments. A number of guest lectures may also be included in the second half of term.

Assessment

The assessment scheme in this course reflects the intention to assess your learning progress through the term. Assessment will consist of a group report on an agreed topic related to material covered in the course; a group wiki and project seminar to the class, various class participation activities, class assignments taken individually and the final exam. **Satisfactory performance in both the class-based assessment and examination is required to pass this course.**

Assignments

The assignments allow self-directed study leading to the solution of partly structured problems. Marks will be assigned according to how completely and correctly the problems have been addressed and the understanding of the course material demonstrated by the report. These assignments must be undertaken by students individually. It is expected that there will be two such assignments during the term. Provisional dates for assignment distribution and submission are provided in the course syllabus.

Project report and wiki

The project will involve students in an activity suited to their interests and skills in the area of electricity industry planning and economics. Groups of three students are very strongly preferred, although smaller or larger groups may also be permitted if and as appropriate – groups and topics must be approved by the course coordinator. In particular, students undertaking a fourth year engineering thesis or post-graduate research thesis should not choose an ELEC9714 project topic that closely relates to their other thesis research. Similarly, students are strongly encouraged not to choose a project that closely relates to any other projects that they have undertaken – for example, in elec9715 or other electricity industry related courses such as SOLA5053. The intent of these group elec9714 projects is to expose you to electricity industry planning and economics issues other than those you might already have already worked on, or are currently working on.

Projects will either focus on

- development and testing of a simple software, spreadsheet or Matlab power system modelling and optimisation tool, or
- an in-depth literature survey of some aspect of electricity industry planning and economics (around 5000 words plus tables, diagrams, references etc.).

More information on these projects and suitable topics will be distributed in week 2 and project topics are to be negotiated and finalised by week 4. Details on the formal requirements for the project reports will also be provided at this time. It should contain a significant review of the literature relevant to the topic and a comprehensive bibliography. All source material must be adequately referenced in the body of the report and it is expected that there will be 25 or more scholarly references in a literature survey. It is also required that the project will include some quantitative analysis of actual electricity industry data. The report will be assessed on the quality of the content and presentation.

Each group is also required to establish a wiki on Moodle and use this to communicate their project work and findings with other students taking the course. It is envisaged that you will post early discussions regarding your topic and host a question forum where other students can come and ask questions or provide comments. You will also need to prepare a slide pack and are invited to undertake additional communication activities such as brief videos. You will also have a chance present a project seminar project in week 10 – a short presentation on how your particular topic is relevant to the future of the electricity industry. If possible this will be a face-to-face activity although online participation will also be possible. **All students are required to attend all of these project seminar sessions and provide a peer mark for each group.**

Assessment of the wikis will be based on the quality and comprehensiveness of the materials and discussion with other students in the course, with extra marks for innovative communication strategies. Each student will receive an individual mark according to the quality and extent of engagement in other student group projects through the wikis, as well as other on-line activities over the term.

More details will be provided on the projects and wikis during the lectures, and on Moodle. *For all of the non-exam assessment tasks in this course, it is essential that you have a complete understanding of the UNSW official position on 'In-class assessment and plagiarism' as outlined below. Please note that there are severe penalties associated with plagiarism offences.*

Final Exam

The exam in this course will be a 2 hour written examination, comprising four compulsory questions, and marks split equally across short essay style questions testing your knowledge of the materials, and quantitative questions assessing your skills in solving relevant problems. University approved calculators are allowed. The examination tests analytical and critical thinking and general understanding of the course material. Questions may be drawn from any aspect of the course unless specifically indicated otherwise by the lecturer. Specific arrangements given the on-line presentation of the course will be advised when confirmed.

Relationship of Assessment Methods to Learning Outcomes

Assessment	Learning outcomes					
	1	2	3	4	5	6
Assignments	✓	✓	✓	✓	✓	
Group project, seminar and wiki	✓		✓	✓	✓	✓
Quizzes	✓	✓	✓	✓	✓	
Final exam	✓	✓	✓	✓	✓	✓

Course Resources

Textbooks

There is no assigned textbook for this subject. The more recent concepts relevant to electricity industry planning and economics in restructured industries are not easily found in textbooks. The UNSW library has a number of power system planning books dating from the 1960s to 1990s. Some of these have useful descriptions of traditional optimal generation mix techniques. However, they generally have very little to say about planning, economics and investment in restructured industries. There are several more recent books on electricity industry economics and markets including, notably, Stoft, 2002. Unfortunately it is rather US centric, as are most of the other books.

On-line resources

Instead of an assigned text book, regular updates and course materials will be added to the course Moodle website and MS Teams group. You should check both these sites frequently. Materials will include summary pdf versions of the lecture PowerPoints (also provided as printouts prior to each on-line lecture). A range of reports, papers and websites will be uploaded throughout the term to provide more background on electricity industry planning, economics and investment within the restructured Australian electricity industry, as well as internationally.

Another useful website is that of the UNSW Collaboration on Energy and Environmental Markets (CEEM) found at www.ceem.unsw.edu.au. It contains useful papers and presentations covering many of the topics that are explored during the course

Moodle and MS Teams

As a part of the teaching component, Moodle and MS Teams will be used to disseminate teaching materials, host forums and occasionally quizzes. On-line lectures will all be recorded. Assessment marks will also be made available via Moodle: <https://moodle.telt.unsw.edu.au/login/index.php>.

