

# UNSW



## COURSE OUTLINE

**School of Photovoltaic and Renewable Energy Engineering**

**SOLA 1070**  
**Sustainable Energy**

**Semester 2, 2014**

**Course Co-ordinator:**  
**Dr. Merlinde Kay**  
**Room: 215, TETB**  
**Email: [m.kay@unsw.edu.au](mailto:m.kay@unsw.edu.au)**

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### **Course Description**

Students will be introduced to the concept of energy in its different forms through a range of lectures and demonstrations. These demonstrations will also introduce the concepts of energy storage, energy efficiency, energy conversion and sustainability. An overview is given of issues surrounding sustainable energy for future generations. The status and impact of present day sources of energy are covered, including the sustainability of fossil fuel reserves and the impact of pollution and greenhouse gas emissions on the environment. Energy efficiency, as an important way to conserve our natural fuel reserves and reduce environmental and financial costs, is covered. Building design, appliance efficiency and other issues related to the smart and efficient use of energy are covered. Trends in the renewable energy industry are considered. An overview is given of renewable energy sources, their harnessing and their conversion into electricity via various technologies. In particular, an overview is given of solar cells and their applications with emphasis on visual presentations and interesting case histories, including some fascinating mistakes and disasters. Students will also explore the design and fabrication of silicon solar cells while working as engineers on the "Virtual Solar Cell Production Line". Occasional lectures will be given by guest lecturers.

### **Assumed Knowledge**

PHYS1121 Physics 1A or 2 unit Physics at HSC level or equivalent.

### **Course Objectives**

The primary aim of this course will be to give the students an understanding of:

- The concept of energy;
- What constitutes sustainable energy and its importance to mankind and the environment?
- The concept of energy conversion;

The importance of energy efficiency;  
 The concept of energy storage.

A secondary objective will be to give students insight into the importance each of these areas has in relation to:

Building design;  
 Suitability of appliances and their design;  
 Provision of energy for society, particularly in relation to renewable energy technologies;  
 Pollution and damage to the environment;  
 Natural resource conservation.

Students will be introduced to a range of renewable energy technologies, and will also learn to perform basic back-of-the-envelope calculations relating to energy technologies.

Material will be learnt through:

The use of exciting and even breathtaking demonstrations;  
 Lectures those aren't quite so exciting or breathtaking;  
 Laboratory exercises;  
 Guest lecturers from industry;  
 Provision of lecture notes

### Graduate Attributes

%	Attribute	%	Attribute
5	Science and engineering fundamentals	5	Communication skills
5	In-depth technical competence	10	Professional and ethical responsibilities
15	Problem identification and solving skills	20	Principles of sustainable design and development
5	Systems approach to design	30	Social, cultural, global and environmental responsibilities
5	Function effectively as an individual and in multi-disciplinary and multi-cultural teams	5	Undertake lifelong learning, and capacity to do so

### Lecture Times and Locations

Day of the Week	Time	Location	
Tuesday	2.00pm – 4.00pm	CLB 8	Lab/Tute/Lecture
Wednesday	2.00pm – 4.00pm	CLB 6	Lab/Tute/Lecture

Lecture times and locations as above unless otherwise specified.

### Lecturer Contact Details

Dr Merlinde Kay  
 Room: 215 TETB  
 Phone: 9385-4031  
 Email: [m.kay@unsw.edu.au](mailto:m.kay@unsw.edu.au)

Dr Alistair Sproul

Room: TETB  
Phone: 9385-4039  
Email: [a.sproul@unsw.edu.au](mailto:a.sproul@unsw.edu.au)

Dr Stephen Bremner  
Room: TETB  
Phone: 9385 7890  
Email: [stephen.bremner@unsw.edu.au](mailto:stephen.bremner@unsw.edu.au)

Dr Alison Lennon  
Room: TETB  
Phone: 9385 7942  
Email: [a.lennon@unsw.edu.au](mailto:a.lennon@unsw.edu.au)

Dr Santosh Shrestha  
Room: TETB  
Phone: 9385 4563  
Email: [s.shrestha@unsw.edu.au](mailto:s.shrestha@unsw.edu.au)

Prof Martin Green  
Room TETB  
Phone: 9385-54018  
Email: [m.green@unsw.edu.au](mailto:m.green@unsw.edu.au)

### **Textbooks/Resources, Lecture Notes and Vista E-learning**

The Virtual Production Line (VPL), software package is included on all the computers in LG34 and LG35. There is no textbook for the course.

