

UNSW



## Course Outline

**School of Photovoltaic &  
Renewable Energy Engineering**

**SOLA5051/SOLA9015**

## Life Cycle Assessment

**Session 2, 2014**

### **Course Coordinators**

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## 1. Staff Contact Details

### Course Coordinators

Emily Mitchell (co-ordinating lectures)  
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### Tutors

To be announced

## 2. Course Details

### Moodle Website:

<https://moodle.telt.unsw.edu.au/login/index.php>

**Credit Points:** 6 units

### Summary of the Course

Life cycle assessment is a “cradle-to-grave” approach for assessing products, processes or systems. This course will deal with life cycle assessment and its relevance to the assessment of energy systems. Methodologies, boundary issues, databases and applications will be studied. The uses of LCA will be illustrated with industrial case studies and with studies aimed at quantifying the externalities associated with different electricity generation technologies. An industry standard software package will be used to conduct an LCA.

### Aims of the Course

The broad aim of this course is to provide the students with a knowledge of the tool of Life Cycle Assessment and an understanding of its relevance to the disciplines of PV and RE Engineering.

More specifically the course aims to:

- Develop within students a solid understanding of the methodology and applications of LCA;
- Expose students to a wide range of examples and LCA case studies in order to demonstrate the complexity of the process;



- Teach students to use available tools and techniques to conduct LCAs.

### **Assumed Knowledge**

To engage with the aspects of the course related to photovoltaic and renewable energy engineering, students should have a basic understanding of the components, design and operation of such systems.

### **Student Learning Outcomes**

At the conclusion of this course students should be able to:

1. Interpret, assess and make use of completed LCAs
2. Determine whether it is worthwhile to commission an LCA for a particular scenario
3. Apply the theory of LCA to the assessment of renewable energy technologies and systems
4. Undertake simple life cycle assessments compliant with international norms
5. Recognise the breadth of LCA applications and the role of LCA in the overall process of environmental management

Students are expected to gain the necessary information through lectures, tutorials, textbooks and self research. Additional information and more detailed explanation will be provided through lectures, and where necessary through access to information in the library.

### **Graduate Attributes**

This course will assist students in their development of the following UNSW Engineering graduate attributes (as listed at <http://www.eng.unsw.edu.au/information-for/future-students/high-school-students/unsw/graduate-attributes>):

- An in-depth engagement with the relevant disciplinary knowledge in its inter-disciplinary context;
- The skills of effective communication.
- A Capacity to Contribute to and Work Within the International Community
- An Appreciation of and Responsiveness to Change
- A Respect for Ethical Practice and Social Responsibility

### **Developed Competencies**

The Engineers Australia policy on Accreditation of Professional Engineering programs requires that all programs ensure that their engineering graduates develop Stage 1 elements of competency (see: <https://www.engineersaustralia.org.au/sites/default/files/shado/Education/Program%20Accreditation/110318%20Stage%201%20Professional%20Engineer.pdf>). Listed below are the aspects of this course that will help students to achieve at least some of these elements of competency.



Professional Engineering Stage 1 Elements of Competencies	Aspects developed in the LCA Course
<b>Knowledge and Skill Base</b>	
1.3 In depth understanding of specialist bodies of knowledge within the engineering discipline.	Application of advanced technical knowledge in the specialist domain of Life Cycle Assessment.
1.6 Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the engineering discipline.	Appreciation of the relevance of standards, the principles of sustainable engineering practice, and the methodologies for managing complexities of sustainability.
<b>Engineering Application Ability</b>	
2.4 Application of systematic approaches to the conduct and management of engineering projects.	Accommodation of contextual issues into engineering design, awareness of the need to plan and quantify performance across the entire life cycle of a project, and commitment to the achievement of sustainable outcomes.
<b>Professional and Personal Attributes</b>	
3.2 Effective oral and written communication in professional and lay domains.	Preparing high quality engineering documents and representing an engineering position to the community.

### 3. Teaching Strategies

The teaching strategy for this course comprises a series of lectures and tutorial sessions.

The lecture series will present theory related to the methodology and applications of life cycle assessment, including various case studies throughout the course. Within each 2-hour lecture, it is intended that a range of teaching formats will be employed. These will include: regular non-assessable quizzes on previous lecture content, class brainstorming sessions, small-group and large-group discussions. Students will be encouraged to actively engage with the topics via these lecture activities. It is likely that one or two topics will be covered by guest lecturers.

