

# ELEC9714

Electricity Industry Planning and Economics

Term 2, 2022



## Course Overview

### Staff Contact Details

#### Convenors

Name	Email	Availability	Location	Phone
Iain MacGill	<a href="mailto:i.macgill@unsw.edu.au">i.macgill@unsw.edu.au</a>	By prior arrangement via email or MS Teams	TETB Rm 316	+612 9385 4920
Navid Haghdadi	<a href="mailto:n.haghdadi@unsw.edu.au">n.haghdadi@unsw.edu.au</a>	Only via email		

### School Contact Information

**Consultations:** Lecturer consultation times will be advised during the first lecture. You are welcome to email the tutor or laboratory demonstrator, who can answer your questions on this course and can also provide you with consultation times. ALL email enquiries should be made from your student email address with ELEC/TELExxxx in the subject line; otherwise, they will not be answered.

**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>. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

### Student Support Enquiries

[For enrolment and progression enquiries please contact Student Services](#)

### Web

[Electrical Engineering Homepage](#)

[Engineering Student Support Services](#)

[Engineering Industrial Training](#)

[UNSW Study Abroad and Exchange](#) (for inbound students)

[UNSW Future Students](#)

## Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

## Email

[Engineering Student Support Services](#) – current student enquiries

- e.g. enrolment, progression, clash requests, course issues or program-related queries

[Engineering Industrial Training](#) – Industrial training questions

[UNSW Study Abroad](#) – study abroad student enquiries (for inbound students)

[UNSW Exchange](#) – student exchange enquiries (for inbound students)

[UNSW Future Students](#) – potential student enquiries

- e.g. admissions, fees, programs, credit transfer

## Course Details

### Units of Credit 6

### Summary of the Course

The nature of the electricity & gas industries with a focus on investment and planning; 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.

### Course 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.

### Course Learning Outcomes

1. Understand and explain 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

### 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 hybrid in-person and online in MS Teams. Some of these lectures will have tutorial/workshop 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 hybrid lectures and workshops either in-person or on-line 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 lectures and workshops 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 lectures and workshops. 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.

## Additional Course Information

### 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.

## Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Assignments	30%	Assignment 1 in week 5, A2 in week 8	2, 3, 4, 5
2. Group project report 	17%	Report due end of week 10	1, 2, 3, 4, 5, 6
3. Group project presentation and associated wiki 	8%	Seminars will be presented in week 10	1, 2, 3, 4, 5, 6
4. Participation in the classes	5%	Assessed over the 10 weeks of the course	1, 2, 3, 4, 5
5. Final Examination	40%	Examination period (date to be determined)	1, 2, 3, 4, 5, 6

### Assessment 1: Assignments

**Start date:** Assignment 1 in Week 3, A2 in Week 6

**Due date:** Assignment 1 in week 5, A2 in week 8

**Marks returned:** week 6 and week 9

### 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.

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.

### Assessment criteria

The assignments will be assessed on

- the ability to explain how you undertook the quantitative analysis
- the quantitative analysis outcomes
- the discussion of what these outcomes highlights
- the presentation of the assignment

### Assessment 2: Group project report (Group)

**Due date:** Report due end of week 10

**Marks returned:** During exam period

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 an early preliminary outline of progress 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 one page summary document, and will 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.**

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.*

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.



## Assessment criteria

These reports will be assessed according to :

- their description of the motivation for investigating the project topic in question, and explanation of key issues
- the quality and rigor of their literature review
- the quality and rigour of the quantitative analysis that is undertaken
- the quality of the presentation of the report

## Assessment 3: Group project presentation and associated wiki (Group)

**Due date:** Seminars will be presented in week 10

**Marks returned:** During the exam period

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 an early preliminary outline of progress 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 one page summary document, and will 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 criteria

Seminars will be assessed for the:

- quality of the discussion on the motivation for this topic, and key issues
- presentation of existing knowledge - literature and context
- presentation of the quantitative analysis undertaken
- quality of the presentation including slides and sharing the participation across the entire group

The wikis will be assessed in terms of the quality of the materials posted - early project description, and then summary document.

## Hurdle requirement

Seminar participation is compulsory, as is attendance at both the seminar sessions in week 10.

## Assessment 4: Participation in the classes

**Assessment length:** Assessed over the 10 weeks of the course

**Due date:** Assessed over the 10 weeks of the course

**Marks returned:** During the exam period

Each student will receive an individual mark according to the quality and extent of their engagement in the lectures and other on-line activities over the term. This will involve the calculation of metrics including how often you attended the lectures, and participated in the various activities and quizzes undertaken during these.

### **Assessment criteria**

Each student will receive an individual mark according to the quality and extent of their engagement in the lectures and other on-line activities over the term. This will involve the calculation of metrics including how often you attended the lectures, and participated in the various activities and quizzes undertaken during these.

## **Assessment 5: Final Examination**

**Due date:** Examination period (date to be determined)

**Marks returned:** Not released unless requested

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.

### **Assessment criteria**

Students will be assessed on

- their knowledge of key issues, challenges and opportunities for electricity industry planning and economics
- their skills in undertaking simple quantitative analysis to solve a series of electricity industry investment and planning problems

### **Hurdle requirement**

Satisfactory performance in the exam is required to pass this course.

## **Attendance Requirements**

Students are strongly encouraged to attend all classes and review lecture recordings.

## **Course Schedule**

As a post-graduate offering, the course consists of 4 hours of lectures and workshops 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 workshop 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.

The indicative lecture schedule is as follows (noting that this may change over the term)

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

## Resources

### Prescribed Resources

The course Moodle and MS Teams group will be the key source of resources for this course.

### Recommended 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](http://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).

## **Course Evaluation and Development**

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 by email, MS Teams or in-person as appropriate. You can also use the formal the Course and Teaching Evaluation and Improvement Process. 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.

## **Laboratory Workshop Information**

There is no laboratory or formal workshop activities in this course.

## **Academic Honesty and Plagiarism**

### **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 <https://student.unsw.edu.au/plagiarism>. To find out if you understand plagiarism correctly, try this short quiz: <https://student.unsw.edu.au/plagiarism-quiz>.

### **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.

## Academic Information

### 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.

### Dates to note

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

## Student Responsibilities and Conduct

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

### Workload

It is expected that you will spend at least **15 hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both formal classes and *independent, self-directed study*. In periods where you need to complete assignments or prepare for examinations, the workload may be greater. Over-commitment has been a common source of failure for many students. You should take the required 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.

### 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>.

## 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 UNSW policies:

<https://student.unsw.edu.au/guide>

<https://www.engineering.unsw.edu.au/electrical-engineering/resources>

## Disclaimer

This Course Outline sets out description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline (as updated in Moodle), the description in the Course Outline/Moodle applies:

## Image Credit

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## CRICOS

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## Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.