Valuable reference material is contained in:

1. Energy Systems and Sustainability – Power for a Sustainable Future, Boyle, G., Everett, B., and Ramage, J., Eds., Oxford University Press 2003.
2. Renewable Energy – Power for a Sustainable Future, Boyle, G. Ed., Oxford University Press 2004.
3. Chemistry of the Environment, Spiro, W.G. and Stigliani, W.M., Prentice-Hall 1996
4. Fundamentals of Thermal-Fluid Sciences 2<sup>nd</sup> Edition, Cengel, Y., and Turner, R.H., McGraw-Hill 2005
5. The website of the International Energy Association, [www.iea.org](http://www.iea.org)
6. The website of the International Energy Association's Photovoltaic Power Systems Programme, <http://www.iea-pvps.org>
7. The School's "Related Websites" page, [www.pv.unsw.edu.au/links/related/](http://www.pv.unsw.edu.au/links/related/)
8. The website of the US Dept of Energy's Energy Information Agency, [www.eia.doe.gov](http://www.eia.doe.gov)
9. Scientific American, Vol. 295, No. 3 (Special issue on energy issues and technologies) September 2006.
10. Brian J. Fleay, "The decline of the age of oil", Pluto Press Australia; ASIN: 1864030216

11. John T. Houghton, "Global Warming: The Complete Briefing," Cambridge Univ Press; ISBN: 0521629322; 2nd edition (December 1997)
12. John Twidell and Tony Weir, "Renewable Energy Resources"
13. the Help Files of The Virtual Production Line (VPL)
14. S.R. Wenham et alia, "Applied Photovoltaics", 2<sup>nd</sup> edition, Earthscan, 2006.
15. Encyclopedia of Energy, (ISBN: 0-12-176480-X) Elsevier Press, 2004. (Available online through UNSW Library)
16. Zweibel, Kenneth. Harnessing Solar Power: The Photovoltaics Challenge. New York: Plenum Press, 1990.
17. Quaschnig, Volker. Understanding Renewable Energy Systems. London: Earthscan, 2004.
18. Hinrichs, Roger A., and Merlin Kleinbach. "Energy. Its Use and the Environment", 3rd ed. Singapore: Thomson Learning, 2002.
19. Mobbs, Michael, "Sustainable house", Choice Books, Marrickville, 1998.
20. Hoogers, Gregor. "Fuel Cell Technology Handbook": CRC Press, 2003. Dürschmidt, W., G. Zimmermann, et al., Eds. (2006). Renewable energies. Innovations for the future. Berlin, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). [http://www.bmu.de/files/english/renewable\\_energy/downloads/application/pdf/broschuere\\_ee\\_innovation\\_eng.pdf](http://www.bmu.de/files/english/renewable_energy/downloads/application/pdf/broschuere_ee_innovation_eng.pdf)
21. Turner, W. C. and S. Doty (2006). "Energy Management Handbook" Lilburn, Fairmont Press & CRC Press.
22. Gervorkian, Peter. Sustainable Energy Systems Engineering, McGraw-Hill, New York, 2007.
23. Kruger, P. (2006) "Alternative energy resources: the quest for sustainable energy": Wiley,
24. Antony, Falk, Düschner, Christian and Remmers, Karl-Heinz (2007), "Photovoltaics for Professionals. Solar Electric Systems – Marketing, Design and Installation", Earthscan: London
25. German Solar Energy Society and Ecofys. "Planning and Installing Photovoltaic Systems: A Guide for Installers, Architects, and Engineers", 2nd ed. London; Sterling, VA: Earthscan, 2008.
26. Kreith, F. and Goswami, Y., "Handbook of Energy Efficiency and Renewable Energy". Boca Raton: CRC Press, 2007.
27. Renewable Energy Centre, Photovoltaic PowerSyst NUER02 Resource Book,, Brisbane North Insitute of TAFE. ISBN: 9781876880293
28. "Harnessing Materials for Energy", special issue of MRS Bulletin, vol. 33, no. 4 April 2008.
29. Khan, N., Z. Saleem, et al. (2008). "Review of natural energy sources and global power needs." Renewable and Sustainable Energy Reviews 12(7): 1959-1973.
30. David Cohen (2007). "Earth's natural wealth: an audit", New Scientist, 23 May

Additional material may be provided as handouts in class

## **Assessment**

Assignments 25%

Lab Class	5%	
VPL Tutorial	10%	
Final Exam	60%	

### **Assignment Schedule**

<b>Assignment</b>	<b>Name</b>	<b>Marks</b>	<b>Deliver Date</b>	<b>Due Date</b>
1	Energy Basics	15%	Wednesday, week 4	Friday, week 7
2	Lab class	5%	Wednesday, week 6	Week 7
3	Virtual Production Line	10%	Wednesday, week 6	Wednesday, week 9
4	Are you sustainable?	10%	Friday, week 9	Friday, week 11

***Late penalty: 50% for the first day it is late plus 5% per day thereafter.***

All assignments will be placed on the Moodle website and an announcement made when they are available. Assignments due by 5pm of the day they are due.