A set of tutorial questions or activities will be made available via Blackboard every week and students will be expected to work through the assigned activities in the tutorial session as directed by the tutor, sometimes working in small groups. In some cases, preparation such as reading prior to the tutorial class will be required. Students can also use their allocated tutorial session to ask tutors any questions they may have about the material taught in lectures. Students are also strongly encouraged to use the discussion group on Blackboard to assist their learning. Tutors will monitor the discussions and help answer posted questions.

The course contains a component of self-learning through the experience gained via using the life cycle assessment software GaBi. The software will be demonstrated in a tutorial session in week 7.

Undergraduate and postgraduate students will attend the same lectures and tutorial sessions.



## 4. Assessment

### Assessable Tasks

Assessment Task	Weight		Due Date
	SOLA5051	SOLA9015	
Tutorial attendance	3%	3%	All tuts
Assignment 1	12%	12%	Mon wk 6 (Sep 1)
Assignment 2	35%	35%	
- Ass2 Presentation (group)	(5%)	(5%)	Tuts wk 9 (Sep 24)
- Ass2 Report (group)	(23%)	(23%)	Sun wk 11 (Oct 19)
- Ass2 Peer Assess (individual)	(7%)	(7%)	Fri wk 13 (Oct 31)
Assignment 3	-	10%	Sun wk 12 (Oct 26)
Final exam	50%	40%	TBA

Tutorials represent 50% of the face-to-face teaching time in this course, and serve a key purpose in learning the complex concepts and methodologies of LCA. Attendance at tutorials will be rewarded with the allocation of marks. There are a total of 12 tutorials and attendance at each 2-hour tutorial is worth 0.25% of the overall course assessment.

Assignments 1 and 2 are to be completed by all undergraduate and postgraduate students and will be made available electronically via UNSW's Blackboard during weeks 2 and 6, respectively. The postgraduate students (SOLA9015) will be required to complete a third Assignment, which will be made available in week 10.

Assignment 1 is to be completed individually and will involve analyzing a published LCA and answering questions related to the methodology followed (i.e. covering the lecture material from weeks 1-5). Assignment 2 consists of three components, two of which are to be completed in small groups. This assignment involves completing a simple LCA according to the international standard process. The presentations will be given prior to submission of the report to allow groups to receive constructive feedback to improve the quality of their report – this feedback will be provided via peer review. The assignment 2 reports will be peer assessed, which is an important skill to be developed in the field of LCA because peer review is required by the international standard for LCA. Marks will be awarded for the peer assessment process and this component of the assignment is to be completed individually. Assignment 3 is to be completed individually by the postgraduate students only, and will involve an in-depth analysis of one aspect of the LCA discipline via literature review.

The final exam will be the same for postgraduate students (SOLA9015) and undergraduate students (SOLA5051), except that the weighting differs. All material presented in the course is examinable in the final exam.



## Submission of Assessment Tasks

All assignments are to be submitted electronically via Blackboard or Moodle as specified in the assignment handout.

Penalties (see Section 9) will apply to the late submission of minor and major assignments.

## 5. Academic Honesty and Plagiarism

Plagiarism is the presentation of the thoughts or work of another as one's own. Examples include:<sup>1</sup>

- Direct duplication of the thoughts or work of another, including by copying work, or knowingly permitting it to be copied. This includes copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person's assignment without appropriate acknowledgement;
- Paraphrasing another person's work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
- Piecing together sections of the work of others into a new whole;
- Presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and,
- Claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.<sup>2</sup>

Submitting an assessment item that has already been submitted for academic credit elsewhere may also be considered plagiarism. The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does *not* amount to plagiarism. Students are reminded of their rights and responsibilities in respect of plagiarism, as set out in the University Undergraduate and Postgraduate Handbooks, and are encouraged to seek advice from academic staff whenever necessary to ensure they avoid plagiarism in all its forms.

The Learning Centre website is the central University online resource for staff and student information on plagiarism and academic honesty. It can be located at:

[www.lc.unsw.edu.au/plagiarism](http://www.lc.unsw.edu.au/plagiarism)

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- Correct referencing practices;
- Paraphrasing, summarising, essay writing, and time management;
- Appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

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<sup>1</sup> Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle.

<sup>2</sup> Adapted with kind permission from the University of Melbourne.



Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

## 6. Course Schedule

Wk	Lecture Topic	Due Dates
1	Course Outline & Motivation for LCA	
2	LCA Methodology 1: Goal and Scope Definition	
3	LCA Methodology 2: Inventory Analysis	
4	LCA Methodology 3: Impact Assessment	
5	LCA Methodology 4: Interpretation	
6	Multifunctionality, System Boundaries & Uncertainty	Ass 1 – Monday Sep 1
7	Application of LCA to Renewable Energy Systems	
8	Application of LCA to Production Processes	
9	Case studies of LCA for Renewable Energy	Ass 2 Presentations – in tutorials
	<b>MID-SEMESTER BREAK</b>	
10	<b>PUBLIC HOLIDAY – NO LECTURE</b>	
11	Input/Output Analysis (Dr Tommy Wiedmann)	Ass 2 Report – Sunday Oct 19
12	LCA in practice (external guest lecturer)	Ass 3 (PG only) – Sunday Oct 26
13	---	Ass 2 Peer Assess – Friday Oct 31

NB: Assume lectures and tutorial sessions are as indicated in your timetables unless told otherwise.





## 7. Resources for Students

### Textbooks

Students should download these 2 textbooks, which are both available for free:

- “Life Cycle Assessment: Principles and Practice” by Scientific Applications International Corporation, U.S. Environmental Protection Agency, 2006. (→ Available for download from website <http://www.epa.gov/nrmrl/std/lca/lca.html>)
- “Life Cycle Assessment: Principles, Practice & Prospects” by Ralph Horne, Tim Grant and Karli Verghese, CSIRO, 2009. (→ Available for download via UNSW library website, see link in blackboard)

If students wish to seek additional resource, this book is available in hard-copy in the UNSW library in the High Use Collection. Plus, a couple of chapters are available electronically via blackboard:

- “Life Cycle Assessment: What it is and how to do it” by United Nations Environment Programme, 1996.

### Software

Students may choose to use the software GaBi Education to complete Assignment 2. This software is available on all computers in computer labs LG34 and LG35 in the TETB building. However, if students wish to also install the software on their own PC (note, there is no version for mac computers) then that is also possible and will not cost anything. To do so, students need to request a licence for Gabi Education software. This requires completing and submitting a form that requires a stamp from the school office and a signature from the course co-ordinator (Ivan Perez-Wurfl). Subsequently the software can be downloaded. The forms will be distributed in class.

### Other Resources

Other resources, including the lecture slides, recorded lectures and sample LCA studies, will be made available via Blackboard.

## 8. Course Evaluation and Development

At the end of the course, you will be asked to complete two evaluation forms – one for the course and one for the course coordinator using the UNSW's Course and Teaching Evaluation and At the end of the course, you will be asked to complete two evaluation forms – one for the course and one for the course coordinator using the UNSW's Course and Teaching Evaluation and Improvement (CATEI) Process. Your feedback is much appreciated and taken very seriously. Continual improvements are made to the course based in part on such feedback and this helps us to improve the course for future students.



## 9. Other Information

### Special Consideration for Illness or Misadventure

If you are unable to submit a piece of assessment on time, or to participate fully in tutorial sessions, due to illness or some other event which was beyond your control, you must follow the central UNSW procedures for seeking special consideration. Details of these can be found at <https://my.unsw.edu.au/student/atoz/SpecialConsideration.html>.

Please be aware that requests for special consideration need to be submitted to UNSW Student Central as soon as is practicable after the problem occurs and within three working days of the due date of the relevant assessment task.

### Penalties for Late Submission of Work

Where a student submits a piece of assessment late, and a request for special consideration has not been approved, the student will be penalised by a deduction of marks.

Late written work will be penalized 10% for up to the first day late (% of the value of the assessment task), plus an additional 5% per additional calendar day, up to a maximum of 100% of the total value of the assessment task. Once solutions are provided for the assessment task the maximum penalty will apply. Requests for special consideration should be submitted, as for all other subjects, through the Registrar. An extension of time may only be granted under exceptional circumstances beyond the student's control.

### Disability Support

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course coordinator prior to, or at the commencement of, their course, with the Equity and Disability Officer in the school office (9385 7993) or with the Equity Officer (Disability) in the Equity and Disability Unit (EADU) 9385 4734. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

Further information for students with disabilities is available at:  
<http://www.studentequity.unsw.edu.au/disabil.html>.