Announcements concerning course information will be given in the on-line lectures and/or on Moodle and/or via email (which will be sent to your student email address).

Other Matters

Dates to note

Important dates available at <https://student.unsw.edu.au/dates>

Academic Honesty and Plagiarism

Plagiarism is the unacknowledged use of other people's work, including the copying of assignment works and laboratory results from other students. Plagiarism is considered a form of academic misconduct, and the University has very strict rules that include some severe penalties. For UNSW policies, penalties and information to help you avoid plagiarism, see <http://www.lc.unsw.edu.au/plagiarism>. To find out if you understand plagiarism correctly, try this short quiz: <https://student.unsw.edu.au/plagiarism-quiz>.

Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see <https://my.unsw.edu.au/student/atoz/ABC.html>), particular attention is drawn to the following:

Workload

It is expected that you will spend around **12-15 hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including face-to-face classes where these run, online lectures and tutorials and *independent, self-directed study*. In periods where you need to need to complete assignments or prepare for examinations, the workload will be greater. Over-commitment is a common challenge for students. You should take the required course workload into account when planning how to balance study with employment and other activities.

Attendance

Regular and punctual attendance at all classes is expected. UNSW regulations state that if students attend less than 80% of scheduled classes they may be refused final assessment.

General Conduct and Behaviour

Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and students may be asked to leave the class.

Work Health and Safety

UNSW policy requires each person to work safely and responsibly, in order to avoid personal injury and to protect the safety of others.

Special Consideration and Supplementary Examinations

You must submit all assignments and attend all examinations scheduled for your course. You can apply for special consideration when illness or other circumstances beyond your control interfere with an assessment performance. If you need to submit an application for special consideration for an exam or assessment, you must submit the application **prior to the start** of the exam or before the assessment is submitted, except where illness or misadventure prevent you from doing so. Be aware of the “fit to sit/submit” rule which means that if you sit an exam or submit an assignment, you are declaring yourself well enough to do so and cannot later apply for Special Consideration. For more information and how to apply, see <https://student.unsw.edu.au/special-consideration>.

Continual Course Improvement

This course is under constant revision in order to improve the learning outcomes for all students. Please forward any feedback (positive or negative) on the course to the course convener or via the Course and Teaching Evaluation and Improvement Process. You can also provide feedback to ELSOC who will raise your concerns at student focus group meetings. As a result of previous feedback obtained for this course and in our efforts to provide a rich and meaningful learning experience, we have continued to evaluate and modify our delivery and assessment methods.

Administrative Matters

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School and, more generally, UNSW policies:

<http://www.engineering.unsw.edu.au/electrical-engineering/policies-and-procedures>

<https://my.unsw.edu.au/student/atoz/ABC.html>

Appendix A: Targeted Graduate Capabilities

Electrical Engineering and Telecommunications programs are designed to address the following targeted capabilities which were developed by the school in conjunction with the requirements of professional and industry bodies:

- The ability to apply knowledge of basic science and fundamental technologies;
- The skills to communicate effectively, not only with engineers but also with the wider community;
- The capability to undertake challenging analysis and design problems and find optimal solutions;
- Expertise in decomposing a problem into its constituent parts, and in defining the scope of each part;
- A working knowledge of how to locate required information and use information resources to their maximum advantage;
- Proficiency in developing and implementing project plans, investigating alternative solutions, and critically evaluating differing strategies;
- An understanding of the social, cultural and global responsibilities of the professional engineer;
- The ability to work effectively as an individual or in a team;
- An understanding of professional and ethical responsibilities;
- The ability to engage in lifelong independent and reflective learning.

Appendix B: UNSW Graduate Attributes

The course delivery methods and course content directly or indirectly addresses a number of core UNSW graduate capabilities, as follows:

- Developing scholars who have a deep understanding of their discipline, through lectures and solution of analytical problems in tutorials and assessed by assignments and written examinations.
 - Developing capable independent and collaborative enquiry, through a series of tutorial exercises spanning the duration of the course.
 - Developing digital and information literacy and lifelong learning skills through assignment work.
 - Developing ethical practitioners who are collaborative and effective team workers, through group activities, seminars and technical reports.
 - Developing independent, self-directed professionals who are enterprising, innovative, creative and responsive to change, through challenging design and project tasks.
 - Developing citizens who can apply their discipline in other contexts, are culturally aware and environmentally responsible, through interdisciplinary tasks, seminars and group activities.
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Appendix C: Engineers Australia (EA) Professional Engineer Competency Standard

Competency Standards		Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals	1-5
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing	2-6
	PE1.3 In-depth understanding of specialist bodies of knowledge	1-6
	PE1.4 Discernment of knowledge development and research directions	5, 6
	PE1.5 Knowledge of engineering design practice	3, 6
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice	1, 5, 6
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving	2, 4
	PE2.2 Fluent application of engineering techniques, tools and resources	1, 2, 5
	PE2.3 Application of systematic engineering synthesis and design processes	2
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects	4, 6
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability	1, 5
	PE3.2 Effective oral and written communication (professional and lay domains)	1, 2, 5
	PE3.3 Creative, innovative and pro-active demeanour	5
	PE3.4 Professional use and management of information	1, 4, 5
	PE3.5 Orderly management of self, and professional conduct	
	PE3.6 Effective team membership and team leadership	5, 6