Submission: Assignments will be submitted to plagiarism detection software (which will retain assignments for checking against future submissions) on the Moodle website. More detailed submission information will be given with each assignment.

### **Student Responsibilities (or Class Policies) Lecture and Laboratory Programs**

1. **Confidentiality:** The software packages used in this course are considered the property of and confidential to UNSW. At present, copies of these packages are not commercially available. Students are not permitted to make any copies of this software or to engage in the distribution or provision of such copies to anyone other than enrolled students within this course.

2. **Plagiarism:** see below.

## What is Plagiarism?

Plagiarism is the presentation of the thoughts or work of another as one's own.\*

Examples include:

- 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. †

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.

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.

\* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle.

† Adapted with kind permission from the University of Melbourne.

To ensure that you are not penalised for plagiarism, ***please check that all material used in your report is referenced and attributed properly and that unreferenced text and figures are your own.***

### Preliminary Lecture and Tutorial Syllabus:

As this course has many guest lecturers who are leaders in their field there may be changes to the lecture schedule during the session depending on their availability. Announcements will be made on blackboard and in the lectures if this occurs. Updated Course Outlines will also be put onto blackboard.

week	date	day, time	activity
1	29th July	Tues. 2-4	intro - motivation
1	29th July	Tues. 2-4	intro - motivation
1	30th July	Wed. 2-4	Film: The Future Makers
1	30th July	Wed. 2-4	Film: The Great Global Warming Swindle
2	5th August	Tues. 2-4	sustainability
2	5th August	Tues. 2-4	sustainability
2	6th August	Wed. 2-4	Climate Change
2	6th August	Wed. 2-4	Climate Change
3	12th August	Tues. 2-4	Lecture4: energy use
3	12th August	Tues. 2-4	Tutorial for energy use
3	13th August	Wed. 2-4	PV Basic
3	13th August	Wed. 2-4	PV Basic
4	19th August	Tues. 2-4	energy reserves
4	19th August	Tues. 2-4	energy impacts
4	20th August	Wed. 2-4	energy basics
4	20th August	Wed. 2-4	Energy basics
5	26th August	Tues. 2-4	hydrogen generation and storage
5	26th August	Tues. 2-4	hydrogen generation and storage
5	27th August	Wed. 2-4	Solar thermal
5	27th August	Wed. 2-4	Solar Thermal
6	2nd September	Tues. 2-4	PV topic
6	2nd September	Tues. 2-4	PV topic
6	3rd September	Wed. 2-4	Virtual Production Line
6	3rd September	Wed. 2-4	Virtual Production Line
7	9th September	Tues. 2-4	tutorial
7	9th September	Tues. 2-4	tutorial
7	10th September	Wed. 2-4	tutorial
7	10th September	Wed. 2-4	tutorial
8	16th September	Tues. 2-4	tutorial
8	16th September	Tues. 2-4	tutorial
8	17th September	Wed. 2-4	tut
8	17th September	Wed. 2-4	tut
9	23rd September	Tues. 2-4	efficiency
9	23rd September	Tues. 2-4	efficiency
9	24th September	Wed. 2-4	biomass (tbc)
9	24th September	Wed. 2-4	biomass tut (tbc)



<b>MID SESSION BREAK</b>			
<b>10</b>	7th October	Tues. 2-4	economics
<b>10</b>	7th October	Tues. 2-4	tut
<b>10</b>	8th October	Wed. 2-4	hydro
<b>10</b>	8th October	Wed. 2-4	hydro
<b>11</b>	14th October	Tues. 2-4	Stuart Wenham
<b>11</b>	14th October	Tues. 2-4	Stuart Wenham
<b>11</b>	15th October	Wed. 2-4	tut
<b>11</b>	15th October	Wed. 2-4	tut
<b>12</b>	21st October	Tues. 2-4	wind
<b>12</b>	21st October	Tues. 2-4	wind
<b>12</b>	22nd October	Wed. 2-4	tbc
<b>12</b>	22nd October	Wed. 2-4	tbc
<b>13</b>	28 <sup>th</sup> October	Tues. 2-4	tut
<b>13</b>	28 <sup>th</sup> October	Tues. 2-4	tut
<b>13</b>	29th October	Wed. 2-4	tut
<b>13</b>	29th October	Wed. 2-4	tut